Exhibit B

LEWISVILLE

Deep Roots. Broad Wings. Bright Future.

City of Lewisville

Prairie Creek Wastewater Treatment Plant Aeration Basin Expansion

COL Project Number: U2100
Bid Number: 26-02-C

Construction Documents
Project Manual

Issued for Bid

October 2025

HDR Project No. 10342803

Texas Firm Registration No. F-754

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00 01 07

SEALS AND SIGNATURES

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Engineer's seal and signature does not apply to the documents that comprise Division 00, Bidding and Contracting Requirements.

It is a violation of applicable laws and regulations governing professional licensing and registration for any person, unless acting under the direction of the licensed and registered design professional(s) indicated above, to alter in any way the Specifications in this project manual.

END OF SEALS AND SIGNATURES

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Appendix A: Electrical Equipment Procurement Packages – Packages available on Bonfire

SECTION 01 11 00
SUMMARY OF WORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Location and description of Work and prior uses of the Site.
2. Construction Contracts for this Project.
3. Others retained by Owner for the Project.
4. Work by others under Owner's control on other projects.
5. Work by others not under Owner's control.
6. Work by Owner.
7. Sequence and progress of Work.
8. Contractor's use of the Site.
9. Easements and rights-of-way.
10. Partial utilization by Owner.
11. Utility owners.
12. Tree trimming, clearing, and tree removal.

B. Related Requirements:
1. Include, but are not limited to, the following:
a. Section 01 14 16 - Coordination with Owner's Operations.
b. Section 01 14 19 - Use of Site
c. Section 01 45 33 - Code-Required Special Inspections and Procedures.
d. Section 01 64 00 - Owner-Furnished Products.
e. Section 01 71 33 - Protection of the Work and Property.

1.2 LOCATION AND DESCRIPTION OF WORK

A. The Work is located in the City of Lewisville, TX, at the Prairie Creek Wastewater Treatment Plant, 897 Treatment Plant Road, Lewisville, TX 75057.

B. Work to be performed under this Contract includes, but is not limited to, demolition of Plant III structures and yard piping, etc., construction of four aeration basins, a blower building, hydraulic splitter structures, associated yard piping, earthwork, and electrical improvements, and rehabilitation of the existing Plant II RAS/WAS Pump Station, and all other Work required in accordance with the Contract Documents.

C. The Project includes constructing the Work broadly described below, in accordance with the Contract Documents, with all related appurtenances. Work shown on the Drawings, or indicated in the Specifications, or indicated elsewhere in the Contract Documents is part of the Work, regardless of whether indicated below. The Work includes, but is not limited to, the following:
1. Demolish Plant III Trickling Filters, Final Clarifiers, Decant Tanks, Blower Pad, Solids Contact Basin, Shed, and associated manholes and junction boxes, to the extents indicated on the Contract Drawings.
2. Demolish Plant III yard piping and ductbanks to the extents indicated in the Contract Drawings.
3. Construct Plant II Aeration Basins 5-8, Plant II Blower Building (Proposed), Aeration Basin Splitter Structure, Secondary Clarifier Splitter Structure as indicated in the Contract Drawings.
4. Rehabilitate Plant II RAS/WAS Pump Station as indicated in the Contract Drawings.
5. Perform electrical, earthwork and yard piping modifications as indicated in the Contract Drawings.

D. Hazardous Environmental Conditions:

1. To the best of Owner's knowledge, information, and belief, the Site has been a wastewater treatment plant since the 1950s. The major buildings and structures of the treatment facility were constructed from the 1950s through the present.
2. A hazardous materials evaluation was performed in May 2024 at the structures to be demolished and the report is available from the Owner upon request.

1.3 OTHERS RETAINED BY OWNER FOR THE PROJECT

A. Engineer:
   1. Engineer is identified in the Agreement.
   2. Engineer's responsibilities for the Project, relative to Contractor, are indicated throughout the Contract Documents.
   3. Services of a Construction Manager (CM) / Resident Project Representative (RPR) for the Project are furnished by OCMI, Inc. Various roles and tasks identified throughout these specifications to be performed by Engineer may be performed by the CM / RPR.

B. Non-Professional Services Contracted by Owner: Owner will retain services of the following entities to perform the services indicated relative to the Project. Contractor shall coordinate and schedule the Work with, and cooperate with, the entities performing the following services for Owner.
   1. Code-Required Special Inspections and Testing:
      a. Owner has, or will, retain the services of a qualified testing laboratory to perform code-required testing and special inspections for the Work, in accordance with Section 01 45 33 - Code-Required Special Inspections and Procedures, and selected other provisions of the Contract Documents related to field testing.

1.4 WORK BY OTHERS UNDER OWNER'S CONTROL - OTHER PROJECTS

A. Other construction contracts have been or will be awarded by Owner that are in close proximity to or border on the Work of this Project. Work under these other contracts is briefly described in this Article.

B. Prairie Creek WWTP Electrical Improvements:
   1. Principal Work Location: Various locations at the plant site.
   2. Scope:
      a. Project involves: replacement of various transformers at the plant.

1.5 WORK BY OWNER

A. Owner will perform the following in connection with the Work:
   1. Operate all existing valves, flow-control gates, pumps, equipment, and appurtenances that will affect Owner's operations or facility processes, unless otherwise specified or indicated.

1.6 SEQUENCE AND PROGRESS OF WORK

A. Requirements for sequencing and coordinating with Owner's operations, including maintenance of facility operations during construction, and requirements for tie-ins and shutdowns, are in Section 01 14 16 - Coordination with Owner's Operations.

1.7 CONTRACTOR'S USE OF SITE

A. Use of Site - General:
   1. Limits on Contractor's use of the Site are indicated in Section 01 14 19 - Use of Site, and as may be shown on the Drawings.
   2. Contractors shall share use of the Site with other contractors and others specified in Articles 1.3 through 1.6 (inclusive) of this Section.
   3. Relocate stored materials and equipment that interfere with operations of Owner, other contractors, and others performing work for Owner.
   4. Comply with restrictions set forth in Section 01 14 19 - Use of Site.

B. Owner will occupy the Site jointly with Contractor during construction for performance of Owner's typical operations. Coordinate with Owner in all construction operations to minimize

conflicts between Contractor and Owner's employees and others under Owner's control. If the Site is a treatment facility or other production facility, Owner will have Owner's suppliers for deliveries of chemicals and other items accessing the Site from time to time, possibly on a daily basis.

1.8 EASEMENTS AND RIGHTS-OF-WAY

A. Easements and Rights-of-Way - General:
   1. Easements and rights-of-way required for the permanent improvements included in the Work will be provided by Owner in accordance with the General Conditions and Supplementary Conditions.
   2. Confine construction operations within Owner's property, public rights-of-way, easements obtained by Owner, and limits shown, and property for which Contractor has made arrangements directly with property owner(s).
   3. Use care in placing construction tools, machinery and equipment, excavated materials, and materials and equipment to be incorporated into the Work to avoid damaging property and interfering with traffic.
   4. Do not enter private property outside the construction limits without permission from the owner of the property.

B. On Private Property:
   1. General limits of Owner-furnished easements are shown on the Drawings.

1.9 UTILITY OWNERS

A. Utilities and their owners indicated in the Contract Documents are for Contractor's convenience. Neither Owner nor Engineer will be liable to Contractor or any utility owner for failure to indicate utility, its owner, or complete and correct contact information in the Contract Documents where Contractor's reasonable and ordinarily-exercised diligence would reveal the presence of the utility and its owner. Nothing in the Contract mitigates Contractor's responsibilities under the General Conditions, Section 01 71 33 - Protection of the Work and Property, and Laws and Regulations, including "call before you dig" regulations.

1.10 TREE TRIMMING, CLEARING, AND TREE REMOVAL

A. Provide all required labor and equipment for trimming, clearing, and tree removal as shown on the Drawings:
   1. Comply with Section 01 71 33 - Protection of the Work and Property.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

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SECTION 01 14 16
COORDINATION WITH OWNER'S OPERATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Requirements for coordinating with Owner's operations during the Project.
   2. Requirements for tie-ins and shutdowns necessary to complete the Work without impact on Owner's operations except as allowed in this Specifications section.

B. Scope:
   1. Contractor shall provide all labor, materials, equipment, tools, and incidentals shown, specified, and required to coordinate with Owner's operations during the Work in accordance with this Specifications section.
   2. Except for shutdowns specified in this Specifications section, perform the Work such that Owner's facilities remain in continuous, satisfactory operation during the Project. Schedule and perform the Work such that the Work does not: impede Owner's production or processes, create potential hazards to operating equipment and personnel, reduce the quality of the facility's products or effluent, cause odors or other nuisances, does not affect the public health, safety, welfare, and convenience, and does not adversely affect the environment resulting in violation of Laws or Regulations.
   3. Work not specifically addressed in this Specifications section or in referenced sections may, in general, be performed, to be completed within the Contract Times, at any time during regular working hours in accordance with the Contract Documents, subject to the requirements in this section. Work outside of regular working hours is subject to Owner approval per Contract requirements.

C. Related Requirements: Include but are not necessarily limited to:
   1. Section 01 11 00 - Summary of Work.
   2. Section 01 73 29 - Cutting and Patching.
   3. Section 01 75 00 - Checkout and Startup Procedures.
   4. Section 02 41 00 - Demolition.

1.2 REFERENCES

A. Terminology:
   1. Terminology indicated below are not defined terms and are not indicated with initial capital letters, but when used in this Specifications section have the meaning indicated below:
      a. The term "Owner" is used throughout this section. When the facility is operated or managed by an entity other than Owner, references in this section to "Owner" as the operator or manager of the facility will be interpreted as referring to the facility manager.
      b. A "shutdown" is when a portion of the normal operation of Owner's facility, whether equipment, systems, conduit (including piping and ducting), has to be temporarily suspended or taken out of service to perform the Work.
      c. A "tie-in" is a connection of new Work to existing facilities, including connecting to existing conduits (including piping and ducting), electrical systems, structural elements, process/mechanical elements, and other physical connections. Some tie-ins may require that the tie-in be made without an associated shutdown.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Review construction procedures under other Specifications sections and coordinate Work that will be performed with or before the Work indicated in this Section.

B. Sequencing and Scheduling:
   1. Refer to this Specifications sections articles on sequencing, tie-ins, and shutdowns.

1.4 SUBMITTALS

A. Informational Submittals: Submit the following:
   1. Shutdown Planning Submittal:
      a. For each shutdown, submit an inventory of labor, materials, and equipment required to perform the shutdown and tie-in tasks, an estimate of time required to accomplish the complete shutdown including time for Owner to take down and start up existing equipment, systems, or conduits, and written description of steps required to complete the Work associated with the shutdown.
      b. Furnish submittal to Engineer not less than 30 days prior to proposed shutdown start date. Do not start shutdown until obtaining Engineer's acceptance of shutdown planning Submittal.
   2. Shutdown Notification:
      a. After Engineer's acceptance of shutdown planning Submittal and prior to starting the shutdown, submit written notification to Owner and Engineer of date and time each shutdown is to start. Submit notification not less than one week in advance of each shutdown.

1.5 GENERAL CONSTRAINTS

A. Indicated in the Contract Documents are the sequence and shutdown durations, where applicable, for Owner's equipment, systems, and conduits (including piping and ducting) that are to be taken out of service temporarily for the Work. New materials and equipment may be used by Owner after the specified field quality control activities are successfully completed and the materials or equipment are substantially complete in accordance with the Contract Documents.

B. The following constraints apply to coordination with Owner's operations:
   1. Operational Access: Owner's personnel shall have access to equipment and areas of the facility that remain in operation.
   2. Temporary Partitions and Enclosures: Provide temporary partitions and enclosures necessary to maintain dust-free, heated, and ventilated spaces in areas of the facility that are adjacent to the Work and that must be kept operational. Comply with Section 01 51 05 - Temporary Utilities.
   3. Schedule and perform equipment and system start-ups in accordance with Section 01 75 00 - Checkout and Startup procedures. Equipment and systems shall not be placed into operation on Friday, Saturday, Sunday, or holidays without prior approval of Owner, unless specifically indicated otherwise in the Contract Documents.
   4. Dead End Valves or Conduits:
      a. Provide blind flanges, watertight bulkheads, or valve at temporary and permanent terminuses of conduits, including piping and ducting.
      b. Blind flanges and bulkheads shall be suitable for the service and braced and blocked, as required, or otherwise restrained as necessary or as required by Engineer.
      c. Temporary valves shall be suitable for their associated service. Where valve is provided at permanent terminus of conduit, including piping or ducting, also provide on downstream side of valve a blind flange with drain/flushing connection.
   5. Owner will assist Contractor in dewatering process tanks, basins, conduits, and other work areas to be dewatered for shutdowns; Owner will operate valves and gates to isolate such tanks and designate onsite disposal locations for Contractor disposal of contents. Maintain clean, dry work area by pumping and properly disposing of fluid and other material that accumulates in work areas.
   6. Draining and Cleaning of Conduits, Tanks, and Basins:
      a. Plant I Aeration Basins 1 and 2 will be drained and cleaned by the Owner including hose spraying solids to a removal point by Owner. Any additional localized cleaning required to perform specified structural modifications shall be by the Contractor.

Influent channels and boxes at these basins shall be drained and cleaned by the Contractor and disposed at Owner designated location onsite. The Contractor is NOT required to drain or clean Plant I Final Clarifiers 1 and 2.

b. Plant II Aeration Basins 1 through 4 will be drained and cleaned by the Owner from the anoxic zone up to the basin effluent weirs. The Contractor is NOT required to drain or clean Plant II Final Clarifiers 1 and 2.

c. Unless otherwise shown or indicated above or in the Contract Documents, Contractor shall dewater process tanks, basins, conduits (including piping) at beginning of each shutdown. Flush, wash down, and clean tanks, basins, conduits (including piping), and other work areas unless otherwise approved by Owner.

d. Contractor shall use existing aeration basins and clarifiers to seed Aeration Basins 5-8 for startup. Basins and clarifiers being taken out of service shall be used for this purpose. Contractor shall furnish temporary pumps, hoses, etc. or other suitable equipment to transfer wastewater and sludge seed without spillage.

e. Contractor shall remove liquids and solids and dispose of them at appropriate location at the Site as directed by Owner. Unless otherwise specified or indicated, contents of tanks, basins, and conduits (including piping) undergoing modifications shall be transferred to existing process tanks or conduits at the Site with capacity sufficient to accept such discharges, using hoses, temporary piping, temporary pumps, tanker trucks, and other means provided by Contractor. Discharge of fluids across floors is not allowed. Contractor to note that not some drain piping in the Plant III area has failed and is not available for Contractor use.

f. If drainage point is not available on the conduit (including piping) to be drained, provide a wet tap using tapping saddle and valve or other method approved by Engineer. Uncontrolled spillage of contents of conduits (including piping) is not allowed.

g. Spillage shall be brought to Owner's attention immediately, both orally and in writing, and reported in accordance with Laws and Regulations. Contractor shall wash down spillage to floor drains or sumps or other appropriate location and flush the system to prevent clogging and odors. If spillage is not suitable for discharge to the drainage system, such as chemical spills, as determined by Owner, Contractor shall remove spillage by other means, such as vactor truck, sorbents, or other method acceptable to Engineer.

7. During Interim work:
   a. Contractor's activities shall not interrupt influent flow to or from Plant I or Plant II at any time.
   b. Plant I WAS and Plant II WAS wasting shall not be interrupted at the same time except where specifically indicated in the Schedule of Shutdowns in Table 01 14 16-B.
   c. Existing WAS pipes shall not be permanently removed from service until the associated rerouted pipes are in service.

1.6 SEQUENCE OF WORK

A. Certain phases or stages of the Work may require working 24 hour days or work during hours outside of regular working hours. Work may be accelerated from a later stage to an earlier stage if Owner's operations are not adversely affected by proposed substitute sequence, with Engineer's approval.

B. Critical aspects of sequencing identified by Engineer are listed here:
   1. Install proposed WAS-II line from Plant II RAS/WAS Pump Station and make tie-ins prior to demolition of the existing WAS lines. Connect downstream end of WAS-II line first.
   2. Perform demolition of western and southern structures within Plant III without disturbing existing WAS piping and as required to install new WAS-I pipeline.
      a. After this demolition, install WAS-I pipeline and tie-in to existing piping.
   3. Plant III Final Clarifier 2 Demolition has sequencing requirements for staged select demolition which are specified on the Drawings.

4. The total number of existing and proposed aeration basins commissioned and operating at Plant II shall not be less than three basins at any time.
5. There shall be no more than two existing clarifiers from Plant I or II offline at any time during construction.
6. Install proposed RAS headers, yard piping, and connect RAS to the proposed Aeration Basin Splitter prior to taking any Plant II secondary clarifiers.
7. Plant I shall not be removed from service until Plant II Aeration Basins 5-8 are commissioned.

1.7 TIE-INS

A. Tie-ins corresponding to Interim drawings are identified as Interim, or with a modifying 'I' identifier. Piping shown on Interim drawings is permanent unless otherwise noted.

B. Connections by Contractor to existing facilities are listed below. This list may not indicate all tie-ins required for the Work; Contractor shall perform tie-ins necessary and required to complete the Work as shown or indicated in the Contract Documents, regardless of whether tie-in is indicated in the list below.

1-I. Proposed WAS-II line
   a. Downstream – Connection to the existing 8" WAS line as shown on 00C164I.
   b. Upstream – Connection to three (3) existing WAS lines west of Plant II RAS/WAS Pump Station shown on sheet 00C162I.

2-I. Proposed WAS-I line
   a. Upstream - Connection to existing 6" WAS line east of Plant I RAS/WAS Pump Station shown on sheet 00C161I of the drawings.
   b. Downstream - Connection to existing 8" WAS line near Filter Pump Station as shown on sheet 00C164I.

3-I. Proposed CS line
   a. Downstream - Connection to existing 4" CS line near the sand filters as shown on sheet 00C164I.
   b. Upstream – Connection to existing 4" CS line near the filter pump station as shown on 00C164I.

4-I. Proposed PW line
   a. Upstream - Connection to existing 8" PW line west of the filter pump station as shown on sheet 00C164I.
   b. Downstream - Connection to existing 8" PW line near the fire hydrant as shown on sheet 00C164I.

1. Grit Removal Effluent & Plant I Splitter
   a. Connection to the existing 24" raw sewage line that feeds existing aeration basin 1 as shown on 00C161 and the process drawings.
   b. Connection to the existing 24" raw sewage line that feeds existing aeration basin 2 as shown on 00C161 and the process drawings.
   c. Demolish existing 30" raw sewage connection as shown on 00CX161 and the process drawings.
   d. Connection to the existing 30" raw sewage line that previously fed Plant III as shown on 00C161 and the process drawings.
   e. Proposed new 30" connection to the grit removal effluent box as shown on 00C161 and the process drawings.
2. Aeration Splitter Structure Influent
   a. Connection of proposed RS-1 to both existing 24" raw sewage lines that feed existing aeration basins 1 and 2, as shown on drawing 00C161.
   b. Connection of proposed RS-2 to the existing 30" that is to be plugged during the Interim phase, as shown on drawing 00C161.
   c. Connection of RS-3 to the existing 36" raw sewage line that feeds existing basins 3 and 4, as shown on drawing 00C161.
3. Existing Aeration Basin Influent

a. Connection of proposed ABI-1 to the existing 24" line that feeds aeration basin 1 as shown on 00C161.
b. Connection of proposed ABI-2 to the existing 24" line that feeds aeration basin 2 as shown on 00C161.
c. Connection of proposed ABI-3 to the existing 27" line that feeds aeration basin 3 as shown on 00C161.
d. Connection of proposed ABI-4 to the existing 30" line that feeds aeration basin 4 as shown on 00C161.

4. Secondary Clarifier Influent
   a. Connection of proposed SCI-1 to the existing 30" secondary clarifier 3 influent as shown on 00C162.
   b. Connection of proposed SCI-2 to the existing 30" secondary clarifier 4 influent as shown on 00C162.
   c. Connection of proposed SCI-3 to the existing 36" secondary clarifier influent as shown on 00C162.
   d. Connection of proposed SCI-4 to the existing 36" secondary clarifier influent as shown on 00C162.
5. Return Activated Sludge
   a. Connection of proposed Secondary Clarifier No. 1 to the proposed RAS header as shown on the process drawings.
   b. Connection of proposed Secondary Clarifier No. 2 to the proposed RAS header as shown on the process drawings.
   c. Connection of proposed Secondary Clarifier No. 3 to the proposed RAS header as shown on the process drawings.
   d. Connection of proposed Secondary Clarifier No. 4 to the proposed RAS header as shown on the process drawings.

1.8 SHUTDOWNS

A. Shutdowns shall be in accordance with Table 01 14 16-B of this Specifications section. Work requiring service interruptions for tie-ins shall be performed during scheduled shutdowns.

B. Work that may interrupt normal operations shall be accomplished at times convenient to Owner unless otherwise indicated in the Contract Documents.

C. If Contractor's operations cause an unscheduled interruption of Owner's operations, immediately re-establish satisfactory operation for Owner.

D. Fines and Penalties Imposed by Authorities Having Jurisdiction:
   1. Unscheduled shutdowns or interruptions of continued safe and satisfactory operation of Owner's facilities that result in fines or penalties by authorities having jurisdiction shall be paid solely by Contractor if, in Engineer's opinion, Contractor did not comply with requirements of the Contract Documents, or was negligent in the Work, or did not exercise proper precautions in performing the Work and complying with applicable permits, Laws, and Regulations.
   2. Owner or Engineer may deduct as set-offs such amounts from payments due Contractor.

E. Temporary, short-term shutdowns of smaller conduits (including piping and ducting), equipment, and systems may not be included in Table 01 14 16-B. Coordinate requirements for such shutdowns with Engineer and Owner. Where necessary, obtain Engineer's interpretation or clarification before proceeding.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 SUBSTITUTE PROCEDURES

A. Proposal of Substitute Sequencing, Shutdowns, and Tie-Ins:
   1. As a substitute to the procedures indicated in this Specifications section, Contractor may propose providing additional temporary facilities that can eliminate or mitigate a constraint without additional cost to Owner, provided such additional temporary facilities: do not present hazards to the public, personnel, structures, and equipment; that such additional temporary facilities do not adversely affect Owner's ability to comply with Laws and Regulations, permits, and operating requirements; that such temporary facilities do not generate or foster the generation of odors and other nuisances; and that requirements of the Contract Documents are fulfilled.
   2. Engineer will consider proposals for substitute procedures after the Effective Date of the Contract. All Bids shall be based on the requirements of the Contract Documents, including this section.
   3. Substitution Requests:
      a. When proposing a substitute procedure for a tie-in or shutdown or other requirements of this section, comply with the requirements of the General Conditions and Supplementary Conditions (regarding substitutes) and Section 01 25 00 - Substitution Procedures.
      b. When deviation from specified sequence or procedures is proposed, Contractor's proposal shall explain in detail the proposed sequence and procedures and associated effects, including evidence that Owner's operations will not be adversely affected, to an extent greater than originally contemplated in the Contract Documents, by proposed substitution. List benefits of proposed substitution, including benefits to Progress Schedule.

3.2 GENERAL PROVISIONS FOR COORDINATING WITH OWNER'S OPERATIONS

A. When possible, combine multiple tie-ins into a single shutdown to reduce impacts on Owner's operations and processes.

B. Operation of Existing Systems and Equipment during the Work:
   1. Do not shut off or disconnect existing operating systems or equipment, unless accepted by Engineer in writing.
   2. Operation of existing systems and equipment will be by Owner unless otherwise specified or indicated.
   3. Where necessary for the Work, Contractor shall seal or bulkhead Owner-operated gates and valves to prevent leakage that may affect the Work, Owner's operations, or both.
   4. Provide temporary watertight plugs, bulkheads, and line stops as necessary and as required. After completing the Work, remove seals, plugs, bulkhead, and line stops to satisfaction of Engineer.

C. Bypassing:
   1. Diversion of flows around treatment processes is not allowed.

D. Performing the Work of this section constitutes Contractor's approval of underlying work and field conditions prevailing at the time of the Work.

3.3 PREPARATION

A. Coordinate preparations for removals with requirements of Section 01 73 29 - Cutting and Patching and Section 02 41 00 - Demolition, as applicable.

B. Shutdowns - General Preparation:
   1. Coordinate shutdowns with Owner and Engineer.

2. Submit shutdown planning Submittals and shutdown notification Submittals in accordance with this Specifications section's "Submittals" Article.
3. Furnish at the Site, in close proximity to the shutdown and tie-in work areas, tools, materials, equipment, spare parts, both temporary and permanent, necessary to successfully perform the shutdown. Complete to the extent possible, prefabrication of piping and other assemblies prior to commencing the associated shutdown. Demonstrate to Engineer's satisfaction that Contractor has complied with such requirements before commencing the shutdown.
4. Engineer shall have no duty to Contractor to advise Contractor of inadequate preparations by Contractor; Contractor is solely responsible for the means, methods, procedures, techniques, and sequences of construction.

END OF SECTION

Table 01 14 16-B
Schedule of Shutdowns

Shut- down No.	Process Equipment and Service Lines Out-of-Service During Shutdown	Process Equipment In Operation During Shutdown	Tie-In Nos.	Maximum Duration
1-I	Plant I and Plant II WAS Wasting	None.	1-Ia	8 hours
2-I	Plant II WAS Wasting	Plant I WAS Wasting.	1-Ib	8 hours
3-I	Plant I WAS Wasting	Plant II WAS Wasting.	2-Ia, 2-Ib	8 hours
4-I	CS service to the Sand Filters	Filters to stay in service.	3-Ia, 3-Ib	6 hours
5-I	PW service to the fire hydrant	All.	4-Ia, 4-Ib	6 hours
1	Plant II Basin 3 and Clarifier 3 for clarifier influent connection to proposed secondary splitter structure and switching to new RAS header.	Plant I. Plant II Aeration Basins 1, 2 and 4. Plant II Clarifiers 1, 2, and 4.	3.c. 4.c.	3 weeks Basin 3 to remain out of service.
2	Plant II Basin 4 and Clarifier 4 for clarifier influent connection to proposed secondary splitter structure and switching to new RAS header. Also to connect 36" raw sewage, RS-3, to the proposed ABI splitter. Basin 3 remains out of service.	Plant I. Plant II Aeration Basins1 and 2. Plant II Aeration Basin 5. Plant II Clarifiers 1, 2, and 3.	3.d. 4.d. 2.c.	3 weeks Basin 4 to remain out of service.
3	Plant II Basin 2 and Clarifier 2 for clarifier influent connection to proposed secondary splitter structure and switching to new RAS header. Basin 3 and 4 remain out of service.	Plant I. Plant II Aeration Basins 1. Plant II Aeration Basins 5 and 6 Plant II Clarifiers 2, 3, and 4.	3.b. 4.b.	3 weeks Basin 2 to remain out of service.

Table 01 14 16-B Schedule of Shutdowns				
Shut- down No.	**Process Equipment and Service Lines Out-of-Service During Shutdown**	**Process Equipment In Operation During Shutdown**	**Tie-In Nos.**	**Maximum Duration**
4	Plant II Basin 1 and Clarifier 1 for clarifier influent connection to proposed secondary splitter structure and switching to new RAS header. Basin 2, 3, and 4 remain out of service.	Plant I. Plant II Aeration Basins 5 and 6. Plant II Clarifiers 2, 3, and 4.	3.a. 4.a.	3 weeks Basin 1 to remain out of service.
5	Plant I Splitter to disconnect the 30" raw sewage line and make other improvements to splitter. Basin 1, 2, 3, and 4 remain out of service,	Plant I. Plant II Aeration Basins 5, 6, and 7 using the 2 existing 24" raw sewage lines and the existing 36" raw sewage line.	2.c.	2 weeks
6	Grit removal effluent box taken out of service to make 30" proposed connection and other box improvements. Basin 1, 2, 3, and 4 remain out of service,	Plant I. Plant II basins 5, 6, and 7, using existing 24" raw sewage lines.	1.e.	1 weeks
7	The two existing 24" raw sewage lines to make new 30" connections from the grit removal effluent channel. Basin 1, 2, 3, and 4 remain out of service,	Plant I. Plant II Aeration Basins , 6, and 7, using 30" and 36" raw sewage lines from the grit removal effluent.	2.a. 2.b.	2 weeks

SECTION 01 14 19
USE OF SITE

PART 1 - GENERAL

1.1 SUMMARY

1. Section Includes:Restrictions on Contractor's use of the Site and premises.
2. Restrictions on use of existing buildings and structures, including:
   a. Permanent utilities and sanitary facilities.
   b. Existing hoisting equipment.

B. Scope:
1. Contractor shall provide all labor, materials, equipment, tools, and incidentals shown, specified, and required to comply with restrictions on Contractor's use of the Site and other areas.
2. Comply with requirements of the General Conditions, as may be modified by the Supplementary Conditions, regarding the Contractor's use of the Site and other areas.

1.2 SUBMITTALS

A. Action Submittals: Submit the following:
1. Shop Drawings:
   a. Site plan showing proposed location of field offices, storage trailers, staging and laydown areas, temporary sanitary facilities, fuel and oil storage, fueling location, bottle gas storage facilities, and other areas Contractor proposes to occupy.

B. Informational Submittals: Submit the following:
1. Notices of Condition:
   a. Notice of condition of Owner's existing hoisting equipment that Contractor proposes to use, together with written evaluation of condition of equipment including condition of equipment's safety devices. If corrective work is necessary or advisable, transmit concurrently with the Submittal Contractor's Change Proposal for remedial work, in accordance with Section 01 26 00 - Contract Modification Procedures.
2. Hoist Manufacturer's Reports: Submit written report of results of each visit to Site by equipment manufacturer's service technician, including purpose and time of visit, tasks performed, and results obtained.
3. Qualifications Statements:
   a. Identification by name, and qualifications and experience of, person Contractor proposes as Contractor's operator of Owner's hoisting equipment.

1.3 USE OF PREMISES

A. Limit use of premises at the Site to work areas shown or indicated on the Drawings and as specified in this Section. Do not disturb portions of the Site beyond areas of the Work.
1. Limits:
   1) Confine construction operations to the Limits shown on the drawings.
   a. Confine storage of materials and equipment, and locations of temporary facilities to the following areas:
      1) Laydown areas within the Limits of Disturbance shown on the Civil drawings.
      2) Contractor's gang boxes and storage containers for tools in active use in the Work may be kept in reasonable quantity in the work areas as long as such items do not obstruct access to the facilities by Owner or occupants.
      3) Do not store items of any sort, whether temporarily or otherwise, in stairways and ramps, whether existing or under construction.
   b. Do not enter the following areas:

1) Areas outside of the work areas indicated in Paragraph A.1.a of the "Use of Premises" Article in this Specifications section, and outside of work areas indicated on the Drawings.

2. Prohibitions:
   a. Do not use the Site for the following:
      1) Conducting Contractor's business not related to the Project or other work for Owner.
      2) Overnight lodging or other, non-work use of the Site by workers or others for whom Contractor is responsible, whether housed in recreational vehicles, other vehicles, tents, quarters in field offices or Contractor-furnished temporary structures, or in work areas, is unacceptable.
3. Access to Site, Access Roads, Parking Areas, and Haul Routes:
   a. Refer to Section 01 55 13 - Access Roads and Parking Areas.

B. Use of Existing Buildings and Structures: Maintain existing buildings and structures in weather-tight condition throughout construction unless otherwise indicated in the Contract Documents. Protect buildings, structures, and occupants during construction.
1. Use of Existing Utilities, Sanitary Facilities, and First-aid Facilities:
   a. Refer to Section 01 51 05 - Temporary Utilities.
   b. Do not use permanent sanitary facilities, whether provided under the Project or existing prior to the Project, at the Site.
   c. Do not use permanent telephone, Internet, or other communications utilities and facilities at the Site, regardless of whether such services and facilities were provided under the Project or existed prior to the Project, except in cases of emergency.
   d. Do not use Owner's or occupants' first-aid facilities, except in cases of medical emergency. Promptly replenish used items and supplies with items identical to those used.
2. Use of Elevators: None available for Contractor use.
3. Use of Owner's Hoisting Equipment and Access to Work Areas for Loading:
   a. General Provisions:
      1) For each of Owner's hoisting systems used by Contractor, Contractor shall thoroughly check the equipment and submit to Engineer written certification that Contractor believes the equipment is sufficient for the intended use and that all safety mechanisms are in place and operating. If existing equipment has one or more deficiencies, notify Engineer before attempting to use such equipment.
      2) When one or more deficiencies are noted in existing hoisting equipment prior to Contractor's use thereof, Owner may authorize Contractor to perform remedial work on the hoisting equipment under a Change Order or allowance authorization (if any).
      3) Contractor's person operating Owner's hoisting equipment shall be experienced with and qualified in using such equipment. Assign one person to operate Owner's hoisting equipment and advise Engineer in writing of the identity and experience of the designated person.
      4) Following completion of Contractor's use of Owner's hoisting equipment, remedy damage and wear caused by Contractor's use of equipment at no cost to Owner. Perform field quality control testing and inspections as indicated in Article 3.1 of this Specifications section; if not indicated in Article 3.1, perform field quality control tests as mutually agreed upon by hoisting equipment manufacturer's service technical and Engineer. Submit results of field quality control testing to Engineer.
   b. Contractor may use Owner's hoisting equipment as follows:
      1) None unless specifically approved by Owner during Construction.
   c. Contractor may use the hoisting equipment and access ways indicated above for moving materials and equipment during construction. Hoisting equipment shall be available to Owner and occupants at all times unless otherwise arranged with Owner and Engineer. Do not load hoisting equipment beyond posted capacity.

C. Promptly repair damage to premises, including existing structures, finishes, equipment, and other features, caused by construction operations. Upon completion of the Work, restore premises to specified condition; if condition is not specified, restore to pre-construction condition.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

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SECTION 01 22 00
MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. General requirements applicable to all bid/pay items.
   2. General provisions on unit prices and quantities.
   3. General provisions on lump sums.
   4. Listing of the various bid/pay items in the Project, together with criteria for measuring Unit Price Work for payment.

B. Related Requirements: Include, but are not necessarily limited to:
   1. Section 01 26 00 - Contract Modification Procedures.
   2. Section 01 29 76 - Progress Payment Procedures.

1.2 REQUIREMENTS APPLICABLE TO ALL BID/PAY ITEMS

A. In this Section and elsewhere in the Contract Documents, the terms "bid item", "pay item", "bid/pay item", "Item" followed by a number designation, "this item", and the like all have the same meaning, and refer to one or more specific elements of the Contract, established for pricing and payment, as indicated in the Bid Form and in the Agreement (or exhibit to the Agreement) at the time the Contract was signed by the parties.

B. This Article applies to all bid/pay items in the Contract.

C. Prices – General:
   1. The bid/pay items listed starting with Article 1.5 of this Section refer to and are the same bid items listed in the Bid Form and included in the Contract, and constitute all bid/pay items for the Work at the time the Contract was signed by the parties.
   2. No direct or separate payment will be made, outside of the bid/pay items in the Contract, for the following: providing miscellaneous temporary or accessory materials or equipment, temporary works, temporary construction facilities, Contractor's project management, superintendence, and similar costs for Subcontractors or Suppliers; bonds and insurance; schedules and schedule updates; coordination (with: Owner's operations (including, but not limited to, lockout/tag-out procedures), other contractors, utility owners, owners of transportation facilities, adjacent property owners and occupants, authorities having jurisdiction, Subcontractors and Suppliers, and others with whom Contractor is to coordinate the Work); information technology systems required by the Contract Documents; Submittals; photographic documentation; Project meetings; Contractor's hazard communication program; Contractor's compliance with environmental procedures for Constituents of Concern (including spill control and countermeasures plans and implementation); professional services (required for Contractor's means and methods of construction, and for delegated designs required by the Contract Documents); obtaining and complying with permits and licenses; temporary utilities (including electric power, water supply and disposal, fuel, and communications); temporary lighting; temporary fire protection; temporary enclosures and HVAC; temporary sanitary facilities; temporary first-aid facilities and services; Contractor's field offices and sheds, Engineer's field offices (when required elsewhere in the Contract Documents); temporary vehicular access and parking (including access to the Site, temporary access roads and parking, onsite traffic controls for construction traffic, and offsite haul routes); traffic control of non-construction vehicular and pedestrian traffic; temporary controls (including temporary erosion and sediment controls, noise control, control of storm water, surface water, and groundwater, pollution controls (including solid waste control, water pollution control, and control of atmospheric pollution), dust control, pest and rodent controls, odor controls, and other

temporary controls required by the Contract Documents); temporary security for the Work; temporary barriers; Project signage (when required elsewhere in the Contract Documents); delivering, handling, and storing materials and equipment to be incorporated into the Work; layouts and surveys for the Work; construction equipment, machinery, tools, and vehicles; safety and protection; Site maintenance during construction; cleaning and removal and disposal of waste and debris; checkout and startup; testing and other quality control activities required by the Contract Documents; record documents, operation and maintenance data; warranties; spare parts and extra materials required by the Contract Documents; instruction of facility personnel as required by the Contract Documents; commissioning (when required elsewhere in the Contract Documents); Contractor's correction period, Contractor's general warranty and guarantee; Contractor's indemnification obligations; other labor, cost, or effort required by the General Conditions and Supplementary Conditions, Division 01 Specifications, and other requirements of the Contract Documents.

3. Price Escalation:
   a. Unless expressly indicated otherwise in the Contract Documents, Owner is not obligated to change the stipulated prices (including lump sums, unit prices, and allowances) that are all or part of the Contract Price because of escalation of costs when there is no corresponding change in the Contract Times.
   b. Changes in the Contract Times do not necessarily entitle Contractor to a change in Contract Price due to escalation.
   c. Should Contractor claim a change in Contract Price for one or more stipulated price pay items without a corresponding change in scope, extent, or quality in the associated Work, prior to receiving any such change in Contract Price, Contractor shall submit with Contractor's associated Change Proposal, documentation satisfactory to Engineer supporting and documenting that Contractor's costs have increased because of delays beyond Contractor's control within the associated change in Contract Times included in such Change Proposal.
4. Compensation for all services, labor, materials, and equipment shall be included in prices stipulated for the lump sum bid/pay items in the Contract.
5. The lump sum price in the Contract shall include an amount considered by Contractor as sufficient for all overhead and profit for each separately identified bid/pay item.

D. Contract Price, Payment Procedures, and Related Matters:
1. Contract Price: The Contract Price, as apportioned among bid/pay items in the Contract, is indicated in the Agreement and any associated exhibits thereto and may be modified by Change Order.
2. Payments to Contractor: Refer to the General Conditions (as may be modified by the Supplementary Conditions), the Agreement (including provisions on retainage, if any), and Section 01 29 76 - Progress Payment Procedures, among other applicable Contract Documents.
3. Schedule of Values: Refer to the General Conditions (as may be modified by the Supplementary Conditions) and Section 01 29 73 - Schedule of Values.
4. Procedures for Changes in Contract Price: Refer to the General Conditions (as may be modified by the Supplementary Conditions) and Section 01 26 00 - Contract Modification Procedures.
5. Defective Work is not eligible for payment.

1.3 GENERAL PROVISIONS ON UNIT PRICES AND QUANTITIES

A. Quantities:
1. Quantities of Unit Price Work indicated in the Bid Form and in the Contract (at the time the Agreement was signed by the parties) are estimates for purposes of pricing and comparison of Bids.
2. Owner does not represent, either expressly or by implication, or agree that the nature of materials encountered below ground surface or in concealed areas, or actual quantities of Unit Price Work required, will correspond with the quantities in the Contract at the time the

Agreement was signed by the parties. Owner reserves the right to increase or decrease quantities, and to eliminate quantities, as Owner may deem necessary or as may be necessary due to Site conditions encountered.

3. Adjustment of Unit Prices Due to Variation in Quantities:
   a. Provisions, if any, regarding adjustment of unit prices due to variations in actual quantities (eligible for payment) from the estimated quantities in the Contract (including quantities at the time the Agreement was signed by the parties and as subsequently modified by Change Order) are in the General Conditions, as may be modified by the Supplementary Conditions.
      1) Engineer's review for possible unit price adjustment, when provision for such adjustment is expressly indicated in the Contract, will be at a time Engineer deems reasonable and proper.
      2) When the Supplementary Conditions establish that, to be eligible for an adjustment in the unit price, a pay item of Unit Price Work must have a total computed, extended price (at the time the Agreement was signed by the parties) equal to or greater than a specified percentage (stipulated in the Supplementary Conditions) of the total Contract Price (at the time the Agreement was signed by the parties), and the total extended price of such pay item does not exceed the stipulated percentage of the Contract Price, then the associated pay item will be paid at the unit price in the Contract without adjustment for variations in actual quantity.
4. Quantities eligible for payment will be actual quantities furnished and installed (as applicable) in accordance with the Contract Documents, within the pay limits shown or indicated, as measured by Engineer (or other entity so empowered in the Contract Documents) and recommended for payment by Engineer.
5. At Contractor's expense, Contractor may independently verify quantities measured by Engineer for payment. Should Contractor disagree with quantities measured and recommended for payment by Engineer, submit appropriate Change Proposal (appealing Engineer's measurements) indicating the specific reasons for Contractor's appeal, with detailed reasons therefor and associated calculations and estimates, in accordance with the Contract Documents.
6. Quantity Overruns:
   a. When the quantity of a pay item of Unit Price Work eligible for payment exceeds the pay item's quantity included in the Contract, Owner will pay for quantities that exceed those in the Contract only while the estimated total payments to Contractor under the Contract will not exceed the Contract Price. Otherwise, a Change Order is required to modify the associated quantity in the Contract, thus changing the Contract Price.
7. Except as may be established elsewhere in the Contract Documents, make no claim for anticipated profit, loss of profit, damages, or additional compensation arising from difference between quantities of Unit Price Work eligible for payment and the estimated quantities in the Contract.

B. Measuring for Payment:
   1. At Engineer's option, Engineer may delegate to Resident Project Representative (RPR) (if any), some or all of Engineer's responsibilities for measuring Unit Price Work eligible for payment.
   2. Unless expressly indicated otherwise in the Contract Documents, measurements will be in United States standard measurements.
   3. Unless indicated otherwise elsewhere in the Contract Documents, quantities of Unit Price Work eligible for payment will be rounded to the nearest whole number.
   4. Assistance with Measurements:
      a. Assist Engineer and Resident Project Representative (RPR) (if any), by providing measuring equipment, labor, and survey personnel necessary to measure quantities eligible for payment.
   5. Quantities eligible for payment can be adjusted by Engineer to correct quantities included in Contractor's prior payment requests, and for incomplete or defective Unit Price Work. Such corrections are at Engineer's sole discretion.

1.4 GENERAL PROVISIONS ON LUMP SUM ITEMS

A. Progress payments for Work paid on a lump sum basis will be based on Engineer's estimate of the Work (in accordance with the Contract Documents) performed through the end of the associated pay period, based on the Schedule of Values accepted by Engineer in accordance with the Contract Documents.

B. At its sole discretion, Engineer may correct amounts of lump sum Work included in prior payment requests based on improved data or information available to Engineer, or Engineer's knowledge or reasonable belief that Work is incomplete or defective.

1.5 BID/PAY ITEMS - GENERAL CONTRACT

A. Item 1 - Mobilization and Demobilization:
   1. Measurement: In accordance with the Contract's provisions on Schedule of Values and progress payments for lump sum Work.
   2. Item Includes:
      a. Work and activities indicated in this provision are intended as illustrative for purposes of scope and payment and do not represent a complete list of all preconstruction activities and Submittals, or all Work or activities required by the contract for mobilization and demobilization.
      b. Mobilization Work paid under this item will include:
         1) Obtaining Owner's acceptance of proposed Subcontractors and Suppliers and entering into subcontracts and purchase orders needed to start the Work.
         2) Preparing and obtaining Engineer's approval of Shop Drawings required in Section 01 14 19 - Use of Site.
         3) Preparing and obtaining Engineer's acceptance of schedules, including Progress Schedule, Schedule of Submittals, and Schedule of Values.
         4) Preconstruction conference(s) required by the Contract Documents.
         5) Preconstruction photographic documentation.
         6) Establishing Contractor's Site-specific health and safety plan, preconstruction activities needed to start implementing Contractor's safety programs, and verifying status of training of construction workers and personnel and condition of construction equipment, machinery, and tools.
         7) Submitting acceptable emergency contact information
         8) Obtaining required permits needed to start the Work.
         9) Initial establishment of temporary utilities and temporary facilities.
         10) Establishing Contractor's field office and sheds, Contractor's storage areas, staging and laydown areas, and other areas necessary to perform the Work.
         11) Initial establishment of construction vehicular access to the Site, parking needed for construction, and offsite haul routes.
         12) Establishing construction equipment, machinery, and tools at the Site.
         13) Providing initial temporary controls.
         14) Temporary security needed to start Work at the Site.
         15) Performing preconstruction assessments and condition surveys required by the Contract Documents.
         16) Other mobilization acceptable to Engineer.
      c. Demobilization Work paid under this item will include:
         1) Performing post-construction assessments and condition surveys required by the Contract Documents and associated remedial Work, if any.
         2) Removal from the Site and adjacent areas of excess materials and equipment.
         3) Removal of temporary controls, temporary facilities, temporary barriers, and similar materials and equipment.
         4) Removal of temporary access roads and parking areas not part of permanent pavement or otherwise allowed to remain by Owner, including temporary traffic controls established for construction vehicles and equipment.

5) Removal of all field office and sheds, storage areas, staging and laydown areas, and other areas needed to perform the Work and restoration of such areas.
6) Removal from the Site of all construction equipment, machinery, tools, Contractor's containers, temporary fuel storage tanks, and similar items.
7) Closeout of permits on which Contractor is a permittee or co-permittee.
8) Final cleaning.
9) Furnishing required warranty bond, if any.
10) Furnishing required closeout documents.
11) Other costs and effort by Contractor for demobilization.

d. Other cost and Work are under other bid/pay items in the Contract.

3. Payment: Lump sum price for this item will be full compensation for all mobilization and demobilization required and needed for the Contract, not included under other bid/pay items or contracts.

B. Item 2 – Trench Safety and Shoring:
1. Measurement: In accordance with the Contract's provisions on Schedule of Values and progress payments for lump sum Work.
2. Item Includes:
a. All applicable trench safety and shoring investigation, design, permit(s), apparatus, installation, maintenance, removal, and related work to meet applicable laws and regulations and requirements of Section 31 23 16.43 Temporary Support of Excavations.
3. Payment: Lump sum payment for this item will be full compensation for completing the Work, as shown and indicated in the Contract Documents.

C. Item 3 – Stormwater Pollution Prevention Plan:
1. Measurement: In accordance with the Contract's provisions on Schedule of Values and progress payments for lump sum Work.
2. Item Includes:
a. All applicable SWPPP work including design, materials and equipment, installation, maintenance, removal, and related work to meet applicable laws and regulations and requirements of the Contract Drawings and Specifications.
3. Payment: Lump sum payment for this item will be full compensation for completing the Work, as shown and indicated in the Contract Documents.

D. Item 4 – 24-inch Diameter Drilled Concrete Pier, complete in place:
1. Measurement: per vertical linear foot of installed drilled concrete pier, 24-inch diameter.
2. Item Includes:
a. All work, materials, equipment, and labor associated with installation of drilled concrete piers in accordance with the Contract Drawings and Specifications including but not limited to:
1) Concrete
2) Rebar
3) Drilling rig mobilization, operation, demobilization
4) Surveying of piers
5) Associated labor
3. Payment: Unit price per vertical linear foot for this item will be full compensation for all 24-inch diameter drilled concrete piers, complete in place as shown and indicated in the Contract Documents or directed by Engineer.

E. Items 5A through 5C – Concrete Surface Repair:
1. Measurement: per square foot of repaired surface.
2. See Section 03 01 30 Repair and Rehabilitation of Existing Construction for item definitions.
3. Payment: Unit price per square foot for this item will be full compensation for all concrete surface repair as shown and indicated in the Contract Documents or directed by Engineer.

F. Item 5D – Reinforcement Replacement:

1. Measurement: per linear foot of replaced reinforcement.
2. Item Includes:
   a. All materials, equipment, and labor to replace reinforcement inclusive of specified coatings and connection to existing rebar. See Section 03 01 30 Repair and Rehabilitation of Existing Construction for related requirements.
3. Payment: Unit price per linear foot for this item will be full compensation for all reinforcement replacement as shown and indicated in the Contract Documents or directed by Engineer.

G. Item 6 – System Integration Services as required in Division 40:
   1. Measurement: In accordance with the Contract's provisions on Schedule of Values and progress payments for lump sum Work.
   2. Item Includes:
      a. All professional services of the System Integrator as specified in Division 40, including but not limited to:
         1) Programming
         2) Configuration
         3) Testing and Startup
         4) Documentation
         5) Training
      b. This item does not include cost of any materials or equipment to be incorporated into the Work.
   3. Payment: Lump sum payment for this item will be full compensation for completing the Work, as shown and indicated in the Contract Documents.

H. Item 7 - Construction of entire Project U2100 work excluding other Bid items:
   1. Measurement: In accordance with the Contract's provisions on Schedule of Values and progress payments for lump sum Work.
   2. Item Includes:
      a. Construction of treatment structures, yard piping, electrical improvements, and sitework.
      b. All work on this project excluding other Bid Items.
   3. Payment: Lump sum payment for this item will be full compensation for completing the Work, as shown and indicated in the Contract Documents.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

SECTION 01 25 00
SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Requirements applicable to all substitution requests.
   2. Provisions specific to Contractor's substitution requests for:
      a. Materials and equipment to be incorporated into the Work.
      b. Methods, procedures, and sequences indicated in the Contract Documents.

B. Scope:
   1. Contractor shall provide all labor, materials, equipment, tools, services, and incidentals, and pay all costs associated with requests for approval of substitutes.
   2. Where the Contract Documents expressly indicate that substitutes are not allowed, are unacceptable, or time-barred, do not submit substitution requests for such items or procedures.
   3. Requirements for Contractor's proposal of "or-equals", where allowed by the Contract, are in Section 01 62 00 - Product Options, and the General Conditions, as may be modified by the Supplementary Conditions.

C. Related Requirements:
   1. Include, but are not necessarily limited to:
      a. Section 01 26 00 - Contract Modification Procedures.
      b. Section 01 62 00 - Product Options.

1.2 REFERENCES

A. Terminology:
   1. The following terminology, although not indicated with initial capital letters, has the following meaning in this Section:
      a. "Or-equal" and "or equal" each means material or equipment items to be incorporated into the completed Work as a functioning whole, or method, procedure, or sequence that, in Engineer's sole opinion, are equivalent to that shown or indicated in the Contract Documents.
      b. "Substitute" means a proposed materials or equipment to be incorporated into the completed Work as a functioning whole, or a proposed construction method, procedure, or sequence that is not, in Engineer's sole opinion, equivalent to the associated, similar material or equipment item or method, procedure, or sequence shown or indicated in the Contract Documents, but accomplishes the same or similar purpose. Unless expressly indicated otherwise in the Contract Documents, Contractor's proposals for "value engineering" (and similar terms) are substitutes.
      c. "Substitution request" means Contractor's written request for Engineer's approval of a proposed substitute, in accordance with this Section. Substitution requests are separate from Shop drawings and other Submittals required by the Contract Documents.

1.3 SUBSTITUTES - GENERAL

A. This Article applies to all substitutes and substitution requests, whether for substitute materials or equipment, or for substitute methods, procedures, or sequences.

B. This Section expands on the provisions on substitutes in the General Conditions, as may be modified by the Supplementary Conditions.

C. Time Limits for Submitting Substitution Requests:

1. Where the Contract allows Contractor's substitution requests, such proposals will be considered by Engineer only during a period of 60 days after the date the Contract Times start to run, unless otherwise indicated.
2. Substitution requests will be accepted for consideration by Engineer after the time limit indicated in the paragraph above this, when materials or equipment shown or indicated, and all associated "or-equals", are either:
    a. Unavailable; or
    b. Despite Contractor's due diligence, are unavailable in time for the Work to be completed within the Contract Times.
3. The foregoing notwithstanding, substitutes will not be approved when received by Engineer after Contractor has commenced the associated Work at the Site, where approval of the substitute would require rework or removing Work already installed.

D. Design Professional:
1. Engineer is responsible for design of the completed Project as a functioning whole and has responsible charge of the Project except for Work for which design responsibility is expressly delegated by the Contract Documents.
2. Do not retain services of any third-party design professional to prepare modifications of Engineer's design of the completed Project as a functioning whole without Engineer's express, written consent via an appropriate Contract modification setting forth appropriate performance and design criteria for delegating the design of the substitute.

E. Contractor's Representations:
1. In submitting each substitution request, Contractor represents that:
    a. Contractor has read and understands the Contract's provisions on substitutes, as indicated in the General Conditions, as may be modified by the Supplementary Conditions, this Section, and elsewhere in the Contract Documents.
    b. Substitution request is complete and includes all documents and information required by the Contract Documents.
    c. Contractor certifications required by the General Conditions, as may be modified by the Supplementary Conditions, and this Section are valid and made with Contractor's full knowledge, information, and belief.
    d. Contractor will provide the same or better guarantees and warranties for substitute as for the specified materials, equipment, methods, procedures, and sequences (as applicable).
    e. Contractor waives all rights for increasing the Contract Price or extending the Contract Times, related to the substitute, that subsequently may become apparent to Contractor after issuance of the associated Contract modification instrument approving such substitute, except for those associated with differing subsurface or physical conditions or discovery of a previously unforeseen Hazardous Environmental Condition associated with the Work involving the approved substitute.

F. Submittal of Substitution Requests - General:
1. Substitution requests must be submitted by Contractor. Engineer will not accept or review substitution requests from prospective or bona-fide Subcontractors or Suppliers.
2. Submit separate substitution request for each proposed substitute.
3. Submit substitution requests in accordance with requirements for Shop Drawings and other Submittals, as indicated in the General Conditions, as may be modified by the Supplementary Conditions, Section 01 33 00 - Submittal Procedures, and Section 01 31 26 - Electronic Communication Protocols.
4. Do not submit substitution requests as any of the following (such substitution requests will be returned by Engineer without review):
    a. Shop Drawing, Sample, or other Submittal.
    b. Request for approval of an "or-equal".
    c. Request for interpretation (RFI) or clarification.
    d. Change Proposal without all other, required substitution request elements indicated below.

e. Other oral or written communication not in accordance with this Section.

5. Each substitution request shall include:
   a. Transmittal letter (one per substitution request) expressly indicating the communication is a substitution request.
   b. Completed substitution request form, on the form attached to this Section.
   c. Certifications and written representations required by the Contract Documents to accompany substitution requests.
   d. Other information: (1) required elsewhere in this Section and in other elements of the Contract Documents, and (2) deemed appropriate by Contractor to support Contractor's substitution request.
6. When Engineer requires additional information to evaluate a substitution request, furnish such information within five days of receipt of Engineer's request, unless additional time is granted by Engineer, in writing.
7. Engineer and Owner have the right to rely upon the completeness and accuracy of information, documents, certifications, and representations in Contractor's substitution request. Contractor accepts full responsibility for completeness and accuracy of substitution requests (except for Engineer's professional liability).

G. Engineer's Review of Substitution Requests:
1. Engineer has no obligation to approve any substitute.
2. Substitutes will not be approved unless all of the following are satisfied for the associated substitute:
   a. The Contract supports submittal of such substitution request; and
   b. Substitute is reasonably consistent with Engineer's design intent for the Project as a completed, functioning whole; and
   c. As indicated in Paragraph 1.3.A.3 of this Section.
   d. Substitute will not have an adverse effect on the work of other contractors, or existing or proposed construction; and
   e. Substitution request is complete in accordance with the Contract Documents and Engineer's requests, and
   f. Owner agrees to the substitute; and
   g. Associated changes in Contract Price and Contract Times, if any, are acceptable to Owner.
3. Engineer is not obligated to approve any substitute where such approval is conditioned on an increase in the Contract Price, the Contract Times, or both.
4. Timeliness of Engineer's Review:
   a. Allow not less than 21 days for Engineer's review of each substitute. Allow longer for larger, more-complex substitutes.
   b. Engineer will endeavor to perform timely review of substitution requests. However, Contractor is responsible for complying with the Contract Times, regardless of whether the substitute is approved.
   c. Where approval of a substitute would necessitate other changes to the Project's design, additional time, beyond that indicated above, will be necessary for Engineer's preparation of revisions to the design.
5. When Design Changes are Required with Approval of Substitute:
   a. Engineer will advise Contractor promptly following Engineer's review (and Owner's comment, if any) on substitution request to indicate whether the substitute will be acceptable. Engineer's advisory to Contractor will indicate whether changes in Engineer's design are necessary and include a preliminary estimate of Engineer's fee and time required for modifying the design and preparing an associated Proposal Request to Contractor.
   b. Engineer's preliminary estimates of fee and time for design modifications will be prepared in good faith, but are not binding on Owner or Engineer.
   c. Contractor shall reimburse Owner for costs incurred by Owner for design modifications necessitated by approval of substitute. Owner may deduct such amounts, as one or more set-offs, from payments due Contractor under the Contract.

d. Upon Contractor's receipt of Engineer's estimate of fee and time for design modifications, contractor shall advise Engineer, in writing, within three days whether Contractor will continue pursing approval of the substitute.
e. Request to Contractor.
f. Engineer may reject a substitute that would require substantial changes in the Project's design.

H. Approval of Substitutes:
1. Substitutes are approved only via issuance of an appropriate Field Order or Change Order in accordance with Section 01 26 00 - Contract Modification procedures, and the General Conditions, as may be modified by the Supplementary Conditions.
2. Approval of a substitute does not relieve Contractor from obligation to comply with the Contract Documents, including submitting Shop Drawings, Samples, and other Submittals in accordance with the Contract Documents.

1.4 SUBSTITUTE MATERIALS AND EQUIPMENT

A. In addition to other requirements of this Section and elsewhere in the Contract Documents, substitution requests for substitute materials or equipment shall include:
1. Manufacturer and Location:
a. Name and address of manufacturer of the proposed substitute. Indicate country where manufacturer is incorporated and owned.
b. Companies and brands owned by or affiliated with manufacturer.
c. Name of manufacturers of principal component items, such as motors, bearings, and similar items.
d. Location where the items would be manufactured, including country and address. Indicate the total percentage of the items' value that will be manufactured outside of the United States and its territories.
e. Name, address, and driving distance from the Site of:
1) Manufacturer's sales representative.
2) Nearest service center offering full array of service capabilities.
3) Warehouse or other location where spare parts for the proposed substitute are available.
f. Number of years that manufacturer has actively participated the North American market.
2. Proposed Materials and Equipment:
a. Model designation and quantity of each proposed for the Work.
b. Manufacturer's literature for proposed substitute, with description of the materials and equipment.
c. Performance information and representative test data.
d. Indication of reference standards with which materials and equipment comply.
e. Preliminary process and instrumentation diagrams (P&ID), where applicable.
f. Identification of hazardous materials, including Constituents of Concern, used in the materials and equipment, and associated permitting or licensing required.
g. Manufacturer's standard warranty and applicable, proposed special or extended warranties, including indication of specific entities that will be beneficiary of such warranties.
h. Complete list of proposed deviations from requirements of the Contract Documents.
i. Itemized comparison of specified materials and equipment and proposed substitute, indicating:
1) Size (physical dimensions) when: item is in use, when not in use, and space required for routine and major maintenance.
2) Weight and loading at supports, when item is full and empty.
Materials of construction.
3. Operation requirements, including:
a. Anticipated consumption of each item of: Electricity, other energy sources, water, chemicals (indicate each), and other needs for operation at the Site.

b. Typical labor required for operation and associated skill level.
c. Description of remote monitoring and control capabilities, as applicable.

4. Maintenance requirements, including:
   a. Anticipated life in the service and environment required.
   b. Frequency and general scope of routine and major maintenance typically necessary.
   c. Typical labor requirements and general qualifications of personnel performing routine maintenance.
   d. Major, associated equipment necessary for routing and major maintenance, including hoisting equipment type and capacity (when applicable).
   e. Availability, scope, cost, and general conditions of service and maintenance contracts, if any.
5. References for similar projects on which the materials and equipment were used. Indicate for each:
   a. Project owner name, name of facility where installed, and name of project.
   b. City, state, and country of installation.
   c. Model number/size and quantity furnished and installed.
   d. Year of installation.
   e. Contact information for owner and design professional, including telephone numbers.
6. Other information required by the Contract Documents.
7. Other information reasonably requested by Engineer.

1.5 SUBSTITUTE CONSTRUCTION METHODS, PROCEDURES, OR SEQUENCES

A. Provisions of the General Conditions, as may be modified by the Supplementary Conditions, regarding substitutes of materials and equipment are hereby extended to apply to substitute methods, procedures, and sequences as shown or indicated in the Contract Documents.

B. In addition to other requirements of this Section and elsewhere in the Contract Documents, substitution requests for substitute methods, procedures, or sequences shall include:
   1. Clear identification of the method, procedure, or sequence shown or indicated in the Contract Documents for which substitute is requested.
   2. Detailed description of proposed substitute method, procedure, sequence, or combination thereof.
   3. Reasons why substitute is proposed and benefits to the Project should the substitute be approved.
   4. Detailed list of how the proposed substitute deviates from associated method, procedure, or sequence shown or indicated in the Contract Documents.
   5. Impact of the substitute, if approved, on Owner's or facility manager's operations, when the Work is at an existing facility.
   6. Effect on other contractors working at the Site, if substitute is approved.
   7. Description of temporary equipment and temporary facilities needed, should the substitute be approved, including quantity of items, capacities, performance characteristics, permitting and approvals required by authorities having jurisdiction, and proposed location at the Site.
   8. Written evaluation of how substitute method, procedure, or sequence complies with Laws and Regulations.
   9. Drawings illustrating method, procedure, or sequence.
   10. Materials to be used that contain Constituents of Concern or that have potential to cause or exacerbate a Hazardous Environmental Condition.
   11. Other information and data required by the Contract Documents.
   12. Other information reasonably required by Engineer.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 ATTACHMENTS

A. The following, bound after this Section's "End of Section" designation, are part of this Specifications Section:
   1. Exhibit A - Substitution Request Form (one page).

END OF SECTION

EXHIBIT A Substitution Request Form (One Item per each Form)

Project:	Date:	
Substitution Requestor:		
Contractor:		
Specification Section No:	Paragraph No. (i.e. 2.1.A.1.e):	Specified Item:
Proposed Substitution:		
Provide Product Data Sheets, Manufacturer's written installation instructions, drawings, diagrams, or any other information as an attached to this Form that will demonstrate the proposed substitution is an Approved Equal.		
State differences between proposed substitutions and specified item. Differences include but are not limited to interrelationship with other items; materials, equipment, function, utility, life cycle costs, applied finished, appearances, and quality. [ ][ ] [ ][ ] [ ][ ] [ ][ ]		
Document how the proposed substitution is compatible with or modifies other systems, parts, equipment or components of the Project and Work under the Contract [ ][ ] [ ][ ] [ ][ ]		
Describe what effect the proposed substitution has on dimensions indicated on the Drawings and previously reviewed Shop Drawings? [ ][ ] [ ][ ] [ ][ ]		
Describe what effect the proposed substitution has on the Construction Schedule and Contract Time. [ ][ ] [ ][ ] [ ][ ]		
Describe what effect the proposed substitution has on the Contract Price. This includes all direct, indirect, impact and delay costs. [ ][ ] [ ][ ] [ ][ ]		
Manufacturer's guarantees of the proposed and specified items are: ☐ Same ☐ Different (explain on attachment)		
The undersigned state that the function, utility, life cycle costs, applied finishes, appearance and quality of the proposed substitution are equal or superior to those of the specified item.		
For use by Engineer: ☐ Accepted – eligible for approval via Change Order ☐ Accepted as Noted – approval via Change Order ☐ Not Accepted [ ] [ ] *Date* *(Telephone):* [ ] Signature of PE, RA, or PG in Responsible Charge	[ ] *(Contractor's Signature)* [ ] *(Contractor's Firm)* [ ] *(Firms Address)* [ ] *(Telephone)*	

Comments:

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SECTION 01 26 00
CONTRACT MODIFICATION PROCEDURES

1.1 SUMMARY

A. Section Includes:
   1. This Specifications section expands upon provisions of the General Conditions, as may be modified by the Supplementary Conditions, and includes:
      a. Requests for interpretation.
      b. Written clarifications.
      c. Minor changes in the Work and Field Orders.
      d. Work Change Directives.
      e. Proposal Requests.
      f. Change Proposals.
      g. Change Orders.

1.2 GENERAL – APPLICABLE TO ALL PROVISIONS OF THIS SECTION

A. Submit Contract modification documents to Engineer, addressed to the contact person and contact information indicated in Section 01 33 00 - Submittal Procedures, and in accordance with Section 01 31 26 - Electronic Communication Protocols.

B. Retain at Contractor's office and at the Site complete copy of each Contract modification document, all interpretations and clarifications, related documents, and Engineer's response.

1.3 REQUESTS FOR INTERPRETATION

A. General.
   1. Transmit written requests for interpretation to Engineer. Contractor and Owner may prepare and transmit requests for interpretation.
   2. Prepare and transmit request for interpretation to obtain clarifications or interpretations of the Contract Documents. Report conflicts, errors, ambiguities, and discrepancies in the Contract Documents by requesting an interpretation.
   3. Do not transmit request for interpretation when other form of communication is appropriate, such as Submittals, requests for approvals of substitutes, notices, ordinary correspondence, or other form of communication. Improperly prepared or inappropriate requests for interpretation will be returned without response or action by Engineer.
   4. Do not submit request for interpretation or clarification when:
      a. answer may be obtained by observations at the Site; or.
      b. required information is clearly indicated in the Contract Documents; or.
      c. required information is included in industry standards referenced in the Contract Documents or Supplier's instructions that are consistent with the Contract Documents; or.
      d. are reasonably inferable from any of foregoing.
   5. Engineer will return requests for interpretation without response for any of the following reasons:
      a. Request is regarding one of the items addressed in Paragraphs 1.3.A.3 and 4 of this Specifications section.
      b. Request is unclear or incomplete.
      c. Request was answered in Engineer's response to a prior request for interpretation.
      d. Request is related to construction means, methods, techniques, procedures, or sequences of construction that are not required by the Contract Documents.
      e. Request is related to safety and protection matters that are solely Contractor's responsibility.
      f. Request resulted in whole or in part to lack of adequate coordination by Contractor, including coordination of Subcontractors and Suppliers.
      g. Requests that are otherwise frivolous or unnecessary.

6. Should requests be categorized by Engineer as within the limits of Paragraphs 1.3.A.3, 4, or 5 of this Specifications Section, Engineer may recommend and Owner may withhold from payments due Contractor under the Contract set-off(s) sufficient to cover Owner's costs of Contractor's submittal of invalid, frivolous, unnecessary, or inappropriate requests for interpretation or clarification..
7. Contractor shall have sole financial responsibility for Contractor's costs for requests for interpretation or clarification that are submitted late, out of sequence, or that are unnecessary.

B. Procedure.
1. Transmit requests for interpretation in accordance with Section 01 31 26 - Electronic Communication Protocols, and requirements of this Specifications section. Include with each request for interpretation a separate letter of transmittal.
2. If Engineer requests additional information to make an interpretation, entity requesting the interpretation shall transmit the information requested within 10 days, unless Engineer allows additional time, via correspondence referring to request for interpretation number.
3. Engineer will review and respond to requests for interpretation with reasonable promptness. Allow sufficient time for review and response.
4. Engineer will maintain log of requests for interpretation. Upon request, copy of log will be transmitted to requestor.
5. Engineer's response to requests for interpretation will be transmitted in accordance with Section 01 31 26 - Electronic Communication Protocols, and requirements of this Specifications section. Each response to a request for interpretation will include a separate letter of transmittal.
6. Engineer's response to each request for interpretation will be distributed to:
   a. Contractor.
   b. Owner.
   c. Resident Project Representative (RPR).
   d. Engineer.
7. If Contractor desires to appeal Engineer's interpretation or clarification, comply with the appeals procedure set forth in the General Conditions, as may be modified by the Supplementary Conditions.
8. Interpretations that One or Both Parties Believes Entails a Change to the Contract:
   a. If Contractor or Owner believes that a change in the Contract Price or Contract Times or other change to the Contract is required as a result of Engineer's interpretation, so advise Engineer in writing before proceeding with the Work associated with the request for interpretation.
   b. If, after this initial communication, either Owner or Contractor believes that change in Contract Price, Contract Times, both, or other relief with respect to the terms of the Contract is necessary, recourse shall be in accordance with the Contract Documents.

C. Preparation of Requests for Interpretation:
1. Prepare each request for interpretation on the "Request for Interpretation" form included with this Specifications section, or other form acceptable to Engineer.
2. Number each request for interpretation as follows: Numbering system shall be the Contract number and designation followed by a hyphen and three-digit sequential number. Example: First request for interpretation on the general contract for project titled, "Contract WWTP09" would be, "RFI No. WWTP09-GC-001".
3. In space provided on form, describe the interpretation requested. Provide additional sheets as necessary. Include text and sketches as required in sufficient detail to describe the need for interpretation.
4. When applicable, request for interpretation shall include Contractor's recommended resolution.

1.4 WRITTEN CLARIFICATIONS

A. General:

1. Written clarifications, when required, will be initiated and issued by Engineer.
2. Written clarifications do not change the Contract Price or Contract Times, and do not alter the Contract Documents.
3. Written clarifications will be issued as correspondence or using clarification notice form acceptable to Engineer, with additional information as required.

B. Procedure.
1. Engineer's written clarifications will be transmitted in accordance with Section 01 31 26 - Electronic Communication Protocols, and requirements of this Specifications section.
2. Each written clarification will be distributed to:
   a. Contractor.
   b. Owner.
   c. Resident Project Representative (RPR).
   d. Engineer.
3. If Contractor desires to appeal Engineer's interpretation or clarification, comply with the appeals procedure set forth in the General Conditions, as may be modified by the Supplementary Conditions.
4. Written Clarifications that One or Both Parties Believes Entails a Change to the Contract:
   a. If Contractor or Owner believe that a change in the Contract Price or Contract Times or other change to the Contract is required as a result of Engineer's written clarification, so advise Engineer in writing before proceeding with the Work associated with the written clarification.
   b. If, after this initial communication, either Owner or Contractor believes that change in the Contract Price, Contract Times, both, or other relief with respect to the terms of the Contract is necessary, recourse shall be in accordance with the Contract Documents.
5. If Engineer's written clarification is unclear, prepare and transmit a request for interpretation in accordance with the Contract Documents.

1.5 MINOR CHANGES IN THE WORK AND FIELD ORDERS

A. General:
1. Field Orders, when required, will be initiated and issued by Engineer.
2. Field Orders authorize minor changes in the Work but do not change the Contract Price or Contract Times.
3. Field Orders will be in the form of Engineers Joint Contract Documents Committee document EJCDC C-942, "Field Order".
4. Engineer will maintain a log of Field Orders issued. Copy of Engineer's log of Field Orders will be transmitted to Contractor or Owner upon request.

B. Procedure:
1. Field Orders will be transmitted in accordance with Section 01 31 26 - Electronic Communication Protocols, and requirements of this Specifications section. Each Field Order will include a separate letter of transmittal.
2. Each Field Order will be distributed to the following:
   a. Contractor.
   b. Owner.
   c. Resident Project Representative (RPR).
   d. Engineer.
3. Field Orders that One or Both Parties Believes Entails a Change to the Contract Price or Contract Times:
   a. If Contractor or Owner believes that a change in the Contract Price or Contract Times or other change to the Contract is required as a result of a Field Order, so advise Engineer in writing before proceeding with the Work associated with the Field Order.
   b. If, after this initial communication, Contractor believes that change in Contract Price, Contract Times, both, or other relief with respect to the terms of the Contract is necessary, recourse shall be in accordance with the Contract Documents.
4. If the Field Order is unclear, submit request for interpretation.

5. If Owner disagrees with the Field Order, Engineer may issue a revised or amended Field Order, or a Change Order or Work Change Directive may be issued.

1.6 WORK CHANGE DIRECTIVES

A. General:
   1. Work Change Directives, when issued, order additions, deletions, or revisions to the Work. When issued, Contractor shall promptly implement the changes ordered in the associated work Change Directive.
   2. Work Change Directives do not change the Contract Price or Contract Times but are evidence that the parties to the Contract expect that the change ordered or documented by the Work Change Directive will be incorporated in subsequently issued Change Order following agreement by the parties as to the Work Change Directive's effect, if any, on the Contract Price, Contract Times, or both.
   3. Work Change Directives will be in the form of EJCDC C-940, "Work Change Directive".

B. Procedure.
   1. Work Change Directives signed by Owner and Engineer will be transmitted in accordance with Section 01 31 26 - Electronic Communication Protocols, and requirements of this Specifications section. Each Work Change Directive will include a separate letter of transmittal. Signed Work Change Directives will be transmitted to:
      a. Contractor.
      b. Owner.
      c. Engineer.
      d. Resident Project Representative.
   2. Documentation of Costs:
      a. Promptly following receipt of the Work Change Directive:
         1) Advise Engineer and Owner in writing of the anticipated quantity and types of construction equipment and machinery required or anticipated for the associated Work.
         2) Advise Engineer and Owner in writing of which construction equipment and machinery is owned by the Contractor or Subcontractor and which is, or will be, rented from an equipment rental firm.
         3) When construction equipment and machinery is rented from a rental firm, transmit to Engineer and Owner copy of the associated rental agreements(s) pertinent to the Work ordered by the Work Change Directive.
         4) For all construction equipment and machinery, indicate to Engineer and Owner whether each item is required only for the Work ordered by the Work Change Directive and whether each item is being, or will be, used for other Work on the Project or other projects for Owner.
         5) Advise Engineer and Owner in writing of information on anticipated temporary materials (including items such as temporary support of excavations, scaffolding, temporary barriers, temporary plates covering excavations, and other temporary materials) to the same extent as that required for construction equipment and machinery.
      b. When basis of payment for Work ordered under a Work Change Directive will be paid as Cost of the Work plus a fee, or when otherwise required by Engineer, document for the Work performed under each separate Work Change Directive, for each day, the following:
         1) Number and labor classifications of workers employed and hours worked each day on the Work ordered via the Work Change Directive.
         2) Construction equipment used, including manufacturer, model, and year of manufacture, and number of hours such equipment was onsite and used each day for the Work under the Work Change Directive. Indicate where the equipment was used for other Work under the Contract and idle time.
         3) Temporary materials; furnish the same information as required for construction equipment and machinery. Where rental costs of such items approaches the

purchase cost of such item, or when otherwise requested by Engineer, furnish evidence, satisfactory to Engineer, of the purchase price of such temporary materials.

4) Consumables and similar materials used.
5) Suppliers' receipts, bills, or invoices for and descriptions of materials and equipment incorporated into the Work.
6) Invoices and labor and equipment breakdowns for Subcontractors.
7) Other information required by Owner or Engineer.
8) Transmit such documentation as a Change Proposal promptly after such documentation is available to Contractor. Actively pursue Subcontractors and Suppliers for required documentation to promptly furnish required documentation to Engineer.

c. Separately track and document Work performed in accordance with each Work Change Directive and Work performed under stipulated price methods of compensation (including lump sums and Unit Price Work).
d. Submit such information in a format acceptable to Engineer.

3. Documentation of Time:
   a. General:
      1) Contractor will be entitled to change of Contract Times Work ordered by a Work Change Directive in accordance with the requirements of the General Conditions, as may be modified by the Supplementary Conditions.
      2) Contractor will be entitled to a change in Contract Times only when the Work ordered by the Work Change Directive is implemented promptly and affects the Contractor's ability to comply with the Contract Times.
   b. Requirement Documentation: Submit the following as part of the Change Proposal documenting price-related impact of the Work ordered by the Work Change Directive:
      1) Statement on whether the subject Work affected Contractor's ability to comply with the Contract Times.
      2) If Contractor's ability to comply with the Contract Times was so affected, indicate the effect on each of the relevant Contract Times.
      3) Document that Contractor acted promptly and properly upon receipt of the Work Change Directive to promptly implement the Work ordered thereby.
   4) Time impact analysis for the affected Work, in accordance with Section 01 32 16 - Construction Progress Schedule.
   5) Other time-related documentation required by Engineer.

1.7 PROPOSAL REQUESTS

A. General:
   1. Proposal Requests may be initiated by Engineer or Owner.
   2. Proposal Requests are for requesting the effect on the Contract Price and the Contract Times and other information relative to contemplated changes in the Work. Proposal Requests do not authorize changes or variations in the Work, and do not change the Contract Price or Contract Times or terms of the Contract.
   3. Proposal Requests will be furnished using the "Proposal Request" form included with this Specifications section.

B. Procedure:
   1. Proposal Requests will be transmitted in accordance with Section 01 31 26 - Electronic Communication Protocols, and requirements of this Section. Each Proposal Requests will include a separate letter of transmittal.
   2. Each signed Proposal Request will be transmitted to the following:
      a. Contractor.
      b. Owner.
      c. Resident Project Representative (RPR).
      d. Engineer.

3. Transmit request for interpretation to obtain clarification of conflicts, errors, ambiguities, and discrepancies in Proposal Request.
4. Upon receipt of Proposal Request, Contractor shall prepare and transmit to Engineer a Change Proposal, in accordance with the Contract Documents, for the proposed Work described in the Proposal Request.

1.8 CHANGE PROPOSALS

A. General:
1. Prepare and transmit written Change Proposal to Engineer in response to each Proposal Request; or when Contractor believes a change in the Contract Price, Contract Times, both, or other change to the terms of the Contract is required; or to appeal an initial decision by Engineer concerning the requirements of the Contract Documents or relating to the acceptability of the Work under the Contract Documents; contest a set-off against payment due; or seek other relief under the Contract.

B. Procedure:
1. Prepare and transmit Change Proposals within time limits indicated in the General Conditions, as may be modified by the Supplementary Conditions.
2. Submit only one Change Proposal for each change issue, unless Engineer requires additional information or clarification. Do not submit repeated Change Proposals for the same change issue. Rather, when Contractor is dissatisfied with Engineer's decision on a Change Proposal, recourse is set forth in the General Conditions, as may be modified by the Supplementary Conditions, and elsewhere in this Article.
3. Transmit Change Proposals in accordance with Section 01 31 26 - Electronic Communication Protocols, and requirements of this Specifications section. Include with each Change Proposal all required supporting documentation and a separate letter of transmittal.
4. Engineer's Review and Requests for Additional Information:
    a. Engineer will review and act on each Change Proposal in accordance with, and within the time limits indicated in, the General Conditions, as may be modified by the Supplementary Conditions.
    b. When, Engineer requests additional information to render a decision, submit required information within five days of receipt of Engineer's request, unless Engineer allows more time. Submit the required information via correspondence that refers to the specific Change Proposal number.
    c. Owner shall transmit to Engineer such comments, if any, that Owner has on the Change Proposal, within 10 days of Owner's receipt of the Change Proposal.
    d. Engineer will render a written decision on the Change Proposal or take other action in accordance with the General Conditions, as may be modified by the Supplementary Conditions.
    e. Engineer's response to Change Proposals will be transmitted in accordance with Section 01 31 26 - Electronic Communication Protocols, and requirements of this Specifications section, the General Conditions, and the Supplementary Conditions.
5. Engineer's response to each Change Proposal will be distributed to:
    a. Contractor.
    b. Owner.
    c. Resident Project Representative (RPR).
    d. Engineer.
6. If Change Proposal is recommended for approval by Engineer and is approved by Owner, a Change Order will be issued or, when applicable, an appropriate use of an allowance (already included in the Contract Price) will be authorized by Owner.
7. If parties do not agree on terms for the change, Owner or Contractor may file a Claim against the other, in accordance with the General Conditions, as may be modified by the Supplementary Conditions.

C. Preparation of Change Proposals:

1. Each Change Proposal shall be submitted on the "Change Proposal" form included with this Specifications section, or other form acceptable to Engineer.
2. Number each Change Proposal as follows: Numbering system shall be the Contract number and designation followed by a hyphen and three-digit sequential number. Example: First Change Proposal for the general contract for project named "Contract No. 8" would be, "Change Proposal No. 8-GC-001".
3. In space provided on Change Proposal form:
    a. Describe scope of each proposed change. Include text and sketches on additional sheets as required to provide detail sufficient for Engineer's review and response. If a change item is submitted in response to Proposal Request, write in as scope, "In accordance with Proposal Request No." followed by the Proposal Request number. Submit written clarifications, if any, to scope of change.
    b. Submit justification for each proposed change. If change is in response to proposal request, write in as justification, "In accordance with Proposal Request No." followed by the Proposal Request number.
    c. Indicate the total change in the Contract Price and Contract Times for each separate change item included in the Change Proposal.
4. Proposed Effect on Contract Price: Unless otherwise directed by Engineer, attach to the Change Proposal detailed breakdowns of pricing (Contractor's cost and Contractor's fee) including:
    a. List of Work tasks to accomplish the change.
    b. For each task, labor cost breakdown including labor classification, total hours per labor classification, and hourly cost rate for each labor classification. Where overtime is included, indicate the overtime hours, labor classifications, and associated overhead rates.
    c. Construction equipment and machinery to be used, including manufacturer, model, and year of manufacture, and number of hours for each. Indicate whether the construction equipment or machinery is owned by Contractor, Subcontractor, or leased from a rental firm; if leased, include with the Change Proposal a copy of the rental agreement. Indicate whether the construction equipment and machinery is already onsite and used for other activities, or whether it is required solely for the Work in the contemplated change. Indicate overtime hours budgeted, if any, and the associated cost rate for overtime compared with the straight-time rate.
    d. Indicate temporary materials required, including description of extent, scope, and quality, and associated cost. Temporary materials include items such as temporary sheeting for support of excavations, scaffolding, temporary plates to cover open excavations, temporary barriers, and other temporary items. Indicate ownership or source of such items. Include copy of rental agreement if rented from a third-party rental firm in which neither Contractor nor any Subcontractor has a financial interest. Indicate intended duration of use for such items and purchase cost of such items.
    e. Detailed breakdown of cost of materials and equipment to be incorporated into the Work, including quantities, unit costs, and total cost, with Supplier's written quotations. When requested by Engineer, submit quotes by multiple prospective Suppliers.
    f. Breakdowns of each Subcontractors' pricing, including labor, construction equipment and machinery, temporary materials, and materials and equipment incorporated into the Work, other costs, and Subcontractor fees (e.g., overhead and profit). Breakdown of Subcontractors' pricing shall be the same level of detail as that for Contractor.
    g. Breakdown of other costs eligible, in accordance with the General Conditions and the Supplementary Conditions under "Cost of the Work" provisions.
    h. Other information required by Engineer.
    i. Contractor's fees (overhead and profit) applied to eligible Contractor costs and eligible Subcontractor costs.
5. Proposed Effect on Contract Times: Unless otherwise directed by Engineer, attach to the Change Proposal detailed information substantiating the proposed change in Contract Times, including:

a. Time impact analysis required by Section 01 32 16 - Construction Progress Schedule.
b. Indication of whether the Work associated with the contemplated change will affect Contractor's ability to comply with the Contract Times.
c. Other time-related information requested by Engineer.

1.9 CHANGE ORDERS

A. General:
1. Change Orders will be recommended by Engineer (when required by the General Conditions) and will be signed by Owner and Contractor (subject to the General Conditions related to a party withholding its signature from a contractually-required Change Order)), to authorize additions, deletions, or revisions to the Work, changes to the Contract Price, changes in the or Contract Times, changes to the terms of the Contract, or a combination thereof.
2. Change Orders will be in the form of EJCDC C-941, "Change Order".

B. Procedure.
1. Change Orders for signature by Contractor will be transmitted in accordance with Section 01 31 26 - Electronic Communication Protocols, and requirements of this Specifications section. Each Change Order will include a separate letter of transmittal. Contractor shall print three originals of Change Order for Contractor's signature.
2. Contractor shall promptly sign each original Change Order and, within five days of receipt, deliver all originals to Engineer.
3. Engineer will sign each original Change Order and forward them to Owner.
4. After approval and signature by Owner, original Change Orders will be distributed as indicated below.
5. Original, signed Change Orders will be distributed as follows:
   a. Contractor: One original.
   b. Owner: One original.
   c. Engineer: One original.
   d. Resident Project Representative (RPR): One copy.
6. Upon Contractor's receipt of the fully-signed Change Order, promptly perform the Work ordered thereby in accordance with the Contract Documents and the Progress Schedule accepted by Engineer.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 ATTACHMENTS

A. The forms listed below and bound following this Specifications section's "End of Section" designation, are part of this Specifications section:
1. Request for Interpretation form (one page).
2. Proposal Request form (one page).
3. Change Proposal form (one page).

REQUEST FOR INTERPRETATION

Owner: _____

Project Name: _____

Contractor: _____ RFI No. [_____]

Date Transmitted: _____ Date Received: [_____]

Date Response Requested: _____ Date Response Transmitted: [_____]

Subject: _____ [_____]

Specification Section and Paragraph: _____

Drawing References: _____

INTERPRETATION REQUESTED:

Signature: _____ Date: [_____]

ENGINEER'S RESPONSE:

Signature: _____ Date: [_____]

PROPOSAL REQUEST

Owner: _____

Project Name: _____

Proposal Request No.: _____ Date: [_____]

Contract Name and No.: _____

Contractor: _____

Other Contracts Involved in Proposed Change: _____

TO CONTRACTOR: Please submit a complete Change Proposal for the proposed modifications described below. If the associated Change Proposal is approved, a Change Order or allowance authorization will be issued to authorize adjustment so the Contract. This Proposal Request is not a Change Order, Work Change Directive, Field Order, or an authorization to proceed with the proposed Work described below.

SCOPE OF PROPOSED CHANGE(S) IN THE WORK:

1. *[Title 1]*:
2. *[Title 2]*:
3. *[Title 3]*:

Attachments to this Proposal Request:

1. [None].

Proposal requested by: _____
HDR (Engineer)

Signature of Requestor: _____

CHANGE PROPOSAL

Owner: _____

Project Name: _____

Change Proposal No.: _____ Date: [_____]

Submitted in Response to Proposal No.: _____

Contractor Name and No.: _____

Contractor: _____

Subject: _____

_____

The following changes to the Contract are proposed:

SCOPE OF PROPOSED CHANGE TO CONTRACT: *(attach supporting information as required)*

1. *[Title 1]*:
2. *[Title 2]*:

JUSTIFICATION:

1. *[Title 1]*:
2. *[Title 2]*:

PROPOSED CHANGES IN CONTRACT PRICE AND CONTRACT TIMES:

We propose that the Contract Price and Contract Times be changed as follows:

For Contract Price, attach detailed cost breakdowns for Contractor and Subcontractors, Supplier quotations, and other information required.

For the Contract Times, state increase, decrease, or no change to Contract Times for Substantial Completion, readiness for final payment, and Milestones, if any. If increase or decrease, state specific number of days for changes to the Contract Times. Submit supporting data, including time impact analysis for the Progress Schedule.

		Contract Times (days)	
Description	**Amount**	**Substantial**	**Final**
1. [Title 1]	$0.00	0	0
2. [Title 2]	$0.00	0	0
Total This Change Proposal	**$0.00**	**0**	**0**

Changes to Milestones, if any: [_____] [_____]

Contractor represents that supporting data attached to this Change Proposal are accurate and complete. The requested time or price adjustment indicated in this Change Proposal is the entire adjustment to which Contractor believes it is entitled as a result of the proposed change(s) indicated herein.

Change Proposal by: _____

Signature of Proposer: _____

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SECTION 01 29 73
SCHEDULE OF VALUES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Requirements for the Schedule of values, including:
      a. Applicability.
      b. General provisions for Schedules of Values.
      c. Format, organization, and content of Schedule of Values.

B. Related Requirements: Include but are not necessarily limited to:
   1. Section 01 22 00 - Measurement and Payment.
   2. Section 01 29 76 - Progress Payment Procedures.
   3. Section 01 32 16 - Construction Progress Schedule.

1.2 PRICE AND PAYMENT PROCEDURES

A. Schedule of Values and Payment – General:
   1. Contractor shall prepare and submit to Engineer and RPR for acceptance Schedule of Values that presents (as applicable): (a) an appropriate, detailed breakdown of the price of lump sum bid/pay items, and (b) an appropriate, detailed breakdown of the price of Work compensated on the basis of Cost of the Work plus a fee, and (c) lists bid/pay items of Unit Price Work. The total of all Work among the various bid/pay items shall equal the Contract Price.
   2. In this Section, all references to "Engineer" shall be interpreted as "Engineer and/or RPR".
   3. For each item of lump sum Work and Work compensated on the basis of Cost of the Work plus a fee, the Schedule of Values shall, establish in detail the portion of the Contract Price allocated to each component of such Work.
   4. Upon request of Engineer, promptly furnish data and information that substantiates and supports the amounts indicated in the Schedule of Values.
   5. Submit preliminary Schedule of Values to Engineer for initial review. Contractor shall incorporate Engineer's comments into the Schedule of Values and resubmit to Engineer. Engineer may require corrections and re-submittals until Schedule of Values is acceptable.
   6. Schedule of Values may be used, where appropriate, as a basis for negotiating price of changes, if any, in the Work.

B. Applicability:
   1. Lump Sum Work:
      a. For Work paid on a lump sum basis, progress payments will be on the basis of Work performed in accordance with the Contract Documents, for each line item in the Schedule of Values, as recommended to Owner by Engineer.
   2. Work Compensated on the Basis of Cost of the Work Plus a Fee:
      a. Such Work will be paid, based on Engineer's recommendation to Owner, based on documentation of eligible costs submitted by Contractor with progress payment requests, in accordance with the General Conditions (as may be modified by the Supplementary Conditions) and Section 01 29 76 - Progress Payment Procedures.
      b. Schedule of Values accepted by Engineer will be used by Engineer in evaluating reasonableness of Contractor's progress payment requests.
      c. While the actual Cost of the Work plus applicable fee for a given line item in the Schedule of Values may vary somewhat from the scheduled amount of such line item, where actual Cost of the Work (plus fee) for such line item differs substantially from the scheduled amount of such line item indicated in the Schedule of Values, Engineer

may refuse to recommend further payment for such line item, in accordance with the Contract Documents.

d. Nothing in the Schedule of Values accepted by Engineer changes the Guaranteed Maximum Price, if any.

3. Unit Price Work:
   a. Breakdown of unit prices (whether in a Schedule of Values or elsewhere) into detailed cost or price components is not required.
   b. Unit Price Work will be measured for payment in accordance with the Contract Documents, including Section 01 22 00 - Measurement and Payment.

1.3 ADMINISTRATIVE PROCEDURES

A. General Provisions for Schedules of Values:
   1. This Section augments requirements for the Schedule of Values, indicated in the General Conditions, as may be augmented by the Supplementary Conditions.

1.4 SUBMITTALS

A. Informational Submittals: Submit the following:
   1. Submit to Engineer the Schedule of Values in the form and quantity required in Section 01 33 00 - Submittals, and in accordance with Section 01 31 26 - Electronic Communication Protocols.
   2. Content of Schedule of Values Submittals shall be in accordance with this Section.
   3. Timing of Submittals:
      a. Preliminary Schedule of Values:
         1) Submit preliminary Schedule of Values within time limit indicated in the General Conditions.
      b. Initial Acceptable Schedule of Values:
         1) Revise the preliminary Schedule of Values in accordance with Engineer's comments.
         2) Contractor will not be eligible for progress payment until acceptable Schedule of Values is submitted in accordance with the Contract Documents.
         3) Submit the Schedule of Values acceptable to Engineer in accordance with the General Conditions.
      c. Updates: Submit updated Schedule of Values when:
         1) The Contract Price has changed.
         2) Requested by Engineer

1.5 FORMAT, ORGANIZATION, AND CONTENT OF SCHEDULE OF VALUES

A. Organization and Major Elements of Schedule of Values.
   1. Prepare Schedule of Values on the "progress estimate" or "continuation sheets", as applicable, of the Application for Payment form indicated in Section 01 29 76 - Progress Payment Procedures.
   2. Include in Schedule of Values itemized list of Work for each major work area included in the Work, for each payment item included in the Contract.
      a. Contractor will not be eligible for progress payment until acceptable Schedule of Values is submitted in accordance with the Contract Documents.
   3. In addition, list either in the Schedule of Values or on a separate worksheet included with Applications for Payment all Unit Price Work bid/pay items in the Contract. The balance of this Article applies to lump sum Work and Work compensated on the basis of Cost of the Work plus a fee.
   4. Organization in Accordance with Specification Sections:
      a. Within each work area, organize the Schedule of Values by the various Specifications section numbers and titles included in the Contract Documents.
      b. Label each row in the Schedule of Values with the appropriate Specifications section number. Include an amount for each row in the Schedule of Values.

c. List sub-items of major materials, equipment, or systems, as appropriate or when requested by Engineer.

B. Requirements for both the preliminary Schedule of Values Submittal and the Schedule of Values Submittal for Engineer's acceptance are:
   1. Subcontracted Work:
      a. Schedule of Values shall indicate division of Work between Contractor and each Subcontractor.
      b. Line items for Work to be performed by each Subcontractor shall include the word, "(SUBCONTRACTED)" and the name of the Subcontractor once the associated subcontract is signed and effective.
   2. Apportionment between Materials and Equipment, and Installation: Schedule of Values shall include separate apportionment of costs for:
      a. Cost of materials and equipment to be incorporated into the completed construction.
      b. Cost of delivery, handling, and storage of materials and equipment to be incorporated into the completed construction.
      c. Cost of temporary materials (such as excavation supports, scaffolding, and other temporary materials), and their associated delivery, handling, and storage costs, if any.
      d. Cost of rentals of construction equipment and machinery, whether owned by Contractor or Subcontractor or leased from a third-party equipment rental entity.
      e. Cost of installing materials and equipment.
      f. Travel and subsistence costs, if any.
      g. Other costs used in preparing the Bid by Contractor and each Subcontractor.
   3. Sum of individual line item amounts indicated on the Schedule of Values shall equal the total of associated bid/pay item. Sum of bid/pay item totals in the Schedule of Values, plus the sum of any separate listing of Unit Price Work items, shall equal the total Contract Price.
   4. Overhead and Profit:
      a. Include in each line item a directly proportional amount of Contractor's overhead and profit in the Contract Price.
      b. Do not include overhead and profit as separate line item(s).
   5. Allowances: Include separate line item for each allowance.
   6. Unit Price Work: Separately indicate items of Unit Price Work in the overall Schedule of Values. Where the required form (in accordance with Section 01 29 76 - Progress Payment Procedures) includes a separate worksheet or page for Unit Price Work, indicate all items of Unit Price Work on such worksheet or page of the form.
   7. Bonds and Insurance Costs:
      a. Separate payment for bonds and insurance is not allowed. Cost of bonds and insurance shall be included among the bid items.
   8. Construction Support, Project Management, and Administrative Cost Elements:
      a. Costs under this category are sometimes informally referred to as "field overhead" but are Project costs rather than costs related to Contractor's general business operations.
      b. Include in the Schedule of Values relevant line items and amounts for work and services required by the General Conditions and specific Division 01 Specifications sections, such as:
         1) Project management costs.
         2) Onsite superintendence and supervision costs.
         3) Itemized list of Work by work area, as applicable, for costs associated with coordination with the Owner's operations, including required sequencing, as set forth in the Contract Documents.
         4) Updating the construction Progress Schedule, preparing time impact analyses, and preparing recovery schedules. Preparation of preliminary Progress Schedule and the initial ("baseline") Progress Schedule acceptable to Engineer are part of mobilization.

5) Construction progress photographic documentation. Preconstruction photographic documentation and final photographic documentation are, respectively, part of mobilization and demobilization.
6) Updates of the Schedule of Submittals.
7) Contractor's safety representative and ongoing implementation of Contractor's Site-specific health and safety plan (SSHASP). Establishing the SSHASP is part of mobilization.
8) Ongoing compliance with permits (when applicable). Contractor's securing of required work permits is part of mobilization.
9) Ongoing cost for temporary utilities and temporary facilities. Establishing such services and facilities is part of mobilization.
10) Ongoing costs for temporary security.
11) Field offices (monthly rental and maintenance) and storage facilities (excluding costs of establishment and removal, which are part of mobilization and demobilization).
12) Ongoing site maintenance, such as temporary controls (dust, air pollution, water pollution, solid waste control, pest and rodent control, temporary erosion and sediment controls, and others), snow and ice removal, and similar activities.
13) Field engineering and surveying.
14) Progress cleaning and cleaning for Substantial Completion.
15) Record documents (preparation, maintenance, and submittal).
    a) If adequate record documents are maintained, up to 50 percent of the value of the record documents line item will be eligible for payment, spread evenly over those progress payments in which construction at the Site is performed.
    b) Remainder of Project record documents line item will be eligible for payment when complete record documents are submitted in accordance with the Contract Documents.
    c) If record documents submitted are unsatisfactory to Engineer, amount may be reduced via set-offs in accordance with the Contract Documents.
16) Other items required by Engineer.

c. Include such items in Applications for Payment on payment schedule acceptable to Engineer.
d. Such line items in the Schedule of Values shall exclude any and all costs associated with Contractor's permanent place(s) of business, personnel stationed at permanent office(s), salaries and bonuses of executive and administrative personnel not directly performing work on the Project, and general business expenses, all of which are part of Contractor's overhead costs.

9. Mobilization and Demobilization: Include all associated costs in the separate bid/pay item for mobilization and demobilization. The scope of such bid/pay item is indicated in Section 01 22 00 – Measurement and Payment.
10. Mobilization and Demobilization:
    a. Include separate line items under each appropriate lump sum bid/pay item for mobilization and demobilization.
    b. Document for Engineer the activities included in mobilization and demobilization line items.
    c. Mobilization includes:
        1) Obtaining Owner's acceptance of proposed Subcontractors and Suppliers and entering into subcontracts and purchase orders needed to start the Work.
        2) Preparing and obtaining Engineer's approval of Shop Drawings required in Section 01 14 19 - Use of Site.
        3) Preparing and obtaining Engineer's acceptance of schedules, including Progress Schedule, Schedule of Submittals, and Schedule of Values.
        4) Preconstruction conference(s) required by the Contract Documents.
        5) Preconstruction photographic documentation.

6) Establishing Contractor's Site-specific health and safety plan, preconstruction activities needed to start implementing Contractor's safety programs, and verifying status of training of construction workers and personnel and condition of construction equipment, machinery, and tools.
7) Submitting acceptable emergency contact information
8) Obtaining required permits needed to start the Work.
9) Initial establishment of temporary utilities and temporary facilities.
10) Establishing Contractor's field office and sheds, Contractor's storage areas, staging and laydown areas, and other areas necessary to perform the Work.
11) Initial establishment of construction vehicular access to the Site, parking needed for construction, and offsite haul routes.
12) Establishing construction equipment, machinery, and tools at the Site.
13) Providing initial temporary controls.
14) Establishing temporary security needed to start Work at the Site.
15) Other mobilization acceptable to Engineer.

d. Mobilization will be limited to 2 percent of the Contract Price. Should Contractor propose mobilization in an amount greater than the limit indicated in this paragraph or on an alternative schedule from that indicated in this paragraph, submit to Engineer for acceptance information and documentation sufficient to support and substantiate the proposed amount and payment schedule for mobilization.

a. Demobilization includes:
1) Removal from the Site and adjacent areas of excess materials and equipment.
2) Removal of temporary controls, temporary facilities, temporary barriers, and similar materials and equipment.
3) Removal of temporary access roads and parking areas not part of permanent pavement or otherwise allowed to remain by Owner, including temporary traffic controls established for construction vehicles and equipment.
4) Removal of all field office and sheds, storage areas, staging and laydown areas, and other areas needed to perform the Work and restoration of such areas.
5) Removal from the Site of all construction equipment, machinery, tools, Contractor's containers, temporary fuel storage tanks, and similar items.
6) Closeout of permits on which Contractor is a permittee or co-permittee.
7) Final cleaning.
8) Furnishing required closeout documents.
9) Other costs and effort by Contractor for demobilization.

b. Demobilization shall be not less than 1 percent of the Contract Price and shall be included with the Application for Payment following Substantial Completion, or other schedule acceptable to Engineer.

11. Costs for Submittals, field quality control activities, and training of operations and maintenance personnel shall be as follows, unless otherwise accepted by Engineer:
a. Submittals: Up to 8 percent of cost (including all associated overhead and profit) of each equipment item, exclusive of transportation and installation costs associated therewith, may be allocated to preparation of Shop Drawings, Samples ,and other Submittals required for release for purchase, fabrication, or delivery (as applicable) and may be included in the Application for Payment following Engineer's approval of Shop Drawings (and acceptance of other Submittals, as applicable) required for fabricating or purchasing for that item for the Work.
b. Field Quality Control: Up to 3 percent of total cost of each item (including all associated overhead and profit), including materials and equipment, and installation, may be apportioned to specified or required field quality control activities (including required testing and inspections) and included in the Application for Payment following Engineer's acceptance of the associated written field quality control report Submittal(s).
c. O&M Manual Submittals and Training: Up to a total of 4 percent of equipment cost (including all associated overhead and profit), exclusive of transportation and installation costs, may be apportioned to operations and maintenance manuals and

training of operations and maintenance personnel, which may be included in the Application for Payment following completion of training for the associated item.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

SECTION 01 29 76
PROGRESS PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Administrative and procedural requirements for Contractor's progress payments.

B. Scope:
   1. Contractor's requests for payment shall be in accordance with the Agreement, General Conditions and Supplementary Conditions, and the Specifications.
   2. Form: Applications for Payment shall be the Engineers Joint Contract Documents Committee (EJCDC) document EJCDC C-620, "Contractor's Application for Payment" (2018 edition or later) or other form acceptable to the Owner and Engineer.

1.2 CONTENT AND PROCEDURE FOR REQUESTING PROGRESS PAYMENTS

A. Procedure:
   1. Review with Resident Project Representative (RPR) quantities and the Work proposed for inclusion in each progress payment request. Application for Payment shall cover only the Work and quantities recommended by the RPR.
   2. Contractor will review with Engineer or RPR the status of Project record documents, in connection with Engineer's review of each Application for Payment. Failure to maintain record document current will be cause for Engineer to recommend a reduction in payment for record documents in accordance with Section 01 29 73 - Schedule of Values, and will entitle Owner to set-offs in accordance with the Contract Documents.
   3. Submit to Engineer electronically through the Project Website with Contractor's and RPR's signature, of each complete Application for Payment and other documents to accompany the Application for Payment.
   4. Engineer will act on request for payment in accordance with the General Conditions and Supplementary Conditions.

B. Content: Each request for payment shall include:
   1. Completed Application for Payment form, including summary/signature page, progress estimate sheets, and stored materials summary. Progress estimate sheets shall have the same level of detail as the Schedule of Values.
   2. Documentation for Stored Materials and Equipment:
      a. For materials and equipment not incorporated in the Work but suitably stored, submit documentation in accordance with the General Conditions and Supplementary Conditions.
      b. UCC-1 Financial Statement:
         1) For each lot or delivery of stored materials and equipment for which payment is requested prior to installation of the item(s) at the Site, complete UCC-1, "Financial Statement" form. On UCC-1 form, indicate Owner as "security party"; indicate Supplier as "debtor" when stored item(s) are in Supplier's custody, and indicate Contractor as "debtor" when stored item(s) are in Contractor's custody; and clearly indicate in detail all stored item(s) included in the filing as "collateral" on the form. Include attachments to the form when necessary to clearly and fully indicate in detail the associated "collateral".
         2) File completed UCC-1 form with the secretary of state in the state where the subject item(s) are stored.
         3) Include with Application for Payment the completed UCC-1 form together with evidence of filing with the required state(s). Submit UCC-1 form and related documentation once for each lot or delivery of stored items.

c. Photographs of the stored items at the storage location, in accordance with requirements for progress photographs in Section 01 42 00 - References. Submit photographs sufficient to clearly indicate each stored item, clearly showing marking of Owner's property in accordance with Paragraph 1.3.C of this section. Such photographs do not count as photographs required under Section 01 42 00 - References. For each month that such item(s) are stored, take and submit monthly new photographs of each stored item, with date-stamp on each photograph.
d. Legibly indicate on invoice or bill of sale the specific stored materials or equipment included in the payment request and corresponding bid/payment item number for each and the Supplier price for each item.

3. For Payment on the Basis of Cost of the Work plus a Fee:
   a. When Work included in an Application for Payment will be compensated on the basis of Cost of the Work plus a fee, whether when the entire Contract is compensated on the basis of Cost of the Work plus a fee or when the Application for Payment includes Change Order Work to be compensated on the basis of Cost of the Work plus a fee, the Application for Payment shall include documentation of the costs, including not less than the following:
      1) Number of and labor classifications of workers employed and hours worked. Separately indicate overtime and holiday hours, when applicable.
      2) Construction equipment used including manufacturer, model, and year of manufacture, and number of hours such equipment was onsite and used for the Work compensated on the basis of Cost of the Work. Where such equipment was used on overtime, separately indicate overtime hours.
      3) Consumables and similar materials used.
      4) Receipts, bills, or invoices for, and descriptions of, materials and equipment incorporated into the Work.
      5) Invoices and breakdowns of labor, construction equipment, and materials and equipment incorporated into the Work by Subcontractors, and Suppliers' onsite time, if any.
      6) Invoices or receipts for other expenses included in the Application for Payment, such as travel and subsistence expenses, costs for bonds and insurance, and all other eligible costs and expenses for which compensation is sought in the subject Application for Payment on the basis of Cost of the Work.
      7) Other information and documents required by Owner or Engineer,
   b. Costs for which progress payment is requested on the basis of Cost of the Work plus a fee and for which documentation acceptable to Engineer is not submitted will not be eligible for payment.
4. Listing of Subcontractors and Suppliers:
   a. In accordance with the General Conditions, submit not less than monthly updated listing of all Subcontractors and Suppliers known to Contractor, whether or not such entities have a contract directly with Contractor.
   b. Submit complete information using the form attached to this Specifications section.
5. Partial Release or Reduction of Retainage:
   a. For each Application for Payment where Contractor requests partial release or reduction of retainage in any amount (other than request for final payment), submit with associated progress payment request consent of surety to partial release or reduction of retainage, duly completed by Contractor and surety.
   b. Acceptable form includes AIA G707A, "Consent of Surety to Reduction in or Partial Release of Retainage" (1994 or later edition), or other form acceptable to Owner.
   c. For payment requests that include reduction in or payment of retainage in an amount greater than that required by the Contract Documents, obtain Owner's concurrence for partial release or reduction in retainage prior to submitting such Application for Payment.
6. See Section 01 78 39 Project Record Documents for additional requirements for submitting an application for payment.

C. Final Payment:
   1. Requirements for request for final payment are in the General Conditions, as may be modified by the Supplementary Conditions, and Section 01 77 19 - Closeout Requirements.

1.3 ADDITIONAL PROCEDURES FOR PAYMENT FOR STORED MATERIALS AND EQUIPMENT

A. Observation of Stored Materials and Equipment as Condition Precedent to Eligibility for Payment:
   1. General:
      a. Prior to materials or equipment suitably stored but not yet incorporated into the Work can be eligible for payment, Resident Project Representative (RPR) shall visit the storage location and verify the extent, condition, and storage environment of the stored items.
      b. When the same material or equipment item is stored for more than two months, such visits to storage location shall be not less than once every two months.
   2. Cost Responsibility for Observations:
      a. When storage location is less than 20 miles from the Site or less than 20 miles from RPR's office, Contractor is not responsible for reimbursing Owner for cost of Engineer's time and expenses for observing stored materials and equipment.
      b. When storage location is more than 20 miles from the Site and more than 20 miles from RPR's office, Contractor shall reimburse Owner, via a set-off under the Contract Documents, for reasonable cost of Engineer's time and expenses, including travel time, to visit the storage location and observe the stored materials and equipment.

B. Other Requirements for Stored Items: Regardless of storage location, perform the following for stored materials and equipment for which payment is sought:
   1. Clearly mark each stored container, crate, or item as follows: "Property of City of Lewisville" using permanent marking. Such marking shall not blemish or deface the finish of items that will be exposed to view after installation at the Site.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 ATTACHMENTS

A. The forms listed below, following this Specifications section's "End of Section" designation, are part of this Specifications section:
   1. List of Subcontractors and Suppliers form (two pages).

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SECTION 01 30 00
SPECIAL CONDITIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Indication of applicable building codes and other related codes.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. References in the Contract Documents to local code(s) means the following:
      a. City of Lewisville: For a complete listing of codes adopted by the City of Lewisville, including applicable versions of and amendments to model codes, see the City of Lewisville's website:
         1) City of Lewisville ordinances and regulations.
         2) Uniform Construction Code, as amended by the City of Lewisville.
         3) International Electric Codes, as adopted by the City of Lewisville.
         4) National Electric Code, 2020, as adopted by the City of Lewisville.
         5) International Plumbing Code, 2021, as adopted by the City of Lewisville.
         6) International Mechanical Code, 2021, as adopted by the City of Lewisville.
         7) International Fire Code, 2021, as adopted by the City of Lewisville.
         8) International Fuel Gas Code, as adopted by the City of Lewisville.
         9) International Energy Conservation Codes, 2021, as adopted by the City of Lewisville.
         10) International Building Code, 2021, as adopted by the City of Lewisville.
         11) International Existing Building Code, as adopted by the City of Lewisville.
         12) International Residential Code, 2021, as adopted by the City of Lewisville.
         13) International Performance Code, as adopted by the City of Lewisville.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

END OF SECTION

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SECTION 01 31 19
PROJECT MEETINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Administrative and procedural requirements for the following types of conferences and meetings required during the Work:
      a. Requirements applicable to all conferences.
      b. Preconstruction conference(s).
      c. Construction progress conferences.
      d. Closeout conference(s).
      e. Other construction conferences.

B. Scope:
   1. This Section addresses the types of conferences indicated in Paragraph 1.1.A of this Section.
   2. Requirements for monthly schedule meetings are in Section 01 32 16 - Construction Progress Schedule.
   3. Requirements for checkout and startup planning meeting, are in Section 01 75 00 - Checkout and Startup Procedures.
   4. Requirements for training schedule conference, are in Section 01 79 23 - Instruction of Operation and Maintenance Personnel.
   5. Requirements for pre-installation conferences, if any, are in the Specifications of Divisions 02-49.

C. Related Requirements: Include, but are not necessarily limited to:
   1. Section 01 29 76 - Progress Payment Procedures.
   2. Section 01 32 16 - Construction Progress Schedule.
   3. Section 01 75 00 - Checkout and Startup Procedures.
   4. Section 01 79 23 - Instruction of Operation and Maintenance Personnel.

1.2 REQUIREMENTS APPLICABLE TO ALL CONSTRUCTION CONFERENCES

A. Requirements of this Article apply to all conferences required under this Section.

B. Participants:
   1. Lead participant for each participating entity of each conference shall be authorized to represent their employer and its interests on the Project and shall be sufficiently familiar with the status of their employer's work, services, and activities related to the Project for purposes of the associated conference.
   2. Required participants for each type of conference are indicated elsewhere in this Section.
   3. Failure to participate by required participants:
      a. Should a required participant be unavailable for a required conference, inform the designated conference chair not less than one day prior to start of the subject conference. Furnish both oral (either in person or via telephone) and written communication regarding planned non-attendance. Expressly indicate the authorized substitute person who will be empowered to represent that entity at the conference.
      b. Failure to properly inform the conference chair as required, or repeated or habitual non-participation by mandatory participants, will be grounds for Owner to withhold (as "set-offs") amounts for mandatory meeting attendance from payments due Contractor under the Contract.
      c. Sending as a substitute lead participant an authorized representative who is ill-informed of their organization's work status and administrative matters related to the Project, or who is not properly authorized to represent their employer for all required matters

indicated on the agenda, will be grounds for Owner to withhold payment, as set-offs, of amounts associated with such unpreparedness.

d. Should Contractor fail to attend without proper, advance notice to conference chair or furnish ill-prepared or unauthorized substitute lead participant, Contractor shall bear full responsibility, including cost- and time-related impacts, for lack of coordination, progress, and other, potentially adverse effects.

4. Conduct:
   a. Conference participants shall always exhibit appropriate, professional conduct and demeanor.
   b. Inappropriate conduct, including shouting, unprofessional language, threatening attitudes, or other types of insult or intimidation are unacceptable.
   c. Conference chair has the authority to eject from a conference, participants exhibiting inappropriate conduct.
   d. Person's exhibiting repeated or habitual inappropriate conduct will not be allowed to participate in conferences. Such person's employer and the contracting party they represent shall bear full responsibility for consequences of actions by its employees and representatives.

C. Agenda:
   1. Each conference required by this Section shall have an established, written agenda available to required attendees not less than one day prior to the subject conference, unless extenuating circumstances dictate a shorter time period.
   2. Unless written agenda specific to a given conference is issued in writing, the default agenda shall be in accordance with this Section.
   3. If a person or entity intending to participate in a required conference desires that such conference should address a given topic not already part of the typical agenda indicated in this Section, a written request for such topic to be added to the agenda must be received by the conference chair not later than two days prior to the scheduled start of such conference.
   4. The agenda may be amended at the outset of the conference, by consent of a majority of principal representatives of Owner, Contractor, Engineer, and RPR. Thereafter, the conference will be conducted, and topics discussed will be in accordance with the established agenda, as may be modified in accordance with this paragraph.

D. Conference Date, Time, and Location:
   1. Date, start time, anticipated duration, and location of each required conference will be established by conference chair, unless otherwise indicated in the Contract Documents.
   2. Conference chair will advise, in writing, required participants of conference date, start time, anticipated duration, and location. Such information may be transmitted as part of an agenda. Upon mutual agreement of required participants, date, start time, anticipated duration, and location of recurring conferences, such as construction progress conferences, may be initially established at the outset of the series and, therefore, do not require written advisory for each individual conference.
   3. Change of Conference Date, Time, or Location:
      a. In general, required conferences will be held on the date, at the time, and at the location required.
      b. Designated conference chair may, at their sole discretion, elect to change the conference date, start time, duration, location, or any combination thereof. Such change, if any, shall be communicated in writing to all required conference participants, and others as appropriate. Contractor is responsible for communicating changes to its Subcontractors and Suppliers.
      c. Notice of such change shall be communicated in accordance with Section 01 31 26 – Electronic Communication Protocols, not later than twenty-four hours prior to scheduled start of the subject conference. Such changes may be communicated by distributing a written agenda for the subject conference, expressly indicating changes from previous arrangements.

d. When changes in date, time, or location are necessary less than the period indicated in the paragraph immediately above, such changes shall be communicated orally, whether in-person or via telephone. When communicated via telephone, calls shall be made to all of the participant's designated telephone numbers on file with the conference chair. Persons intending to participate in such conference are encouraged to check their voicemail and written communications prior to departing for the conference.

E. Minutes:
1. For each conference required in this Section, the conference chair will be responsible for preparing and distributing a written record ("minutes") of the conference proceedings, unless expressly indicated otherwise for a specified type of conference.
2. Purpose of minutes is to furnish a written record of the following for the associated conference: participants (indicating whether everyone participated in-person, virtually, arrived late, or departed early), topics discussed, questions asked and answered, and decisions made, and other pertinent matters as indicated on the established agenda for the associated conference. Minutes are not intended as a transcript or as complete record of minutia discussed at the associated conference.
3. Distribution of Minutes:
   a. Minutes will be distributed promptly after the associated conference.
   b. Minutes will be distributed, in accordance with Section 01 31 26 - Electronic Communication Protocols.
   c. Minutes will be distributed to all conference participants, personnel invited to or required to attend the conference but who did not attend or participate, and others as appropriate.
   d. Unless indicated otherwise in this Section or elsewhere in the Contract Documents, minutes of conferences required by this Section will be distributed to Owner, Contractor, RPR, and Engineer.
4. Amendment of Minutes:
   a. Minutes distributed by, or on behalf of, the conference chair are subject to comments and potential amendments by other attendees of the subject conference. The period for commenting on, or requesting amendments to, minutes is limited to 7 days following initial distribution of the minutes, unless indicated otherwise elsewhere in the Contract Documents.
   b. Comments or requests for amendments may be furnished at the next, subsequent meeting in the same series of conferences. For example, comments on minutes of a construction progress conference may be presented at the next, subsequent construction progress conference. Comments on the minutes of the preconstruction conference may be presented at the first construction progress conference unless the designated time limit for requesting amendments has elapsed prior to the first progress conference.
   c. Minutes may be amended either by issuing revised minutes for the subject conference or by appropriate indication in the minutes of the next, subsequent conference in the same series, at the sole discretion of the conference chair.
   d. Conference chair has sole authority to accept or reject comments or requests for amendments on previously issued minutes.
   e. In general, requests, by persons who participated in the subject conference, for amendments to minutes will be given greater consideration by conference chair than request for amendments received from persons who did not participate in the subject conference.
   f. Should a person or entity believe the final minutes do not accurately reflect their opinion of how events transpired at the subject conference, such person or entity may prepare and submit appropriate correspondence presenting their viewpoint.

1.3 PRECONSTRUCTION CONFERENCES

A. The requirements of Article 1.2 of this Section also apply to this Article.

B. Preconstruction Conferences - General:

1. Purpose of preconstruction conference is reviewing administrative and procedural requirements, site mobilization matters, coordination with utility owners, coordination with authorities having jurisdiction, and related matters. Required agenda, unless otherwise amended by conference chair, is indicated in this Article.
2. Conference Chair: Resident Project Representative.
3. Location, Date, and Time:
    a. Preconstruction conference will be held either at the Site or another location chosen by the Owner in the City of Lewisville.
    b. Preconstruction conference will be held following the Effective Date of the Contract on a day and at a time to be established by RPR, following consultation with principal representatives of Owner, Engineer, Contractor, and other required participants. Preconstruction conference will be held prior to commencement of the Work at the Site.
    c. Anticipated duration of preconstruction conference is two hours, followed by time necessary for visiting the Site.
    d. Location, date, and time will be established in accordance with requirements of Article 1.2 of this Section.
4. Required Participants:
    a. Owner: Project manager.
    b. RPR.
    c. Contractor: Project manager and site superintendent.
    d. Engineer: Project manager or delegate.
5. Required participants may invite to the preconstruction conference others they deem necessary or appropriate.
6. Designation of Authorized Representatives:
    a. Either prior to or at the preconstruction conference, Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit and receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

C. Agenda:
1. Procedural and Administrative:
    a. Personnel and Teams:
        1) Designation of roles and personnel.
        2) Limitations of authority of personnel, including personnel who will sign Contract modifications and make binding decisions.
        3) Subcontractors and Suppliers in attendance.
        4) Authorities having jurisdiction.
    b. Procedures for communications and correspondence, including electronic communication protocols.
    c. Copies of the Contract Documents and availability.
    d. The Work and Scheduling:
        1) General scope of the Work.
        2) Contract Times, including Milestones (if any).
        3) Phasing and sequencing.
        4) Preliminary Progress Schedule.
        5) Critical path activities.
    e. Safety and Protection:
        1) Responsibility for safety.
        2) Contractor's safety representative.
        3) Emergency procedures and accident reporting.
        4) Emergency contact information.
        5) Confined space entry permits.
        6) Hazardous materials communication program.
        7) Impact of the construction on public safety.
        8) Responsibilities for protection of property.

f. Review of insurance requirements and insurance claim procedures.
g. Coordination:
    1) Coordination of Subcontractors and Suppliers.
    2) Construction coordinator (for projects with multiple prime construction contracts and locations where multiple projects may be underway simultaneously in reasonable proximity to each other).
    3) Coordination with Owner's operations.
    4) Construction progress conferences – schedule and frequency.
    5) Coordination conferences with other, separate projects.
h. Submittals:
    1) Current Critical Submittals:
        a) Preliminary schedules -- Progress Schedule, Schedule of Submittals, Schedule of Values.
        b) Preconstruction photographic documentation.
        c) List of proposed Subcontractors and Suppliers using the form included in Section 01 29 76 - Progress Payment Procedures.
        d) List of emergency contact information.
        e) Notice of elements of Contractor's safety program with which Owner and Engineer are to comply.
        f) Action Submittals required under Section 01 14 19 - Use of Site.
        g) Evaluation of need for SPCC plan required under Section 01 35 44 – Spill Prevention Control and Countermeasures Plan.
        h) Form of Contractor's site superintendent's daily reports.
    2) Work is ineligible for payment without approved or accepted Submittals (as applicable).
    3) Submittal procedures.
        a) Compliance with accepted Schedule of Submittals.
        b) Actions required of Contractor prior to furnishing Shop Drawings and other Submittals.
        c) Contractor's Submittal approval stamp required; Contractor's coordination of Submittals.
        d) Furnishing of Submittals.
        e) Submittal types and meaning of Engineer's action on each.
        f) Resubmittals—responsibility for, limitations on quantity.
    4) Identification of initial, critical Shop Drawings and product data.
    5) Construction photographic documentation.
i. Substitutes and "Or-Equals":
    1) Product options.
    2) Procedures for proposing "or-equals".
    3) Procedures for proposing substitutes.
j. Contract Modification Procedures:
    1) Requests for interpretation.
    2) Written clarifications.
    3) Field Orders.
    4) Proposal Requests.
    5) Change Proposals.
    6) Work Change Directives.
    7) Change Orders.
    8) Differing site conditions or discovery of unanticipated Hazardous Environmental Condition.
    9) Substantiating and documenting Change Proposals and Claims.
    10) Claims.
k. Progress Payment:
    1) Owner's Project financing and funding, as applicable.
    2) Owner's tax-exempt status.

3) Preliminary Schedule of Values
4) Procedures for measuring for payment (Unit Price Work).
5) Retainage.
6) Progress payment procedures; documents to accompany Applications for Payment.
7) Payment for stored items not yet installed.
8) Date of Owner's payments; payment is due.

l. Subcontractors and Suppliers:
1) List of proposed Subcontractors and Suppliers; monthly updates.
2) Coordination and management.
3) Subcontracts and purchase orders.

m. Testing and inspections:
1) Owner-hired and contractor-hired.
2) Identification of Owner-hired testing entity and special inspectors.
3) Responsibility for advising testing entity and special inspectors of need for services.
4) Results of code-required special inspections and tests.
5) Prompt remedy of apparent defects.
6) Notices of defective Work.
7) Remedy of defective Work.
8) Defective Work is ineligible for payment.
9) Covering up defective Work.
10) Cost responsibility for defective Work and retesting/re-inspection.

n. Disposal of demolition and spoil materials.

o. Record documents.

p. Preliminary discussion of Contract closeout:
1) Procedures for Substantial Completion.
2) Partial utilization procedures; property insurance.
3) Contract closeout requirements.
4) Correction period; duration of Contractor's general warranty and guarantee.
5) Duration of bonds and insurance.

2. Authorities Having Jurisdiction (if not covered in a separate conference):
a. Municipal licenses.
b. Municipal permits required.
1) Permits required and status.
2) Inspections for building code official.
3) Code-required special inspections and tests (if not covered in Administrative and Procedures part of conference).
c. Right-of-way work permits; status of occupancy permit(s).
d. Environmental permits:
1) Spill prevention control and countermeasures plan (40 CFR 112).
e. Any other permits required.

3. Site Mobilization (if not covered in a separate conference):
a. Working days, working hours, and overtime.
b. Use of Site and other areas; use of existing facilities.
c. Field offices, storage trailers, and staging areas.
d. Temporary facilities.
e. Temporary utilities and limitations on utility use (where applicable).
f. Utility company coordination (if not done as a separate conference).
g. Access to Site, access roads, and parking for construction vehicles.
h. Traffic controls.
i. Temporary controls:
1) Erosion and sediment control; storm water pollution prevention plans.
2) Dust control and air pollution control (including emissions control).
3) Water control (storm water, surface water, groundwater).
4) Water pollution control; spill prevention control and countermeasures plan.

5) Solid waste control.
6) Pest control.
7) Other temporary controls.

j. Temporary security; temporary security fencing (where required).
k. Storage of materials and equipment to be incorporated into the Work.
l. Protection of the Work and property; protective barriers.
m. Field engineering:
1) Reference points and benchmarks.
2) Surveys and layouts.
3) Professional services for Contractor's means and methods (not delegated design).
4) Contractor's site superintendent's daily records and submittal requirements.
n. Site maintenance during the Project:
1) Progress cleaning; removal of trash and debris.
2) Maintenance and cleaning of existing access roads and parking areas.
o. Restoration.

4. Next conference.
5. Site visit, as necessary.

1.4 CONSTRUCTION PROGRESS CONFERENCES

A. The requirements of Article 1.2 of this Section also apply to this Article.

B. Construction Progress Conferences - General:
1. Purpose of construction progress conferences is to review and summarize Work performed since the previous construction progress conference; review and summarize planned progress through the next, subsequent construction progress conference; review and summarize compliance with the Progress Schedule; review progress and necessary actions on pending and critical administrative items; discuss matters pertinent to the Site and construction quality; and other matters.
2. Conference Chair: Resident Project Representative.
3. Location, Date, and Time:
a. Construction progress conferences will be held either at the Site or another location chosen by the Owner in the City of Lewisville.
b. Frequency: construction progress conferences will be held once per month unless more frequent meetings are required due to construction activities. Such conferences are in addition to other recurring conferences that may be required elsewhere in the Contract Documents.
c. Construction progress conferences will be held following preconstruction conference on a day and at a time to be established by RPR, following consultation with principal representatives of Owner, Engineer, Contractor, and other required participants. Timing on which construction progress conferences will commence will be at the discretion of the designated chair of construction progress conferences.
d. Construction progress conferences required by this Section are separate from monthly schedule meetings required in Section 01 32 16 - Construction Progress Schedule.
e. Anticipated duration of each construction progress conference is one hour, plus time necessary for visiting the Site.
f. Location, date, and time will be established in accordance with requirements of Article 1.2 of this Section.
4. Required Participants:
a. Owner: Project manager.
b. RPR
c. Contractor: Project manager, site superintendent, and safety representative.
d. Principal Subcontractors: Project manager or site superintendent, for Subcontractors performing significant Work since the previous conference and that will perform significant Work prior to the next, subsequent construction progress conference. When Subcontractor's site superintendent represents Subcontractor at construction progress

conferences, site superintendent shall be authorized and informed of administrative matters relating to Subcontractor's Work in accordance with Article 1.2 of this Section.

e. Major Suppliers: Field representative of Suppliers of significant materials and equipment, when such field representatives are performing onsite services under the Contract, or as otherwise deemed necessary by Contractor relative to conference participation.

f. Engineer: Project manager or delegate.

5. Required participants may invite to construction progress conferences others they deem necessary or appropriate.

C. Handouts:

1. Contractor shall bring to each construction progress conference not less than 12 paper copies of each of the following (furnish up to 20 copies when more than 12 staff are scheduled to attend):

a. List of Work accomplished since the previous construction progress conference and list of construction activities planned through the next, subsequent construction progress conference. Coordinate list of planned activities with both the updated Progress Schedule and look-ahead schedule.

b. Up-to-date Progress Schedule, in accordance with Section 01 32 16 - Construction Progress Schedule.

c. Up-to-date Schedule of Submittals, in accordance with Section 01 33 00 - Submittal Procedures.

d. "Look-ahead" schedule, in accordance with Section 01 32 16 - Construction Progress Schedule.

e. When applicable, list of upcoming, planned time off (with dates) for personnel with significant roles on the Project, and the designated contact person in their absence.

D. Preliminary Agenda for Construction Progress Conferences:

1. Review, comment, and amend (if necessary) of minutes of previous progress conference.
2. Review of progress since the previous progress conference.
3. Planned progress through next progress conference.
4. Overview of Progress Schedule:
   a. Review of the Contract Times; Contractor's ability to comply with Contract Times.
   b. Identification of critical path activities.
   c. Schedules for fabrication and delivery of materials and equipment.
   d. Corrective measures, if necessary, including recovery schedule(s).
5. Submittals:
   a. Review status of critical Submittals.
   b. Review revisions to Schedule of Submittals.
6. Contract Modifications:
   a. Requests for interpretation.
   b. Written clarifications.
   c. Field Orders.
   d. Proposal Requests.
   e. Change Proposals.
   f. Work Change Directives.
   g. Change Orders.
   h. Claims.
7. Progress Payment Requests:
   a. Status and deadline for submittal.
   b. Stored materials and equipment; observation by Engineer or RPR; documents required.
   c. Set-offs to which Owner is entitled (as applicable).
   d. Other matters related to progress payments.
8. Problems, conflicts, and observations.
9. Quality standards, testing, and inspections.
10. Coordination between Project participants.

11. Site management issues, including vehicular access and parking, traffic control, security, status of temporary controls and temporary utilities, site maintenance and cleaning, and other Site matters.
12. Safety and protection.
13. Permits and compliance.
14. Construction photographic documentation.
15. Record documents status.
16. Completion matters (as appropriate):
    a. Status of checkout, startup, field quality control activities.
    b. Status of training of facility O&M personnel and O&M manuals.
    c. Partial utilization; requesting and scheduling inspection for Substantial Completion.
    d. Punch list status (as applicable).
    e. Other closeout matters (if any).
17. Other business.

1.5 CLOSEOUT CONFERENCES

A. The requirements of Article 1.2 of this Section also apply to this Article.

B. Closeout Conferences – General.
    1. Purpose of closeout conferences is to familiarize participants with administrative and procedural requirements for Substantial Completion (including partial utilization by Owner) and readiness for final payment, and status of the Work required for achieving Substantial Completion and readiness for final payment.
    2. Conference Chair: Same as indicated elsewhere in this Section for construction progress conferences.
    3. Location, Date, and Time:
        a. Location, date, and time will be the same as indicated elsewhere in this Section regarding construction progress conferences.
        b. In general, as the Work, or a designated part thereof, progresses toward Substantial Completion, topics addressed at construction progress conferences will transition to discussing closeout-related topics.
        c. The conference chair may require one or more additional closeout conferences as the conference chair deems necessary. Required participants shall participate in such conferences without changes in the Contract Price or the Contract Times.
        d. Should additional closeout conferences be necessary, or should location, date, or times for closeout conferences differ from those established for construction progress conferences, the conference chair will so advise required participants, and others as appropriate, in accordance with Article 1.2 of this Section.
    4. Required Participants: Same as required participants for construction progress conferences, unless otherwise indicated by conference chair.

C. Preliminary Agenda for Closeout Conferences:
    1. Same as "Completion matters" portion of preliminary agenda for construction progress conferences as indicated elsewhere in this Section.
    2. Checkout and startup planning meeting, in accordance with Section 01 75 00 - Checkout and Startup Procedures.
    3. Training schedule conference, in accordance with Section 01 79 23 - Instruction of Operation and Maintenance Personnel.
    4. Additional closeout related topics as determined by closeout conference chair.

1.6 OTHER CONSTRUCTION CONFERENCES

A. The requirements of Article 1.2 of this Section also apply to this Article.

B. Other Construction Conferences – General.
    1. Other construction conferences may be scheduled and held as deemed necessary by Owner or Engineer. Such conferences may be focused on specific matters, such as discussing remedies and schedules for defective Work, negotiating changes in the Contract Price and

Contract Times, or other matters related to the Project where time limits prevent addressing such items as part of other conferences addressed elsewhere in the Contract Documents.

2. Conference Chair: Resident Project Representative.
3. Location, Date, and Time:
   a. Location: Same as location of construction progress conferences as indicated elsewhere in this Section, unless location is changed in accordance with Article 1.2 of this Section.
   b. Other construction conferences will be held on a day and at a time to be established by RPR, following consultation with principal representatives of Owner, Engineer, Contractor, and other required participants.
   c. Each other construction conference is one hour, plus time that may be necessary for visiting the Site when conference purpose warrants.
   d. Location, date, and time will be established in accordance with requirements of Article 1.2 of this Section.
4. Required Participants: As deemed necessary by conference chair.

C. Agenda: Agenda presenting topics to be discussed at each other construction conference will be developed by the conference chair and distributed to required participants, and others as appropriate, in accordance with Article 1.2 of this Section.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

SECTION 01 31 26
ELECTRONIC COMMUNICATION PROTOCOLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Procedures with which Users will comply regarding transmission or exchange of Electronic Documents for the Project.

B. Related Requirements:
   1. Refer to the General Conditions, as may be modified by the Supplementary Conditions, regarding transmitting Electronic Documents by Electronic Means.
   2. In addition to the requirements of this Specifications Section, comply with the requirements for Electronic Documents in the following Specifications:
      a. Section 01 32 16 - Construction Progress Schedule.
      b. Section 01 32 33 - Photographic Documentation.
      c. Section 01 33 00 - Submittals.
      d. Section 01 78 39 - Project Record Documents.

1.2 DEFINITIONS

A. The following terms are defined for use in this Specifications Section and are indicated herein using initial capital letters. The terms have the associated meaning regardless of whether indicated in singular or plural.
   1. Electronic Documents Protocol (abbreviated as "EDP"): Procedures and requirements set forth in this Specifications Section for the exchange of Electronic Documents by Electronic Means.
   2. Project Website: An internet-based software platform, such as a website or other project management information system (PMIS) designated by Contract or mutual consent of Users as the means of exchanging Electronic Documents during the Project.
   3. System Infrastructure: Hardware, operating system(s) software, internet access, e-mail service and software, security software, and large-file transfer functions.
   4. Users: Owner, Contractor, Engineer, and others exchanging Electronic Documents on the Project in accordance with the EDP.

1.3 ADMINISTRATIVE REQUIREMENTS.

A. Coordination:
   1. Contractor shall require all Subcontractors and Suppliers to comply with the EDP established in the Contract Documents.

1.4 GENERAL PROVISIONS OF ELECTRONIC DOCUMENT PROTOCOL

A. EDP – General:
   1. To the fullest extent practical, Users agree to and will transmit and accept Electronic Documents transmitted by Electronic Means in accordance with the requirements of this Specifications Section. Use of the Electronic Documents and any information contained therein is subject to requirements of this Specifications Section and other provisions of the Contract Documents governing transmittal of Electronic Documents.
   2. Content of Electronic Documents will be the responsibility of transmitting User.
   3. Unless otherwise provided in: (1) the EDP, (2) elsewhere in the Contract Documents, or (3) or other agreement between two or more Users governing use of Electronic Documents, Electronic Documents exchanged in accordance with the Contract Documents may be used in the same manner as paper or other printed versions of the same documents exchanged using other than Electronic Means, subject to the same governing requirements, limitations, and restrictions set forth in the Contract Documents.

4. Except as otherwise explicitly indicated in the EDP, the terms of this EDP will be incorporated into any other agreement or subcontract between a party and a third party for a portion of the Work or Project-related services, where such third party is, either directly or indirectly, required to exchange Electronic Documents with Owner, Contractor, or Engineer. Nothing in this EDP modifies the requirements of the Contract Documents regarding communications between and among Owner, Contractor, and Engineer Subcontractors, Suppliers, consultants, and others for which each is responsible.
5. When transmitting Electronic Documents, transmitting User makes no representations regarding long-term compatibility, usability, or readability of the items resulting from the receiving User's use of software applications or System Infrastructure differing from those established in this EDP.
6. This EDP does not negate or mitigate any obligation: (1) in the Contract Documents to create, provide, or maintain an original paper record version of Drawings and Specifications, signed and sealed in accordance with Laws or Regulations; (2) to comply with Laws and Regulations governing signing and sealing of design documents or signing and electronic transmission of other documents; or (3) to comply with notice requirements of the General Conditions (as. May be modified by the Supplementary Conditions).
7. Modifications to EDP:
    a. When modifications to the EDP are necessary to address issues affecting System Infrastructure, Users shall cooperatively resolve the issues.
    b. If resolution within a reasonable time is not achieved, Owner is empowered to require reasonable and necessary changes to the EDP consistent with the original intent of the EDP.
    c. If such changes result in additional cost or delay to Contractor, not reasonably anticipated under the original EDP, Contractor may seek an adjustment in the Contract Price, Contract Times, or both in accordance with the Contract Documents.

B. System Infrastructure and Systems for Exchanging Electronic Document:
1. Each User will provide System Infrastructure (as defined in this EDP) at its own cost and sufficient for complying with EDP requirements. Except for minimum standards set forth in this EDP [and explicit system requirements specified by attachment to this EDP], it is the obligation of each User to determine, for itself, such User's own System Infrastructure.
    a. Maximum size of e-mail file attachment under this EDP is 10 megabytes (MB) unless otherwise coordinated during Construction. Attachments larger than the maximum size indicated in this paragraph shall be exchanged via secure electronic transfer using method mutually acceptable to Owner, Engineer, and Contractor.
    b. Each entity transmitting or receiving Electronic Documents has full responsibility for its own costs, delays, deficiencies, and errors associated with converting, translating, updating, verifying, licensing, and otherwise enabling its System Infrastructure for use in accordance with this EDP.
    c. Each User will provide its own printing facilities and will be responsible for its own costs of printing Electronic Documents.
2. Each User is responsible for its own system operations, security, back-up, archiving, audits, and other technology and resources for operations of its System Infrastructure during the Project, including coordination with the User's individual(s) or subcontractor(s) responsible for managing its System Infrastructure and capable of addressing communications and other technology issues affecting exchange of Electronic Documents.
3. Security:
    a. Each User will operate and maintain industry-standard, industry-accepted, ISO standard, commercial-grade security software and systems to protect against threats including software viruses and other malicious software including worms, trojans, adware; data breaches; loss of confidentiality; and other threats in transmission to, or storage of, Electronic Documents from other Users, including transmission of Electronic Documents by physical media including flash drives/thumb drives, hard drives, compact discs (CD), digital video discs (DVD), and other portable devices, whether connected physically or wirelessly.

b. To the extent that a User maintains and operates such security software and appropriate System Infrastructure, such User will not be liable to other Users participating in the Project for breach of system security.

4. Principal means of exchanging Electronic Documents will be e-mail and files attached to e-mail, in accordance with the EDP.
5. Project Website:
   a. Contractor will establish, operate, and maintain a Project Website (as defined in this EDP) at sole cost of Contractor for use of Owner, Engineer, Contractor, and other Users as appropriate during the Project, for exchanging and storing Project Electronic Documents.
   b. Unless otherwise provided in the Contract Documents, use of Project Website by Owner, Contractor, and Engineer is mandatory for exchanging Project documents as set forth in the EDP.
   c. Project Website Conditions and Standards:
      1) Project Management Information System or other Software Application(s).
      2) Duration of Project Website Availability and Reliance by Users: 12 months after Final Completion.
      3) Services and Functions Available on Project Website:
         a) Document Management
         b) Construction Schedule
         c) Meeting Minutes
         d) RFIs (Requests for Information)
         e) Submittals
         f) CTRs (Certified Test Reports)
         g) Owner Inspector Daily Field Report.
         h) Contractor's Site Visit Reports
         i) Change documentation
         j) Applications for Payment with Schedule of Values
         k) Warranty documents
         l) Test Reports.
   d. Address of Project Website shall be furnished by Contractor, and Project Website shall be available from Contractor, within 10 days following the Effective Date of the Contract.

C. General Requirements and Limitations for Software for Electronic Document Exchange:
   1. Software and file formats for exchange of Electronic Documents shall be as indicated in Article 1.5 of this Specifications Section.
   2. Software Versions:
      a. Each User will acquire the software and associated licenses necessary to create, transmit, receive, read, and us Electronic Documents for the Project, using the software and file formats indicate in Article 1.5 of this Specifications Section.
      b. Prior to using any updated version of the software required in the EDP for Electronic Document(s) transmitted to other User(s), the originating User will first notify and either (1) receive concurrence from receiving User(s) for use of the updated version, or (2) adjust its transmission to comply with the EDP.
   3. Preservation of Intellectual Property and Confidentiality of Electronic Documents:
      a. Users agree to not intentionally edit, reverse-engineer, decrypt, remove security or encryption features, or convert to another format for modification purposes Electronic Documents, and information and data contained therein, transmitted in a file format, including portable document format (PDF), intended by transmitting User to not be modified, unless the receiving User (1) obtains permission from owner of the Electronic Document and intellectual property contained therein, or (2) is expressly allowed by the EDP to edit or modify the Electronic Document.
      b. Where modifying, editing, decryption, or reverse-engineering is allowed by the EDP, such use is conferred only for the Project.

c. The EDP does not transfer any ownership or rights of any sort regarding use outside of the Project of Electronic Documents.
d. Users shall not cite or quote excerpts of Electronic Documents for purposes outside of the Project unless required to do so by Laws and Regulations.

D. Contractor's Requests for Electronic Documents in Other Formats:
1. Release of Electronic Documents in format(s) other than those indicated in in Article 1.5 of this Specifications Section and elsewhere in the Contract Documents will be at the discretion of Owner and subject to terms and conditions required by the owner of such files and documents, and the provisions indicated below.
2. To extent determined by Owner, in its sole discretion, to be appropriate, release of Electronic Documents in alternative format(s) requested by Contractor ("Request") are subject to provisions of Owner's response to the Request and to the following:
a. Contractor's Request shall be in writing. Owner and others, as appropriate, will consider and respond to Request promptly, but neither Owner nor Engineer will be responsible for any time or cost impacts on Contractor associated with timing of the Request, or with Owner's decision associated therewith.
b. When Engineer is the owner of the Electronic Documents requested by Contractor in native format, prior to Engineer transmitting such Electronic Documents to Contractor, Contractor shall sign and deliver to Engineer, without modifying or amending, Engineer's "Electronic Media Release" agreement.
c. Content included in Electronic Documents created by Engineer and furnished in response to the Request was prepared by Engineer as an internal working document for Engineer's purposes solely and, when provided to Contractor, is on an "as-is" basis without warranties of any kind, including, but not limited to any implied warranties of fitness for purpose. Contractor acknowledges that content of Electronic Documents furnished in response to the Request may not be suitable for Contractor's purpose(s), or may require substantial modification and independent verification by Contractor. Content may include limited resolution of models, not-to-scale schematic representations and symbols, use of notes to convey design concepts in lieu of accurate graphics, approximations, graphical simplifications, undocumented intermediate revisions, and other shown or indicated information that may affect subsequent use by Contractor or others for whom Contractor is responsible.
d. Electronic Documents containing text, graphics, metadata, or other types of data furnished by Engineer in response to the Request are only for Contractor's convenience and any and all conclusions or information obtained or derived from such Electronic Documents will be at Contractor's sole risk and expense. Contractor waives any and all claims against Engineer, Owner, or both arising from Contractor's use of Electronic Documents furnished in response to the Request.
e. Contractor shall indemnify and hold harmless Owner, Engineer, and their respective consultants and subconsultants from any and all claims, damages, losses, and expenses, including attorneys' fees and defense costs, fees and costs of engineers, architects, geologists, accountants, and other professionals, and any and all other costs, direct and indirect, resulting from Contractor's use, adaptation, or distribution of Electronic Document(s) furnished in response to the Request.
f. Contractor shall not sell, copy, transfer, forward, give away or otherwise distribute the Electronic Documents (in source format or modified file format) to any third party without direct written authorization of Engineer or other entity that owns the Electronic document(s), unless such distribution is specifically indicated in the Request and is limited to Subcontractors and Suppliers. Contractor warrants that subsequent use by Subcontractors and Suppliers complies with terms and conditions of the Contract Documents, Owner's response to the Request, and release agreement(s) (if any) by owner of the Electronic Documents (including Engineer, where applicable).
3. When the Request is for Electronic Documents in a format not other than that indicated in the Contract Documents, and Owner (and others, as applicable) decide to comply with the Request, and when the requested Electronic Documents are not easily available in the

format(s) requested, Contractor shall reimburse Owner for costs incurred by Owner, either directly or indirectly, to furnish Electronic Documents in accordance with the to furnish the requested format(s). In compensation, Owner may retain such amount(s) as set-off(s) under the Contract Documents.

1.5 EXCHANGE OF ELECTRONIC DOCUMENTS

A. Comply with the Electronic Document formats, transmission methods, and permitted uses set forth in Table 01 31 26-A, Exchange of Electronic Documents, below, when transmitting or using Electronic Documents on the Project. Where a row in the table has no indicated means of transmitting Electronic Documents, use for such documents only paper copies transmitted to the receiving party via appropriate delivery method.

TABLE 01 31 26-A – EXCHANGE OF ELECTRONIC DOCUMENTS

Electronic Document Type	Format	Transmitting User	Transmission Method	Receiving User	Allowed Uses	Notes
1.5.A.1. Project communications						
General communications & correspondence	EM, PDF	O, E, C, RPR	EM, EMA	O, E, C, RPR	R	
Meeting notices and agendas	EM, PDF	RPR	PW	O, E, C	R	
Meeting minutes	PDF	RPR	PW	O, E, C	R	
1.5.A.2. Contractor's Submittals to Engineer						
Shop Drawings	PDF	C	PW	E	M (1)	(1)
Product data Submittals, delegated design Submittals, and other action Submittals (except Samples)	PDF	C	PW	E	M (1)	(1)
Informational and closeout Submittals:	PDF	C	PW	E, RPR	M (1)	(1) (6)
Documentation of delivery of maintenance materials Submittals	PDF	C	PW	E, RPR	M (1)	
1.5.A.3. Engineer's return of reviewed Submittals to Contractor						
Shop Drawings	PDF	E	PW	O., C, RPR	R	
Product data Submittals, delegated design Submittals, and other action Submittals	PDF	E	PW	O., C, RPR	R	
Informational and closeout submittals:	PDF	E	PW	O., C, RPR	R	(6)
Documentation of delivery of maintenance materials submittals	PDF	E	PW	O. C, RPR	R	
1.5.A.4. Contract Modifications Documents						
Requests for interpretation to Engineer	PDF	C., O, RPR	PW	E	M (1)	(1)
Engineer's interpretations (RFI responses)	PDF	E	PW	C, O, RPR	R	
Engineer's clarifications to Contractor	EM, PDF	E	PW	C, O, RPR	R	
Engineer's issuance of Field Orders	PDF	E	PW	C, O, RPR	R	
Proposal Requests	PDF	E, O, RPR	PW	C	R	
Change Proposals – submitted to Engineer	PDF	C	PW	O, E, RPR	S	
Change Proposals – Engineer's	PDF	E	PW	C. O, RPR		

Electronic Document Type	Format	Transmitting User	Transmission Method	Receiving User	Allowed Uses	Notes
response						
Work Change Directives (for Contractor signature)	PDF	E	PW	C	R	(2)
Change Orders (for Contractor signature)	PDF	E	PW	C	R	(2)
1.5.A.5. Applications for Payment						(3)
1.5.A.6. Claims and other notices						(4)
1.4.A.7. Closeout Documents						
Record drawings	DWG and PDF	C	PW	E, O, RPR	M (5)	(5)
Other record documents	PDF	C	PW	E. O, RPR	M (5)	(5)
Contract closeout documents						

1. Key to Table 01 31 26-A:
   a. Data Format:
      1) EM: .msg, .htm, .txt, .rtf, e-mail text.
      2) W: .docx, Microsoft Word 2013 or later.
      3) EX: .xlsx, Microsoft Excel 2013 or later.
      4) PDF: .pdf. portable document format.
      5) DWG: .dwg. Autodesk AutoCAD 2014 drawing.
   b. Transmitting User:
      1) O: Owner.
      2) C: Contractor.
      3) E: Engineer.
      4) RPR.
   c. Transmission Method:
      1) EM: Via e-mail.
      2) EMA: Attachment to e-mail transmission.
      3) PORT: Delivered via portable media such as flash drive/thumb drive, CD, or DVD
      4) PW: Posted to Project Website.
      5) FTP; FTP transfer to receiving FTP server.
   d. Receiving User:
      1) O: Owner.
      2) C: Contractor.
      3) E: Engineer.
      4) RPR
   e. Permitted Uses:
      1) S: Store and view only.
      2) R: Reproduce and distribute.
      3) I: Integrate (incorporate additional electronic data without modifying data received)
      4) M: Modify as required to fulfill obligations for the Project.
   f. Notes:
      1) Modifications by Engineer to Contractor's Submittals and requests for interpretations are limited to printing, marking-up, and adding comment sheets.
      2) May be distributed only to affected Subcontractors and Suppliers. Print, sign document, and return signed paper originals to Engineer.
      3) Submit printed Applications for Payment with original ("wet") signatures.

4) Submit notices, including Claims, in accordance with the notice provisions of the General Conditions, as may be modified by the Supplementary Conditions.
5) Submit record drawings in native CAD format indicated when Contractor has signed Engineer's standard agreement for release of electronic media. In addition, always submit record drawings as PDF files. Comply with Contract Documents requirements for Project record documents.
6) For operation and maintenance data, also submit paper copies as required by Section 01 78 23 - Operations and Maintenance Manuals.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

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SECTION 01 32 16
CONSTRUCTION PROGRESS SCHEDULE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Administrative and procedural requirements for Contractor's construction Progress Schedules and related Submittals, including:
      a. Administrative requirements regarding progress Schedules.
      b. Qualifications of Progress Schedule preparer and related personnel.
      c. Submittals of Progress Schedules and associated schedule-related Submittals..
      d. Initial Progress Schedules.
      e. Look-ahead schedules.
      f. Progress Schedule updates.
      g. Narrative reports.
      h. Time impact analyses.
      i. Recovery schedules.

B. Scope:
   1. Contractor shall prepare and submit to Engineer and RPR required Progress Schedules and related Submittals, as required by this Section and elsewhere in the Contract Documents. Maintain and update Progress Schedules and related Submittals throughout the Project.
   2. All references to "Engineer" in this Section shall be interpreted as "Engineer and/or RPR". Engineer and RPR shall each have authority to schedule meetings and approve the construction progress schedule. All submittals shall be sent to both Engineer and RPR. Responses may be from either or from both. References to "RPR" do not refer to "Engineer".
   3. Owner, facility manager (if other than Owner), Engineer, and others involved with the Project have the right to rely on accuracy of Contractor-prepared Progress Schedule.
   4. Engineer's review or acceptance of the Progress Schedule or related Submittals, and Engineer's comments on and expressed opinions concerning activities in the Progress Schedule and related Submittals, and progress of the Work, does not control Contractor's independent judgment concerning construction means, methods, techniques, sequences and procedures, unless the associated means, method, technique, sequence, or procedure is required by the Contract Documents. Contractor is solely responsible for complying with the Contract Times.

C. Related Requirements: Include, but are not necessarily limited to:
   1. Section 01 11 00 - Summary of Work.
   2. Section 01 26 00 - Contract Modification Procedures.
   3. Section 01 31 19 - Project Meetings.

1.2 REFERENCES.

A. Defined Terms and Terminology:
   1. Defined terms, indicated with initial capital letters, are indicated in the General Conditions, as may be modified by the Supplementary Conditions.
   2. Terminology: The following are not defined terms and are not indicated with initial capital letters but, when used in this Section, have the meaning indicated below, whether applied to the singular or plural thereof.
      a. "Activity" is an element of the Work that has the following specific characteristics: consumes time, requires resources, has a definable start and finish, is assignable, and is measurable.

b. "Baseline Progress Schedule" means, in addition to the General Conditions' definition of "Progress Schedule", the version of the Progress Schedule (for the entire Project) initially accepted by the Engineer. In the event of subsequent modifications to the Project, Contractor and Engineer may mutually agree that a subsequent revision of the Progress Schedule constitutes a new baseline Progress Schedule that supersedes the prior baseline Progress Schedule.
c. "Constraint" means an imposed date on the Progress Schedule or an imposed time between activities. The Contract Times are constraints.
d. "CPM Progress Schedule" means, in addition to the General Conditions' definition of "Progress Schedule", a computerized Progress Schedule in critical path method (CPM) format, for the entire Work, indicating interrelationships between elements of the Work; indicates sequences, dates, and durations for Work performed to date; indicates sequences, dates, and duration for incomplete Work yet to be performed; indicates constraints; and indicates the critical path for the Work.
e. "Critical path" is the continuous chain of activities, from start to completion of the Work, with the longest duration for completion within the Contract Times.
f. "Early finish" means the earliest date an activity can finish according to the assigned relationships among the activities in the Progress Schedule.
g. "Early start" means the earliest possible date an activity can start according to the assigned relationships among activities in the Progress Schedule.
h. "Float" means the time difference between the calculated duration of an activity chain on the Progress Schedule and the critical path.
i. "Late finish" means the latest date an activity on the Progress Schedule can finish without extending the Contract Times.
j. "Late start" means the latest date an activity on the Progress Schedule can start without extending the Contract Times.
k. "Network diagram" means a time-scaled logic diagram showing the durations and relationships of the activities on the Progress Schedule.
l. "Schedule date" (and similar terms, whether used in this Section or Project communications related to Progress Schedules) mean the "early start" and "early finish" date for the associated activity. "Late start" and "late finish" dates are for determining float and do not represent the schedule dates.
m. "Total float" means the total number of days an activity (or chain of activities) on the Progress Schedule can be delayed without affecting the Contract Times.
n. "Work areas" and "work system" means a logical breakdown of the Work elements or a group of activities which, when collectively assembled, are readily identifiable on the Project (for example: yard piping, a structure or building, a treatment process, or other logical grouping).

1.3 ADMINISTRATIVE REQUIREMENTS

A. General Provisions on Progress Schedules:
1. This Section augments requirements for the Progress Schedule, and Contractor's control of the Work, indicated in the General Conditions, as may be augmented by the Supplementary Conditions..

B. Use of Float:
1. Float belongs to the Project and may be used by Contractor or Owner to accommodate changes in the Work, or to mitigate the effect of events delaying the Work or compliance with the Contract Times.
2. Changes or delays that influence activities that have float and do not extend the critical path do not justify changes in the Contract Times..
3. Float Suppression: Pursuant to float sharing requirements of this Section, use of float suppression techniques in Progress Schedules, such as preferential sequencing logic, special lead/lag logic restraints, and extended activity durations are unacceptable.

C. Factors Affecting the Progress Schedule:

a. In preparing and updating the Progress Schedule, take into consideration: preparing and signing subcontracts and purchase orders, complying with Submittal requirements and Submittal review times, fabricating materials and equipment, source quality control (including required shop tests and inspections), shipping and deliveries, field quality control (including required field tests and inspections at the Site), Work by Subcontractors, coordination with others (such as other contractors including those indicated in Section 01 11 00 – Summary of Work, utility owners, and owners of transportation facilities), compliance with Laws and Regulations and permits, availability of construction equipment and machinery, abilities of workers, weather conditions, condition of the Site, seasonal restrictions, restrictions in operations at the Site and coordination with Owner's (or facility manager's) operations, shutdowns of Owner's facilities, training of facility operation and maintenance personnel, checkout, startup, adjusting and balancing, and other factors that have the potential to affect completion of the Work within the Contract Times.

2. Comply with sequencing requirements including:
   a. Section 01 14 16 - Coordination with Owner's Operations.

D. Scheduling Workshop Conferences:
1. Prior to preparing the preliminary Progress Schedule, Contractor shall participate with Engineer in one workshop conference(s), up to two hours in duration, to discuss technical requirements relative to sequencing and organizing the Work, Progress Schedule development, and Progress Schedule procedures.
2. Contractor and Engineer will mutually agree on the date, time, and location of scheduling workshop conference(s).
3. Required Attendees:
   a. Contractor's project manager, site superintendent, and Progress Schedule preparer.
   b. Engineer
   c. Owner or facility manager (if other than Owner) may attend scheduling workshop conferences.
4. RPR will prepare minutes of the scheduling workshop conferences and distribute minutes to conference attendees and others as deemed appropriate by RPR.

1.4 QUALITY ASSURANCE

A. Qualifications:
1. Progress Schedule Preparer.
   a. Contractor shall retain services of a scheduling consultant to, or shall self-perform, preparation and updating of the Progress Schedule using qualified personnel experienced in: (1) construction scheduling, (2) the scheduling software required for the Project, and (3) serving as Progress Schedule preparer on construction projects of similar type, size, and complexity as the Project.
   b. Progress Schedule preparer shall have not less than five years' experience using the required schedule software on construction projects of similar type, size, and complexity as the Project.
   c. Prior to engaging a scheduling consultant or using a qualified, experienced employee, submit to Engineer the following qualifications information:
      1) Name, employer, and business address of proposed Progress Schedule preparer and names, employer(s), and business address(es) of personnel who will be assigned to assist the preparer in developing and updating the Progress Schedule.
      2) Information sufficient to demonstrate that proposed Progress Schedule preparer and scheduling assistant personnel possess qualifications complying with this Section. For each person assigned, submit list of similar type, size, complexity, and construction contract amount for each project, together with project name, owner, location, and dates, and name(s) of scheduling personnel involved.
   d. Engineer's Review of Qualifications:
      1) Engineer will complete review of Progress Schedule preparer qualifications within five days of receipt of such qualifications.

2) If qualifications are unacceptable, submit qualifications of acceptable personnel within five days of Contractor's receipt of Engineer's non-acceptance.
3) Engineer's acceptance or non-acceptance of qualifications does not reduce or mitigate Contractor's obligations under the Contract Documents.

e. If Contractor intends to replace any Progress Schedule preparer personnel previously acceptable to Engineer, submit qualifications of proposed replacement(s) in accordance with this Article.

1.5 SUBMITTALS

A. Informational Submittals: Submit the following:
1. Qualifications Statements:
   a. Submit qualifications of Progress Schedule preparer, and other personnel that will assist Progress Schedule preparer in preparing and updating the Progress Schedule.
   b. Obtain Engineer's acceptance of qualifications prior to starting preparation of preliminary Progress Schedule..
2. Planned Work Schedule:
   a. Submit initial and updated (as necessary) planned work schedule, in accordance with this Section's "Progress Schedule" Article.
3. Progress Schedule:
   a. Preliminary Progress Schedule with associated narrative report.
   b. Acceptable Progress Schedule ("baseline Progress Schedule") with associated narrative report.
4. Look-Ahead Schedules:
   a. Submit 30-day look-ahead schedule at each construction progress meeting, in accordance with this Section's "Look-Ahead Schedules" Article.
5. Progress Schedule Updates:
   a. Progress Schedule updates shall comply with requirements of this Section, and shall include updated Progress Schedule and narrative report.
   b. Submit updated Progress Schedule prior to each associated construction progress meeting. When a Progress Schedule remains unchanged from one construction progress meeting to the next, submit written statement expressly so stating. In addition to monthly Progress Schedule update Submittals, also bring to construction progress meetings the number of paper copies of the updated Progress Schedule indicated in Section 01 31 19 - Project Meetings.
6. Time Impact Analyses: Submit in accordance with this Section.
7. Recovery Schedules: Submit in accordance with this Section.

1.6 INITIAL PROGRESS SCHEDULES

A. Applicability of this Article:
1. This Article addresses the initial Progress Schedules and selected, related Submittals required at the outset of the Project's construction phase, through Engineer's and/or 's acceptance of the Progress Schedule and its related Submittals.
2. Subsequent Progress Schedule Submittals, including Progress Schedule updates, recovery schedules, and other schedule-related Submittals, shall comply with software, type, organization, content, and similar requirements of this Article.

B. Type and Organization of Progress Schedules:
1. Prepare Progress Schedules using Oracle Primavera P6 software, unless other scheduling software is acceptable to Engineer.
2. Sheet Size: 22 inches by 34 inches, unless otherwise accepted by Engineer.
3. Time Scale: Indicate first date of each work week.
4. Activity Assignments and Designations:
   a. Limit activities, where possible, excluding fabrication of materials and equipment, to durations not longer than 20 days. Activities shall be definable and measurable. For example, an activity described only as "Concrete" will likely be unacceptable.
   b. Assign to each activity an appropriate, unique numerical designation and description.

c. Numerical designation shall incorporate the associated Specifications section number.
d. Activity description shall include sufficient detail to clearly communicate the intended activity. Descriptions shall include identifiers for physical locations of work area or work system, such as (where appropriate): column lines, stationing (for linear projects), and elevations. Indicate unique description for each activity.
e. Group deliveries of materials and equipment into a separate sub-schedule that is part of the Progress Schedule.
f. Group construction into work area sub-schedules (that are part of the Progress Schedule) by activity.
g. Clearly indicate, as activities separate from installation, necessary and required curing periods.

5. Organization of Progress Schedules:
a. Indicate interfaces and dependencies with preceding, concurrent, and follow-on activities, including those associated with the Work, other contractors at the Site, Owner and facility manager, Owner's consultants (including Engineer), authorities having jurisdiction, and others as appropriate. Clearly indicate activities not under Contractor's control.
b. Progress Schedules shall be CPM Progress Schedules.
c. Indicate on the separate Schedule of Submittals dates for submitting and reviewing Shop Drawings, product data Submittals, Samples, and other required Submittals. Coordinate Progress Schedule with the Schedule of Submittals.
d. Clearly indicate the critical path on the Progress Schedule.

C. Planned Work Schedule:
1. Within 30 days of the Effective Date of the Contract, indicate to Engineer the work days and hours proposed by Contractor. Also indicate planned non-work days, such as Contractor's holidays, weekends, and the like.
2. Enforce Subcontractors' and Suppliers' (when at the Site) compliance with Contractor's work schedule submitted to Engineer.
3. In the event of changes, submit to Engineer revised work schedule. Furnish such Submittal not less than three days prior to changing Contractor's work schedule, except in event of unanticipated emergency.

D. Preliminary Progress Schedule:
1. Within 10 days after the Contract Times commence running, Contractor shall submit to Engineer the preliminary Progress Schedule covering the entire Project, with associated schedule-related Submittals required in this Section's "Submittals" Article.
2. Submit preliminary Progress Schedule in accordance with Section 01 31 26 - Electronic Communication Protocols and Section 01 33 00 - Submittal Procedures. Also submit preliminary Progress Schedule in its native (executable) format generated by the scheduling software, transmitted in accordance with Section 01 31 26 - Electronic Communication Protocols.
3. Engineer will perform timely review of the preliminary Progress Schedule.
4. Preliminary Progress Schedule shall comply with the Contract Documents relative to Progress Schedules.

E. Initial Acceptance of Progress Schedule:
1. Not less than 10 days before submission of the first Application for Payment, a scheduling conference attended by Contractor, Progress Schedule preparer, Engineer, and others as appropriate will be held at the Site or nearby location furnished by Owner to review for acceptability to Engineer the preliminary Progress Schedule and associated schedule-related Submittals. Following the scheduling conference, Contractor shall have five days to make corrections and adjustments and to complete and resubmit the Progress Schedule and associated schedule-related Submittals. Contractor will not be eligible for first progress payment until acceptable Progress Schedule and associated schedule-related Submittals are submitted to Engineer and are acceptable to Engineer.

2. Submit acceptable Progress Schedule, together with associated schedule-related Submittals in accordance with this Section's "Submittals" Article, Section 01 31 26 – Electronic Communication Protocols, and Section 01 33 00 - Submittal Procedures. Also submit acceptable form of Progress Schedule in its native (executable) format generated by the scheduling software, transmitted in accordance with Section 01 31 26 - Electronic Communication Protocols.
3. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times, in accordance with the Contract Documents.
4. Initially-accepted Progress Schedule shall be identified as the baseline Progress Schedule.

F. Planned Completion Different from the Contract Times:
1. If the Progress Schedule accepted by Engineer indicates completion date(s) different than the Contract Times, the Contract Times are not thereby changed.
2. In the event the Progress Schedule accepted by Engineer indicates one or more early completion dates and the Contract Times have not been reduced, Owner may, at Owner's option, use available float without Owner being liable for Contractor's costs to remain onsite, mobilized, and working (whether on the original scope of the Work or for modified Work) beyond the scheduled early completion date(s), as long as the Work will be completed within the Contract Times.
3. When the Work will not be completed within the Contract Times, the Contract Documents' provisions concerning delays and changes in the Contract Times govern.

1.7 LOOK-AHEAD SCHEDULES

A. Look-Ahead Schedules – General:
1. Look-ahead schedules are short-duration, often more-detailed, time-based schedules for the Work to be performed during the coming month or other required span of the look-ahead schedule.
2. Purpose of look-ahead schedules is to present , for Project stakeholders, including Owner, facility manager (if other than Owner), Engineer, Owner-hired testing and inspection entities, other contractors working at or adjacent to the Site, utility owners, transportation facility owners, and others as necessary, Contractor's detailed, time-based plan for performing the Work during the period covered by the timespan of the look-ahead schedule.
3. This Section's "Submittals" Article indicates the required span and frequency of look-ahead schedules..
4. Each look-ahead schedule shall be fully coordinated and consistent with the current Progress Schedule update.
5. Submit look-ahead schedules concurrent with construction progress meetings, in accordance with Section 01 31 26 - Electronic Communication Protocols, and Section 01 33 00 - Submittal Procedures. Also submit look-ahead schedules in native (executable) format, in accordance with Section 01 31 26 - Electronic Communication Protocols.
6. As handouts, bring to each construction progress meeting the quantity of paper copies of the new look-ahead schedule indicated in Section 01 31 19 - Project Meetings. If quantity is not indicated in Section 01 31 19 - Project Meetings, furnish quantity equal to typical number of attendees of progress meetings.

B. Organization and Content of Look-Ahead Schedules:
1. Look-ahead schedules shall be prepared from the current Progress Schedule update, of the same type, using the same software, content, and organization required in this Section for initial Progress Schedules.
2. Activity designations on look-ahead schedules shall incorporate the associated activity designations from the Progress Schedule.
3. Sheet Size: Format look-ahead schedules to sheet size of 11 inches by 17 inches, unless other sheet size is acceptable to Engineer.
4. Look-ahead schedules should generally be more-detailed than the Progress Schedule. Activity durations on look-ahead schedules should not exceed five days.

1.8 PROGRESS SCHEDULE UPDATES

A. Updates – General:
   1. Update the Progress Schedule not less-often than once per month. If during progress of the Work events develop that necessitate changes in the initially accepted Progress Schedule (baseline Progress Schedule), identify updated Progress Schedules sequentially as "Progress Schedule Revision "1", "2", "3", and continuing in sequence as required. Number the Progress Schedule submittals in accordance with Section 01 33 00 - Submittal Procedures.
   2. Progress Schedule updates shall comply with this Section's requirements for initial progress Schedule, relative to type, required software, organization, content, and related matters.
   3. Starting with first Progress Schedule update, and continuing with each subsequent update, indicate on the Progress Schedule the actual start and finish dates of each activity that is completed or is currently underway. Inaccurate representation of completed or in-progress activities will be grounds for Engineer's non-acceptance of the Progress Schedule update.
   4. Contractor's Progress Schedule update shall include a narrative report in accordance with this Section. Narrative report shall include description of: progress achieved to date and status of each work area of the Project, planned progress for the upcoming period, identification of the critical path, current or potential delays, Change Orders (pending and approved since the previous Progress Schedule update), and other problems associated with performing the Work in accordance with the baseline Progress Schedule and complying with the Contract Documents, including the Contract Times. Indicate in the narrative report delays that have occurred since the previous updated Progress Schedule.
   5. The update to the Progress Schedule shall be based on retained logic. Progress override logic is not allowed.
   6. Submit to Engineer updated Progress Schedule, together with associated schedule-related Submittals, in accordance with this Section's "Submittals" Article, Section 01 31 26 - Electronic Communication Protocols, and Section 01 33 00 - Submittal Procedures. Also submit updated Progress Schedule in its native (executable) format generated by the scheduling software, transmitted in accordance with Section 01 31 26 - Electronic Communication Protocols.

B. Monthly Schedule Meeting:
   1. During the month, utilizing the previous month's look-ahead schedule. Contractor shall record the percent complete, start and finish dates of each scheduled activity with the remaining duration for each activity started but not completed, including activities associated with procurement of materials and equipment.
   2. On the same day each month, not less than one week prior to a progress meeting, Contractor, Progress Schedule preparer, Engineer (or Resident Project Representative), and others as appropriate shall meet at the Site to tour the Work to review and recommend updates to the Progress Schedule and progress information gathered by Contractor during the month. After discussion of Contractor's current progress information and attendees' review of the current status of the Work, Progress Schedule preparer shall appropriately and accurately update the Progress Schedule.

1.9 NARRATIVE REPORTS

A. Narrative Reports – General:
   1. Prepare and include with the preliminary Progress Schedule Submittal and each subsequent Progress Schedule Submittal, written narrative report describing the schedule-related constraints required by the Contract Documents and Contractor's plan and schedule for complying with such requirements. Narrative reports shall also include required content indicated above in this Section's "Progress Schedule Updates" Article.
   2. Narrative report shall describe the methods of sequencing and operation, resources to be employed, time frames for the construction of each of the major work area or work system on the Project, and time frames for complying with the Contract Times and Contractor's interim schedule milestones.

3. Prepare narrative reports on Contractor's company letterhead and clearly indicate the Progress Schedule revision and date associated with the narrative report.
4. Narrative reports shall be written in English and typed. Use clear, concise, complete, and accurate language in narrative reports. Clearly indicate in narrative report the name of person preparing the narrative report and date of preparation
5. Narrative report Submittals do not constitute contractual Change Proposals, nor are they notice of a Claim.
6. Engineer's receipt, review, and acceptance of narrative reports does not mitigate or reduce Contractor's obligations to furnish contractually required notices.

1.10 TIME IMPACT ANALYSIS

A. Time Impact Analyses – General:
   1. Prepare and submit time impact analysis when one or more of the following occurs: (a) Change Proposal is prepared; (b) Work Change Directive is issued that will affect the Progress Schedule; or (c) when delays occur.
   2. Time impact analysis shall illustrate influence of each Change Order, Work Change Directive, allowance authorization, or delay, as applicable, on Contractor's ability to comply with the Contract Times and Progress Schedule constraints.
   3. In performing time impact analysis, use Progress Schedule having revision date closest to and prior to the event giving rise to the delay or other change in the Work.
   4. Indicate in time impact analysis activities on the Project's critical path prior to the event giving rise to the delay or other Change in the Work; activities added, extended, or deleted as a result of the delay or change in the Work; and impact of such changes on the Project's critical path activities.
   5. Indicate in time impact analysis activities not within Contractor's control.
   6. Time impact analysis shall demonstrate the time impact, based on date the Change Order, Work Change Directive, or allowance authorization was given to Contractor or, as applicable, date the delay started to occur; the status of the Work at that time; and activity duration of affected activities. Activity duration used in time impact analysis shall be those included in most recent Progress Schedule update accepted by Engineer, closest to start of the delay or start of the Change Order, Work Change Directive, or allowance authorization as adjusted by mutual, written agreement of the parties and Engineer.
   7. Timing of Time Impact Analysis:
      a. Submit time impact analysis with Change Proposal, in accordance with Section 01 26 00 - Contract Modification procedures.
      b. When time impact analysis is not part of a Change Proposal, submit each time impact analysis within 15 days after the following, as applicable:
         1) Start of the delay.
         2) After Contractor's receipt of Work Change Directive.
      c. When Contractor does not submit time impact analysis for a specific change or delay, within the specified period for such submittal, such non-submittal will indicate extension of the Contract Times is not needed.

B. Evaluation by Engineer and Acceptance:
   1. Engineer's evaluation of each time impact analysis comprised of complete information will be completed in timely manner (in accordance with the Contract Documents) after Engineer's receipt.
   2. When time impact analysis is incomplete or otherwise inappropriate, Engineer will furnish comments to Contractor. When time impact analysis is complete and apparently appropriate, its acceptability will be indicated by associated Contract modification or allowance authorization.
   3. Changes in the Contract Times will be made only by Change Order.
   4. When mutual agreement is reached between the parties on effect of the change or delay in the Project, incorporate into the next Progress Schedule update the associated fragnets illustrating the influence of changes and delays.

1.11 RECOVERY SCHEDULES

A. Recovery Schedules – General:
   1. When updated Progress Schedule indicates the ability to comply with the Contract Times falls 14 days or more behind schedule, and there is no excusable delay, Change Order, or Work Change Directive to support an extension of the Contract Times, Contractor shall prepare and submit to Engineer Contractor's recovery schedule.
   2. Recovery schedule is a Progress Schedule demonstrating Contractor's plan to accelerate the Work to achieve compliance with the Contract Times. If achieving the Contract Times is not feasible, Contractor's recovery schedule shall indicate Contractor's plan to recover as much of the lost time as possible to complete the Work as close as possible to the Contract Times.
   3. Submit recovery schedule within 10 days after submittal of updated Progress Schedule where need for recovery schedule is indicated.

B. Recovery Schedule Report:
   1. With each recovery schedule Submittal, include recovery schedule narrative report, manually prepared by Contractor, on Contractor's company letterhead, indicating name of person responsible for preparing the recovery schedule and report.
   2. Recovery schedule report shall verbally indicate Contractor's plan for accelerating the Work and recovering lost time, and shall indicate the total number of days expected to be recovered by Contractor's implementation of the recovery schedule. Clearly indicate how the intended actions will recover lost time.
   3. Contractor is fully responsible for complying with the Contract Documents, including the contract Times.

C. Implementation of Recovery Schedule:
   1. At no additional cost to Owner, do one or more of the following, as appropriate: (a) furnish additional labor, (b) provide additional construction equipment and machinery, (c) provide suitable materials to accelerate the Work, (d) employ additional work shifts, (e) expedite procurement of materials and equipment to be incorporated into the Work or otherwise expedite delivery of such items, (f) provide other needed resources, and (g) provide other measures necessary to complete the Work within the Contract Times.
   2. Upon acceptance of recovery schedule by Engineer, incorporate recovery schedule into the next Progress Schedule update.

D. Contractor's Failure to Recover Lost Time:
   1. Contractor's refusal, failure, or neglect to take appropriate measures to recover lost time, or to submit a recovery schedule, shall constitute reasonable evidence that Contractor is not prosecuting the Work, or designated part of the Work, with diligence to ensure completion in accordance with the Contract Times. Such action or inaction by Contractor shall constitute sufficient basis for Owner to exercise remedies available to Owner under the Contract Documents.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

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SECTION 01 32 33
PROJECT PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Requirements for the following types of Contractor-furnished construction photographic documentation:
      a. Still photographs.
      b. Video.
   2. Requirements for preconstruction, construction progress, and final photographic documentation.

B. Scope:
   1. Contractor shall perform construction photography and submit construction photographic documentation, including providing all labor, materials, equipment, and services required.
   2. Perform photography (i.e., still photography and video) and submit construction photographic documentation, in accordance with this Section, throughout the Work.
   3. Obtain and pay for required permits and licenses, if any, and obtain approvals required by authorities having jurisdiction for Contractor's construction photography.

C. Related Requirements:
   1. Section 01 31 26 - Electronic Communication Protocols.
   2. Section 01 33 00 - Submittal Procedures.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate construction photography with progress of the Work. Unless otherwise required by the Contract Documents, do not cover or conceal the Work until construction photographic documentation has been properly obtained.
   2. Coordinate dates and times for performing construction photography with Resident Project Representative (RPR).
   3. Coordinate construction photography with other contractors at the Site.

1.3 QUALITY ASSURANCE

A. Selection of Views for Construction Photography:
   1. At the Site, Resident Project Representative will indicate the views to be taken and will select time at which images will be obtained.
   2. Photographic subjects, views, and angles will vary with progress of the Work.

1.4 SUBMITTALS

A. Informational Submittals: Submit the following:
   1. Preconstruction Photographic Documentation:
      a. Submit Electronic Documents (still photographs and video).
      b. Submit acceptable preconstruction photographic documentation prior to mobilizing to and disturbing the Site, and not later than the first progress payment request, unless other schedule for preconstruction photographic documentation is accepted by Engineer.
   2. Construction Progress Photographic Documentation:
      a. Submit prints and Electronic Documents (still photographs and video).
      b. Obtain construction progress photographic documentation at the frequency indicate in this Section. Coordinate submittal of construction progress photographic documentation with submittal of each progress payment requests.

3. Qualifications Statements:
    a. Photographer: When requested by Engineer, prior to starting photographic documentation Work, submit photographer qualifications and record of experience. List of construction photography experience shall include for each project:
        1) Project name and location
        2) Nature of construction.
        3) Photographer's client with contract information.
        4) Approximate duration of photographer's services.

B. Closeout Submittals: Submit the following:
    1. Final Photographic Documentation:
        a. Submit prints and Electronic Documents (still photographs and video).
        b. Submit acceptable final photographic documentation prior to requesting final inspection.

1.5 CONSTRUCTION PHOTOGRAPHY – GENERAL

A. Images - General:
    1. Photographic documentation shall be in color.
    2. Photographic images shall be suitably staged and set up ("framed"), focused, and have adequate lighting to illuminate the Work and conditions that are the subject of the photograph.
    3. For still photographs and video, use digital camera equipment with resolution of not less than 16.0-megapixels.
    4. Do not imprint date and time in the image.
    5. Key Plan for Each Submittal of Still Photographs: With submittal of each group of still photographs, furnish one key plan, 8.5 inches by 11 inches in size, of the Site, indicating location and direction where each still photograph was taken. Key plan and each associated photograph shall clearly indicate a number or other designation for each still photograph. When prints of photographs are required, submit equal quantity of prints of each key plan.

B. Photographic Electronic Documents:
    1. For each still photograph submitted, furnish high-quality, high-resolution digital image in JPEG (".jpg") file format compatible with Microsoft Windows 10 and higher operating systems.
    2. GPS geo-tagging enabled and recorded with each image.
    3. Image Resolution: Sufficient for clear, high-resolution digital images and prints. Minimum resolution shall be 600 dots per inch (dpi). Minimum size of digital images shall be:
        a. Non-Aerial Still Photographs: Eight inches by ten inches.
    4. Electronic Document image filename shall describe the image; do not submit filenames automatically created by camera. Where applicable, include area designation and area number as defined on the Contract Drawings. For example, acceptable Electronic Document image filenames are, "31 Pl ll Blower Bldg – Looking West at Blower 2.jpg". and "Main St.-Elm St. Intersection – Looking North.jpg"
    5. Submittal of Electronic Documents Still Photographs:
        a. Submit in accordance with Section 01 31 26 – Electronic Communication Protocols.
        b. When use of online document management system is required by the Contract Documents, also save copy of Electronic Documents of photographic documentation in a directory for Contractor's photographic images. Each time photographs are obtained , save the associated Electronic Documents files in a new subdirectory named for the date and basic subject of the photographs. For example, "2022-06-30 – Site Work" and "2023-03-21 – New Control Room".
        c. Submit Electronic Documents of still photographs not more than 72 hours after such images are obtained.

1.6 PRECONSTRUCTION PHOTOGRAPHIC DOCUMENTATION

A. Preconstruction Photographic Documentation:

1. Obtain and submit sufficient preconstruction photographic documentation to record conditions at the Site prior to construction. Photography shall document all work areas for the Project.
2. Preconstruction photography is separate from construction progress photographic documentation required in this Section.
3. Submit preconstruction video of all work areas included in the Project, including indoor and outdoor work areas and areas to be occupied by field offices, temporary sheds, material and equipment storage areas, staging and laydown areas, areas that will be used by or for construction vehicular traffic and parking, and other locations that will or may be disturbed by construction of the Project.

B. If disagreement arises on the condition of the Site and insufficient preconstruction photographic documentation was submitted prior to the disagreement, restore the property in question to extent directed by Engineer and to Engineer's satisfaction.

1.7 CONSTRUCTION PROGRESS PHOTOGRAPHIC DOCUMENTATION

A. Progress Photography:
1. Take still photographs not less often than once per month.
2. Take not less than 20 still photographs each time photographer is at the Site.
3. Maximum number of progress photographs required is based on the Contract Times to Substantial Completion of the entire Project and scope of the Project on the Effective Date of the Contract. Proportionately modify the extent of photographic documentation if scope of the Project or the Contract Times are modified.
4. Obtain and submit interior and exterior photographic documentation of each building and structure in the work area as directed by Engineer or Resident Project Representative at the time photographs are taken.

1.8 FINAL PHOTOGRAPHIC DOCUMENTATION

A. Final Photography:
1. Take still photographs at time and day acceptable to Engineer. Do not take final photographs prior to Substantial Completion of the entire Project, removal of temporary facilities, and restoration. Work documented in final, still photographs shall be complete in accordance with the Contract Documents, including painting and finishing, furnishings, landscaping, and other visible Work
2. Submit final photographs based on scope of the Project upon the Effective Date of the Contract. Proportionately modify the quantity of final, still photographs if scope of the Project is modified. Final, still photographs are not part of construction progress photographs required elsewhere in this Section.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

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SECTION 01 33 00
SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Definition of various types of Submittals.
   2. Coordination requirements for Submittals.
   3. General provisions concerning Submittals.
   4. Schedule of Submittals.
   5. Contractor's preparation of Submittals, including:
      a. Numbering.
      b. Marking.
      c. Organization and content.
      d. Proposed "or-equals", substitutes, and deviations from Contract requirements.
      e. Electronic Documents Submittals.
      f. Contractor's review and approval of each Submittal.
      g. Resubmittals.
   6. Contractor's transmittal of Submittals, including transmittal letters, transmittal and delivery method, and delivery of Samples, Closeout Submittals, and Maintenance Materials Submittals.
   7. Engineer's review, including:
      a. Timing.
      b. Meaning of Engineer's Submittal action code(disposition) assigned.
      c. Delivery of Engineer's responses on Submittals.

B. Scope:
   1. Contractor shall provide all labor, materials, equipment, tools, services, incidentals, and other effort necessary to furnish Shop Drawings, product data Submittals, Samples, and other Submittals in accordance with the Contract Documents.
   2. This Section's Article, "General Provisions Concerning Submittals" includes a summary of the Contract Documents' locations of Submittals requirements.
   3. Shop Drawings, product data Submittals, Samples, and other Submittals, whether or not approved or accepted by Engineer, are not Contract Documents. Engineer's approval or acceptance, as applicable, of a Submittal does not alter or modify the Contract Documents.
   4. Engineer and Owner have the right to rely on Contractor's representations and certifications made regarding each Submittal.

C. Related Requirements: Include but are not limited to:
   1. Section 01 25 00 - Substitution Procedures.
   2. Section 01 31 26 - Electronic Communication Protocols.
   3. Section 01 32 16 - Construction Progress Schedule.
   4. Section 01 62 00 - Product Options.

1.2 REFERENCES

A. References – Introduction:
   1. This Article presents definitions and terminology used in this Section and throughout the Contract Documents.
   2. Applicability of the Term "Submittals": Where reference is made to Shop Drawings, product data Submittals, Samples, or other Submittals in this Section and elsewhere in the Contract Documents, the term "Submittals", as defined in the Contract Documents, is intended. The foregoing applies regardless of whether such term is indicated with an initial capital letter, unless context of the subject provision clearly indicates otherwise.

3. Types of Submittals:
    a. Submittal types are classified as follows: (1) Action Submittals, (2) Informational Submittals, (3) Closeout Submittals, and (4) Maintenance Materials Submittals.
    b. Type of each required Submittal is indicated in the associated Specifications section. When Submittal type is not clearly indicated in the associated Specifications section, Submittal will be classified as indicated in this Article. Submit request for interpretation when Contractor is uncertain of required Submittal type.

B. Action Submittals:
    1. Action Submittals require an explicit, written approval or other appropriate action by Engineer (or other entity to whom the Submittal is required to be furnished, in accordance with the Contract Documents) before Contractor may release the associated item(s) for raw materials procurement, fabrication, production, and shipping.
    2. Unless otherwise indicated in the Contract Documents, Action Submittals include the following:
        a. Shop Drawings.
        b. Product data.
        c. Samples.
        d. Testing plans for quality control activities required by the Contract Documents.
        e. Delegated Designs: Delegated design professional's "instruments of service" Submittals required by the Contract Documents , as further described in Section 01 35 73 – Delegated Design Procedures.
    3. General Conditions' requirements for Shop Drawings and Samples hereby apply to all Action Submittals.

C. Informational Submittals:
    1. Informational Submittals are so indicated in the Contract Documents. Unless otherwise indicated, Informational Submittals include certifications, evaluation reports, results of source quality control activities, results of field quality control activities, Supplier instructions, reports of Suppliers' visits to the Site, sustainable design Submittals (that are not Closeout Submittals), delegated design Submittals that are not "instruments of service" Submittals, qualifications statements, and others.
    2. Informational Submittals, when submitted in accordance with the Contract and indicating full compliance with the Contract Documents, do not require explicit response from Engineer (or other entity to whom the Submittal is to be delivered); Engineer's (or other entity's) acceptance thereof will be indicated in the Engineer's Submittals log. Copy of Engineer's Submittals log is available to Contractor upon Contractor's written request.
    3. When Informational Submittal does not indicate full compliance with the Contract Documents, Engineer (or other entity to which Submittal is to be delivered) will indicate the non-compliance in a written response to Contractor.

D. Closeout Submittals:
    1. Closeout Submittals are so indicated in the Contract Documents and are, in general, required before the associated Work is completed, unless earlier submittal is required by the Contract Documents.
    2. Unless indicated otherwise in the Contract Documents, Closeout Submittals include maintenance contracts, operation and maintenance data, warranties, bonds (other than performance and payment bonds required prior to the start of construction), record documents, sustainable design closeout Submittals, software, keys, and others.
    3. Closeout Submittals are processed in the same manner as described above for Informational Submittals.

E. Maintenance Materials Submittals:
    1. Maintenance materials include spare parts, extra materials, tools, and similar items required to be furnished in accordance with the Contract Documents.

2. Furnish required physical maintenance materials, delivered to Owner or facility manager (if other than Owner), as applicable, at the location(s) indicated in the Contract Documents, for the corresponding required Maintenance Materials Submittals.
3. Maintenance Materials Submittals are documentation of delivery to Owner's or facility manager, and their acceptance of, required physical maintenance materials.
4. Maintenance Materials Submittals are processed in the same manner as described above for Informational Submittals.

F. Additional Terms:
1. The following terms have the meanings indicated below, regardless of whether such terms are indicated using initial capital letters, and apply to singular and plural of each:
a. "Product data" means illustrations, standard schedules, performance charts, Supplier's published instructions, brochures, diagrams, and other information furnished by Contractor to illustrate or describe materials or equipment for some portion of the Work. In general, product data are manufacturers' pre-published information on the items proposed to be incorporated into the Work. Product data includes manufacturer's catalog pages and similar documents with contractor-made markings and indications of proposed products and proposed options.
b. The term "Shop Drawings", defined in the General Conditions, is supplemented by the following: Shop Drawings include: (1) fabrication and assembly drawings, usually having a title block, or (2) schedules, prepared specifically for the Project. Here, "schedules" means a Project-specific summary of systems and components, such as a schedule of HVAC equipment, schedules of doors and door hardware, or windows, or a schedule of paint systems by room and surface, or other, similar Project information in a tabular format. In contrast, construction Progress Schedules, Schedules of Submittals, and Schedules of Values are not Shop Drawings.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
1. Furnish Submittals well in advance of need for the associated material or equipment, or procedure (as applicable), in the Work and with ample time necessary for delivery of materials and equipment and to implement procedures following Engineer's approval or acceptance of the associated Submittal.
2. Work covered by a Submittal will not be included in payments by Owner until approval or acceptance (as applicable) of related Submittals has been obtained in accordance with the Contract Documents.

1.4 GENERAL PROVISIONS CONCERNING SUBMITTALS

A. Locations of Requirements:
1. Requirements concerning Submittals are generally located as follows:
a. General Conditions, as may be modified by the Supplementary Conditions, applicable to the Project.
b. This Section, which presents general requirements for Submittals applicable to the Project.
c. Other Division 01 Specifications that include general requirements for certain types of Submittals, such as Section 01 31 26 - Electronic Communications Protocols, Section 01 78 23 - Operation and Maintenance Data, Section 01 35 73 - Delegated Design Procedures (when the Contract includes delegation of professional design services), and others.
d. The "Submittals" Article of the various Specifications sections, which indicates the required Submittals for the associated Work. Furnish all Submittals required by the Contract Documents regardless of whether explicitly indicated in the associated Specifications' "Submittals" Article.

B. This Section augments and supplements the requirements of the General Conditions, as may be modified by the Supplementary Conditions, relative to Submittals.

1.5 SCHEDULE OF SUBMITTALS

A. Informational Submittals: Submit the following:
   1. Schedule of Submittals:
      a. Timing:
         1) Furnish Schedule of Submittals within time frames indicated in the General Conditions, as may be modified by the Supplementary Conditions.
         2) Submit updated Schedule of Submittals with each submittal of the updated Progress Schedule.
      b. Content: In accordance with the General Conditions, as may be modified by the Supplementary Conditions, and this Section. Requirements for content of preliminary Schedule of Submittals and subsequent Submittals of the Schedule of Submittals are identical. Identify on Schedule of Submittals all Submittals required in the Contract Documents. Updates of Schedule of Submittals shall show scheduled dates and actual dates for completed tasks. Clearly indicate Submittals that are on the Project's critical path. Indicate the following for each Submittal:
         1) Date by which Submittal will be received by Engineer.
         2) Whether Submittal will be for a substitution or "or-equal".
         3) Date by which Engineer's response is required. Allow not less than 14 days for Engineer's review, starting on Engineer's actual receipt of each Submittal. Allow increased time for large or complex Submittals.
         4) For Submittals for materials or equipment, date by which material or equipment must be at the Site to avoid delaying the Work and to avoid delaying the work of others (if any).
      c. Major Equipment Submittals shall be included in the Progress Schedules in Section 01 32 16 - Construction Progress Schedule. The overall Schedule of Submittals may also be in this software or may be maintained by spreadsheet.
      d. Coordinate Schedule of Submittals with the Progress Schedule.
      e. Schedule of Submittals that is not compatible with the Progress Schedule, or that does not indicate Submittals on the Project's critical path, or that places extraordinary demands on Engineer for time and resources, is unacceptable. Do not include Submittals not required by the Contract Documents.
      f. In preparing Schedule of Submittals:
         1) Considering the nature and complexity of each Submittal, allow sufficient time for reviews and revisions.
         2) Allow reasonable time for: Engineer's review and processing of Submittals, for Submittals to be revised and resubmitted, and for returning Submittals to Contractor.
         3) Identify and accordingly schedule Submittals that are expected to have long anticipated review times.

1.6 PREPARATION OF SUBMITTALS

A. Prior to Submittal Preparation:
   1. The General Conditions, as may be modified by the Supplementary Conditions, address Contractor's responsibility for submitting for Owner's acceptance identification of Subcontractors and Suppliers. Obtain Owner's acceptance before entering into subcontracts and purchase orders for the Work.
   2. Comply with the Contract Documents relative to terms and conditions of subcontracts and purchase orders for the Work.
   3. Contractor's responsibilities for the following are set forth in the General Conditions, as may be modified by the Supplementary Conditions, and as may be augmented elsewhere in the Contract Documents:
      a. Obtaining field measurements and dimensions.
      b. Determining and verifying required quantities.
      c. Verifying compatibility of materials.
      d. Apportioning the Work among Subcontractors, Suppliers, and Contractor.

e. Reconciling required materials, equipment, and other Contract requirements with Contractor's means, methods, techniques, sequences, and procedures of construction and with Contractor's safety and protection programs and precautions incident thereto.
f. Reviewing applicable provisions of the Contract Documents and obtaining from Engineer necessary interpretations or clarifications.

B. Submittal Identification:
1. Submittal Number: Shall be a unique number assigned to each individual Submittal. Assign Submittal numbers as follows:
a. First part of Submittal number shall be the applicable Specifications section number, followed by a hyphen.
b. Second part of Submittal number shall be a three-digit number (sequentially numbered from 001 through 999) assigned to each separate Submittal furnished under the associated Specifications section.
c. Example: Submittal number for the third Submittal furnished for Section 10 14 00 - Signage, would be "10 14 00-003".
2. Review Cycle Number: Each resubmittal of a given Submittal shall be indicated with a lower-case letter designation:
a. No letter designation for initial (first) submittal of the Submittal number.
b. "a" shall indicate first resubmittal of the Submittal number.
c. "b" shall indicate second resubmittal of the Submittal number.
3. Examples:

Example Description	Submittal Identification	
	Submittal No.	Review Cycle
Initial (first) review cycle of the third Submittal furnished under Section 10 14 00 – Signage	10 14 00-003-	
Second review cycle (first resubmittal) of third Submittal furnished under Section 10 14 00 - Signage	10 14 00-003-	a

C. Marking of Submittals:
1. Mark on each page of each Submittal and each individual component submitted with Submittal number and applicable Specifications paragraph.
2. Mark each page of each Submittal with the Submittal page number.
3. Each Shop Drawing sheet shall have title block with complete identifying information satisfactory to Engineer.
4. For product data Submittals, operation and maintenance data Submittals, and other Submittals:
a. Mark options to be furnished using broad, dark arrows or "clouds" clearly drawn around the relevant text or diagrams. Do not use highlighter for indicating options and features.
b. Indicate options and features not furnished using clear strikeouts through the text or diagrams.

D. Submittal Organization and Content – General:
1. Page or Sheet Size; Furnish Submittals with one or more of the following page or sheet sizes: (a) 8.5 inches by 11 inches; (b) 11 inches by 17 inches; (c) 22 inches by 34 inches; unless another sheet size is acceptable to Engineer.
2. Language: All parts of each Submittal shall be in the English language.
3. Units of Measurement: Clearly indicate units of measurement on Shop Drawings, product data Submittals, record documentation, and operation and maintenance data Submittals.
4. Organize each Submittal logically to facilitate ease of understanding and review.
5. To the extent practicable, arrange Submittal information in same order as requirements are written in the associated Specifications section.

6. Each Submittal shall cover Work under only one Specifications section.
7. To the extent practicable, package together Submittals for the same Specifications section. Do not furnish required information piecemeal.
8. For large or complex Submittals, include a title page and table of contents.
9. Include appropriately labeled fly sheets to separate distinct parts of each Submittal.
10. Ensure legibility of all pages in each Submittal.
11. Minimize extraneous and unnecessary information in Submittals for materials and equipment. Do not submit information not relevant to the Submittal and associated requirements of the Contract Documents.
12. Contractor's, Subcontractor's, and Supplier's written comments on Shop Drawings and product data diagrams shall be colored green
13. Do not submit under Specifications sections with title that include "Basic Requirements", unless the subject material or equipment is specified, in total, in a Specifications section with the words, "Basic Requirements" in its title.

E. Electronic Documents Submittals:
1. Format: Electronic Documents Submittals shall be "portable document format" (.PDF) files unless expressly required otherwise by applicable provisions of the Contract Documents.
2. Electronic Documents Submittals must be electronically searchable when delivered to Engineer and other recipients.
3. Organization and Content:
   a. Each Electronic Documents Submittal shall be one file; do not divide individual Submittals into multiple Electronic Documents files each unless file size will exceed 100 MB.
   b. When Submittal is large or contains multiple parts, furnish PDF file with suitably titled electronic bookmark for each section of the Submittal.
   c. Content shall be identical to paper or other original Submittal. First page of each Electronic Documents Submittal shall be transmittal letter required in this's Paragraph 1.7.A.
4. Quality and Legibility: Electronic Documents Submittal files shall be made from the original and shall be clear and legible. Markings applied by Contractor, Subcontractor, or Supplier shall be clear, distinct, and readily apparent. Electronic Documents file shall be full size of original documents. Properly orient all pages for convenient reading on a computer display; do not furnish pages sideways or upside-down..
5. Provide sufficient internet service, software, and systems for Contractor with capability appropriate for transmitting the necessary files and receiving responses from Engineer or other entities.
6. Check not less than once per day for distribution of Electronic Documents Submittals responses and related Electronic Documents correspondence.

F. Proposed "Or-Equals", Substitutes, and Deviations from Contract Requirements:
1. "Or-Equals":
   a. The meaning of "or-equal" is addressed in Section 01 25 00 - Substitution Procedures.
   b. Contractor's request for approval of "or-equals" is to be presented via the associated Action Submittal(s) and shall include the information required in provisions governing "or-equals" in Section 01 62 00 - Product Options.
   c. Expressly and prominently indicate, "Proposed Or-Equal" on the associated Action Submittals when Submittal is for an "or-equal".
   d. Submittals requesting approval of an "or-equal" but not accompanied by the required, supplemental information will be deemed incomplete by Engineer and returned to Contractor without approval.
2. Substitutes:
   a. The meaning of "substitute" is indicated in Section 01 25 00 - Substitution Procedures.
   b. Requests for approval of substitutes shall comply with Section 01 25 00 - Substitution procedures, and other relevant provisions of the Contract Documents.

c. Contractor's request for approval of substitute is separate from the associated Action Submittal(s). Action Submittals that request approval of a substitute when a separate, formal substitution request (furnished in accordance with the Contract Documents) was not previously furnished to Engineer, followed by formal approval in via an appropriate contract modification (typically either a Field Order or Change Order), will be deemed by Engineer as non-compliant with the Contract Documents and will be returned to Contractor without approval.
d. Contractor is solely responsible for delays incurred due to substitutes proposed via Submittals that have not been previously duly approved via an appropriate Contract modification.
e. Action Submittals for items or procedures approved via an appropriate Contract modification shall include a copy of the Contract modification in which the substitute was approved.

3. Submittals with Proposed Deviations from Contract Requirements:
   a. When Submittal proposes deviations from requirements of the Contract Documents, the Submittal shall clearly and expressly indicate each proposed deviation.
   b. Also comply with this Section's provision, in the Article below, on Contractor's transmittal letter expressly alerting Engineer to the proposed deviations.
   c. Comply with requirements of the Contract regarding substitutes and "or-equals".
   d. When deviation is proposed, also appropriately revise text of Contractor's approval, from that required below in this Article.
   e. When Submittal includes deviations from Contract requirements and either the Submittal itself, Contractor's transmittal letter, or both, do not comply fully with Contract requirements for indicating deviations in Submittals and giving separate written notice thereof, Engineer's approval of such deviations will be deemed null and void unless Engineer's written response to the Submittal has expressly acknowledged such deviation and indicated Engineer's approval thereof.
   f. Contractor is solely responsible for delays and costs incurred due to any and all Submittals with deviations from Contract requirements that were not properly, expressly indicated and approved in accordance with the Contract Documents. Deviations not duly approved in accordance with the Contract Documents may be deemed defective Work. Contractor is solely responsible for remedying defective Work and all associated cost and time impacts.

G. Contractor's Approval of Submittals:
   1. Contractor's Review: Before transmitting Submittals to Engineer, review each Submittal to:
      a. Ensure proper coordination of the Work.
      b. Determine that each Submittal is in accordance with Contractor's desires.
      c. Verify that Submittal contains sufficient information for Engineer to determine compliance with the Contract Documents.
   2. Incomplete or inadequate Submittals will be returned without detailed review by Engineer.
   3. Contractor's Approval Stamp and Signature:
      a. Each Submittal furnished shall bear Contractor's approval stamp (or facsimile thereof) and signature, as evidence that the Submittal has been reviewed and approved by Contractor and verified as complete and in accordance with the Contract Documents.
      b. Submittals without Contractor's approval and signature (as required by the contract Documents) will be returned to Contractor without further review by Engineer and deemed incomplete.
      c. Contractor's approval shall contain the following text:

         Project Name: _____
         Contractor's Name: _____
         Contract Designation: _____
         Date: _____

         ---------- *Reference* ----------

Submittal Title: _____
Specifications:
Section: _____
Page No.: _____
Paragraph No.: _____
Drawing No.: [_____] of _____
Location of Work: _____

Submittal No. and Review Cycle: _____
Coordinated by Contractor with Submittal Nos.: _____
_____

I hereby certify that Contractor has satisfied Contractor's obligations under the Contract Documents relative to Contractor's review and approval of this Submittal, including: (1) reviewed and coordinated the Submittal with other Submittals and with the requirements of the Work and the Contract Documents; (2) determined and verified all: field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect to the Submittal, (b) the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work, and (c) all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto; (3) confirmed the Submittal is complete with respect to all related data included in the Submittal; and (4) clearly and expressly indicated all proposed deviations (if any) from the requirements of the Contract Documents both in the Submittal itself and in the Submittal's transmittal letter. Accordingly, this Submittal is hereby approved for Contractor by:

Approved for Contractor by: _____

H. Resubmittals:
1. Refer to the General Conditions, as may be modified by the Supplementary Conditions, for requirements regarding resubmitting required Submittals.
2. In addition to limits on the quantity of resubmittals, as indicated in the General Conditions, Contractor shall furnish Submittals with such completeness, accuracy, and compliance with the Contract Documents to obtain Engineer's approval or acceptance, as applicable, without the total quantity of Submittals furnished, including all initial Submittals and all resubmittals, exceeding 150% of the number of Submittals indicated on the Schedule of Submittals initially accepted by Engineer, plus a corresponding percentage of the quantity of Submittals required by Change Orders, Work Change Directives, and Field Orders.
3. Do not increase the scope of prior review cycle of the same Submittal.
4. Indicate on Contractor's transmittal letter how Submittal was revised from previous review cycle of the Submittal and where the revisions or corrections are located within the resubmittal.
5. Expressly address and provide response for all components previously transmitted by Engineer on prior review cycles of the subject Submittal. Where resubmittal lacks complete response to Engineer's prior comments, Engineer may deem such resubmittal as incomplete and return it to Contractor without further review.
6. Where part of the Submittal's prior review cycle was expressly approved or accepted, as applicable, by Engineer, do not include such items in subsequent resubmittals.
7. Indicate, "Not Yet Resolved—To Be Resubmitted at a Later Date" for any items not approved in prior review cycle of the Submittal for items not included in the subject resubmittal. Engineer reserves the right to deem incomplete Submittals "Not Approved" or "Revise and Resubmit". Furnishing incomplete or partial resubmittals is discouraged.
8. Resubmittal of Previously Approved or Accepted Items:

a. Do not resubmit on a given item previously approved or accepted, as applicable, by Engineer, without Engineer's advance consent. Consent will be given for bona-fide unavailability of a previously approved or accepted item where Contractor has acted in good faith in a timely manner with due diligence to comply with the Contract Times.
b. Destroy or conspicuously mark "SUPERSEDED" on all documents having previously received Engineer's approval or acceptance, as applicable, that are superseded by a resubmittal.

1.7 TRANSMITTAL OF SUBMITTALS BY CONTRACTOR

A. Contractor's Transmittal Letters for Submittals:
1. Furnish separate transmittal letter with each Submittal. Use transmittal form attached to this Section (as Exhibit 01 33 00-A) unless other transmittal form is acceptable to Engineer at the start of the Project's construction.
2. When transmittal form other than this Section's Exhibit 01 33 00-A is acceptable to Engineer, at beginning of each transmittal, include a reference heading indicating: Contractor's name, Owner's name, Project designation, Contract designation, transmittal number, and Submittal number (with review cycle).
3. "Or-Equals": When the Submittal is proposing an "or-equal", expressly so indicate on transmittal form submitted by Contractor.
4. Proposed Deviations from Contract Requirements: When the Submittal proposes deviations from requirements of the Contract Documents, transmittal letter shall specifically describe each proposed deviation.

B. Submittal Delivery Method:
1. This provision presents general requirements for delivery or all Submittals unless otherwise required elsewhere in the Contract Documents.
2. Furnish Submittals as Electronic Documents delivered in accordance with Section 01 31 26 – Electronic Communication Protocols.
3. Furnish Submittals to Engineer and each other entity indicated in the Contract Documents as receiving a Submittal directly from Contractor.
4. Address Submittals to Engineer as follows: HDR Engineering, Inc., 17111 Preston Road, Suite 300, Dallas, Texas 75248-1232, to attention of Jenifer Rayshell, jenifer.rayshell@hdrinc.com.
5. Preliminary Copy for Engineer: Simultaneously with delivering Electronic Documents Submittal to Engineer, also deliver:
a. Electronic Documents Submittal to Resident Project Representative.

C. Samples - Transmittal and Delivery:
1. Labeling and Tagging Samples:
a. Securely label or tag each Sample with Submittal identification number.
b. Label or tag shall include clear space at least 4 inches by 4 inches in size for affixing Engineer's review stamp indicating disposition assigned by Engineer.
c. Label or tag shall not cover, conceal, or alter Sample's appearance or features.
d. Label or tag shall not be separated from the Sample.
2. Timing: Deliver required Samples concurrently with other Action Submittals required for the same element of the Work, unless other delivery time frame is indicated in the Schedule of Submittals accepted by Engineer.
3. Quantity Required:
a. Where the Contract Documents require a Sample as a field mock-up, provide Sample at the Site or in the Work at location acceptable to Engineer. Provide the quantity of field mock-ups required by the contract Documents; if not otherwise shown or specified, provide one of each required field mock-up. .
b. For reasonably portable Samples, deliver the quantity of Samples required in the associated Specifications. If quantity of Samples is not indicated in the associated Specifications section, deliver to Engineer not less than three identical Samples of each item for which Sample is required.

c. Samples will not be returned to Contractor. If Contractor requires Sample(s) for Contractor's use, so advise Engineer in writing and furnish additional copies of the Sample. Contractor is responsible for furnishing, shipping, and transporting additional Samples.

4. Locations for Delivery of Reasonably Portable Samples for Review:
   a. Deliver physical Samples to Owner's Site Representative's field office at the Site.

D. Closeout Submittals –Transmittal and Delivery:
   1. Furnish the following Closeout Submittals in accordance with general requirements for transmitting and delivering Submittals, indicated above in this Article: maintenance contracts; warranty bonds (when required) and other bonds required for specific materials, equipment, or systems; warranty documentation; and sustainable design closeout documentation (when required). On documents such as maintenance contracts and bonds, include on each document furnished original ("wet") signature of entity issuing said document. When original "wet" signatures are required, furnish such Submittals to Engineer both on original paper and as Electronic Documents, and to other entities furnish as indicated above in this Article for general requirements for Submittals.
   2. Operations and Maintenance Manuals: Submit in accordance with Section 01 78 23 - Operation and Maintenance Data.
   3. Record Documents: Submit in accordance with Section 01 78 39 - Project Record Documents.
   4. Software: In addition to software installed on Owner's computer system, furnish number of copies of software required in the Specifications section where the software is specified. Preferred means of transmittal is via secure file transfer directly to Owner (or facility manager, if other than Owner) via secure file transfer method mutually acceptable to software developer and the receiving entity. When secure file transfer is used, submit to Engineer documentation signed or electronically acknowledged by Owner that the files were received. Where such software is available only on the software developer's portable media, furnish such software on software developer's original, portable media, sealed in software developer's original, unopened, clearly labeled packaging.

E. Maintenance Materials Submittals – Delivery:
   1. Deliver physical maintenance materials required by the Contract Documents in accordance with applicable provisions of the Contract, including Section 01 78 43 - Spare Parts and Extra Materials.
   2. Submit documentation of delivery of (Maintenance Materials Submittals) in accordance with general requirements for Submittals as indicated in this Section.

1.8 ENGINEER'S REVIEW OF SUBMITTALS

A. This Article applies to review of all Submittals by Engineer or other entity to whom the Contract Documents require such Submittal be furnished.

B. Timing:
   1. Timing of Engineer's review will be in accordance with the Schedule of Submittals accepted by Engineer.
   2. When Submittal is delivered to Engineer on a date other than that indicated in the Schedule of Submittals accepted by Engineer, duration of Engineer's review may differ from that indicated in the Schedule of Submittals, based on Engineer's availability and resources. Engineer will make good-faith effort to furnish responses to Submittals in a timely manner.
   3. Contractor is responsible for communicating to Engineer when a Submittal is on the Project's critical path.

C. Engineer's Review:
   1. Markings:
      a. Comments or responses marked directly on Submittal by Engineer (or other entity reviewing Submittal) will be colored red.

b. Engineer may also present narrative comments on a comment sheet inserted by Engineer into the Submittal or included on Engineer's transmittal letter for the Submittal. Such comments will be in black text. When a separate comment sheet is included by Engineer, such sheet will be clearly identified as Engineer's comments.

2. Engineer's review and disposition assigned to Submittal are subject to the following:
   a. Submittal disposition is subject to: Engineer's comments on the Submittal; disclaimer language on Engineer's Submittal transmittal letter; Engineer's Submittal review stamp (when used) or equivalent (when used); and this provision.
   b. Engineer's review is only for general compatibility with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents, and for general compliance with the information given in the Contract Documents.
   c. Contractor shall be solely responsible for complying with the Contract Documents, as well as with Supplier instructions consistent with the Contract Documents, Owner's directions, and Laws and Regulations. Contractor is solely responsible for obtaining, correlating, confirming, and correcting dimensions at the Site; quantities; information and choices pertaining to fabrication processes; means, methods, sequences, procedures, and techniques of construction; safety precautions and programs incident thereto; and for coordinating the work of all trades.
   d. Engineer is not responsible for resubmittals not yet furnished by Contractor or tracking Contractor's progress on resubmittals.
3. Documents not required by the Contract Documents but nonetheless furnished by Contractor as submittals will not be reviewed by Engineer.

D. Meaning of Submittal disposition Assigned by Engineer:
1. Action Submittals:
   a. "Approved" (Action Code A): Upon return of Submittal marked "Approved", order, ship, or fabricate materials and equipment included in the Submittal (pending Engineer's approval or acceptance, as applicable, of production-related qualifications statements and certifications, and required source quality control Submittals) or otherwise proceed with the Work in accordance with the Submittal and the Contract Documents.
   b. "Approved as Noted" (Action Code B): Upon return of Submittal marked "Approved as Noted", order, ship, or fabricate materials and equipment included in the Submittal (pending Engineer's approval or acceptance, as applicable, of production-related qualifications statements and certifications, and required source quality control Submittals) or otherwise proceed with the Work in accordance with the Submittal and the Contract Documents, and in accordance with Engineer's comments and notes indicated in Engineer's Submittal response
   c. "Revise and Resubmit" (Action Code C): Upon return of Submittal marked "Revise and Resubmit", make the revisions necessary and indicated and resubmit to Engineer for approval.
   d. "Not Approved" (Action Code D): This disposition indicates material or equipment that cannot be approved. "Not Approved" disposition may also be applied to Submittals that are incomplete. Upon return of Submittal marked "Not Approved", repeat initial submittal procedure utilizing approvable material or equipment, with a complete Submittal clearly indicating all information required.
2. Informational, Closeout, and Maintenance Materials Submittals:
   a. "Accepted" (Action Code F): Information included in Submittal complies with the applicable requirements of the Contract Documents and is acceptable. No further action by Contractor is required relative to such Submittal, and the Work covered by the Submittal may proceed. Materials and equipment with Submittals with this disposition may be shipped or operated, as applicable. Submittals assigned "Accepted" by Engineer (or other reviewing entity) does not indicate Engineer's acceptance of the associated Work, which is indicated only as set forth in the General Conditions and Section 01 77 19 – Closeout Requirements.

b. "Not Acceptable" (Action Code G): Submittal, or part thereof, does not indicate full compliance with applicable requirements of the Contract Documents and is not acceptable. Provide labor, materials, equipment, services, and incidentals necessary to properly and accurately revise Submittal and resubmit to indicate acceptability and compliance with the Contract Documents

3. Other:
   a. "Submittal Not Reviewed" (Action Code E): Documents so marked by Engineer are not required by the Contract Documents. Submittals may also be marked with this disposition when information in the document was previously reviewed and approved or accepted by Engineer, as applicable.

E. Distribution of Engineer's Responses:
   1. Unless otherwise indicated in the Contract Documents, Engineer will distribute written responses (as Electronic Documents) to Submittals to the following:
      a. Contractor.
      b. Owner.
      c. Resident Project Representative.
      d. Engineer's file.
   2. Engineer's acceptance of Informational Submittals, Closeout Submittals, and Maintenance Materials Submittals will be recorded in Engineer's Submittal log. Copy of Engineer's Submittals log is available from Engineer upon written request of Owner or Contractor. If no such request is received by Engineer, Engineer will distribute copy of Engineer's Submittals log once per month (when Submittals have been received or acted on by Engineer). Engineer may distribute copy of Engineer's Submittals log as an Electronic Document or as handout at construction progress meetings.
   3. Paper copies of Engineer's Submittal responses will not be distributed unless otherwise required by the Contract Documents or otherwise agreed to by Engineer.
   4. Contractor is responsible for forwarding Engineer's Submittals responses to Subcontractors and Suppliers as appropriate, and for coordinating the Work of all trades.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 ATTACHMENTS

A. The documents listed below, following this Section's "End of Section" designation, are part of this Specifications Section:
   1. "Exhibit 01 33 00-A – Transmittal for Submittal No. [_____]" (one page).

END OF SECTION

Exhibit 01 33 00-A

Transmittal for Submittal No. [_____]-[_____]

Project Name:		Date Received:	
Project Owner:		Checked By:	
Contractor:	HDR Engineering, Inc.	Log Page:	
Address:	Address:	HDR No.:	
		Spec Section:	
		Drawing/Detail No.:	
Attn (Contractor):	Attn (HDR):	Review Cycle	
Date Transmitted by Contractor:	Date of Engineer's Response Transmittal:		

Item No.	Submittal No.	Description (indicate number of copies where paper copies of physical Samples are returned)	Manufacturer	Supplier Dwg or Data No.	Engineer's Disposition (Action Code) *
1					
2					
3					
4					

Contractor's Remarks *(insert text)*:

Engineer's Remarks *(insert text)*: :

*** Legend for Action Code** indicated above, assigned by Engineer:

Action Submittal:
- A – Approved
- B – Approved as Noted
- C – Revise and Resubmit
- D Not Approved
- E – Submittal Not Reviewed

Informational, Closeout, or Maintenance Materials Submittal:
- F – Accepted (this code normally recorded in Engineer's Submittals log).
- G Not Acceptable

Engineer's Disclaimer (for Submittals that do not involve delegated design):

a. Submittal action code is subject to: Engineer's comments on the Submittal, comment sheets (if any), and this transmittal letter; disclaimer language on Engineer's Submittal review stamp or equivalent; and Specifications Section 01 33 00 – Submittal Procedures.

b. Engineer's review is only for general compatibility with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents, and for general compliance with the information given in the Contract Documents.

c. Contractor shall be solely responsible for complying with the Contract Documents, as well as with Supplier instructions consistent with the Contract Documents, Owner's directions, and Laws and Regulations. Contractor is solely responsible for obtaining, correlating, confirming, and correcting dimensions at the Site; quantities; information and choices pertaining to fabrication processes; means, methods, sequences, procedures, and techniques of construction; safety precautions and programs incident thereto; and for coordinating the work of all trades.

Reviewed for HDR by:	**Date of Engineer's Review:**

Distribution: Contractor | File | Field | Owner | Other

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SECTION 01 35 44
SPILL PREVENTION CONTROL AND COUNTERMEASURES PLAN

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Requirements for Contractor's spill prevention control and countermeasures, in accordance with 40 CFR 112 and other Laws and Regulations.

B. Scope:
1. Contractor shall provide all labor, materials, equipment, tools, professional services (when necessary or required), and incidentals as shown, specified, and required to comply with Laws and Regulations regarding spill prevention, control, and countermeasures (SPCC) planning and compliance, including 40 CFR 112.
2. Single Prime Contract: Contractor shall determine whether a SPCC plan is necessary. If SPCC plan is necessary, Contractor shall prepare, implement, and maintain SPCC plan in accordance with Laws and Regulations.
3. Existing SPCC Plan: Owner's existing facility has an existing SPCC plan, administered and maintained by Owner or facility manager (if other than Owner). Contractor's SPCC plan shall be consistent with facility's existing SPCC plan. Copy of facility's existing SPCC plan and related documents (if any) are available upon request to the Owner.

1.2 REFERENCES

A. Terminology:
1. Terminology indicated below are not defined terms and are not indicated with initial capital letters, but when used in this Section have the meaning indicated below:
   a. "Oil" has the meaning set forth in Laws or Regulations and generally includes petroleum products, fuel oil, hydraulic fluid, oil sludge, oil refuse, oil mixed with wastes other than dredged material, synthetic oil, vegetable oil, animal fats and oils, and other oils defined in Laws and Regulations.
   b. "Navigable waters of the United States" includes navigable waters of the United States, contiguous zones, and associated shorelines, as set forth in Laws and Regulations.
   c. "SPCC" means "spill prevention control and countermeasures".
   d. "SPCC plan" means a SPCC plan complying with this Section and Laws and Regulations.

1.3 DETERMINATION OF NEED FOR SPCC PLAN FOR PROJECT

A. Determination of Need for SPCC Plan:
1. Contractor shall determine need for SPCC plan for the Project.
2. Onsite oil storage thresholds at which a SPCC plan is necessary are indicated in this Article.
3. Depending on Site conditions and oil storage at the Site and other factors, the Project may: (a) not need a SPCC plan, or (b) need a SPCC plan prepared by a Contractor-hired professional engineer, or (c) need part of the SPCC plan prepared by a Contractor-hired professional engineer. When Contractor-hired professional engineer is not necessary for all or part of a required SPCC plan, Contractor may self-prepare and self-certify SPCC plan elements not prepared by Contractor's professional engineer.
4. Contractor's Professional Engineer:
   a. If the Site will include storage of more than 10,000 GAL of oil, as defined in Laws and Regulations, in aboveground storage, or if the Site does not comply with oil discharge history criteria of 40 CFR 112, Contractor shall retain a qualified professional engineer to determine need for SPCC plan for the Project and, if SPCC plan is necessary, Contractor's professional engineer shall prepare or supervise preparation of Contractor's SPCC plan.

b. Qualifications requirements and basic responsibilities of Contractor's professional engineer are set forth in this Section's "Quality Assurance" Article.
c. If a professional engineer is not required to prepare the entirety of the Project's SPCC plan, but the SPCC plan includes environmentally-equivalent SPCC measures (as set forth in Laws or Regulations), or impracticality determinations (in accordance with Laws or Regulations), then Contractor shall retain a qualified professional engineer to prepare and certify those portions of the SPCC plan dealing with environmentally equivalent measures and impracticality determinations; the balance of the SPCC plan may be prepared by and be self-certified by Contractor.

5. Submit to Engineer letter presenting results of evaluation of whether a SPCC plan is necessary for the Project, in accordance with Laws and Regulations.

B. SPCC plan is necessary when the Project activities at the Site meet the following criteria:
1. The Site and activities thereon are not exempt from Laws and Regulations relative to SPCC planning and implementation.
2. Oil is stored, used, transferred, or otherwise handled at the Site, unless otherwise exempted by Laws or Regulations.
3. Maximum oil storage capacity at the Site equals or exceeds either of the following thresholds: 42,000 GAL of completely-buried capacity, or 1,320 GAL of aboveground capacity. Capacity includes total storage tank volume and operational storage volume at the Site for Contractor, other prime contractors, and Subcontractors, including bulk storage tanks, containers with 55 GAL storage capacity and larger, mobile tanks located at the Site, and other containers covered by Laws or Regulations. Exempt from the storage capacity determination are motive storage containers, such as those integral to construction equipment and vehicles.
4. There is reasonable expectation, based on location of the Site, that oil spill would reach navigable waters of the United States (or contiguous zones or adjoining shorelines).

C. Reassessment of Need for SPCC Plan after Initial Determination that SPCC Plan is not Needed:
1. After initial determination that SPCC plan is not necessary, Contractor shall ensure that conditions that preclude the need for SPCC plan for the Project, including the activities of Contractor, all other prime contractors (if any), and Subcontractors working on the Project at the Site, are maintained throughout the Project's duration.
2. Should changes that affect the storage, use, or handling of oil at the Site occur, reassess the need for SPCC plan for the Project at no additional cost to Owner and submit written reassessment to Engineer.

1.4 QUALITY ASSURANCE

A. Qualifications:
1. Contractor's Professional Engineer:
a. When required by Laws and Regulations, engage a licensed, registered professional engineer legally qualified to practice in the jurisdiction where the Site is located and experienced in performing engineering services of the type required. Submit qualifications data.
b. Responsibilities include but are not necessarily limited to:
1) Carefully reviewing Laws and Regulations relative to SPCC.
2) Preparing written requests for interpretations of the Contract Documents relative to SPCC for submittal to Engineer by Contractor, and obtaining from authorities having jurisdiction clarifications regarding Laws and Regulations as required.
3) Preparing or supervising the preparation of letter-report evaluation of need for Contractor's SPCC plan in accordance with the Contract Documents. Evaluation shall include professional engineer's seal or stamp, registration number, and original signature.
4) When Contractor's SPCC plan is necessary, preparing, supervising the preparation of, or reviewing Contractor's SPCC plan (or designated portions thereof when oil storage at the Site will be less than the threshold indicated in this Section or Laws

and Regulations) in accordance with the Contract Documents. Contractor's SPCC plan (or designated portions thereof) shall include professional engineer's seal or stamp, registration number, and original signature..

5) Periodically re-evaluating the need for Contractor's SPCC plan and issuing findings as letter-reports with seal or stamp, license number, and signature. When Contractor's SPCC plan is required, periodically evaluating Contractor's SPCC plan and providing recommendations for compliance with Laws and Regulations, in accordance with the Contract Documents.
6) Certifying that:
    a) it is familiar with the Laws and Regulations, including 40 CFR 112, and
    b) it has visited, examined, and is familiar with the Site, planned modifications to the Site under the Project as such modifications pertain to SPCC Laws and Regulations, and
    c) it has performed the evaluations and prepared Contractor's SPCC plan in accordance with the Contract Documents, and
    d) procedures for required testing and inspections have been established, and
    e) the said evaluations and Contractor's SPCC plan are adequate for the Project, and
    f) the said evaluations and Contractor's SPCC plan comply with Laws and Regulations, applicable industry standards, and to prevailing standards of practice.

1.5 SUBMITTALS

A. Furnish Submittals required under this Section to Owner's environmental representative indicated in Section 01 35 43.13 - Environmental Procedures for Hazardous Materials.

B. Submittals: Submit the following:
    1. Certifications:
        a. With each evaluation letter and Contractor's SPCC plan Submittal, include certification signed by preparer of Submittal that the Submittal complies with the Contract Documents and Laws and Regulations. Signature on all certifications shall be original.
    2. Evaluations:
        a. Submit letter presenting results of evaluation of whether Contractor's SPCC plan is required for the Project. Submit evaluation not later than 14 days after the Contract Times commence running, unless longer time is allowed (in writing) by Owner or Engineer.
        b. Submit updated evaluations as required when conditions at the Site change. Submit updated evaluation not later than seven days after the conditions at the Site changed, or within seven days of Owner's or Engineer's request, unless longer time is allowed (in writing) by Owner or Engineer.
        c. Owner, facility manager (if other than Owner), and Engineer have no responsibility for completeness, accuracy, or appropriateness of Contractor's evaluations and Contractor and Subcontractors (as applicable) have full responsibility and all liability associated therewith.
    3. Contractor's SPCC Plan: When SPCC Plan is required:
        a. Submit jointly to Owner and facility manager (if other than Owner). Submit within 14 days of Owner's or facility manager's acceptance of evaluation Submittal.
        b. Limitations Regarding Reviews:
            1) Review and comments (if any) by Owner or facility manager on Contractor's SPCC plan Submittal are not for benefit of Contractor, Subcontractors, or anyone else for whom Contractor may be responsible.
            2) Such reviews and comments (if any) shall not impose on Owner, facility manager, or Engineer any obligation to evaluate the completeness, accuracy, or appropriateness of Contractor's SPCC plan.

3) Contractor, together with Subcontractors (as applicable), bears full responsibility and all liability for completeness, accuracy, and appropriateness of Contractor's SPCC plan.

4. Record of Distribution of Contractor's SPCC Plan:
   a. When Contractor's SPCC plan is required, submit copies of letters transmitting Contractor's SPCC plan and amendments (if any) to other prime contractors and Subcontractors working at the Site.
5. Qualifications Statements:
   a. Submit qualifications of Contractor's professional engineer, when requested by Owner or Engineer.

1.6 CONTRACTOR'S SPCC PLAN AND IMPLEMENTATION

A. When Contractor's SPCC plan is required, develop the SPCC plan and submit for acceptance to entity indicated in this Section's "Submittals" Article. Contractor's SPCC plan shall be specific to the Site and the Project and shall include the following:
   1. Seal or stamp, original signature, date, and license number of Contractor's professional engineer, when self-certification by Contractor is not allowed by Laws and Regulations.
   2. Site plan identifying the name (or tag number) and location of each tank and container that will contain a substance regulated in 40 CFR 112 and other Laws and Regulations, including aboveground and buried tanks. Site plan shall indicate general directions of storm water runoff, including storm sewers, drainage inlets, and catch basins. Show arrows indicating directions of storm water flow. Show and label all storm sewer outfall locations.
   3. For each tank and container shown or indicated on the Site plan, include a table indicating tank or container's name and tag number, type of oil stored therein, and maximum storage capacity in gallons. Indicate total storage capacity of all regulated tanks and containers at the Site covered by SPCC Laws and Regulations.
   4. Predictions of direction, rate of flow, and total quantity of oil that could be discharged from the Site as result of storage tank or container failure.
   5. Operating procedures that prevent oil spills, including procedures for oil handling, details of secondary containment structures at fuel and oil transfer areas, and details and descriptions of equipment to be used for oil handling, including piping.
   6. Control Structures and Secondary Containment:
      a. Show details of and indicate descriptions of control measures to be provided at the Site by Contractor to prevent spill from reaching navigable waters of the United States, including secondary containment and diversionary structures.
      b. For on-shore Sites, use not less than one of the following: dikes, berms, or retaining walls; curbing; culverts, gutters, or other drainage systems; weirs, booms, or other barriers; spill diversion ponds; retention ponds; or sorbent materials or methods.
      c. Where appropriate, Contractor's SPCC plan shall clearly demonstrate that containment or diversionary structures or equipment are not practical.
      d. Include brittle fracture evaluation, where necessary, for field-constructed aboveground storage containers undergoing repair, alteration, construction, or change in service.
   7. Plans for countermeasures to contain, clean up, and mitigate effects of oil spills that reach navigable waters of the United States, including written commitment of manpower, equipment, and materials to quickly control and remove spilled oil. Include estimation of time required to contain spills after spill occurs.
   8. Contact list and telephone numbers for facility response coordinator, National Response Center, cleanup Subcontractors, and all appropriate federal, state, and local authorities having jurisdiction to be contacted in event of spill or discharge.
   9. Program for monthly inspections of the Site by Contractor for compliance with Contractor's SPCC plan and Owner's SPCC plan (as applicable). Advise Owner (and facility manager, if other than Owner) in writing of each inspection not less than 72 hours prior to each inspection.
   10. Measures for Site security relative to oil storage.

11. Procedures for safely handling mobile containers such as totes and drums, and procedures for refueling vehicles and construction equipment and machinery at the Site.
12. Procedures and schedules for periodic testing of integrity of tanks and containers, and associated piping and valves.
13. Plans for bulk storage container compliance with Laws and Regulations and the Contract Documents.
14. Plans for personnel training and oil spill prevention briefings.
15. For SPCC plans that do not follow the format indicated in Laws and Regulations, provide cross-reference to requirements of Laws and Regulations, including 40 CFR 112.7.

B. Obtain acceptance of Contractor's SPCC plan by entity indicated in this Section's "Submittals" Article, for coordination with Owner's Site-specific SPCC plan, if any.

C. Contractor's SPCC plan shall be reviewed by Contractor's professional engineer (when professional engineer is required) and Owner every five years, as applicable, unless more-frequent reviews or updates are required by Laws or Regulations. Contractor shall perform updates and revisions of Contractor's SPCC plan as necessary and submit same in accordance with the provisions of this Section for submittal and acceptance of Contractor's initial SPCC plan.

D. Post a copy of Contractor's accepted, certified SPCC plan in conspicuous location at the Site and furnish copies to Owner, facility manager (if other than Owner), other prime contractors (if any), and Subcontractors as appropriate. All contractors shall comply with Contractor's SPCC plan.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 SPILL OR VIOLATION OF CONTRACTOR'S SPCC PLAN

A. In event of violation of Contractor's SPCC plan or release of oil attributable to construction or related activities, Contractor shall:
   1. Notifications:
      a. Immediately issue oral advisories and written notifications in accordance with Laws and Regulations, including 40 CFR 110 and 40 CFR 112.
      b. When required by Laws and Regulations, report to National Response Center, USEPA, and other authorities having jurisdiction, if any.
   2. Perform spill cleanup promptly and in accordance with Laws and Regulations, Contractor's SPCC plan, and requirements of authorities having jurisdiction.
   3. Pay fines and civil penalties (or responsible portion thereof) imposed on Owner and facility manager (if other than Owner) by authorities having jurisdiction, and pay costs associated with cleanup of spills. If Contractor fails to promptly pay such costs, Owner may withhold such amounts from payments due Contractor, as one or more set-offs.

B. Should cleanup of spills attributable to Contractor be necessary, Contractor will not be entitled to any associated increase in the Contract Price or Contract Times. Should Contractor share responsibility for spill and cleanup with another entity, changes in Contract Price and Contract Time, if any, will be proportionate to other entity's responsibility.

END OF SECTION

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SECTION 01 35 73
DELEGATED DESIGN PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. General provisions for delegated design services.
   2. Coordination of delegated designs with other Work.
   3. Qualifications requirements for delegated design professionals.
   4. Limitations on Engineer's review of delegated design Submittals.
   5. Responsibilities of delegated design professionals.

B. Scope:
   1. Where delegated design is specifically Contractor's responsibility in accordance with the Contract Documents, Contractor shall provide labor, services, other effort, and pay all costs necessary and required to perform delegated design services for Work that will be part of the completed Project as a functioning whole.
   2. Perform delegated design Work in accordance with the Contract Documents, delegated design Action Submittals approved by Engineer, and Shop Drawings, product data Submittals, and Samples approved by the associated delegated design professional.
   3. Contractor's correction period, general warranty and guarantee, and obligations for safety and protection apply to delegated design Work to the same extent such provisions apply to all other Work under the Contract.
   4. Specifications requiring delegated design services include, but are not necessarily limited to, the following:
      a. Section 03 15 19 - Anchorage to Concrete.
      b. Section 05 21 00 - Steel Joists.
      c. Section 05 50 00 - Metal Fabrications.
      d. Section 05 52 46 – Mechanically Fastened Aluminum Railings.
      e. Section 40 05 07 - Pipe Support Systems.
   5. Not Delegated Design: The following are not delegated design and are not covered by this Section:
      a. Contractor's use of design professionals for: (1) temporary construction or temporary facilities not part of the completed Project as a functioning whole, or (2) Contractor's means, methods, procedures, techniques, and sequences of construction and safety and protection measures incident thereto.
      b. Certain final designs that, in accordance with commonly accepted practice, are typically prepared by unlicensed, unregistered individuals, including for manufactured or fabricated systems, components or assemblies, not acting under the supervisory control of the design professional in responsible charge, but who commonly possess appropriate certification from a relevant industry organization, together with appropriate training and experience.

C. Related Requirements:
   1. Sections of Divisions 02-49 where delegated design Work is required.

1.2 REFERENCES

A. Terminology:
   1. Terminology indicated below are not defined terms and are not indicated with initial capital letters but, when used in this Section and Specifications of Division 02-49 where delegated design Work is required, have the meaning indicated below:
      a. "Delegated design" means preparing the final design of part of the completed, permanent Work by one or more delegated design professionals, in accordance with the

Contract Documents. The terms "delegated design", "delegated design services", "delegation of design responsibility", and similar or derivative terms have the same meaning.

b. "Delegated design professional" means the licensed and registered engineer, architect, geologist, or other design professional retained by or employed by Contractor, Subcontractor, or Supplier to perform delegated design services for delegated design Work and possessing appropriate experience and qualifications for such delegated design services.

c. "Delegated design Work" means delegated design services, associated construction, and related Work.

d. "Instruments of service", relative to delegated designs, means delegated design professional's: (1) certifications (including delegated design professional's certification of compliance, as required in this Section, and other certifications required of delegated design professional), (2) reports (where required), (3) design drawings, (4) design specifications, (5) other documents specifically indicated as delegated design professional's "instruments of service" in the Contract Documents, and (6) documents modifying a delegated design (after Engineer's approval of the original delegated design Submittals). "Instruments of service" are to be sealed, signed, and dated by delegated design professional and expressly required as Submittals. Shop Drawings sealed and signed by delegated design professional are delegated design professional's "instruments of service".

1.3 GENERAL PROVISIONS CONCERNING DELEGATED DESIGN SERVICES

A. Delegated Designs - General:

1. This Section augments the requirements of the General Conditions, as may be amended by the Supplementary Conditions, and other provisions of the Contract Documents regarding Contractor's responsibilities for delegated design Work.
2. Delegated design professionals or their employer shall furnish professional liability insurance. Provisions on professional liability insurance are set forth in the Supplementary Conditions. Submit through Contractor appropriate documentation of professional liability insurance.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordination - General:
   a. Contractor shall coordinate the services of delegated design professionals with all other elements of the Work.
   b. Contractor has full responsibility for scheduling delegated designs and all related Work.
   c. Allow sufficient time in Progress Schedule for performance of delegated design services, including requests for interpretation or clarification between delegated design professional and Contractor and between Contractor and Engineer.
2. Coordination of Delegated Design Work's Connections to Other Work:
   a. Where delegated design Work connects to other Work designed by Engineer, existing construction, or both, the delegated design Work shall be consistent with the other Work and existing construction to which delegated design Work connects, and adjacent construction.
   b. Submit details, loading, anchorage, and other coordinating information necessary for the delegated design Work to properly interface with Work designed by Engineer.
   c. Changes in the Work, whether designed by Engineer, designed by delegated design professional, or existing construction, necessary as a result of the delegated design are ineligible for increase in Contract Price or Contract Times, unless: (1) otherwise agreed by both Engineer and Owner, or (2) expressly indicated otherwise elsewhere in the Contract Documents for the associated delegated design Work.

d. Changes requiring extra compensation, time, or both arising from delegated design aspects needed for convenience of Contractor, Subcontractor, or Supplier, are not grounds for increase in Contract Price or Contract Times.

3. Coordination of Submittals, Fabrication, Production, and Shipment:
   a. Do not release for raw materials procurement, fabrication, production, and shipment to the Site materials, equipment, or systems designed by delegated design professional until the associated delegated design professional has reviewed and approved all associated Shop Drawings, product data, Samples, and (relative to shipment) source quality control Submittals, and such Submittals have been delivered to and accepted by Engineer.
      1) For delegated design systems that required reactions to be submitted to the Engineer. These submittals shall be submitted and approved first before approval is given for the delegated design submittal.
   b. Allow sufficient time in the Progress Schedule for required Submittals and required actions by delegated design professionals and Engineer.

1.5 QUALITY ASSURANCE

A. Qualifications:
   1. Delegated Design Professionals:
      a. Each delegated design professional shall possess not less than the minimum qualifications set forth in this provision. Where the Specifications for the associated delegated design Work establish more-stringent qualifications requirements, comply with the more-stringent requirements.
      b. Each delegated design professional shall comply with all of the following:
         1) Legally qualified, as both an individual and as a business entity, to practice the associated design discipline(s) in the jurisdiction where the Site is located, including possessing current, valid license and registration for the design discipline(s) for which the delegated design professional will render its services on the Project.
         2) Possess not less than five years of experience in the subject design discipline(s).
         3) Served as design professional in responsible charge on not less than five other designs similar in scope and complexity to the Work for which delegated design professional is retained on the Project; construction of such prior projects shall be complete by the start of the Project's construction.
      c. Summary of Qualifications: Submit to Engineer summary of delegated design professional's experience and qualifications, including:
         1) Evidence of coverage under appropriate professional liability insurance in accordance with the Contract Documents.
         2) Evidence of delegated design professional's ability to legally conduct business as a design professional in the same jurisdiction as the Site, as a business entity.
         3) Copy of delegated design professional's current, valid personal design professional license and registration for the same jurisdiction as the Site. Such documents shall indicate the individual's name, license or registration number, and dates for which the license or registration is valid.
         4) Other information reasonably requested by Engineer.

1.6 GENERAL PROVISIONS FOR DELEGATED DESIGN SUBMITTALS

A. Under the Division 02-49 Specifications section(s) where delegated design Work is required, furnish to Engineer Submittals such as:
   1. Action Submittals:
      a. Delegated design professional's instruments of service Submittals.
   2. Informational Submittals:
      a. When delivered to Engineer, the following must bear delegated design professional's Submittal approval stamp:
         1) Shop Drawings, product data Submittals, Samples, testing plans.

2) Results of source quality control and field quality control activities.
b. Delegated design professional's calculations.
c. Other Informational Submittals required for the subject delegated design Work.

B. Limitations of Engineer's Review of Delegated Design Submittals:
1. Delegated Design Professional's Instruments of Service Submittals:
a. Engineer's review of delegated design instruments of service Submittals is for the limited purposes indicated in this Section's "General Provisions Concerning Delegated Designs" Article.
b. The following disclaimer applies to Engineer's responses to delegated design professional's instruments of service Submittals:
1) Engineer's review and approval of delegated design instruments of service is only for the limited purpose of verifying that performance and design criteria given in the Contract were used in the delegated design, and checking for compliance with the Engineer's design concept expressed in the Contract Documents.
2) Contractor is solely responsible for complying with: the Contract Documents, Subcontractor and Supplier instructions consistent with the Contract Documents, Owner's directions, and Laws and Regulations.
3) Contractor is solely responsible for obtaining, correlating, confirming, and correcting dimensions at the Site; quantities; information and choices pertaining to fabrication processes; means, methods, sequences, procedures, and techniques of construction; safety precautions and programs incident thereto; and for coordinating the Work of all trades.
4) Engineer is not responsible for the effects of resubmittals or tracking progress of resubmittals.
2. Delegated Design Informational Submittals:
a. Other provisions of the Contract Documents notwithstanding, Engineer's review of delegated design Informational Submittals is limited to only:
1) Verifying the Submittal was furnished as required; and
2) Submittal generally appears complete (except for calculations); and
3) Submittal bears delegated design professional's approval stamp; or, for calculations prepared by or for delegated design professional, that such calculations bear delegated design professional's seal, signature, and date; or, for delegated design professional's reports of visits to the Site, that such report is legible, and bears delegated design professional's signature with date.
b. Engineer receives such Submittals, including delegated design professional's calculations, on behalf of Owner, for Owner's records.
c. Engineer, Owner, and others involved in the Project have the right to rely on delegated design professional's approval stamp as meaning that the delegated design professional has performed and appropriate review of the Submittal and determined it to be complete, in accordance with delegated design professional's instruments of service approved by Engineer, in accordance with delegated design professional's design intent, and in accordance with the Contract Documents.
3. Engineer's Other Comments on Delegated Design Submittals:
a. Despite the limitations of Engineer's review of Submittals for delegated design Work, should Engineer become aware of, or reasonably suspect existence of, potential of associated delegated design Work to adversely affect health, safety, or welfare of persons, or pose reasonable potential for damage to the Work, work of other contractors, or adjacent property, Engineer will advise Contractor in writing of general nature of Engineer's concern.
b. Such advisory by Engineer, if issued, is rendered in good faith and does not in any way constitute:
1) Engineer's review of all aspects of the delegated design.
2) Any sharing by Engineer of any of delegated design professional's responsibilities or professional liability.

3) Any responsibility imposed, in any way, on Engineer for any aspect of the delegated design professional's services or design, beyond the limited purposes of Engineer's review as set forth in the Contract Documents. .

c. Contractor and its Subcontractors and Suppliers, including delegated design professionals, shall immediately investigate Engineer's concern indicated in such advisory and remedy as necessary and required.

d. Neither Engineer nor Owner, nor their respective consultants and subcontractors, is obligated to review any Submittal for delegated design Work beyond the limited review required by the Contract Documents. No such advisory, if issued, entitles Contractor, Subcontractor, or Supplier, including delegated design professionals, to rely on such advisory or to assume that any further such reviews or written or oral advisories are forthcoming.

1.7 RESPONSIBILITIES OF DELEGATED DESIGN PROFESSIONALS

A. Standard of Care:

1. Unless a higher standard of care is established by the Division 02-49 Specifications section where the associated delegated design Work is required, the delegated design services shall comply with the following standard of care:
   a. Except as provided in the paragraph immediately above this, the standard of care for all delegated design professional services and related services performed or furnished by delegated design professionals for the Project will be the care and skill ordinarily used by members of the subject profession practicing under similar circumstances at the same time and in the same locality.

B. Responsibilities of delegated design professionals employed on the Work include, but are not necessarily limited to, the following, unless specifically indicated otherwise in the associated elements of the Contract Documents where the delegated design is required:

1. Ethical Conduct and Professionalism: Comply with Laws and Regulations and applicable standards and guidelines relevant design professional organizations for ethical conduct and professional practice.
2. Comply with Laws and Regulations and relevant design standards applicable to the subject delegated design Work.
3. Performance and Design Criteria Indicated in the Contract Documents and Other Information:
   a. Review performance and design criteria, indicated in the Contract Documents, that the delegated design Work must satisfy.
   b. Prepare written requests for interpretations or clarifications of performance or design criteria.
   c. Review existing information about the Site that constitutes Technical Data (if any, applicable to the subject delegated design Work), as indicated in the Supplementary Conditions.
4. Site Information and Investigations: With Contractor, obtaining all other necessary dimensions, field information, and other information necessary for preparing delegated design Submittals.
5. Design and Other Professional Services: Personally perform and prepare, or actively exercise direct, personal, supervisory control over others performing or preparing:
   a. Necessary design professional evaluations of conditions, materials, and equipment.
   b. Prepare the instruments of service Submittals and calculations Submittal for the subject delegated design Work, where required by the associated Division 02-49 Specifications and other, associated Contract Documents.
   c. Assist Contractor with applying for and obtaining permits and approvals (not previously obtained by Owner or those for whom Owner is responsible) necessary for the delegated design Work.
   d. Review and approve or take other appropriate action on Shop Drawings (unless such Shop Drawings are sealed and signed by delegated design professional), product data,

Samples, and testing plans, and other Submittals associated with the delegated design Work.

e. Prepare modifications of the delegated design instruments of service as necessary.

6. Sealing and Signing:
   a. Seal, sign, and indicate date of sealing and signing, on all of the following when such Submittals are required by the Division 02-49 Specifications where the delegated design Work is required:
      1) Instruments of service Submittals, including certification of compliance required.
      2) Calculations.
      3) Modifications to the delegated design.
      4) Other documents required to be sealed and signed by Laws or Regulations or the Contract Documents.
   b. Sealing and signing documents in accordance with Laws and Regulations and the Contract Documents, prior to submittal (through Contractor) to Engineer, and for submittal to authorities having jurisdiction to obtain necessary permits and approvals.
   c. Sealing and signing shall be in accordance with Laws and Regulations.
7. Certification of Compliance by Delegated Design Professional:
   a. Schedule:
      1) Submit certification of compliance after Engineer's acceptance of delegated design professional's qualifications statement.
      2) Obtain Engineer's approval of certificate of compliance Submittal prior to furnishing other Submittals for delegated design Work under the same Specifications section, unless otherwise allowed by Engineer.
   b. Through Contractor, submit to Engineer, delegated design professional's written certification indicating:
      1) General Information: (1) Project name and designation, (2) Contractor name and Contract designation, (3) Subcontractor or Supplier name (when applicable), (4) full name of delegated design professional's business entity under which the delegated design services were performed, (5) full name and license number of the individual sealing and signing the subject delegated design Work, (6) specific elements of delegated design Work to which the certification applies, and (7) delegated design professional's seal, signature, and date of signature.
   c. Explicit certification that the subject delegated design complies with:
      1) All applicable performance and design criteria indicated in the Contract Documents. Expressly indicate on certification of compliance the specific performance and design criteria used in the delegated design, and reaction forces of the delegated design imparted to other Work and existing construction. Reaction forces imparted from the delegated design elements to the Engineer's designed system shall include the following:
         a) Reaction forces imparted from the delegated design elements to the Engineer's designed system shall be presented as follows:
            (1) Unfactored loads per category (dead, live, wind, seismic, etc.).
            (2) Load combinations presented in Load Factor Resistance Design (LRFD) format from each element transmitting load.
         b) All Laws and Regulations.
         c) Applicable design standards commonly applicable to such types of construction. Expressly indicate such design standards on the certification of compliance.
         d) The applicable standard of care. Expressly indicate the applicable standard of care.
8. Approvals of Other Delegated Design Submittals:
   a. Review and taking appropriate action on Submittals for delegated designs:
   b. Such reviews and approvals or other appropriate action shall be to ascertain compliance with:
      1) Delegated design professional's design intent.

2) Delegated design professional's instruments of service and calculations.
3) Associated requirements of the Contract Documents.

c. Delegated design professional's review stamp or facsimile thereof, review action or disposition concerning the associated Submittal for the delegated design, date of review, and name of person performing the review shall be clearly legible on the associated Submittals (except for delegated design professional's own instruments of service Submittals, calculations, and reports of delegated design professional's visits to the Site). Prominently display delegated design professional's Submittal review stamp or facsimile thereof on: (1) each sheet of Shop Drawings, (2) each major section of product data Submittals, (3) each Sample, (4) each testing plan, and (5) each other Submittal associated with the delegated design for which such review stamp is required.

d. Do not apply delegated design professional's Submittal review stamp and comments, if any, over other text, tables, or graphics.

e. Where review stamp or facsimile thereof is required, submit to Engineer only those Submittals for delegated design Work that bear delegated design professional's explicit approval of the Submittal.

9. Respond promptly to requests for interpretation or clarification on delegated design professional's instruments of service and other Submittals for the delegated design Work.
10. Progress and Quality of Construction of Delegated Design Work:
    a. Where appropriate for the subject delegated design Work, periodically visit the Site at appropriate intervals to observe the progress and quality of the subject delegated design Work.
    b. Where delegated design professional does not visit the Site during construction, keep informed of the progress and quality of the subject delegated design Work via discussions with Contractor, Subcontractor, and Suppliers, via photographic documentation, and other means acceptable to delegated design professional.
    c. Advise Contractor in writing when the subject delegated design Work is not in accordance with the delegated design professional's instruments of service (approved by Engineer) and related Submittals approved by delegated design professional.
    d. Furnish to entity that retained delegated design professional copy of delegated design professional's written report of each visit to the Site.
11. Modifications to Design:
    a. Design appropriate modifications to the delegated design Work, including preparing new or revised certifications, reports, design drawings, sketches, design specifications, and calculations, as appropriate.
    b. Such instruments of service and calculations shall be submitted to Engineer through Contractor to same extent original instruments of service Submittals and calculations, if any, where required by the Contract Documents for the subject delegated design Work.
12. Other services, as mutually agreed upon by delegated design professional and its client, or as required elsewhere in the Contract Documents.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

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SECTION 01 42 00
REFERENCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Defined terms and terminology.
   2. Construction Codes: Indication of applicable building code and other construction codes.
   3. Referenced Standard Specifications and Construction Guidelines: Indication of Owner's or third-party specifications and construction standards applicable to one or more parts of the Work.
   4. Abbreviations in general use in the Contract Documents.
   5. Reference Standards: General requirements regarding reference standards, including a listing of reference standard-issuing organizations (and their acronyms) used in the Contract Documents.

1.2 REFERENCES

A. Contract Language Addressed to Contractor:
   1. Unless expressly indicated otherwise, language of the Contract Documents addresses Contractor, and the Contract Documents show and indicate Contractor's obligations.
   2. Unless indicated otherwise, expressions such as, "provide", "furnish", "install", "perform", "retain services of", "remove", "demolish", "replace", and the like refer to Contractor's obligations under the Contract.

B. Defined Terms:
   1. Defined terms, indicated with initial capital letters or with all-capital letters, used in the Contract Documents, are indicated in the General Conditions, as may be modified by the Supplementary Conditions. Additional defined terms, if any, in general use in the Contract Documents are indicated below. Where used, such defined terms apply to the singular and plural thereof.
      a. None.
   2. Additional defined terms, applicable to the Work of a given Specifications Section, may be indicated in the associated Specifications Section.

C. Terminology:
   1. Terminology, indicated without initial capital letters, used in the Contract Documents, are indicated in the General Conditions, as may be modified by the Supplementary Conditions. Additional terminology in general use in the Contract Documents are indicated below. Where used, such terminology applies to the singular and plural thereof.
      a. "Shown" means information or requirements presented on the Drawings, in schedules, or in other types of graphic instruments.
      b. "Indicated" means, as applicable: (1) graphic representations, notes, or schedules on the Drawings, or (2) other paragraphs, provisions, tables, or schedules in the Specifications and elsewhere in the Contract Documents.
      c. "Specified", "noted", "scheduled", and similar terms, have the same meaning as "shown" and "indicated", as applicable, and are used to help the user locate the reference without limitation on the location.
      d. "Installer", "applicator", or "erector" is Contractor's employees or Subcontractor, engaged to perform a specific construction activity, including installation, erection, application, or similar Work. Installers shall be experienced in the Work that installer is engaged to perform.
      e. "Experienced", when used in conjunction with terms such as "installer", "Subcontractor", "Supplier", "manufacturer", and similar terms means (unless

expressly indicated otherwise for the subject Work elsewhere in the Contract Documents) such person or entity, as applicable, has successfully completed not less than five previous projects similar in size, scope, and complexity to such person's or entity's work on this Project; being familiar with the special requirements indicated and required; being familiar with Laws and Regulations; and having complied with requirements of authorities having jurisdiction, and complying with written requirements of the Supplier of the material or equipment being installed.

f. "Assigned specialists" and similar terms: Certain Specifications require specific construction activities be performed by specialists with recognized, extensive experience in such operations. Engage said specialists for such activities, and their engagement is a requirement over which Contractor has no option. These requirements do not conflict with enforcement of building codes and other Laws and Regulations. Such requirements are not intended to interfere with local trade union jurisdictional settlements and similar conventions. Such assignments shall not relieve Contractor of responsibility for complying with the requirements of the Contract Documents.

g. Trades: Use of terms such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter", unless otherwise indicated in the Contract Documents or required by Laws or Regulations, or required by an applicable project labor agreement. Such terminology also does not imply that indicated requirements apply exclusively to trade personnel of the corresponding generic name..

2. Additional terminology, applicable to the Work of a given Specifications Section, may be indicated in the associated Specifications Section.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. References in the Contract Documents to local building and construction code(s) means the following:
      a. IBC 2021 International Building Code.

1.4 REFERENCED STANDARD SPECIFICATIONS AND CONSTRUCTION GUIDELINES

A. Except as otherwise shown or indicated in the Contract Documents, the Work shall comply with the Contract Documents and the following referenced specifications and construction guidelines:
   1. Texas Department of Transportation (TxDOT) Standard Specifications, which can be viewed online on the DOT website. Paper copies can be obtained directly from TxDOT at Contractor's (non-compensable) cost. DOT Standard Specifications' bidding and contracting requirements do not apply to this Contract.

B. Engineer is not the author of, is not responsible for, and did not seal and sign the referenced specifications and construction guidelines indicated above. Such referenced specifications and construction guidelines are not part of the Contract Documents. Where compliance with referenced specifications or construction guidelines is required by the Contract but requirements are unclear or conflict with requirements of the Contract Documents, submit to Engineer request for interpretation or clarification. .

C. Maintain at the Site complete copy (in either paper or electronic form) of referenced specifications and construction guidelines indicated above. Make such copy available for Engineer's, Resident Project Representative's (RPR), or Owner's Site Representative's (OSR) use in Contractor's field office at the Site.

1.5 ABBREVIATIONS.

A. Abbreviations - General:
   1. Abbreviations commonly used in the Contract Documents are indicated in this Article or on the Drawings, except as further indicated in the following paragraphs, .
   2. Additional abbreviations, specific to the Work of a given Specifications section, may be indicated in the associated Specifications.

3. Typical equipment abbreviations are indicated in Section 01 61 03 - Equipment - Basic Requirements.
4. Piping system abbreviations are indicated in Section 40 05 00 - Pipe and Pipe Fittings - Basic Requirements.

B. Common abbreviations that may be used in the Contract Documents are indicated below, alphabetically by their written-out meaning:.

alternating current	AC
ampere	A, or amp
Americans with Disabilities Act	ADA
Americans with Disabilities Act Accessibility Guidelines	ADAAG
ante meridian	a.m.
Architectural Barriers Act	ABA
average	avg
biochemical oxygen demand	BOD
five-day biochemical oxygen demand	BOD_5
brake horsepower	Bhp or BHP
British thermal unit	Btu
building information model	BIM
carbonaceous biochemical oxygen demand	CBOD
five-day carbonaceous biochemical oxygen demand	$CBOD_5$
chemical oxygen demand	COD
Celsius (or Centigrade)	C
chlorinated polyvinyl chloride	CPVC
chlorofluorocarbons	CFC
Code of Federal Regulations	CFR
computer-aided drafting and design	CADD, or CAD
cubic inch	cu in, or CU IN, or in^3
cubic foot	cu ft, or CU FT, cf, CF, or ft^3
cubic yard	cu yd, or CU YD, or CY, or yd^3
cubic feet per minute	CFM, or cfm
cubic feet per second	CFS, or cfs
decibel	dB, dBA, or dBa
degree Celsius	degrees C, °C, or deg C
degrees Fahrenheit	degrees F, °F, or deg F
diameter	dia
direct current	DC

dollars	$
each	ea
efficiency	eff
Fahrenheit	F
feet	ft or FT
feet per hour	FPH, or ft/hr
feet per minute	FPM or ft/min
feet per second	fps, or ft/s
figure	fig
flange	flg
foot-pound	ft-lb or FT-LB
gallon	gal or GAL
gallons per hour	GPH, gph, or gal/hr
gallons per minute	GPM, or gpm
gallons per second	GPS, or gps
gram	g
grams per liter	g/L
heating, ventilating, and air conditioning	HVAC
Hertz	Hz
horsepower	hp or HP
hour	hr or HR
human-machine interface	HMI
inch	in. or IN
inches of mercury	in. Hg
inches water gage	in. w.g.
inch-pound	in.-lb
inside diameter	ID
iron pipe size	IPS
thousand pounds	kips
thousand pounds per square inch	ksi or KSI
kilovolt-ampere	kva, or kVA
kilowatt	Kw, or
kilowatt-hour	Kwhr, kWhr, or kwh, kWh
linear foot	lin ft or LF
liter	L

Leadership in Energy and Environmental Design (USGBC)	LEED
maximum	max
mercury	Hg
mile	mi
miles per hour	mph or MPH
milligram	mg
milligrams per liter	mg/l or mg/L
milliliter	ml
millimeter	mm
million gallons per day	mgd or MGD
million gallon	MG
minimum	min
national pipe threads	NPT
net positive suction head	NPSH
net positive suction head available	NPSHA
net positive suction head required	NPSHR
nitrogen oxide (total concentration of mono-nitrogen oxides such as nitric oxide (NO) and nitrogen dioxide (NO_2))	NOx
nominal pipe size	NPS
number	no. or #.
operator interface terminal	OIT
ounce	oz
ounce-force	ozf
outside diameter	OD
parts per hundred	PPH, or pph
parts per million	PPM, or ppm
parts per billion	PPB, or ppb
polychlorinated biphenyl	PCB
polyvinyl chloride	PVC
post meridian	p.m.
pound	lb, LB, lbs, or LBS
pounds per square inch	PSI, or psi
pounds per square inch absolute	PSIA, or psia
pounds per square inch gauge	PSIG, or psig
pounds per square foot	PSF, or psf
process control system	PCS

programmable logic controller	PLC
revolutions per minute	RPM, or rpm
second	sec, or s
specific gravity	sp gr, or SG
square	sq
square foot	sq ft, or SQ FT, or sf, or ft^2
square inch	sq in., or SQ IN, or in^2
square yard	sq yd, or SY, or yd^2
standard	std
standard cubic feet per minute	SCFM, or scfm
total dynamic head	TDH
totally-enclosed fan-cooled	TEFC, or tefc
volt	V
volts alternating current	VAC, or vac
volts direct current	VDC, or vdc
volatile organic compounds	VOC

1.6 REFERENCE STANDARDS AND ORGANIZATIONAL ACRONYMS

A. Reference Standards - General:
   1. Each entity engaged in the Work, including Contractor, Subcontractors, and Suppliers, shall be familiar with reference standards applicable to its portion(s) of the Work. Comply with such reference standards when required by the Contract Documents or appropriate fabrication and construction practice, unless the Contract Documents requirements exceed those of the associated reference standard.
   2. Refer to the General Conditions, as may be modified by the Supplementary Conditions, relative to reference standards and resolving discrepancies between reference standards and the Contract Documents.
   3. Provisions of reference standards are in effect in accordance with the Specifications and other provisions of the Contract Documents where reference standards are cited.
   4. Copies of applicable reference standards are not included in or bound with the Contract Documents. Where reference standards are needed for the Work, obtain such reference standards(s) from the publication source.

B. Organization Names and Acronyms:
   1. Where reference standards, specifications, manuals, Laws or Regulations, or other published data of international, national, regional, or local organizations are cited in the Contract Documents, the organization issuing the standard (or other type of document) may be referred to by its acronym only.
   2. The following acronyms that may appear in the Contract Documents shall have the meanings indicated below, unless expressly indicated otherwise in that part of the Contract Documents where such standard (or other document) is cited.
   3. Listing is alphabetical by acronym.

AA	Aluminum Association
AABC	Associated Air Balance Council

AAMA	American Architectural Manufacturers Association
AAR	Association of American Railroads
AASHTO	American Association of State Highway and Transportation Officials
ABMA	American Bearing Manufacturers Association (formerly Anti-Friction Bearing Manufacturers Association (AFBMA))
ACI	American Concrete Institute
ACS	American Chemical Society
ADSC-IAFD	International Association of Foundation Drilling.
AEIC	Association of Edison Illuminating Companies
AF&PA	American Forest and Paper Association
AGI	American Geosciences Institute
AGMA	American Gear Manufacturers Association
AI	Asphalt Institute
AIA	American Institute of Architects
AIChE	American Institute of Chemical Engineers
AIPG	American Institute of Professional Geologists
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
ALSC	American Lumber Standards Committee
AMA	Acoustical Materials Association
AMCA	Air Movement and Control Association
AMP	National Association of Architectural Metal Manufacturers, Architectural Metal Products Division
AMPP	Association for Materials Protection and Performance
ANSI	American National Standards Institute
APA	The Engineered Wood Association
APHA	American Public Health Association
API	American Petroleum Institute
AREA	American Railway Engineering Association
ARI	Air Conditioning and Refrigeration Institute
ARS	American Rail Standard
ASAE	American Society of Agricultural Engineers
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASNT	American Society for Non-Destructive Testing

ASQ	American Society for Quality
ASSE	American Society of Safety Engineers
ASTM	American Society for Testing and Materials
AWCI	Association of the Wall and Ceiling Industry
AWI	Architectural Woodwork Institute
AWPA	American Wood Protection Association
AWPI	American Wood Preservers Institute
AWS	American Welding Society
AWWA	American Water Works Association
BAAQMD	Bay Area Air Quality Management District
BHMA	Builders Hardware Manufacturers Association
BIA	Brick Industry Association
CASE	Coalition of American Structural Engineers (part of the American Council of Engineering Companies (ACEC))
CBMA	Certified Ballast Manufacturers Association
CBP	United States Customs and Border Protection
CDA	Copper Development Association
CEMA	Conveyor Equipment Manufacturers Association
CGA	Compressed Gas Association
CISCA	Ceilings and Interior Systems Construction Association
CISPI	Cast Iron Soil Pipe Institute
CLFMI	Chain Link Fence Manufacturers Institute
CMAA	Crane Manufacturers Association of America
CRSI	Concrete Reinforcing Steel Institute
CSI	Construction Specifications Institute
DBIA	Design-Build Institute of America
DHS	United States Department of Homeland Security
DIN	Deutsches Institut für Normung, eV (German Institute for Standardization)u
DIPRA	Ductile Iron Pipe Research Association
EJCDC	Engineers Joint Contract Documents Committee
EJMA	Expansion Joint Manufacturers Association, Inc.
ETL	Intertek Testing Services, Inc. (formerly ETL Testing Laboratories, Inc.)
FAA	Federal Aviation Administration (US Department of Transportation)
FCC	United States Federal Communications Commission
FEMA	Federal Emergency Management Agency (US Department of Homeland Security)
FHWA	Federal Highway Administration (US Department of Transportation)
FIDIC	International Federation of Consulting Engineers

FM	Factory Mutual (FM Global)
FRPI	Fiberglass Reinforced Plastics Institute
FS	Federal Specification
FTA	Federal Transit Administration, United States Department of Transportation
GA	Gypsum Association
GANA	Glass Association of North America
HEW	United States Department of Health, Education and Welfare
HI	Hydraulic Institute
HMI	Hoist Manufacturers Institute
HUD	United States Department of Housing and Urban Development
IBC	International Building Code
ICC	International Code Council
ICEA	Insulated Cable Engineers Association
IEEE	Institute of Electrical and Electronics Engineers
IESNA	Illuminating Engineering Society of North America
IFI	Industrial Fasteners Institute
IRI	Industrial Risk Insurers
ISA	International Society of Automation
ISI	Institute for Sustainable Infrastructure
ISO	Insurance Services Office
ISO	International Organization for Standardization
LPI	Lightning Protection Institute
MIA	Marble Institute of America
ML/SFA	Metal Lath/Steel Framing Association
MS	Military Specifications
MSS	Manufacturers' Standardization Society
MMA	Monorail Manufacturers Association
NAAMM	National Association of Architectural Metal Manufacturers
NACE	National Association of Corrosion Engineers
NAPF	National Association of Pipe Fabricators, Inc.
NARUC	National Association of Regulatory Utilities Commissioners
NAVFAC	Naval Facilities Engineering Command (US Navy)
NBHA	National Builders Hardware Association
NBS	National Bureau of Standards (United States Department of Commerce)
NCMA	National Concrete Masonry Association
NEC	National Electric Code

NELMA	Northeastern Lumber Manufacturers' Association
NEMA	National Electrical Manufacturers Association
NEPA	National Environmental Policy Act
NESC	National Electrical Safety Code
NETA	International Electrical Testing Association
NFPA	National Fire Protection Association
NFRC	National Fenestration Rating Council
NGA	National Glass Association
NHLA	National Hardwood Lumber Association
NHPMA	Northern Hardwood and Pine Manufacturers Association
NICET	National Institute for Certification in Engineering Technologies
NIST	National Institute of Standards and Technology (United States Department of Commerce)
NLGA	National Lumber Grades Authority
NRC	United States Nuclear Regulatory Commission
NRCA	National Roofing Contractors Association
NRMCA	National Ready Mixed Concrete Association
NSF	National Sanitation Foundation
NSPE	National Society of Professional Engineers
NSSGA	National Stone, Sand, and Gravel Association
NTMA	National Terrazzo and Mosaic Association
OSHA	Occupational Safety and Health Administration, United States Department of Labor
PCA	Portland Cement Association
PCI	Precast/Prestressed Concrete Institute
PEI	Porcelain Enamel Institute
PFI	Pipe Fabrication Institute
PPI	Plastics Pipe Institute
PGMC	Primary Glass Manufacturers Council
PS	Product Standards Section, United States Department of Commerce
RCSC	Research Council on Structural Connections (part of AISC)
RMA	Rubber Manufacturers Association
RUS	Rural Utility Service (division of Rural Development of the USDA)
SAE	Society of Automotive Engineers
SCAQMD	Southern California Air Quality Management District
SCPRF	Structural Clay Products Research Foundation
SCTE	Society of Cable Telecommunications Engineers
SDI	Steel Deck Institute

SDI	Steel Door Institute
SIGMA	Sealed Insulating Glass Manufacturing Association
SJI	Steel Joist Institute
SMACNA	Sheet Metal and Air Conditioning Contractor's National Association
SPI	Society of the Plastics Industry
SPIB	Southern Pine Inspection Bureau
SSPC	Society for Protective Coatings (formerly, Steel Structurs Painting Council)
SWI	Steel Window Institute
TCEQ	Texas Commision on Environmental Quality
TCNA	Tile Council of North America
TEMA	Tubular Exchanger Manufacturers Association
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance
TSA	Transportation Security Administration (United States Department of Homeland Security)
TxDOT	Texas Department of Transportation
UCC	Uniform Commercial Code
UL	Underwriters Laboratories, Inc.
USAB	United States Access Board
USACE	United States Army Corps of Engineers (also abbreviated as COE or USACOE)
USDA	United States Department of Agriculture
USDOE	United States Department of Energy
USDOT	United States Department of Transportation
USEPA	United States Environmental Protection Agency
USGBC	United States Green Building Council
USGS	United States Geological Survey
USPHS	United States Public Health Service
WCLIB	West Coast Lumber Inspection Bureau
WCMA	Window Covering Manufacturers Association
WCMA	Wood Component Manufacturers Association
WDMA	Window and Door Manufacturers Association
WEF	Water Environment Federation (formerly the Water Pollution Control Federation)
WWEMA	Water and Wastewater Equipment Manufacturers Association
WWPA	Western Wood Products Association

END OF SECTION

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SECTION 01 45 25
TESTING AND DISINFECTING HYDRAULIC STRUCTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Indication of specific hydraulic structures to which requirements of this Section apply, as indicated in the "Schedules" Article near the end of this Section.
   2. Water required for the Work of this Section.
   3. Preparation for testing.
   4. Hydrostatically testing hydraulic structures for leakage.

B. Scope:
   1. Contractor shall perform testing of hydraulic structures indicated in the "Schedules" Article at the end of this Section. For such hydraulic structures, provide all labor, materials, equipment (whether temporary or permanent), tools, services, and incidentals necessary or required for the Work of this Section.
   2. Separately test each hydraulic structure.
      a. Perform separate hydrostatic testing for each portion of the hydraulic structure that can be isolated upon Substantial Completion and used while adjacent portion of hydraulic structure is dry.

C. Related Requirements: Include, but are not necessarily limited to, the following:
   1. Section 03 01 30 - Repair and Rehabilitation of Existing Construction.
   2. Section 03 31 30 - Concrete, Materials and Proportioning.
   3. Section 03 35 00 - Concrete Finishing and Repair of Surface Defects.
   4. Section 03 64 23 - Crack Repair and Injection.

1.2 REFERENCES

A. Terminology:
   1. Terminology indicated below are not defined terms and are not indicated with initial capital letters, but when used in this section have the meaning indicated below:
      a. "Hydraulic structures" means those structures indicated in one or more of the schedules (tables) at the end of this Section.

B. Reference Standards: Standards referenced in this section include, but are not necessarily limited to, the following:
   1. American Concrete Institute (ACI):
      a. 350.1 - Specification for Tightness Testing of Environmental Engineering Concrete Containment Structures and Commentary.
   2. American Public Health Association (APHA), American Waterworks Association (AWWA), Water Environment Federation (WEF):
      a. APHA/AWWA/WEF - Standard Methods for Examination of Water and Wastewater.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the Work of this Section with other Work, trades, and contractors (if any) to allow such entities to perform their responsibilities that must be performed or completed prior to the Work of this Section.
   2. Completion of the Work of this Section and Engineer's acceptance of associated test results is required prior to Contractor requesting inspection for Substantial Completion of the associated Work.

B. Scheduling and Sequencing:

1. Provide the Work via sequences and scheduling to minimize the impact of, and on, hydrostatic testing.
2. For concrete hydraulic structures, prior to testing, verify required 28-day concrete strength has been achieved and concrete is fully cured.
3. Prior to testing, the structure shall be complete, including the installation of all structural slabs, baffle walls, and connecting elements, unless allowed otherwise by the Contract Documents or the Engineer.
4. Scheduling and interior coatings or finishing of hydraulic structures.
    a. Provide required coatings and finishing of interior surfaces of hydraulic structures before performing testing.
5. Scheduling and exterior coatings or finishing of hydraulic structures.
    a. Perform testing prior to installing required waterproofing, cementitious finishing, and coatings, unless otherwise indicated or acceptable to Engineer.
    a. Sequencing of backfilling, filling and hydrostatic testing unless allowed by the Engineer, perform testing prior to placing exterior backfill or fill, as applicable.
    b. Perform hydrostatic testing of the following after backfilling or filling, as applicable:
        1) At Aeration Basin Nos. 5-8 and Secondary Clarifier Splitter Structure, it is acceptable to backfill the basins east wall and necessary portion of north wall to the extent required to support construction of the effluent channel prior to hydrostatic testing.
    c. Re-excavation, if any, waterproofing repair, temporary support of foundations, backfilling, or filling required to remedy apparent leaks shall be performed at no additional cost to Owner.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
1. Testing plan:
    a. In accordance with the "Testing Plan" Article in this Section.
2. Leak Remediation Plan: Prior to commencing hydrostatic testing, furnish Submittal indicating the following:
    a. Indication of each type of potential leak, including indication of construction materials for applicable hydraulic structures.
    b. Proposed repair materials for each type of potential leak. For concrete hydraulic structures, repair material shall be in accordance with applicable Specifications of Division 03 - Concrete.
    c. Proposed repair procedures for each type of potential leak. For concrete hydraulic structures, repair procedures shall be in accordance with applicable Specifications of Division 03 - Concrete.

B. Informational Submittals: Submit the following:
1. Test and Evaluation Reports:
    a. Within 24 hours of completion of hydrostatic testing for each hydraulic structure, submit photographs (in accordance with Section 01 32 33 - Project Photographic Documentation) of each leak and damp area prior to performing remedial work. Include distant photos and close-ups to document conditions. Include drawing or sketch showing locations of each leak, including key plan as necessary.
2. Supplier's Instructions:
    a. Supplier's repair procedures for remedying leaks in precast concrete or prestressed concrete.
3. Field Quality Control Submittals:
    a. Results of each hydrostatic test.

1.5 TESTING PLAN

A. Testing Plan - General:
1. Submit testing plan for the Work of this Section.

2. Obtain Engineer's approval of testing plan Submittal not later than 30days prior to starting the Work for the first hydrostatic test.
3. Where necessary, obtain permits and approvals of authorities having jurisdiction before submitting the testing plan. Include such permits and approvals, where necessary, in the testing plan Submittal.
4. Engineer's approval (or other disposition assigned to testing plan Submittal) and comments in no way modifies Contractor's sole responsibility for means, methods, techniques, procedures, and sequences of construction or the associated safety and protection measures. Engineer's approval (or other disposition assigned) and comments are only to endeavor to determine compliance with the Contract Documents relative to judging the acceptability of the Work.

B. Required Content of Testing Plan Submittal:
   1. Hydrostatic Testing:
      a. Schedule (table) of hydraulic structures to be hydrostatically tested, indicating for each the structure's name, location, and proposed water surface elevation for the hydrostatic test.
      b. Time-based schedule for required hydrostatic tests, coordinated with the current Progress Schedule accepted by Engineer. For each hydrostatic test, indicate planned dates for cleaning, observation by Engineer of cleaned hydraulic structure, completion of temporary bulkheading or other temporary facilities required or necessary, dates of filling the hydraulic structure, wetting period (if required) in accordance with the Contract Documents, testing period, drainage of hydraulic structure (if necessary), and submittal of written results of test.
      c. Source of water for each hydrostatic test, including indication of whether source is potable or non-potable water.
      d. For each test, provide brief, narrative description of how water will be conveyed to and, where necessary, from, the hydraulic structure, including indication of proposed rate of water withdrawal from source, proposed rate of water discharge from hydraulic structure after testing, and temporary equipment proposed for use. Where the Contract Documents establish maximum allowable flow rates, clearly indicate how monitoring such compliance will be performed. Where temporary flow meter is proposed or required, include in testing plan copy of current, valid calibration of each flow meter proposed for use.
      e. Where potable water will be used for hydrostatic testing, include in testing plan written approval of owner of water utility for use of source and indication of whether water utility or Contractor will furnish and install temporary backflow preventers. Where temporary backflow preventers will be provided by Contractor, include copy of current, valid certification (by duly certified backflow preventer technician) for backflow preventer(s) proposed for use, including indication of specific, identification data for such equipment.
      f. For hydraulic structures that will be open to the atmosphere, indicate, via brief narrative and appropriate drawings, sketches, or photographs, proposed means for monitoring evaporation and precipitation during testing, including indication of each location of such monitoring.
      g. Proposed location and means of measuring water surface elevation at start and end of hydrostatic testing. Where necessary, include appropriate drawing, sketch, or photograph to indicate proposed location.
      h. Proposed location(s) for discharge of test water, including copy of approval for such discharge from authority having jurisdiction, where applicable. Indication of acceptable leakage volume, in accordance with the allowable leakage rates indicated in the "Schedules" Article of this Section. Where necessary include calculation of volume of hydraulic structures being tested and determination of allowable leakage, if any, allowed by the Contract Documents. Indicate plan and duration for repeating hydrostatic testing, if required, after leaks (if any) are remedied.
      i. Sample format for presenting written results of hydrostatic testing.

PART 2 - PRODUCTS

2.1 WATER

A. Water for Testing:
   1. In addition to requirements of this Section, comply with Section 01 51 05 - Temporary Utilities. Among other requirements Section 01 51 05 - Temporary Utilities indicates responsibility for furnishing water necessary for testing.
   2. Comply with ACI 350.1 for water for hydrostatic testing of concrete structures, unless otherwise indicated in the Contract Documents.
   3. Sources - General:
      a. Water for hydrostatic testing shall be plant effluent from the plant non-potable water system.
   4. Project-Specific Water Source(s):
      a. The following may be used as source of water for hydrostatic testing:
         1) Non-potable water from plant NPW fire hydrants. Plant potable water fire hydrants shall not be used. Rate of water withdrawal shall not exceed value specified in Section 01 51 05 - Temporary Utilities.
      b. Do not use water source not acceptable to Engineer (following Engineer's consultation with Owner or facility manager as applicable).
   5. Limitations on Water Conveyance Rates:
      a. In addition to limitation(s), if any, on rate of water withdrawal from source, indicated above, maximum rates of water conveyance through temporary equipment and materials shall:
         1) Not result in filling of hydraulic structure at rate greater than 4 vertical feet per hour.
         2) Not cause damage or erosion at point of discharge. Provide appropriate energy-dissipating materials as necessary.
         3) Not cause temporary equipment and materials used for conveyance to exhibit undue strain or movement during operation.
      b. For testing at Aeration Basin Nos. 5-8 and Effluent Channel, water shall be reused for each consecutive test unless otherwise approved by the Owner. For each test, Contractor shall provide means to transfer water from one basin to the next to complete the next test (e.g., pumps, hoses, etc.).
   6. Temporary Equipment and Materials for Conveyance of Water for Testing:
      a. Provide, operate, and maintain temporary equipment and materials necessary for conveying water used for testing, including conveyance to hydraulic structure and discharge from hydraulic structure.
      b. Sizes, capacity, and materials of temporary equipment and materials shall be suitable for the intended purpose and Contractor's means, methods, procedures, techniques, and sequences of construction.
      c. Provide temporary piping, couplings, valves, pumps, and appurtenances necessary.
      d. Temporary Flow Meter: Contractor shall coordinate with Owner to use an Owner-furnished temporary flow meter for any non-potable water used by the Contractor. During water withdrawal from source, allow Engineer and Owner continuous access to temporary flow meter. Supervise and monitor water withdrawal and filling of hydraulic structure. Record for each withdrawal: Time water withdrawal commenced and was completed, total volume of water withdrawn, and maximum flow rate recorded during withdrawal process.
   7. Temporary Backflow Prevention:
      a. At each location (if any) where potable water is withdrawn for testing, install and use temporary backflow preventer on water source, to prevent contamination of the water source.

2.2 REPAIR MATERIALS

A. This Article addresses materials required for repairing hydraulic structures that do not pass required hydrostatic testing or exhibit leakage.

B. Materials for Repairing Cracks and Surface Defects in Concrete:
   1. Materials for repairing concrete shall be in accordance with the following:
      a. Section 03 01 30 - Repair and Rehabilitation of Existing Construction.
      b. Section 03 31 30 - Concrete, Materials and Proportioning.
      c. Section 03 35 00 - Concrete Finishing and Repair of Surface Defects.
      d. Section 03 64 23 - Crack Repair and Injection.
   2. When the Contract Documents do not address materials for necessary repairs, submit request for interpretation or clarification and Engineer will furnish requirements.
   3. For precast concrete or prestressed concrete hydraulic structures, obtain from Supplier that furnished the associated precast or prestressed concrete (and submit to Engineer), Supplier's recommendations and procedures for remedial work. Where such recommendations conflict with Contract requirements or Engineer's direction regarding repair materials required, obtain written interpretation or clarification from Engineer.
   4. Provide repair materials, for concrete that does not pass hydrostatic testing or otherwise exhibit leakage, at no additional cost to Owner, unless such testing is performed on hydraulic structure that existed prior to the Effective Date of the Contract, and Contractor's action or inaction did not create or exacerbate cracks or other defects in concrete.
   5. Coatings shall not be used as a material for stopping leakage through cracks unless approved by the Engineer.

C. Materials for Repairing Hydraulic Structures Fabricated of Materials Other than Concrete:
   1. Provide repair materials consistent with the materials to be repaired, that will not result in corrosion or reduction in the useful life of the hydraulic structure and its appurtenances.
   2. Provide repair materials in accordance with recommendations of Supplier of the hydraulic structure.
   3. Provide repair materials, for hydraulic structures that do not pass hydrostatic testing or otherwise exhibits leakage, at no additional cost to Owner, unless such testing is performed on hydraulic structure that existed prior to the Effective Date of the Contract, and Contractor's action or inaction did not create or exacerbate cracks or other defects in the associated hydraulic structure.

PART 3 - EXECUTION

3.1 PREPARATION

A. Preparation – General:
   1. Prepare for hydrostatic testing of concrete hydraulic structures in accordance with ACI 350.1.
   2. Prepare for testing of hydraulic structures, regardless of materials of construction in accordance with the Contract Documents.
   3. Prior to performing hydrostatic testing, provide necessary materials, whether temporary or permanent, such as caps, blind flanges, watertight bulkheads, and the like.
   4. Each hydraulic structure shall be free of visible defects and apparent leakage. Repair leaks in accordance with the Contract Documents.
   5. When the hydraulic structure is fully or partially buried, prior to commencing hydrostatic testing, draw down groundwater surface elevation to below bottom of hydraulic structure's base slab or mat. Maintain such groundwater surface elevation throughout the hydrostatic test.

B. Cleaning - General:
   1. Prior to testing, remove all scaffolding, planking, tools, rags, dirt, debris, rubbish, foreign matter, and material not part of the permanent structure.

2. Thoroughly clean hydraulic structures' walls, floors, and operating equipment by sweeping, high-pressure wash, scrubbing, or other methods that will not injure the Work and existing facilities.
3. Remove from each hydraulic structure all water, dirt, and foreign material accumulated during cleaning. Provide temporary pumps, piping, and facilities as necessary to discharge water from the cleaning operation in manner acceptable to Engineer, compliant with Section 01 57 05 - Temporary Controls, and in accordance with Laws and Regulations.
4. Do not proceed with testing until Engineer has accepted results of cleaning, following either Engineer's observation of the cleaned hydraulic structure or Engineer's observation via digital means.
5. Comply with Section 01 74 00 - Cleaning, and this Section.

C. Other Testing Required for Tanks:
1. As required by reference standards indicated in this Section and in the Specifications for the associated tank, perform other testing indicated, in addition to testing required in this Section.
2. Submit written results of such required testing together with other test results required in this Section.

D. Patching and Finishing of Concrete Hydraulic Structures:
1. Prepare concrete surfaces in accordance with ACI 350.1 and Section 03 31 30 - Concrete, Materials and Proportioning, Section 03 35 00 - Concrete Finishing and Repair of Surface Defects.

3.2 HYDROSTATIC TESTING

A. Prior to starting hydrostatic testing, perform the following:
1. Comply with "Scheduling and Sequencing" provision of this Section's "Administrative Requirements" Article.
2. Valves, gates, blind flanges, and items other than concrete that control the flow of or otherwise retain fluid in the hydraulic structure shall be watertight for the hydrostatic test.
3. Repair defective concrete.
4. Advise Engineer and Owner prior to commencing filling hydraulic structure for hydrostatic testing. Minimum time between notice and starting to fill for hydrostatic testing shall be three days.
5. Do not perform hydrostatic testing during period when ambient temperature is below 33degrees F.
6. Cold Weather Hydrostatic Testing: Comply with the following when hydrostatic testing will be performed when ambient air temperature has fallen below 40degrees F within 48 hours prior to testing, or is projected to fall below 40degrees F during hydrostatic testing:
   a. Cold Weather Requirements – General:
      1) Visible ice, snow, or other frozen material on outside surface of hydraulic structure or within hydraulic structure being tested is unacceptable.
      2) Results of hydrostatic testing will be unacceptable when these requirements for cold weather hydrostatic testing are not implemented as required unless otherwise acceptable to Engineer (following Engineer's consultation with Owner or facility manager as applicable).
   b. Ambient Air Temperature: Measure and record ambient air temperature at location of hydrostatic testing each day during hydrostatic testing at approximately 8:00 o'clock am local time.
   c. Temperature of Structure Surface and Water: Measure and record temperatures of exterior surface of hydraulic structure and water at start of hydrostatic testing, and once per hour whenever ambient air temperature is less than recorded at start of day as follows:
      1) Measure concrete surface temperatures every 300 square feet of wall of hydraulic structure being tested. Surface temperature shall not be less than 35 degrees F.

2) Measure temperature of water in hydraulic structure at location not less than three feet from wall of hydraulic structure and not less than three below water surface elevation. Water temperature eight hours or longer during any period 72 hours prior to scheduled hydrostatic testing, or at any point during the scheduled test period.

d. Provide tenting or other temporary enclosures, together with temporary heating, for hydraulic structures being hydrostatically tested when ambient air temperature is predicted to fall below 32 degrees F for eight hours or longer within 72 hours immediately prior to hydrostatic testing, or at any time during the hydrostatic testing.

7. Hydraulic structures with interior, wetted concrete surfaces shall remain filled with water for an initial adsorption period of not less than 72 hours. Following this initial period, provide make-up water to fill the hydraulic structure to specified water surface test elevation.

B. Hydrostatic testing – General:
1. Perform hydrostatic testing in accordance with this Section, other applicable provisions of the Contract Documents and the following:
a. ACI 350.1, Sections 1 and 2 for concrete hydraulic structures.
2. In the event of conflicting requirements between the Contract Documents and reference standards indicated, obtain written interpretation or clarification from Engineer before proceeding with the associated Work.
3. Analysis of data from hydrostatic testing of hydraulic structures shall be by Contractor in accordance with ACI 350.1 and this Section.

C. Required Water Surface Elevation for Hydrostatic Testing:
1. Required water surface elevation for hydrostatic testing of each hydraulic structure is indicated in the appropriate table in the "Schedules" Article at the end of this Section.
2. Using the water source indicated in "Article 2.1" of this Section, fill hydraulic structures to indicated water surface test elevation.
3. Where test elevation is not indicated and fluid level in the structure will normally be controlled by a weir, fill structure to elevation 6 inches below the weir crest.
4. Where test elevation is not indicated and structure does not have a flow control weir, test elevation shall be two feet below top of structure.

D. Filling Hydraulic Structures with Water:
1. Fill hydraulic structure for hydrostatic testing at rate that does not exceed limitations indicated in Article 2.1 of this Section.

E. Visual Observation for Apparent Leakage:
1. When water has reached indicated test elevation and required wetting period has elapsed, inspect hydraulic structure's exposed surfaces for leakage. Before starting hydrostatic testing, repair apparent leakage or weeping.
2. Apparent leakage is when one or more areas evidence visible flow or area where moisture can be picked up on a dry hand.
3. Provide proper remedy of apparent leaks independent of hydrostatic testing.
4. Successfully passing hydrostatic testing does not relieve Contractor from obligation to remedy all apparent leaks.

F. Duration of Hydrostatic Testing:
1. Hydrostatic test duration will be approved by Engineer in the required testing plan Submittal and shall not be less than the following:
a. Cast-in-place concrete hydraulic structures.
b. Hydraulic structures for which allowable leakage is zero: 72 hours.
1) For hydraulic structures where allowable leakage is greater than zero: The theoretical time required for the water surface to decrease by 3/8-inch, at the maximum allowable leakage rate indicated in the schedules (tables) at the end of this Section, but in no event longer than 120 hours.
c. Other types of tanks with non-absorbant surfaces: One hour.

G. Allowable Leakage:
   1. Leakage during the test period for hydraulic structures with vertical walls is defined as the volume calculated using the difference in water surface elevations at the start and end of the test period adjusted by adding the volume of precipitation and subtracting the volume of evaporation measured during the test period, and accounting for the change (if any) of water volume resulting from temperature caused change in water density.
   2. Leakage during the test period for hydraulic structures with sloping walls is the quantity of water that must be supplied to the hydraulic structure or section thereof to maintain the water level within three inches of specified water surface test elevation during the hydrostatic test, plus the volume of water required to fill the hydraulic structure to specified water surface test elevation at conclusion of hydrostatic test, plus precipitation, minus evaporation, and accounting for the change (if any) of water volume resulting from temperature caused change in water density.
   3. Allowable leakage rate for each hydraulic structure to be hydrostatically tested is indicated in the "Schedules" Article at the end of this Section.

H. Measurement Locations:
   1. For hydraulic structures or portions thereof (when entire hydraulic structure is not tested as a whole) that are equal to or less than 1,000 square feet in water surface area, measure water level at not less than two locations approximately 180 degrees apart.
   2. For hydraulic structures or portions thereof (when entire hydraulic structure is not tested as a whole) that are greater than 1,000 square feet in water surface area, measure water level at not less than four locations approximately 90 degrees apart.
   3. Each measurement location shall be marked and given distinct reference number. Mark reference point on face of wall above test water surface in manner that will prevent movement or deterioration of reference point mark during the test. Remove reference point mark upon completion of testing and acceptance of testing results by Engineer.
   4. Position the measurement locations to minimize effects of wave action and wind.

I. Evaporation and Precipitation Measurement:
   1. Evaporation and Precipitation Measurement Vessels:
      a. In hydraulic structures open to atmosphere, whether fully or partially covered, a plastic, calibrated, open-topped container not less than 11-inch diameter and not less than 14-inches deep (for example, a five-gallon bucket) shall be provided at each measurement location.
      b. Before starting test, fill with water to depth of six inches each evaporation-precipitation measurement vessel and float the vessel in the hydraulic structure, held in position near each measurement location.
      c. Calibration increments in container shall be 1/16-inch or less.
   2. Position evaporation-precipitation measurement vessels so that vessels are not shaded by hydraulic structure's walls, away from overhead items such as beams, pipes, and walkways.

J. Obtaining Test Measurements:
   1. Do not start hydrostatic tests when severe weather conditions, such as heavy precipitation, high winds, change in average daily temperature of 35 degrees F or more, and other severe conditions are predicted for duration of test period.
   2. Record the following measurements at each test location at start of test period and at 12-hour intervals thereafter, to nearest 1/16-inch and nearest 0.1 degree F:
      a. Distance from reference point elevation to actual water surface.
      b. Depth of water in evaporation-precipitation containers.
      c. Temperature of test water at point 18 inches below water surface.
      d. Temperature of water in evaporation-precipitation measurement vessels at mid-depth.
   3. If actual water surface in hydraulic structure is subject to wave action at measurement location, record as data the average water surface elevation of wave oscillations. Contractor may desire to provide temporary baffling of appropriate material and dimensions to reduce wave oscillations in open-topped hydraulic structures.

4. Change in the water surface elevation at each measurement location shall be averaged and adjusted as follows:
    a. Total change in hydraulic structure's water surface elevation shall be adjusted by average change in water surface elevation in evaporation-precipitation measurement vessels.
    b. Where averaged water temperature measurements vary by more than three degrees F from start to completion of test period, adjustment in test volume shall be determined by change of density of water resulting from change in the average water temperature.
5. Determination of Leakage:
    a. Hydraulic Structures with Vertical Walls: Leakage volume shall be the drop in water surface elevation measured during the test, averaged across all water level measurement locations, multiplied by water surface area of hydraulic structure tested.
    b. Initial full volume shall include the volume of sloping tank bottoms, sump pits, and other features that contain water that is connected to the hydraulic structure during the hydrostatic test.
    c. Allowable leakage shall be determined by multiplying the initial full volume by the daily leakage allowance and by the leakage test time in days.

K. Criteria for Acceptance:
1. Hydrostatic test will pass if measured leakage is less than allowable leakage and the hydraulic structure does not evidence active leaks or weeping (where moisture can be picked up with a dry hand).
2. If test becomes unreliable due to excessive precipitation, freezing, or other external factors, re-start and re-perform the test at no additional cost to Owner.
3. If hydrostatic test fails, the hydraulic structure may be re-tested immediately without repairs. If subsequent hydrostatic test fails, repair probable areas of leakage and repeat the hydrostatic test.
4. Re-test hydraulic structure until it meets criteria indicated for acceptance. Repair probable leakage areas before testing.

L. Reuse and Disposal of Water Used in Hydrostatic Tests:
1. Obtain Engineer's acceptance before water used in one hydrostatic test is pumped to a different hydraulic structure for reuse in subsequent test.
2. Water used in hydrostatic testing shall be discharged to the plant drain system unless another location onsite is identified by the Owner.

M. Unless otherwise indicated in the Contract Documents, hydraulic structure shall not be backfilled or have exterior coating applied (such as damp-proofing) until Engineer accepts hydrostatic test results.

3.3 REPAIR

A. This Article addresses repairing hydraulic structures that do not pass required hydrostatic testing or otherwise require repairs to eliminate apparent leakage. Repairs to remedy apparent leaks shall be performed independent of hydrostatic testing. Obtaining acceptable results from the hydrostatic test does not relieve Contractor from remedying running water leaks, seepage, or other apparent leaks.

B. Repairing cracks and surface defects in concrete:
1. Repairing of concrete shall be in accordance with the following:
    a. Section 03 01 30 - Repair and Rehabilitation of Existing Construction.
    b. Section 03 31 30 - Concrete, Materials and Proportioning.
    c. Section 03 35 00 - Concrete Finishing and Repair of Surface Defects.
    d. Section 03 64 23 - Crack Repair and Injection.
2. When the Contract Documents do not address providing necessary repairs, submit request for interpretation or clarification and Engineer will furnish requirements.
3. For precast concrete or prestressed concrete hydraulic structures, also obtain recommended repair methods from Supplier that furnished the associated precast or prestressed concrete

and submit to Engineer. Where such recommendations conflict with Contract requirements or Engineer's direction regarding repairs required, obtain written interpretation or clarification from Engineer.

4. Perform repairs for concrete that does not pass hydrostatic testing or otherwise exhibits leakage, at no additional cost to Owner, unless such testing is performed on hydraulic structure that existed prior to the Effective Date of the Contract, and Contractor's action or inaction did not create or exacerbate cracks or other defects in concrete. Provide drawing(s) or sketch(es) showing locations of leaks, including key plan as necessary.
5. Provide digital images (photographs) of each leak and damp area following implementation of remedy. Furnish distant photographic images and close-ups documenting conditions, keyed to Contractor-furnished drawing(s) or sketch(es), of leakage locations.
6. Complete implementation of remedies of leakage independent of results of hydrostatic testing.
7. Successful completion of hydrostatic testing does not relieve Contractor from remedying leakage.

C. Repairing Hydraulic Structures Fabricated of Materials Other than Concrete:

1. Perform repairs consistent with the materials to be repaired, that will not result in corrosion or reduction in the useful life of the hydraulic structure and its appurtenances.
2. Perform repairs in accordance with recommendations of Supplier of the hydraulic structure and reference standards applicable to the type of hydraulic structure.
3. Perform repairs for hydraulic structures that do not pass hydrostatic testing or otherwise exhibit leakage, at no additional cost to Owner, unless such testing is performed on hydraulic structure that existed prior to the Effective Date of the Contract, and Contractor's action or inaction did not create or exacerbate cracks or other defects in the associated hydraulic structure.

3.4 TESTING OF PIPING CONNECTED TO HYDRAULIC STRUCTURES

A. Test piping connected to hydraulic structures in accordance with applicable requirements of the Contract Documents.

3.5 SCHEDULES

A. Table 01 45 25-A - Hydraulic Structures Scheduled for Hydrostatic Testing Only: Clean and perform hydrostatic testing for the following:

Hydraulic Structure Number	Hydraulic Structure Service and Location	Water Surface Elevation for Hydrostatic Test (feet)	Allowable Leakage Rate (percentage of volume tested per 24-hour period)
11	Aeration Basin Splitter Structure	479.00	0.05%
21	Aeration Basin Nos. 5-8 (tested one at a time with adjacent basins and channel empty)	474.67	0.05%
22	Secondary Clarifier Splitter Structure	474.67	0.05%

END OF SECTION

SECTION 01 45 33

IBC 2021 - CODE-REQUIRED SPECIAL INSPECTIONS AND PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Contractor responsibilities for code-required Special Inspections and testing.
   2. Special Inspection program and reporting requirements.
   3. Attachment A to this Section includes requirements for submittal of Special Inspections.
   4. Attachment B to this Section includes Special Inspector qualifications, reporting requirements, and material specific Special Inspections and tests.
      a. Attachments A and B are for the Contractor's reference only and are not part of the Contract Documents.
      b. Attachments A and B are included to assist Contractor in understanding the Owner-provided services so the effect of such services may be factored into the Contractor's pricing and Progress Schedule.
      c. The Testing Agency and Special Inspector(s) performing the Owner-furnished services will be identified following the Effective Date of the Contract, unless otherwise identified in Section 01 11 00 - Summary of Work.

B. Purpose:
   1. This Section and its attachments were developed to address the requirements of the 2021 edition of the International Building Code, IBC section 1704.1 and applicable amendments, if any, by authorities having jurisdiction.
      a. One or more Special Inspectors will be retained by Owner or Owner's consultant to perform Special Inspections on the types of Work addressed by the applicable building code under Section 1704.
   2. One or more Special Inspectors or Testing Agencies will be retained by Owner or Owner's consultant to perform Special Inspections and tests for the types of Work indicated in the building code.
   3. A Statement of Special Inspections will be submitted to the Building Code Official as a condition for issuance of applicable permit. This statement is included as Attachment A to this Section. Attachment B indicates a complete list of materials and Work requiring Special Inspections, required Special Inspections and the minimum qualifications of the Testing Agencies and Special Inspectors.
   4. Special Inspections performed by entities retained by Owner or and entity for whom Owner is responsible are for benefit of Owner, Engineer, RDPRC, and Building Code Official. Contractor, together with Subcontractors and Suppliers, are not intended beneficiary of Special Inspections.

C. Related Requirements: Include, but are not necessarily limited to, the following:
   1. Section 03 05 05 - Concrete Testing and Inspection.
   2. Section 03 15 19 - Anchorage to Concrete.
   3. Section 03 31 31 - Concrete Mixing, Placing, Jointing, and Curing.
   4. Section 04 22 00 - Concrete Masonry.
   5. Section 05 14 00 - Structural Aluminum.
   6. Section 05 21 00 – Steel Joists.
   7. Section 05 50 00 - Metal Fabrications.
   8. Section 05 52 46 – Mechanically Fastened Aluminum Railings.
   9. Section 31 23 05 - Excavation and Fill.
   10. Section 31 63 29 - Drilled Piers.

1.2 REFERENCES

A. Definitions:
   1. The following defined terms, indicated in this section with initial capital letters, have the meaning assigned below, which apply to the singular and plural thereof:
      a. "Building Code Official" means officer (or their subordinate) having appropriate jurisdiction and authority charged with ministering and enforcing the building code in effect at the Site, or their duly authorized representative.
      b. "Geotechnical Special Inspector or Consultant" or "Soils Consultant" means a Special Inspector engaged for the specific purpose of performing specialized Special Inspections relative to subgrade conditions, fill, special foundations, or a combination of these. "Geotechnical Special Inspector or Consultant" or "Soils Consultant", when used relative to Special Inspections, is an entity separate from Engineer. Relative to the Division 31 Specifications, for the purposes of Special Inspection, "Geotechnical Special Inspector or Consultant", "Soils Consultant," and "Special Inspector" have the same meaning.
      c. "Registered Design Professional in Responsible Charge" (RDPRC) means the licensed and registered design professional who is responsible for reviewing and coordinating submittal documents prepared by others, including phased and deferred submittal items, for compatibility with the design of the facility.
      d. "Special Inspections" means inspection of specific elements of the Work requiring the expertise of an appropriate special inspector for compliance with the building code and the Contract Documents. Elements requiring special inspection are identified within this Section or elsewhere in the Contract Documents. Materials, mechanical, performance, and other testing required by the contract in other Specification sections, but not listed in this Section, are not part of the special inspections program.
      e. "Special Inspector" means representative of Owner-approved inspection entity designated for that portion of the Work.
      f. "Statement of Special Inspections" means document provided to Building Code Official outlining special inspections and tests to be done on the Project and frequency of required tests.
      g. "Testing Agency" means appropriate entity, not affiliated with or hired by Contractor, and responsible for materials testing requirements of the Project including but not limited to concrete cylinder breaks, soils testing, and masonry materials testing. Testing Agency does not include any testing entity or laboratory retained by Contractor, Subcontractor, or Supplier either for tests that are Contractor's responsibility in accordance with the Contract Documents but are not required by the building code, or test performed for Contractor's convenience and information.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Meetings:
   1. Attend and participate in preconstruction conference to review and coordinate responsibilities for inspection and testing procedures and requirements, as well as other preconstruction conference topics indicated in Section 01 31 19 - Project Meetings. Relative to this Section, in addition to required attendees indicated in Section 01 31 19 - Project Meetings, required conference attendees include: Owner, Testing Agency and Special Inspectors, Building Code Official (when available), Engineer, and Contractor, together with appropriate Subcontractors and Suppliers.
   2. Attend and participate in construction progress meetings prepared to discuss matters related to coordination and cooperation with Testing Agency and Special Inspectors, defective Work, and other topics indicated for construction progress meetings in Section 01 31 19 - Project Meetings.

1.4 CONTRACTOR'S RESPONSIBILITIES REGARDING SPECIAL INSPECTIONS

A. Contractor's Responsibilities Regarding Special Inspections – General.

1. Coordinate and cooperate with Testing Agency personnel, Special Inspectors, and employees and agents of Building Code Official.
2. Provide storage facilities for testing agencies exclusive use as described in the Contract Documents.
3. Special Inspection is Owner's independent quality control. Special Inspections do not, in any way, reduce or mitigate Contractor's responsibilities for quality assurance, quality control, workmanship, complying with the Contract Documents, correction period or warranties. Contractor's own personnel shall review all Work requiring Special Inspections for compliance with the Contract prior to calling for the inspection.

B. Advising Testing Agency and Special Inspectors of Need for Services:
1. Not less than 24 hours prior to the need for Special Inspection or code-required testing or sampling, advise Testing Agency or Special Inspector, as applicable, in writing of Work for which Special Inspections or testing is required, indicating approximate time the Work will be ready for such inspection, testing, or sampling.
2. When Special Inspection, testing, or sampling is necessary on a Monday or day following a holiday, furnish such written advisory not later than the prior business day.

C. Work for which Special Inspections are required shall remain accessible and exposed for the purposes of Special Inspections until completion of required Special Inspections.

D. Work to be inspected shall be complete at time of Testing Agency's or Special Inspector's, as applicable, arrival at the Site.

E. Work that is defective shall be corrected and re-inspected. Such portions of the Work shall not be covered or concealed until authorized by Engineer.

F. Payment for Special Inspection services will be in accordance with the following:
1. Payment indicated below is for the Testing Agency and Special Inspector costs and does not include the Contractor's costs listed in Paragraph 1.4 A of this Section.
2. Work is Satisfactory: After Contractor notification of Testing Agency or Special Inspector, as applicable, inspector arrives at the Site and performs inspection within the timeframe indicated in Paragraph 1.4.F.4 below, and inspection reveals work is satisfactory, then Owner will pay for the associated Special Inspection. Contractor's eligibility for payment for the associated Work shall be in accordance with the Contract Documents.
3. Work initially defective but remedied and re-inspected within 2 hours: After Contractor notification of Testing Agency or Special Inspector, as applicable, inspector arrives at the Site and performs inspection within the timeframe indicated in Paragraph 1.4.F.4 below, and inspection reveals work is defective, and the defective Work is remedied in accordance with the Contract within the period indicated in Paragraph 1.4.F.4, below, and the subject work is re-inspected within 2 hours of initial inspection and subsequently determined to be in accordance with the Contract, then Owner will pay for the associated Special Inspection. Contractor's eligibility for payment for the associated Work shall be in accordance with the Contract Documents.
4. Work not ready for inspection upon Special Inspector arrival: After Contractor notification of Testing Agency or Special Inspector, as applicable, inspector arrives at the Site and the Work is not ready for the associated inspection when inspector arrives, then inspector will remain on-site for a maximum of two hours awaiting the completion of the Work. If the subject Work is not ready for inspection at the end of this period, inspector will be dismissed until Contractor requests re-inspection. All costs associated with this inspection trip, including onsite time and travel time and expenses, will be Contractor's responsibility. Owner may set-off such amounts from payments due Contractor under the Contract.
5. Work initially defective and attempted remedy is also defective: After Contractor notification of Testing Agency or Special Inspector, as applicable, inspector arrives at the Site and performs the inspection within the period indicated in Paragraph 1.4.F.4 of this Section, but inspection reveals defective Work, and Contractor attempts remedy and requests re-inspection within two hours, and the reinspection also reveals defective Work,

inspector will be dismissed until Contractor requests re-inspection. All costs associated with this inspection trip, including onsite time and travel time and expenses, will be Contractor's responsibility. Owner may set-off such amounts from payments due Contractor under the Contract.

6. Work determined to be defective is ineligible for payment by Owner. Contractor is fully responsible for costs and time impacts of performing remedies so that the Work complies with the Contract Documents. Unless otherwise indicated in the Contract Documents, when re-inspection is necessary, Contractor is responsible for re-inspection costs, including onsite time, travel time and expenses, and other associated costs, if any. Owner may set-off such amounts from payments due Contractor under the Contract.

G. Structural Observations:
   1. Owner or other entity, acting on behalf of Owner (and not part of Contractor's team), agent shall employ or retain services of design professional, properly licensed and registered in the same jurisdiction as the Site, to perform structural observations.
   2. Prior to commencing structural observations, structural observer shall submit to building official written statement identifying frequency and extent of anticipated structural observations.
   3. At conclusion of the Work included in permit, structural observer shall submit to building official written statement that observations have been made and identify reported deficiencies that, to best of structural observer's knowledge, information, and belief, have not been resolved.
   4. Timing of Structural Observations:
      a. Not less than seven days before such Work commences, Contractor shall advise Owner or other entity, acting on behalf of Owner, in writing, when Work requiring structural observations is to occur.
      b. Observations shall occur before Work is subsequently covered and is no longer visible.

1.5 REPORTING DUTIES AND AUTHORITY

A. Reporting:
   1. Testing Agency and Special Inspectors will furnish to RDPRC and Engineer written results of Special Inspections promptly after performance of such tests and inspections. When acceptable results are indicated, Contractor may obtain copies thereof from Engineer.
   2. Reporting of Defective Work:
      a. Testing Agency and Special Inspectors will report defective Work to Contractor, Engineer, and RDPRC promptly.
      b. Defective Work that has been covered up or concealed prior to re-inspection will be reported by RPDRC to Engineer and Building Code Official.

B. Limitations on Authority of Special Inspectors and Testing Agencies:
   1. Special Inspector and Testing Agencies expressly do not have authority for:
      a. Ordering, stopping, or suspending the Work.
      b. Modifying the requirements of the Contract Documents.
      c. Accepting defective Work.
      d. Directing the Contractor's, means, methods, techniques, sequences, or procedures of construction.
      e. Directing or advising on Contractor's safety programs or measures for safety and protection.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 ATTACHMENTS

A. Attachments: The following, bound after this Section's "End of Section" designation, are furnished for Contractor's reference but are expressly not part of the Contract Documents.
   1. Attachment A - Submittal of Special Inspections, (one page).
   2. Attachment B - Special Inspections, Inspector Qualifications and Reporting Requirements, (four pages).

END OF SECTION

ATTACHMENT A TO SECTION 01 45 33
SUBMITTAL OF SPECIAL INSPECTIONS

Statement Date: June 13, 2025

Project Name: Prairie Creek Wastewater Treatment Plant Aeration Basin Expansion
Site Address: 897 Treatment Plant Road, Lewisville, Texas 75057
Owner: City of Lewisville
Registered Design Professional in Responsible Charge (RDPRC): Joel R. Cantwell, PE

The Statement of Special Inspections (Statement) is submitted as a condition for permit issuance in accordance with the Special Inspection requirements of the building code. The Special Inspection program is outlined in Specifications Section 01 45 33 – Code-Required Special Inspections and Procedures, including its Attachments A and B. A detailed explanation of the requirements for Special Inspections and Testing are indicated in Specifications Section 01 45 33 in conjunction with Specifications for each material and construction work result governed by the applicable building code.

Monthly Special Inspection reports will be submitted to the RDPRC and the Building Code Official. Apparent defective Work will be brought to the immediate attention of the Contractor for correction. If the defective Work is not corrected, the defective Work will be brought to the attention of the RDPRC and Engineer. Only documents that are prepared and signed or sealed by the Special Inspectors (SI) are valid.

The SI is responsible for verifying all information on each document prior to signing or sealing and directly forwarding it to the RDPRC and Engineer. The RDPRC will furnish to Building Code Official results of Special Inspections indicating acceptable results, unless Building Code Official directs that reports indicating unacceptable results also be furnished to the Building Code Official. The SI is responsible for verifying all inspectors under its supervision maintain current, valid certifications for the duration of the Project's construction. At the conclusion of each individual Special Inspection type, the SI will complete a Final Report.

The Special Inspection program does not relieve the Contractor or any other entity of any contractual duties, including quality control, quality assurance, or safety and protection. The Contractor is solely responsible for construction means, methods, techniques, procedures and sequences and associated safety and protection, and for complying with the Contract Documents. Failure to comply with the SI program as outlined herein may result in a stop work notice being issued by the Building Code Official.

Respectfully submitted,
Design Professional in Responsible Charge,

Joel R. Cantwell
Type or Print Name

Texas PE License # 86209
Expires: 12/31/2025

Signature

June 13, 2025
Date

END OF ATTACHMENT A

ATTACHMENT B TO SECTION 01 45 33

SPECIAL INSPECTIONS, INSPECTOR QUALIFICATIONS AND REPORTING REQUIREMENTS

PART 1 - ATTACHMENT B

1.1 QUALIFICATIONS

A. Qualifications stated here are the minimum recommended by the RDPRC. If the Building Code Official has more stringent qualifications, the more stringent qualifications will take precedence.

B. All Special Inspections and testing will be done under the direction of a professional engineer or registered architect licensed and registered in the state of Texas herein referred to as Registered Professional for Special Inspections (RPSI), who will be employed by or retained by Testing Agency or other entity furnishing Special Inspectors.

C. Soil, concrete, masonry, mortar, grout, steel and aluminum related testing.
   1. The Testing Agency shall have a minimum of 10 years experience in the testing of the materials indicated.
   2. The Testing Agency's technician(s) performing such testing:
      a. Shall have a minimum of five years experience in the testing of soil, concrete, mortar, grout, steel and aluminum as appropriate.
   3. Concrete Related Work:
      a. International Code Council certification for Reinforced Concrete and American Concrete Institute Concrete Field Testing Technician – Grade 1.

D. Structural Special Inspections:
   1. Professional engineers or architects, licensed and registered in the state of Texas, may perform Special Inspections in accordance with their licensure.
   2. Other individuals, working under the direct supervision of a licensed, registered, professional engineer or architect and possessing the following qualifications, may perform Special Inspections.
   3. Soils Related Work:
      a. NICET Level II Certification in geotechnical engineering technology/construction; or
      b. Professional geologist licensed and registered in the same jurisdiction as the Site; or
      c. Engineer intern, also known as an Engineer in Training (EIT) (i.e., a person who has successfully passed the EIT exam that is part of the overall process of becoming a licensed, registered professional engineer, serving under the direct supervision of professional engineer licensed and registered in the same jurisdiction as the Site).
   4. Concrete Related Work:
      a. International Code Council certification for Reinforced Concrete Special Inspector; or
      b. American Concrete Institute Concrete Construction Special Inspector; or
      c. Engineer intern/EIT under the direct supervision of a professional engineer licensed and registered in the same jurisdiction as the Site possessing not less than two years' of appropriate training, relevant experience, or a combination thereof.
   5. Masonry Related Work:
      a. Certified by International Code Council or American Concrete Institute for structural masonry and possess not less than one year of related experience; or
      b. Engineer intern/EIT under the direct supervision of a professional engineer licensed and registered in the same jurisdiction as the Site possessing not less than two years' of appropriate training, relevant experience, or a combination thereof.
   6. Steel and Aluminum Related Work:
      a. Frame and material verification perSection 1705.2 of the applicable building code.
      b. Welding:
         1) American Welding Society Certified Welding Inspector; or

2) International Code Council Structural Steel and Welding Certification and American Welding Society-qualified, and possessing not less than one year of related experience; or
3) Non-Destructive Testing (NDT) Level II or III Certificate (for non-destructive testing only).

c. High strength bolting:
1) International Code Council Structural Steel and Welding Certification, and possessing not less than one year of related experience; or
2) Engineer intern/EIT under the direct supervision of a professional engineer licensed and registered in the same jurisdiction as the Site with appropriate training and experience.

7. Other equivalent certifications are unacceptable unless approved by Engineer.

1.2 REPORTING DUTIES AND AUTHORITY

A. Reporting requirements for Special Inspector in accordance with the applicable building code for Building System Related Work.
1. Comply with requirements of applicable building code Section 1704.2.4.
2. Provide written documentation of all inspections and testing, including results, performed by Testing Agency and Special Inspectors.
a. Indicate exact location of the subject Work.
b. If testing of specimens is performed, include detailed information on storage and curing of specimens prior to testing.
3. Furnish inspection and test reports to Contractor, RDPRC, and Engineer.
a. Expressly indicate whether the Work inspected was performed in accordance with the Contract Documents.
b. Immediately report defective Work to Contractor, RDPRC, and Engineer.
c. If the defective Work is not remedied promptly, notify RDPRC and Engineer.
4. Issue a report, as an Electronic Document, summarizing all inspections, corrective action notifications and resolution of defective Work every 14 days.
a. Furnish reports to:
1) Engineer's project manager.
2) Owner.
3) Building Code Official.
4) Contractor.
5. Prior to requesting inspection for Substantial Completion, the RDPRC shall compile all test reports for each inspected material and work result for each Special Inspector and summarize in a single Electronic Document (as a PDF file) and submit to Engineer and Building Code Official.
a. Final summary report shall be sealed and signed by the RDPRC, who shall be licensed and registered in the same jurisdiction as the Site, for Special Inspections, stating:
1) The required Special Inspections have been performed.
2) All defective Work has been remedied to comply with the Contract Documents except as specifically indicated in the summary report.

B. Special Inspector shall report all defective Work to Contractor, RDPRC, and Engineer promptly.
1. Defective Work that has been covered up or concealed prior to re-inspection shall be reported to Engineer and RDPRC.

C. Special Inspector does not have authority to order stopping or suspending the Work or modify the requirements of the Contract Documents.

1.3 MATERIAL SPECIFIC SPECIAL INSPECTIONS AND TESTS

A. Material specific requirements for Special Inspection and testing are indicated in the Specifications listed below. Special Inspection and testing requirements are indicated in the

associated Specifications section under "Source Quality Control", "Field Quality Control" or "Quality Assurance" as appropriate for each material.

1.4 SOILS

A. Special Inspections will be performed in accordance with applicable building code Section 1705.6 as required to determine that subgrades were prepared in accordance with the Contract Documents, and to verify the allowable soil bearing pressure, materials, compaction densities, trenching and backfill and compliance with the Contract Documents.

B. Inspection and testing requirements are indicated separately in the Division 31 Specifications and are indicated as being performed by the Geotechnical Special Inspector or Consultant (which may potentially not be indicated using initial capital letters in the referenced Specifications), Testing Agency, or Special Inspector.

1.5 CAST IN PLACE DEEP FOUNDATIONS

A. Special Inspections will be performed in accordance with applicable building code Section 1705.8 and Table 1705.8 as required to determine that the deep foundations were provided in accordance with the Contract Documents.

B. Inspection requirements are indicated in Specifications Section 31 63 29 – Drilled Piers and are the responsibility of Geotechnical Special Inspector or Consultant (which may potentially not be indicated using initial capital letters in the referenced Specifications).

1.6 CONCRETE

A. Special Inspection and testing will be performed in accordance with applicable building code Table 1705.3. Inspection is required for material verification, reinforcing steel size and layout, reinforcing steel mechanical splices, embedded bolts, concrete tests, concrete placement and curing, and waterstop installation.
   1. Inspections of welding of reinforcing shall be in accordance with AWS D1.4 and special inspector shall be qualified under AWS D1.4.

B. Inspection and testing requirements are indicated in Specifications Section 03 05 05 - Concrete Testing and Inspection and Specifications Section 03 31 31 - Concrete Mixing, Jointing, Placing and Curing, and are indicated as services to be performed by the Special Inspector or Testing Agency.

1.7 MASONRY

A. Special Inspections and testing will be performed in accordance with applicable building code Section 1705.4 and TMS 402/602 Table 3.1 (Level 2)]. Inspection is required for material tests and verification, reinforcing steel, embedded bolts and anchorages, grouting, and welding of reinforcing.

B. Inspection and testing requirements are indicated in Specifications Section 04 22 00 - Concrete Masonry, and are indicated as the responsibility of the Special Inspector.

1.8 STEEL, STAINLESS STEEL, AND ALUMINUM

A. Special Inspections will be performed for structural steel and aluminum in accordance with applicable building code Section 1705.2 and AISC 360 Chapter N and Aluminum Design Manual Chapter N. Inspection is required for material verification, high-strength bolting, welding and other Work shown or indicated in the Contract Documents.

B. Inspection and testing requirements are indicated in Specifications Section 05 14 00 - Structural Aluminum and Section 05 50 00 - Metal Fabrications, and are indicated as the responsibility of the Special Inspector. Inspection requirements are applicable to aluminum, stainless steel, and structural steel.

C. Inspection and testing requirements of cold-formed steel are required only when connections are made by welding.

END OF ATTACHMENT B

SECTION 01 51 05
TEMPORARY UTILITIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Temporary electricity.
2. Temporary lighting.
3. Temporary communications.
4. Temporary heating, cooling, ventilating, and temporary enclosures.
5. Temporary water supply.
6. Temporary sanitary facilities.
7. Temporary first-aid facilities.
8. Temporary fire protection.

B. Scope:
1. Contractor shall provide all temporary utilities and temporary facilities required for the Project, including those indicated in this Specifications section.
2. Make all arrangements with utility owners for temporary utilities and with others as appropriate for temporary facilities. Obtain required permits and approvals for temporary utilities and temporary facilities.
3. Pay all service costs for utilities and facilities indicated in this Specifications section as Contractor's responsibility, including cost of electricity, water, fuel, and other utility services and temporary facilities required for the Work.
4. Continuously maintain adequate temporary utilities and temporary facilities for all purposes for the Project, until removal of temporary utilities and temporary facilities. At minimum, provide and maintain temporary utilities and temporary facilities through Substantial Completion and removal of temporary field offices and sheds unless otherwise approved in writing by Engineer.
5. Should Owner occupy part of the Work prior to Substantial Completion of the entire Work, cost of utilities consumed via temporary utilities serving the portion occupied by Owner will be shared proportionately by Owner and Contractor as mutually agreed to by the parties.
6. Maintain, including cleaning, temporary utilities and temporary facilities, and continuously provide consumables as necessary.
7. Temporary utilities and temporary facilities shall be adequate for personnel using the Site and the needs of the Project.
8. Provide temporary utilities and temporary facilities in compliance with Laws and Regulations and requirements of authorities having jurisdiction and, when applicable, requirements of utility owners.

1.2 REQUIREMENTS FOR TEMPORARY UTILITIES AND TEMPORARY FACILITIES

A. Temporary Electricity:
1. Provide temporary electric service necessary for the Work, including continuous power for temporary field offices and sheds. Provide temporary outlets with circuit breaker protection and ground fault protection.

B. Temporary Lighting:
1. Provide temporary lighting at the Site of not less than the greater of (1) Laws and Regulations, and (2) the following:
   a. Five foot-candles for open areas, 10 foot-candles for shops 25 foot-candles for stairs.
   b. Provide not less than one, 300 W lamp every 15 feet in indoor work areas.
   c. Where temporary lighting is required in office or laboratory areas occupied by Owner: 40 foot-candles at a height of 2.5 feet above the finished floor.

d. Night Security Lighting: Five foot-candles within 50 feet of all parts of the Site during hours of darkness, controlled by photocell.

2. Do not work in areas with insufficient lighting. Where lighting is insufficient for the work activities to be performed, provide additional temporary lighting.
3. Provide temporary lighting sufficient for observation of the Work by Engineer and inspection by Contractor, entities performing code-required tests and special inspections, and authorities having jurisdiction. Where required by Engineer, provide additional temporary lighting.

C. Temporary Communications:
1. Provide temporary telephone and high-speed internet service and communications necessary for Contractor's operations at the Site and for summoning emergency medical assistance and other first-responders as necessary.

D. Temporary Heating, Cooling, Ventilating, and Enclosures:
1. Provide sufficient temporary heating, cooling, and ventilating and temporary enclosures to ensure safe working conditions and prevent damage to existing property and the Work.
2. Except where otherwise specified, temporary heating shall maintain temperature of the space served between 50 degrees F and maximum design temperature of building or facility and its contents.
3. Maintain temperature of areas occupied by Owner's personnel or electronic equipment, including offices, lunch rooms, locker rooms, toilet rooms, and rooms containing computers, microprocessors, and control equipment, between 65 degrees F and 75 DEGF with relative humidity less than 65%.
4. Required temperature range for storage areas and certain elements of the Work, including preparation of materials and surfaces, installation or application, and curing as applicable, shall be in accordance with the Contract Documents for the associated Work and the Supplier's recommended temperature and humidity ranges for storage, application, or installation, as appropriate.
5. Provide temporary ventilation sufficient to prevent accumulation in construction areas and areas occupied by Owner of hazardous and nuisance levels or concentrations of dust and particulates, mist, fumes, vapors, odors, and gases, associated with construction. Similarly, provide temporary ventilation for building or structure spaces temporarily without ventilation due to the Work.
6. Temporary Enclosures:
   a. Provide temporary enclosures and partitions required to maintain required temperature and humidity.
   b. Temporary enclosures shall be sufficiently sturdy and durable for the intended use and duration... Maintain and repair temporary enclosures as necessary.

E. Temporary Water:
1. General:
   a. Provide temporary water service and facilities including piping, valves, meters if not provided by owner of existing waterline, backflow preventers, pressure regulators, and other appurtenances. Provide freeze-protection as necessary to prevent freezing of temporary services.
   b. Continuously maintain adequate water flow and pressure for all purposes during the Project, until removal of temporary water systems.
2. Water for Construction Purposes:
   a. Provide water for Site maintenance and cleaning and, water necessary for construction activities, and water for disinfecting and testing of systems.
   b. Contractor may use existing hose bibs for short-term wash-downs and intermittent use of water for work areas in existing building and existing structures. Obtain consent of Engineer and Owner if connections to existing hose bibs and similar existing connections will be used for more than one day at a time.
3. Water for Human Consumption and Sanitation:

a. Provide potable water in accordance with Laws and Regulations for consumption by personnel at the Site, for field offices, and for sanitary facilities.
b. When necessary, provide bottled, potable water for use and consumption by personnel at the Site, including Contractor, Engineer, and visitors to the Site.
c. Contractor may connect to onsite potable water piping. Coordinate tapping and metering requirements with Owner during Construction.

F. Temporary Sanitary Facilities:
1. Provide suitably-enclosed chemical or self-contained toilets for Contractor's employees, Subcontractors, Suppliers, Engineer, and visitors to the Site. Location of temporary toilets shall be acceptable to Owner and Engineer.
a. In addition to above toilets, the Contractor's field office trailer sanitary drain may be routed to an onsite manhole to be approved by Owner during Construction.
2. Refer to Paragraph 1.2.E of this Specification Section for requirements for temporary water service intended for human consumption during construction.
3. Provide suitable temporary washing facilities for employees and visitors.

G. Temporary First-aid Facilities.
1. Provide temporary first-aid stations at or immediately adjacent to the Site's work areas, and inside Contractor's field office. Locations of temporary first-aid stations shall be determined by Contractor's safety representative. Replenish supplies in first-aid stations as items are used, prior to expiration of items, and as necessary. Monitor and log inventory of supplies in temporary first-aid stations [not less than once per week].
2. Provide list of emergency telephone numbers at each hardwired telephone at the Site.

H. Temporary Fire Protection.
1. Provide temporary fire protection in accordance with Laws and Regulations and the requirements of this Specifications section.
2. For work areas without standpipe fire protection systems, during construction provide portable fire extinguishers rated not less than 2A or 5B in accordance with NFPA 10 – Portable Fire Extinguishers, for each temporary building and for every 3,000 square feet of floor area under construction.
3. Provide Class A (ordinary combustibles), Class B (combustible liquids and gases), and Class C (electrical equipment) fire extinguishers as necessary.
4. Comply with NFPA 241 – Standard for Safeguarding Construction, Alternation, and Demolition Operations, and requirements of fire marshals and authorities having jurisdiction at the Site.

1.3 USE OF OWNER'S SYSTEM

A. Existing Utility Systems: Do not use systems in existing buildings or structures for temporary utilities without Owner's written permission and mutually acceptable basis agreed upon by the parties for proportionate sharing of costs between Owner and Contractor.

B. Use of Permanent Utility Systems Provided Under the Project:
1. Permanent electrical, lighting, water, heating, ventilating, and fire protection systems and first-aid facilities may be used to provide temporary utilities and temporary facilities if the following are met:
a. Obtain Owner's written permission to use permanent systems.
b. Permanent systems to be used for temporary utilities or temporary facilities shall be substantially complete, including complete functionality of all controls. Engineer will not certify Substantial Completion for facilities and systems used solely by Contractor during construction.
c. Contractor shall pay all costs while using permanent system, including operation, maintenance, replacement of consumables, and provide replacement parts.
2. Do not use the following permanent facilities:
a. Telephone and communication facilities.
b. Sanitary facilities.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials and equipment for temporary utilities and temporary facilities:
   1. may be new or used but, if used, shall be in good condition;
   2. shall be adequate for purposes intended;
   3. shall not create unsafe or unsanitary conditions; and
   4. shall comply with Laws and Regulations.

B. Provide required materials, equipment, and facilities, including piping, cabling, supports, controls, and appurtenances.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install temporary utilities and temporary facilities in neat, orderly, manner, and make structurally, mechanically, and electrically sound throughout.

B. Location of Temporary Utilities and Temporary Facilities:
   1. Locate temporary systems for proper function and service.
   2. Temporary systems shall not interfere with or provide hazards or nuisances to: the Work under this and other contracts, movement of personnel, traffic areas, materials handling, hoisting systems, storage areas, finishes, and work of utility owners and others.
   3. Do not install temporary utilities on the ground, with the exception of temporary extension cords, hoses, and similar systems in place for short durations.

C. Modify and extend temporary systems as required by progress of the Work.

3.2 USE

A. Maintain temporary systems to provide safe, continuous service as necessary and as required.

B. Properly supervise operation of temporary systems:
   1. Enforce compliance with Laws and Regulations.
   2. Enforce safe practices.
   3. Prevent abuse of services.
   4. Prevent nuisances and hazards caused by temporary systems and their use.
   5. Prevent damage to finishes.
   6. Ensure that temporary systems and equipment do not interrupt continuous progress of construction.

C. At end of each work day, check temporary systems and verify that sufficient consumables are available to maintain operation until work is resumed at the Site. Provide additional consumables if the supply on hand is insufficient for continuous operation.

3.3 REMOVAL

A. Completely remove temporary utilities, temporary facilities, equipment, and materials when no longer required. Repair damage caused by temporary systems and their removal and restore the Site to condition required by the Contract Documents; if restoration of damaged areas is not otherwise specified, restore to preconstruction condition.

B. Where temporary utilities are disconnected from existing utility, provide suitable, watertight or gastight (as applicable) cap or blind flange, as applicable, on service line, in accordance with requirements of utility owner. If utility owner will perform such work, coordinate with and pay utility owner for such work.

C. Where permanent utilities and systems were used for temporary utilities, upon Substantial Completion replace all consumables such as filters and light bulbs and parts used during the Work.

SECTION 01 52 13
CONTRACTOR'S FIELD OFFICE AND SHEDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. General requirements for:
      a. Contractor's field office at the Site.
      b. Contractor's storage and work sheds.
      c. Maintenance and removal of Contractor's field offices and sheds and associated restoration.

B. Scope:
   1. Contractor shall provide temporary field office for Contractor's use during the Work.
   2. Provide required temporary storage and work sheds.
   3. Obtain and pay for required permits and utilities.

C. Related Requirements:
   1. Section 01 11 00 - Summary of Work.
   2. Section 01 14 19 - Use of Site.
   3. Section 01 51 05 - Temporary Utilities.
   4. Section 01 66 00 - Product Storage and Handling Requirements.
   5. Section 01 71 33 - Protection of the Work and Property.
   6. Section 01 78 39 - Project Record Documents.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate with Owner, facility manager (if other than Owner), other contractors, and others using the Site, location of field offices and sheds, including contracts and projects indicated in Section 01 11 00 – Summary of Work.

B. Staffing:
   1. Not less than one Contractor staff member shall be reasonably present at, or in reasonable proximity to, Contractor's field office during normal working hours when work is in progress.
   2. When Contractor's staff are absent from, and not within reasonable proximity to, Contractor's field office, provide clearly legible sign, each entrance to Contractor's field office, indicating specific location onsite of Contractor's site superintendent, together with (a) valid mobile phone number of Contractor's site superintendent, and (b) Contractor's 24-hour emergency contact telephone number.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S FIELD OFFICE

A. Structure:.
   1. Provide for Contractor's field office structurally sound, weathertight, temporary structures in good condition, complying with Laws and Regulations, and suitable for the intended purpose and environment.
   2. Where field office and sheds will be occupied, whether regularly or on an interim basis, comply with Laws and Regulations governing accessibility, egress, fire detection and prevention, and other Laws and Regulations related to health and safety.
   3. Size and layout of Contractor's temporary field office and sheds to be determined by Contractor and appropriate for Contractor's purposes. .

B. Temporary Utilities and Related Items – Materials and Equipment:
   1. Provide materials and equipment for temporary utilities, temporary lighting, temporary control of temperature and ventilation, temporary fire protection, temporary sanitary facilities, and temporary first-aid facilities, in accordance with Section 01 51 05 – Temporary Utilities.

C. Furnishings and Equipment:
   1. Sign for Field Office:
      a. Provide on exterior of Contractor's field office, at location plainly visible for visitors, an identification sign displaying Contractor's company name.
      b. Maximum size of sign shall be four feet by three feet.
      c. Provide highly-visible, plainly legible, text on contrasting background color.
      d. Sign shall be suitable for outdoor use for the duration of the Project.
   2. Provide other furnishings and equipment deemed necessary and appropriate by Contractor.
   3. Personal Protective Equipment for Use by Visitors:
      a. Furnish and maintain at Contractor's field office 10 protective helmets ('hard hats" and other, appropriate personal protective equipment deemed necessary by Contractor, for use by visitors to the Site.

2.2 CONTRACTOR'S STORAGE SHEDS AND WORK SHEDS

A. Storage and Work Sheds – General:
   1. Provide storage and work sheds sized, furnished, and equipped to accommodate personnel, materials, and equipment used in the Work, including temporary utility services and facilities necessary for environment and sufficient for personnel, materials, and equipment.
   2. Provide in accordance with Laws and Regulations.
   3. Storage sheds used for storing materials and equipment to be incorporated into the Work shall comply with Section 01 66 00 – Product Storage and Handling Requirements, and other requirements of the Contract Documents.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Location:
   1. Locate Contractor's field office and sheds in accordance with Section 01 14 19 – Use of Site, other relevant provisions of the Contract Documents, and decisions made during site mobilization discussions at the preconstruction conference.

B. Installation:
   1. Install Contractor's temporary field office, sheds, and related facilities in accordance with Laws and Regulations.
   2. Install materials and equipment, including prefabricated structures, in accordance with manufacturer's instructions.
   3. Provide temporary utilities in accordance with Section 01 51 05 – Temporary Utilities, and requirements of utility owner.

C. Provide the following in Contractor's field office at the Site:
   1. Not less than one complete set of the Contract Documents, Submittals approved or accepted (as applicable) by Engineer, Engineer's interpretations and clarifications, copies of Contractor's daily field reports, all necessary and required safety data sheets, copies of documents comprising Contractor's safety program, and copies of applicable permits issued for the Work by authorities having jurisdiction, for ready reference by interested persons,
   2. In addition to the reference set of Contract Documents, comply with Section 01 78 39 – Project Record Documents and provisions of the General Conditions, as may be modified by the Supplementary Conditions, regarding Project record documents.

3.2 MAINTENANCE

A. Clean and maintain field offices and sheds as necessary.

B. Provide consumables as necessary.

3.3 REMOVAL AND RESTORATION

A. Removal:
   1. Do not remove temporary field offices and sheds until after Substantial Completion of the entire Work, unless otherwise approved by Engineer.
   2. Fully remove field offices and sheds and restore areas prior to final inspection.

B. Restoration:
   1. Restore to preconstruction conditions areas damaged by Contractor while installing and using temporary field offices and sheds, subject to approval of the owner of affected property. Remedy damage in accordance with Section 01 71 33 - Protection of the Work and Property, and other provisions of the Contract Documents.

END OF SECTION

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SECTION 01 52 53
FACILITY - TEMPORARY PUMPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Requirements for temporary pumping at facilities such as treatment plants and pump stations.

B. Scope:
   1. Contractor shall provide all labor, materials, tools, equipment, and incidentals shown or indicated for temporary pumping and handling of fluids and slurries during the Project.
   2. This Section does not apply to dewatering of excavations, which is addressed in the Division 31 Specifications.
   3. This Section does not address temporary handling of storm water runoff at the Site, which is addressed in Section 01 57 05 - Temporary Controls.

C. Related Requirements: Include, but are not necessarily limited to, the following:
   1. Section 01 14 16 - Coordination with Owner's Operations.
   2. Section 01 35 44 - Spill Prevention Control and Countermeasures Plan.
   3. Section 01 57 05 - Temporary Controls.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate with Owner, facility manager (if other than Owner), other contractors, and others using the Site, the locations of temporary pumping systems and appurtenances.

B. Scheduling and Sequencing:
   1. Include on the Progress Schedule separate activities for set up, check out, and testing of each temporary pumping system; operation of each temporary pumping system; removal of temporary pumping system; and associated restoration.
   2. Where necessary include on the Progress Schedule separate activities for shut downs, installation, and removal of temporary plugs, bulkheads, and line stops, and other Work associated with temporary pumping.
   3. Submit Progress Schedule with required temporary pumping activities prior to furnishing temporary pumping Submittal required by this Section.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Provide, operate, and maintain temporary pumping systems in accordance with Laws and Regulations.
   2. Comply with Laws and Regulations relative to locations of temporary pumping systems (including effect, if any, on public transportation routes and facilities and private property), secondary containment (regarding temporary fuel storage), air quality (relative to emissions from internal combustion engines), water quality (regarding leakage and cleanout of temporary pumping systems), compliance with facility operating permits, and other matters.
   3. Onsite fuel storage for temporary pumping systems shall be included in Contractor's spill prevention control and countermeasures plan required by Section 01 35 44 – Spill Prevention Control and Countermeasures Plan.

B. Qualifications:
   1. Temporary Pumping System Supplier or Subcontractor:
      a. Retain a single Supplier or Subcontractor to furnish, install, operate, and remove temporary pumping systems required for the Project.

b. Supplier or Subcontractor shall possess not less than five years of experience providing temporary pumping systems similar in size or larger than those required for the Project.
c. Upon request, submit evidence of having previously provided not less than five temporary pumping systems on other projects similar in size (or larger) and similar in service to temporary pumping systems required for the Project.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
1. Temporary pumping plan:
a. Submit the following for each required temporary pumping system not less than 30 days prior to delivery of temporary pumping system to the Site:
1) Layout Drawings:
a) Sketches showing proposed layout of temporary pumping system, including locations of temporary plugs, bulkheads, and line stops; suction and discharge locations; location of pumps and associated piping and valves; and source of power for temporary pumping system. Sketches shall be scale drawings acceptable to Engineer, and shall include site plans similar to those in the Contract Documents.
b) Details of system suction and discharge locations. Discharge details shall include measures to protect the receiving structure and dissipate energy.
c) Where temporary lines will be buried, submit trench details. Submit sketches and information on other types of protection proposed for temporary piping.
2) System curve of flow plotted against total dynamic head, and calculations that substantiate the proposed temporary pumping system, including comparison of net positive suction head required and net positive suction head available.
3) Manufacturer's data and specifications on each type and size of pump proposed and its capacity, including pump curves.
4) Manufacturer's data and specifications for engines and other equipment required for temporary pumping system, including expected exhaust emissions data. Furnish information on emissions air pollution control system, when proposed, together with expected air quality of emissions.
5) Technical information and specifications on noise controls for noise-emitting equipment.
6) Technical data on temporary piping, pipe joints, valves, pipe supports, controls, flow meter, secondary containment for fuel tanks, and other information pertinent to the temporary pumping system.
7) Temporary Plugs, Bulkheads, and Line Stops: Manufacturer's literature and fabrication drawings showing type of plug, bulkhead or line stop as applicable, materials, and hydrostatic head that the plug, bulkhead, or line stop is designed to withstand. Submit complete technical information for Contractor-proposed line stops, line stop manufacturer's name and product data for line stops proposed, installation procedures, name of proposed line stop installer, and documentation of experience on at least five similar projects.
8) Narrative describing proposed operation of temporary pumping system, including who will operate system, staffing, planned frequency of fueling, contingency plan in event of pump failure, and statement of existing systems that may be affected during operation of temporary pumping system. Where temporary pumping system's instrumentation and controls will be connected to Owner's existing facility monitoring and control system, clearly indicate how and where such temporary connection will be performed and other information necessary to demonstrate compliance with the Contract Documents.
b. Disclaimer and Limitations of Engineer's review: Engineer's review, comments (if any), and approval (or other appropriate action) on the temporary pumping plan Submittal are only for the limited purposes of endeavoring to verify compliance with the Contract Documents. Engineer's review will not address calculations for the

temporary pumping system, sizing of components of temporary pumping systems, or other matters that are part of Contractor's construction means, methods, procedures, techniques, and sequences, for which Contractor remains solely responsible, together with associated safety and protection measures.

B. Informational Submittals: Submit the following:
   1. Qualifications Statements:
      a. Temporary pumping system Supplier or Subcontractor.

PART 2 - PRODUCTS

2.1 TEMPORARY PUMPING SYSTEMS

A. Suppliers:
   1. Subject to compliance with the Contract Documents, provide temporary pumping systems by one of the following:
      a. Godwin, a Xylem brand.
      b. Western Oilfields Supply Company doing business as Rain for Rent.
      c. Or equal.

B. Description:
   1. Design, provide, and maintain temporary pumping systems, including temporary plugs, bulkheads, and line stops as necessary or required; pumps; piping, supports, restraints, and valves; temporary instrumentation and control systems; fuel and electricity; personnel; and appurtenances. System shall be suitable for its service and operating environment.

C. Performance Criteria:
   1. Required capacity of temporary pumping systems is indicated in Section 01 14 16 - Coordination with Owner's Operations. Provide each temporary pumping system of required capacity with not less than the largest pump out of service.
   2. System components shall be suitable for continuous operation with the fluid or slurry pumped.
   3. Noise Controls: Provide noise controls for temporary pumping systems. Noise emitted from temporary pumping systems shall comply with Laws and Regulations and shall not exceed 70 decibels at a distance of thirty feet from noise source.
      a.
   4. Fuel-consuming temporary pumping system components intended for use when Contractor is not present shall include fuel tanks sized for not less than 24 hours of uninterrupted operation at system's operating capacity, and means to automatically notify Contractor upon high and low suction water level and low fuel level.

D. Operation:
   1. Instrumentation and Controls:
      a. Provide each temporary pumping system with flow meter acceptable to Engineer and suitable for pumped fluid or slurry, pipe material, and hydraulic conditions. Flow meter shall provide accurate flow measurement and include local display of flow rate in gallons per minute or million gallons per day as required, and be capable of providing 4 to 20 mA vdc output signal for flow rate.
      b. Controls: Provide controls for temporary pumping systems in accordance with Section 01 14 16 - Coordination with Owner's Operations.

E. Temporary Piping Systems:
   1. Piping shall be high density polyethylene, steel, ductile iron, or other material accepted by Engineer, and suitable for system operating pressures. Aluminum piping and PVC piping not mechanically restrained are unacceptable. Durable hoses can be used only for short sections and with acceptance by Engineer.

2. Piping systems shall have watertight joints of the following types: fused joints, restrained couplings, flanged coupling adapters, quick-connects by Camlok or equal, flanged joints, grooved and shouldered end-type couplings, or other watertight joints accepted by Engineer.
3. Size discharge piping for flow velocity of not more than 10 feet per second.
4. Provide check valves or appropriate pump control valves as necessary.
5. Provide air valves on discharge piping as necessary. Air valves shall expel air upon pipe filling and admit air upon pipe dewatering, and release small quantities of entrained air during operation. Air valves shall be suitable for service with the pumped fluid or slurry.
6. Discharge from temporary pumping systems shall not adversely affect the existing process or facilities. Provide energy-dissipating measures at piping discharge as necessary.

F. Temporary Plugs, Bulkheads, and Line Stops:
1. Acceptable temporary plugs and bulkheads include inflatable dams specifically designed for such service, brick bulkheads, timber bulkheads, sandbags, and other bulkhead methods suitable for the service and conduit conditions. Temporary line stops, where necessary or required, shall be manufactured units specifically intended for use as line stops.
2. Each temporary plug, bulkhead, and line stop shall be suitable for the maximum pressure encountered.
3. Where temporary plugs and bulkheads are under pressure or surcharged, provide either two plugs or a plug and temporary bulkhead.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Preparation and Installation of Temporary Pumping Systems:
1. Temporary piping shall be located off of roads, drives, other travelled ways, and sidewalks. Piping shall not be located in environmentally-sensitive areas such as wetlands.
2. Where required for Owner's access to and operation of existing facilities, bury temporary piping that would otherwise inhibit access to processes, buildings, structures, roads, drives, and travelled ways. In paved areas, provide temporary surfacing, sufficient for AASHTO H-20 wheel loads over buried temporary piping.
3. Install temporary pumping systems in accordance with written instructions of manufacturer of system component, Laws and Regulations, and requirements of temporary pumping system Supplier.
4. Hydrostatic Testing of Temporary Piping System:
   a. Perform successful hydrostatic testing of temporary piping systems using clean water at pressure equal to 1.2 times highest expected system operating pressure, for one hour while maintaining test pressure within 3.0 psig of required test pressure.
   b. RPR will witness hydrostatic test.
   c. Hydrostatic test criteria for acceptance: No leakage.
5. Verify that entire temporary pumping system is ready for operation before commencing shutdown of Owner's operations, facilities, or systems. Verify that temporary pumping system controls and flow meter are properly connected and functional.
6. Furnish to Owner, facility manager (if other than Owner), and Engineer written advisory of intent to commence temporary pumping system operation in accordance with Section 01 14 16 - Coordination with Owner's Operations.

3.2 OPERATION OF TEMPORARY PUMPING SYSTEMS

A. During Operation of the Temporary Pumping Systems:
1. Temporary pumping system shall operate continuously unless otherwise indicated. In the event of equipment failure, immediately make repairs or replace equipment. Provide spare parts and redundant units as necessary for continuous operation.
2. Provide personnel to monitor, operate, and maintain temporary pumping system 24 hours per day when system is in service.

3.3 DEMOBILIZATION

A. Upon Conclusion of Temporary Pumping:
   1. Remove temporary plugs, bulkheads, and line stops in manner that allows flow to slowly return to normal, without surging, surcharging, and adverse effects on existing system. Completely remove all elements of temporary plugs, bulkheads, and line stops.
   2. Flush out temporary pumping system with clean water discharged to an appropriate location.
   3. Remove temporary pumping system and appurtenances from the Site.
   4. When Contractor has obtained permit(s) for temporary pumping from authorities having jurisdiction, furnish written notice to such authorities that temporary pumping has been completed.

END OF SECTION

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SECTION 01 55 13
VEHICULAR ACCESS AND PARKING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. General requirements for:
      a. Contractor's access to the Site.
      b. Contractor's use of existing access roads and parking areas.
      c. Temporary access roads and parking areas.
      d. Traffic controls for access roads and parking areas.
      e. Maintenance of vehicle access roads and parking areas.
      f. Offsite haul routes.
      g. Removals and restoration.

B. Scope:
   1. Contractor shall provide temporary signage on existing access roads, construction roads, walks, parking areas, and appurtenances necessary and required during the Project for use by Contractor, Owner and entities for which they are responsible, and emergency vehicles.
   2. Temporary access roads and parking areas shall be designed and maintained by Contractor and shall be fully passable to vehicles in all weather conditions.
   3. After the entire Project is substantially complete, existing access roads and parking areas may be used by Contractor when such use does not impair or restrict operations at the Site by Owner or facility manager.
   4. Contractor shall make arrangement for offsite haul routes and shall comply with restrictions on haul routes imposed by authorities having jurisdiction and the Contract Documents.

C. Related Requirements:
   1. Include but are not necessarily limited to:
      a. Section 01 14 19 - Use of Site.
      b. Section 01 57 05 - Temporary Controls.
      c. Section 01 71 33 - Protection of the Work and Property.
      d. Section 01 74 00 - Cleaning.

1.2 SUBMITTALS

A. Informational Submittals: Submit the following:
   1. Map of proposed offsite haul routes, together with list of right-of-way owner for each roadway proposed as offsite haul routes and indication of other authorities, if any, having jurisdiction over offsite haul routes. Furnish such Submittal, acceptable to Engineer, prior to furnishing the Submittals indicated immediately below this paragraph.
   2. Written permit or permission for use of offsite haul routes, issued by authorities having jurisdiction. Furnish such Submittals acceptable to Engineer prior to commencing use of offsite haul routes.

PART 2 - PRODUCTS

2.1 TEMPORARY ACCESS ROADS AND PARKING AREAS

A. Materials:
   1. Temporary access roads and parking areas shall be of materials that are either new or of good quality and sufficient for the intended purpose, load-bearing capacity, and frequency and duration of use.

2. Use materials that limit emissions of dust to be consistent with air quality Laws and Regulations and to avoid creating nuisances, inconvenience, and undue additional maintenance requirements onsite, on adjacent properties, and at downwind properties.
3. Where deemed necessary by Contractor, provide temporary geotextile or other appropriate materials to stabilize subgrade and subbase of temporary access roads and parking areas.

2.2 TEMPORARY TRAFFIC CONTROLS FOR ACCESS ROADS AND PARKING AREAS

A. Traffic controls shall comply with requirements of authorities having jurisdiction. When such authority is Owner or facility manager (if other than Owner), and no other applicable requirements are indicated in the Contract Documents or applicable permits, comply with:
   1. Standard specifications of the associated state or provincial (as applicable) department of transportation; and
   2. Manual of Uniform Traffic Control Devices (MUTCD), by the United States Department of Transportation (USDOT) Federal Highway Administration (FHWA).

2.3 TEMPORARY ACCESS GATES

A. Temporary Access Gates – General:
   1. Provide temporary gates appropriate for construction of the Project and passage of necessary construction vehicles, construction equipment and machinery, deliveries of temporary facilities, and deliveries of materials and equipment to be incorporated into the Work.

PART 3 - EXECUTION

3.1 ACCESS TO THE SITE

3.2 USE OF EXISTING ACCESS ROADS AND PARKING AREAS

A. Existing Access Roads and Parking Areas – General:
   1. Use of Existing Access Roads:
      a. Contractor is allowed to use Owner's existing access roads, starting on the Effective Date of the Contract and after complying with other Contract requirements relative to starting the Work at the Site.
   2. Existing Parking Areas for Use by Contractor:
      a. Contractor is allowed use of the existing open grass area adjacent to the plant road for parking of Contractor's workers' vehicles and construction vehicles. If designated existing parking area is insufficient for Contractor's purposes, either provide temporary parking at the Site or parking at offsite location. Do not park outside of designated parking areas.
         1) Contractor to coordinate with Owner on availability and exact location for parking.
   3. Restrictions:
      a. Prevent interference with traffic on existing access roads and parking areas. Always keep access roads and entrances serving the Site clear and available to Owner, facility manager (if other than Owner), and their respective employees, suppliers, and consultants; emergency vehicles; and other contractors.
      b. Do not use access roads or Site entrances for parking or storage of materials or equipment.
      c. Obey posted speed limits. If the Site has no posted speed limit, restrict traffic of Contractor's personnel, construction vehicles and equipment, deliveries, and haul-trucks to maximum speed of 15 miles per hour on access roads at the Site.
      d. Schedule deliveries to minimize use of existing access roads and Site entrances.
      e. Use only rubber-tire vehicles on existing roads and parking areas. Do not use tracked (caterpillar-type) vehicles or equipment on existing pavement unless such pavement will be replaced by Contractor. Maintain existing pavement for safe access by Owner, facility manager (if other than Owner), and their respective employees, suppliers, and consultants; emergency vehicles; and other contractors.

f. Remedy damage to existing access roads and parking areas caused by Contractor's operations.

4. Contractor shall indemnify and hold harmless Owner, facility manager (if other than Owner), Engineer, and their respective consultants and subcontractors from expenses and losses caused by Contractor's operations over existing access roads and parking areas.

3.3 TEMPORARY ACCESS ROADS AND PARKING AREAS

A. Temporary Access Roads and Parking Areas – General:

1. Show proposed locations of temporary access roads and parking areas on site plan Submittal required in Section 01 14 19 - Use of Site. Indicate number of proposed parking spaces and changes (if any) to site maintenance procedures. Indicate the scheduled dates the temporary access roads and parking areas will be established, in use, and removed. Indicate proposed measures for restoring such areas after removal of temporary access roads and parking areas.
2. Where temporary access roads or parking areas connect to existing public road or highway, obtain approval of right-of-way owner prior to constructing the associated access road or connection to the existing pavement. Comply with Laws and Regulations and requirements of authorities having jurisdiction.
3. Provide temporary lighting of temporary access roads and parking areas in accordance with the Contract Documents.

B. Temporary Access Roads and Parking in Areas Different from Permanent Pavement:

1. Provide temporary access roads and parking areas adequate to support and withstand traffic loads during the Project. Locate temporary access roads and parking areas within the construction limits shown or indicated in the Contract Documents.
2. Perform clearing and grubbing as required and properly dispose of resulting materials. Stockpile at the Site existing topsoil appropriate for use in restoring disturbed areas.
3. Provide reasonably-level, graded, well-drained subgrade of satisfactory soil material, compacted to not less than 95% of maximum dry density in the upper 6 inches.
4. To support loads and provide separation between subgrade and subbase materials, provide geosynthetic separation fabric for all temporary access roads and parking areas outside of locations of permanent pavement.
5. Subbase:
   a. Provide crushed stone subbase material not less than 6 inches thick, roller-compacted to a level, smooth, dense surface.
   b. Subbase for temporary access roads and parking areas traveled by construction vehicles shall be adequate for loads and traffic served.

C. Temporary Access Roads and Parking in Same Areas as Permanent Pavement:

1. Provide temporary access roads and parking areas adequate to support and withstand traffic and construction loads during the Project. Locate temporary access roads and parking areas in same locations as permanent access roads and parking areas. Extend temporary access roads and parking areas, within construction limits shown or indicated in the Contract Documents, as necessary for construction operations.
2. Coordinate elevations of temporary access roads and parking areas with permanent roads and parking areas.
3. Prepare subgrade, subbase, and base for temporary access roads and parking areas in accordance with the Contract Documents' requirements for areas of permanent pavement.
4. Provide geosynthetic separation fabric on compacted subgrade for subbase support and separation of subbase and subgrade materials.
5. Re-condition granular subbase of temporary access roads and parking areas, including removing and properly disposing of granular material that has become intermixed with soil, re-grading, proof-rolling, compacting, and testing.

3.4 TRAFFIC CONTROLS FOR ACCESS ROADS AND PARKING AREAS

A. Onsite Traffic Controls – General:

1. Provide temporary traffic controls at intersections of temporary access roads and parking areas with each other, including intersections with other temporary access roads, intersections with public roads, and intersections with permanent access roads at the Site.
2. Provide temporary warning signs on permanent access roads, and provide temporary stop signs for traffic on temporary access roads where required and at entrances to permanent pavement.
3. Comply with requirements of authorities having jurisdiction. When such authority is the Owner or facility manager (if other than Owner), and no other requirements are indicated in the Contract Documents or applicable permits, comply with the standard specifications of the applicable state department of transportation .
4. Provide temporary signs indicated maximum allowable speed limit on temporary access roads.

3.5 MAINTENANCE OF VEHICLE ACCESS AND PARKING AREAS

A. Maintenance of Vehicle Access and Parking Areas -- General:
   1. Maintain temporary access roads and parking areas to continuously provide at the Site access for construction vehicles and trucks, Owner and facility manager's (if other than Owner) vehicles, deliveries for Owner and facility manager, emergency vehicles, and parking areas for Owner's and facility manager's personnel.
   2. Public roads shall be passable at all times unless a road closure is allowed in writing by authority having jurisdiction.
   3. Refer to cleaning and dust control provisions of this Article.

B. Maintenance of Existing Access Roads and Parking Areas Used by Contractor:
   1. Unless otherwise indicated in the Contract Documents, Owner or facility manager (if other than Owner) will perform routine maintenance of access roads and parking areas, existing prior to the start of construction, during the Project. Contractor is responsible for dust control and cleaning existing paved areas used by Contractor.

C. Maintenance of Temporary Access Roads and Parking Areas:
   1. Contractor is fully responsible for maintaining temporary access roads and parking areas until either; (a) temporary access roads and parking areas are removed, or (b) when Owner has indicated in writing that temporary access roads and parking areas may remain following final payment, Contractor shall maintain such areas until final payment becomes due under the Contract.
   2. When temporary access roads or parking areas become muddy, remove the mud and soil material down to hard, competent surface as often as necessary. Avoid nuisances and unnecessary tracking of mud and dirt onto permanent pavement.
   3. When granular material of temporary access roads and parking areas without hard surfacing becomes intermixed with soil, or when temporary access roads otherwise create a nuisance, remove intermixed granular-and-soil material and replace with clean granular material as necessary and required.
   4. Provide snow and ice removal for temporary access roads and parking areas. Properly dispose of such materials, in accordance with Laws and Regulations. Do not create traffic hazards, such as areas of reduced visibility, caused or exacerbated by locations of displaced snow and ice. Dispose of such materials off of existing pavement and off of temporary access roads and parking areas.

D. Cleaning and Dust Control -- All Vehicle Access and Parking Used by Contractor:
   1. Cleaning:
      a. Clean paved surfaces over which construction vehicles, construction equipment, and construction machinery travel. Perform cleaning not less-often than indicated in Section 01 74 00 - Cleaning, or more frequently as directed by Engineer, by mechanical sweeping or other means acceptable to Engineer.
      b. Clean paved areas using vacuum powered street sweeper, when visible soil materials are tracked onto pavement.
      c. Clean the following surfaces:

1) Roads within limits of the Project.
2) Permanent roads at the Site between the Site entrance and work areas, and between the Site entrance and construction parking and areas used for staging, storage, and laydown.
3) Public roads that require sweeping and cleaning due to construction operations.

2. Dust Control:
   a. Control dust resulting from construction activities to prevent nuisances, violations of air quality Laws or Regulations, and adverse health effects at and adjacent to the Site and in downwind areas.
   b. Comply with Section 01 57 05 - Temporary Controls.

E. Protection of Underground Facilities:
1. Regarding construction traffic, vehicles, construction equipment and machinery, and parking and protection of Underground Facilities, comply with the General Conditions, as may be modified by the Supplementary Conditions, Section 01 71 33 - Protection of the Work and Property, and other requirements of the Contract Documents.
2. Where existing Underground Facilities are close to the ground surface over which construction equipment or machinery, other construction vehicles, or traffic will pass, protect the Underground Facilities, including providing temporary bridging, as necessary.

3.6 OFFSITE HAUL ROUTES

A. Offsite Haul Routes – General:
1. Where required by Laws or Regulations, or by one or more authorities having jurisdiction, obtain, pay for, and comply with permits and orders of authorities having jurisdiction regarding use of offsite haul routes. Submit to Engineer copy of each permit or written permission necessary for use of offsite haul routes.
2. Unless expressly allowed otherwise by authorities having jurisdiction or the express provisions of the Contract Documents, to the extent practicable, avoid routing construction traffic through residential areas and other areas sensitive to noise, vibration and vehicle exhaust emissions.
3. Restrict use of offsite haul routes to days and hours of construction allowed in the General Conditions and Supplementary Conditions.
4. Comply with requests of authorities having jurisdiction relative to coordinating construction traffic on haul routes with community events. When such events are held on a recurring basis or are otherwise reasonably foreseeable at the time of the opening of Bids (or, if there were no Bids, on the Effective Date of the Contract), Contractor is not eligible for increases in Contract Price or Contract Time for delays or other inconvenience to the Work associated with this provision.
5. In transporting spoil and waste materials from the Site and transporting materials and equipment to the Site, avoid creating or contributing to potential Hazardous Environmental Conditions. Properly secure loads to prevent airborne particulates, liquids, slurries, and solid matter from discharging from Contractor's vehicles along haul routes. Contractor's responsibilities for Hazardous Environmental Condition caused by Contractor are set forth in the General Conditions, as may be modified by the Supplementary Conditions, and may be further augmented elsewhere in the Contract Documents.

B. Remedy of Damaged Existing Paving:
1. Comply with Section 01 71 33 - Protection of the Work and Property, and other applicable provisions of the Contract Documents.
2. Contractor shall indemnify and hold harmless Owner, facility manager (if other than Owner), Engineer, and their respective consultants and subcontractors from expenses and losses caused by Contractor's operations on offsite haul routes.

C. Project-Specific Haul Routes:
1. Contractor shall arrange offsite haul routes.

3.7 REMOVAL AND RESTORATION

A. Removals: When no longer needed for the Project and prior to eligibility for final inspection:
   1. Remove temporary access roads, walks, and parking areas that are not intended for, or acceptable for, integration into permanent pavement. Return areas of temporary access roads, walks, and parking to preconstruction condition unless otherwise required by the Contract Documents.
   2. Remove temporary gates, fencing, and traffic controls associated with Contractor's vehicular access and parking areas.
   3. Where areas of temporary access roads and parking will be permanently landscaped, remove pavement, granular subbase, geosynthetic materials, soil, and other materials that do not comply with the Contract Documents regarding fill, subsoil, and landscaping.
   4. Remove and properly dispose of all materials contaminated with oil, bitumen, or other petrochemical compounds resulting from Contractor's operations, and other substances. These substances are considered contaminants may impair growth of plants and lawns or quality of soil or groundwater.

B. Restoration:
   1. Restore to preconstruction conditions existing roads, walks, and parking areas damaged by Contractor, subject to approval of the owner of affected roads, walks, and parking areas. Remedy damage in accordance with Section 01 71 33 - Protection of the Work and Property, and other provisions of the Contract Documents.

END OF SECTION

SECTION 01 57 05
TEMPORARY CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Requirements for temporary controls during construction, including:
      a. Temporary erosion and sediment controls.
      b. Noise control.
      c. Dust control.
      d. Temporary pest and rodent controls.
      e. Water control, including storm water, surface water, and groundwater.
      f. Pollution control, including solid waste, water pollution, atmospheric pollution, and other types of pollution.
      g. Odor control.

B. Scope:
   1. Contractor shall provide and maintain materials, equipment, labor, services, and temporary construction as necessary and required to control environmental conditions at the Site and adjacent areas during construction.
   2. Contractor shall pay all costs, including fines and civil penalties, if any, for failure to implement and maintain temporary controls in accordance with the Contract Documents and Laws and Regulations. Contractor is not eligible for increase in Contract Price or Contract Times due to failure to comply with requirements for temporary controls.
   3. Maintain temporary controls until no longer necessary or required. Provide temporary controls at all times when Contractor is working at the Site.

C. Related Requirements:
   1. Include, but are not necessarily limited to, the following:
   2. Section 01 35 43.13 - Environmental Procedures for Hazardous Materials.
   3. Section 01 35 44 - Spill Prevention Control and Countermeasures Plan.
   4. Section 01 41 26 - Storm Water Pollution Prevention Plan and Permit.
   5. Section 01 74 00 - Cleaning.
   6. Section 31 23 05 - Excavation and Fill.
   7. Section 31 23 19 - Dewatering.
   8. Section 31 37 00 - Stone Revetment (Riprap).

1.2 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Comply with applicable provisions and recommendations of the following:
      a. Code of Ordinances, City of Lewisville, Texas.

1.3 SUBMITTALS

A. Action Submittals:
   1. Submit the following:
      a. Shop Drawings:
         1) Plan for construction staging and maintenance of the Site relative to erosion and sediment controls. Indicate on a site plan approximate areas of planned disturbance of soils and soil cover over time during the Project. For areas not indicated in the Contract Documents as being disturbed and that Contractor proposes to disturb, Shop Drawing shall include proposed erosion and sediment control measures for the additional areas.
         2) Location and details of each temporary settlement basin.

b. Product Data:
   1) Silt fencing materials.
   2) Other materials proposed for temporary erosion and sediment controls, when requested by Engineer.

B. Informational Submittals:
   1. Submit the following:
      a. Procedural Submittals:
         1) Proposed dust control measure, when Submittal is requested by Engineer.
      b. Field Quality Control:
         1) When requested by Engineer, promptly obtain and submit results of field measurements and field test data substantiating compliance of Contractor's temporary controls with the Contract Documents.

PART 2 - PRODUCTS

2.1 MATERIALS FOR TEMPORARY EROSION AND SEDIMENT CONTROLS

A. Materials for temporary erosion and sediment controls shall be as shown or indicated on the Drawings.

PART 3 - EXECUTION

3.1 NOISE CONTROL

A. Noise Control – General:
   1. Contractor's vehicles, construction equipment, and machinery shall minimize noise emissions to greatest degree practicable. When necessary, provide mufflers and silencers on construction equipment, machinery, and vehicles, and provide temporary sound barriers sound-absorbing blankets, sound-reducing enclosures, modified backup alarms, and other mitigation measures when necessary.
   2. Noise threshold levels shall comply with Laws and Regulations, including (a) OSHA requirements and recommendations, and (b) local ordinances or other Laws or Regulations.
      a. Comply with Code of Ordinances, City of Lewisville, Texas.
   3. Noise emissions shall not interfere with the work of Owner, facility manager (if other than Owner), or others. The use of noise-producing signals, including horns, whistles, alarms, and bells shall be for safety warning and emergency purposes only.
   4. Music or entertainment systems, including personal and vehicle radios, media players, and the like, when used, shall not be audible at the property line and shall not disturb others at the Site.
   5. Field Quality Control of Noise:
      a. If Owner or Engineer believes potential exists that allowable noise levels are being exceeded, Contractor will be required to, and shall promptly perform, appropriate noise monitoring in presence of Owner or Engineer and shall submit written results to Engineer.
      b. Owner and Engineer reserve the right to perform independent noise monitoring at any time during the Work.
   6. If noise level exceeds allowable maximum, Contractor shall immediately cease the activity emitting the excessive noise and promptly implement noise-mitigating measures to comply with noise limitations.

3.2 DUST CONTROL

A. Dust Control – General:
   1. Control objectionable dust caused by Contractor's operation of vehicles and construction equipment and machinery, site clearing, demolition, cleaning, and other actions. To

minimize airborne dust, apply water or use other methods subject to acceptance of Engineer and approval of authorities having jurisdiction.

2. Contractor shall prevent blowing and movement of dust from exposed soil surfaces and access roads to reduce onsite and off-Site damage, inconvenience, nuisances, and health hazards associated with dust emissions from Contractor's activities.

B. Dust Control Methods:
   1. Dust control may be accomplished by irrigation in which the dust-prone work activity or area of the Site is sprinkled with water until the surface is moist.
   2. Apply dust controls as frequently as necessary or required without creating inconveniences, nuisances, or hazards, such as excessive mud and ponding of water at or adjacent to the Site. Do not use water for dust control when water will cause hazardous or objectionable conditions such as ice, mud, ponds, and pollution.
   3. Provide dust control that is non-polluting and does not contribute to tracking-out of dirt, mud, and dust onto pavement.
   4. Do not allow water used for dust control to discharge to storm water drainage system or surface waters.
   5. Where appropriate, reduce travel speed of construction vehicles and construction equipment to reduce the potential for dust emissions arising from vehicle and equipment passage.
   6. Where appropriate, apply gravel or other appropriate binder to access roads and parking areas.

C. Removal of Dust and Dirt from Pavement and Other Travelled Ways:
   1. Remove dust, mud, and dirt from roads, parking areas, and other travelled ways not less than the frequency indicated in Section 01 74 00 - Cleaning.
   2. Perform dust and dirt removal from travelled ways by mechanical wet vacuum sweeping or other method acceptable to Engineer.
   3. Remove mud from roads, parking areas, and other travelled ways by appropriate means, including scraping. Avoid damaging surface of travelled way. Remedy damage to roads, parking areas, and travelled ways resulting from mud removal activities.

D. Removal of Dust and Dirt from Buildings and Structures:
   1. When dust and dirt from Contractor's activities has accumulated to a noticeable or objectionable extent (compared with preconstruction conditions) on buildings or structures, remove the dust and dirt caused by Contractor's operations by appropriate methods, including power-washing using mild detergent. Remedy damage caused by dust, dirt, and power-washing.
   2. Dust in sensitive equipment, such as electrical and control panels, instruments, HVAC systems and other equipment shall be cleaned by a Subcontractor specializing in cleaning such items.
   3. During the Project, remove objectionable and noticeable dust, dirt, and mud in areas occupied by Owner or facility manager, and Contractor's work areas, resulting from Contractor's activities. Owner and facility manager will take reasonable measures to avoid tracking dust, dirt, and mud into their occupied areas.
   4. Comply with Section 01 74 00 - Cleaning.

3.3 PEST AND RODENT CONTROL

A. Pest and Rodent Control – General:
   1. Provide pest and rodent controls as necessary to prevent infestation of the Site, storage areas, and adjacent areas.
   2. Pests and rodents include, but are not limited to: flies, mosquitoes, gnats, midges, stinging insects, other insects and the like, worms, rats, mice, moles, voles, and similar animals, objectionable numbers and species of birds, and others.
   3. Implement appropriate pest and rodent controls when pests, rodents, or both are apparent at the Site or offsite storage, staging, or laydown areas.
   4. Control or remove pests and rodents from adjacent properties when Contractor's activities have fostered or exacerbated pest or rodent problems. For example, ground vibration, such

as that associated with horizontal directional drilling, may cause migrations of subterranean animals such as moles and voles. Coordinate with affected property owners regarding appropriate control methods, materials, equipment, and disposal techniques.

B. Methods, Materials, and Equipment for Pest and Rodent Control during Construction:
   1. Employ methods and use materials and equipment for pest and rodent control that do not adversely affect conditions at the Site or on adjacent and nearby properties.
   2. Do not use control methods or poisons injurious to household pets or animals other than targeted pests and rodents.
   3. Avoid control methods that present hazards to humans, including children.

C. Disposal of Pests and Rodents:
   1. In accordance with Laws and Regulations, promptly and properly dispose of pests and rodents trapped or otherwise controlled. Do not bury or dispose of deceased animals at the Site or in adjacent areas.

3.4 WATER CONTROL

A. Water Control – General:
   1. During the Project, provide methods to appropriately control storm water, surface water, water from excavations and structures, groundwater flows altered by Contractor's activities, and groundwater discharges from the Site, to prevent damage to the Work, the Site, adjacent properties, and downstream properties.
   2. Control trenching, filling, and grading to direct water away from excavations, pits, tunnels and other construction areas, and prevent water from entering existing buildings and structures.
   3. Properly manage and control storm water, surface water, and groundwater entering the Site from upstream, where such flows or discharges have potential to affect the Work or to be exacerbated by Contractor's activities.
   4. Avoid ponding of water onsite, except in specially-designated, temporary settlement basins. Where water ponding occurs during construction, perform rough grading to eliminate ponding.
   5. Prevent water from discharging onto roads, parking areas, paved or finished areas, and other travelled ways. Prevent storm water runoff from discharging across access roads and parking areas.

B. Materials, Equipment, and Facilities for Water Control:
   1. Provide, operate, and maintain materials, equipment, and facilities of adequate size, materials, and capacity to control storm water, surface water, groundwater, and discharges from tanks.

C. Discharge and Disposal of Water during Construction:
   1. Discharge storm water, surface water, and groundwater from the Site, and discharges of clean water from tanks, to proper discharge locations, in accordance with Laws and Regulations and the Contract Documents.
   2. Prevent damage and nuisances arising from water discharges on the Site and discharges from the Site.
   3. Dispose of water in manner that avoids flooding, erosion, sediment transport, and other damage, in accordance with Laws and Regulations.
   4. Avoid overland discharges from the Site and construction activities to adjacent properties,
   5. Water discharges from the Site and construction activities shall be via a storm water drainage route or conduit with sufficient capacity for the flow under associated weather and flow conditions and in accordance with requirements of authorities having jurisdiction
   6. Do not discharge storm water, surface water, groundwater, or clean water from tanks, into sanitary sewers. Obtain consent of sewerage system owner before discharging such flows into existing combined sewers.
   7. Obtain sewerage system owner's consent and approval before discharging polluted water to sewerage system.

3.5 POLLUTION CONTROL

A. Pollution Control – General:
   1. Provide means, methods, and facilities necessary and required to prevent contamination of soil, water, and atmosphere caused by accumulation or discharge of substances and materials that are either noxious, polluting, or both, from or caused by construction and related activities.
   2. Construction equipment and machinery shall comply with Laws and Regulations.
   3. Comply with Section 01 35 43.13 - Environmental Procedures for Hazardous Materials.

B. Spills and Contamination:
   1. Perform emergency containment, cleanup, and remedy of spills and contamination resulting from construction and related activities. Promptly remove and properly dispose of contaminated soils and liquids.
   2. Excavate contaminated material and properly dispose of off-Site, and replace with suitable compacted fill and appropriate cover.
   3. Comply with Section 01 35 44 - Spill Prevention Control and Countermeasures Plan, and Owner's hazard control procedures as indicated in the Supplementary Conditions.

C. Protection of Surface Water and Groundwater:
   1. Provide and maintain appropriate, temporary measures to prevent harmful substances from entering surface water, groundwater, and drinking water. Prevent disposal of wastes, effluents, chemicals, and the like into or adjacent to groundwater, surface water, drainage routes (including swales, ditches, and storm sewers) and drinking water.
   2. Obtain sewerage system owner's consent and approval prior to discharging into sanitary sewers or combined sewers. Do not discharge pollutants not in accordance with Laws and Regulations into combined sewers, or sewers tributary to combined sewers, when wet weather overflows to receiving waters may occur.

D. Atmospheric Pollutants:
   1. Provide and maintain temporary controls for atmospheric pollutants resulting from construction and related activities, whether to outdoor or indoor atmospheres.
   2. Prevent harmful dispersal of pollutants into atmosphere.
   3. Do not discharge exhaust from internal combustion engines or combustion operations into buildings, structures, or near ventilation intakes for buildings or structures.
   4. Prevent toxic and noxious concentrations of chemicals, fumes, and vapors.

E. Solid Waste:
   1. Provide and maintain temporary controls for managing solid waste related to the Work.
   2. Prevent solid waste from:
      a. Becoming airborne or blowing in the wind.
      b. Being inadvertently transmitted to adjacent, offsite properties, and areas of the Site not part of the Project.
      c. Being deposited in or discharging to surface waters, open process tanks (except as otherwise approved by Owner), and drainage routes..
   3. Properly handle and dispose of solid waste. Burning or burying solid waste, including unused materials, at the Site or adjacent areas is prohibited.
   4. Cleaning and Disposal of Debris: Comply with applicable requirements of the General Conditions, as may be modified by the Supplementary Conditions, and Section 01 74 00 - Cleaning.
   5. Do not mix or store in the same container solid waste containing Constituents of Concern (and constitutes, or may constitute, a Hazardous Environmental Condition) with solid waste that does not contain Constituents of Concern.
   6. Store solid waste in appropriate, covered, containers.
   7. Promptly, and at regular intervals, remove solid waste from the Site for transport and disposal in accordance with Laws and Regulations.

3.6 ODOR CONTROL DURING CONSTRUCTION

A. Odors – General:
   1. Avoid discharges of unpleasant or noxious odors from construction and related activities. Whether nature of the Work is such that odor generation is unavoidable, provide appropriate temporary controls for odors.
   2. Give priority to avoiding odor generation, followed by:
      a. Counteracting (treating the cause of) odors.
      b. Containing odors.
      c. Odor masking as the last resort for odor control.

3.7 EROSION AND SEDIMENT CONTROLS

A. Installation and Maintenance of Temporary Erosion and Sediment Controls – General:
   1. General Provisions:
      a. Provide temporary erosion and sediment controls as shown and indicated on the Drawings and as indicated in this Section and elsewhere in the Contract Documents, and as necessary for compliance with Laws and Regulations.
      b. Provide erosion and sediment controls as the Work progresses into areas where ground cover was previously undisturbed.
      c. Use necessary and required methods to appropriately control erosion and sediment transport in storm water runoff, including using soil conservation-oriented construction practices (including scheduling and sequencing), vegetative measures, and temporary physical controls.
      d. Use best management practices (BMP) in accordance with Laws and Regulations, and regulatory requirements indicated in this Section's "Quality Assurance" Article (unless more-stringent requirement are shown or indicated in the Contract Documents), to control erosion and sediment transport in storm water runoff during the Project.
      e. Plan and execute disturbances of soils and soil cover, and earthwork by methods to control storm water runoff from exposed soil (including stockpiles, borrow areas, and spoil disposal areas), banks of surface waters affected by the Work, and discharges of groundwater, to prevent erosion and sediment transport.
      f. Where areas must be cleared for storage of materials or equipment, or for temporary facilities, provide measures for regulating storm water discharges and controlling erosion and sediment transport. Where Owner is a co-permittee with Contractor for applicable permits, or when plans for temporary erosion and sediment controls were sealed and signed by Engineer, such methods are subject to Engineer's approval or acceptance, as applicable.
      g. Provide erosion and sediment controls, including stabilization of soils, at the end of each workday.
   2. Coordination:
      a. Coordinate temporary erosion and sediment controls with this Section's requirements on water control and Section 01 41 26 - Storm Water Pollution Prevention Plan and Permit.
      b. Coordinate temporary erosion and sediment controls with construction of permanent drainage facilities, permanent erosion controls and soil stabilization (if any), and other Work, to the extent necessary for effective and continuous erosion and sediment controls.
   3. Before commencing activities that will disturb soil or soil cover at the Site or other areas to be occupied by Contractor during the Project, provide all appropriate temporary erosion and sediment controls required by the Contract Documents for the areas where soil or soil cover will be disturbed.
   4. Vegetation Removal and Disturbance:
      a. Remove only those shrubs, grasses, trees, and other vegetation that must be removed for construction.
      b. Protect undisturbed vegetation. Do not wantonly or unnecessarily drive construction vehicles and equipment over undisturbed vegetation and soil cover.

c. Promptly stabilize exposed soil where vegetation or soil cover was unnecessarily disturbed. Fill and restore ruts and damage to vegetation and soil cover caused by wanton or unnecessary passage of construction vehicles and equipment.

5. Access Roads and Parking Areas:
   a. When possible, locate and construct temporary access roads and parking areas to avoid adverse effects on the environment.
   b. Provide measures to regulate drainage, avoid erosion and sediment transport in storm water runoff, and minimize damage to vegetation and soil cover.
6. Earthwork and Temporary Controls:
   a. Perform excavation, fill, and related activities in accordance with Section 31 23 05 – Long Form – Excavation And Fill and Section 31 23 19 - Dewatering.
   b. Temporary erosion and sediment control measures may include, but are not limited to, using berms, swales and ditches, silt fencing, straw bale sediment barriers, gravel or crushed stone, mulching and soil stabilization, slope drains, and other methods. Apply such temporary measures to erodible soils and other erodible materials exposed by construction activities.
   c. Minimize areas of bare soil exposed at one time. Provide fills and spoil areas by selectively placing fill and spoil materials to reduce or eliminate exposed erodible soils.
   d. Exercise special care on and above steep slopes, where disturbance of vegetation and soil cover shall be minimized to greatest extent reasonably practicable.
   e. Protect stockpile storage not in active use by providing suitable, durable covering prevent sediment transport in storm water runoff and windblown transport. Covering shall be suitable for outdoor exposure.
7. Inspection and Maintenance:
   a. Periodically inspect areas of non-stabilized, erodible soils, including all areas of soil cover disturbance and stockpiles, for evidence of start of erosion and sediment transport. Promptly implement corrective action as necessary and appropriate to control erosion and sediment transport. Continue inspections and corrective action until soils are permanently stabilized and permanent vegetation has been appropriately established.
   b. Inspect not less often than the frequency indicated in Section 01 41 26 - Storm Water Pollution Prevention Plan and Permit.
   c. Repair or replace damaged erosion and sediment controls within 24 hours of Contractor becoming aware of such damage.
   d. Periodically remove sediment that has accumulated in or behind sediment and erosion controls. Remove sediment not less often than when sediment is at approximately one-half of storage capacity of associated control element, unless more-frequent interval is indicated elsewhere in the Contract Documents Properly dispose of sediment.
8. Duration of Temporary Erosion and Sediment Controls:
   a. Maintain temporary erosion and sediment controls in effective, working condition until soil cover of the associated storm water drainage area has been permanently stabilized.
9. Work Stoppage:
   a. If the Work is temporarily stopped or suspended for any reason, Contractor shall provide additional temporary controls necessary to prevent environmental damage to the Site and adjacent areas while the Work is stopped or suspended.
   b. When temporary erosion and sediment controls remain in place during periods of stopped or suspended Work, continue to perform Contractor's obligations relative to periodic inspection and maintenance of temporary erosion and sediment controls, including removal of accumulated sediment.
10. Failure to Provide Adequate Temporary Erosion and Sediment Controls:
    a. If Contractor repeatedly fails to satisfactorily control erosion and sediment transport in storm water runoff, Owner reserves the right to use Owner's own forces or employ a third-party contractors for temporary erosion and sediment control. Owner's costs for such work, including engineering and inspection costs, will be deducted from amounts due Contractor, as set-offs in accordance with the Contract Documents.

B. Silt Fencing:
   1. Provide and maintain silt fencing in a vertical plane, at the locations shown or indicated in the Contract Documents and where necessary or required.
   2. Locations of Temporary Silt Fencing:
      a. Where possible, provide silt fencing along contour lines, so each run of silt fencing is at the same elevation.
      b. On slopes, provide temporary silt fencing at intervals that do not exceed the maximum indicated in the following table:

Silt Fence Spacing on Slopes	
Slope (percent)	Maxim Allowable Length of Slope Above Each Silt Fence (feet)
2 and less	150
2.1 to 5	100
5.1 to 10	50
10.1 to 20	25
20.1 to 25	20
25.1 to 40	15
40.1 to 50	10

      c. Provide temporary silt fencing around perimeter of each stockpile of topsoil, general fill material, and excavated spoil material. Install silt fencing before expected soil is subject to precipitation. Maintain until stockpile is removed.
      d. Do not install temporary silt fencing at the following types of locations:
         1) Area of concentrated storm water flows such as ditches, swales, or channels.
         2) Where rock or rocky soils prevent full and uniform anchoring of silt fencing.
         3) Across upstream or discharge ends of storm water conduits.
   3. Installation:
      a. Securely fasten wire mesh to posts, and securely fasten filter cloth to wire mesh.
      b. When two sections of filter cloth are adjacent to each other, fold over edges and overlap by not less than 6 inches and securely fasten to wire mesh.
      c. Embed posts in the ground to the depth necessary for proper controls; embed posts to not less than 16 inches below ground.
      d. Filter cloth and wire mesh shall extend not less than 8 inches below ground and not less than 16 inches above ground.
      e. Remove accumulated sediment from behind silt fencing as necessary or required. Repair and reinstall silt fencing as necessary or required.
   4. Maintenance:
      a. Do not allow formation of concentrated storm water flows on slopes above temporary silt fencing unless so shown or indicated in the Contract Documents. If unauthorized concentrated storm water flows occur, stabilize the slope via other appropriate stabilization methods as necessary and required to prevent flow of concentrated storm water flows toward temporary silt fencing.

C. Straw Bale Dike.
   1. Provide temporary straw bale dikes where shown or indicated and where necessary or required, including in swales, along contours, and along toe of slopes.
   2. Provide temporary straw bales in shallow excavation as wide as the bale and approximately 4 to 6 inches below surrounding grade.
   3. Ends of straw bales shall tightly abut ends of adjacent straw bales.

4. Securely install each straw bale using two support posts, driven into the ground not less than 1.5 to 2 feet below bottom of straw bale. Top of post shall be flush with top of straw bale. Angle first post for each straw bale toward the previously-installed straw bale.
5. Frequently inspect straw bales and repair or replace as required. Remove accumulated sediment and debris from behind straw bales.

D. Mulching and Soil Stabilization:
   1. Use mulching to temporarily stabilize exposed soil, including spoil and fill materials.
      a. Immediately following final grading, provide mulch and stabilize with mats or netting, or sprayed soil stabilization emulsion with fiber additive.
      b. Application of mulching for soil stabilization shall be as follows.
         1) Non-Rotted Straw or Salt Hay: Provide 1.5 to two tons per acre.
         2) Soil stabilization emulsions, when used, shall be applied in accordance with manufacturer's instructions, and shall be applied with mulch or stabilization fibers.
         3) Wood-Fiber or Paper-Fiber Application: Provide 1,500 pounds per acre, installed by hydroseeding.
      c. Where mats or netting are used:
         1) Cover entire area to be stabilized with mats or netting.
         2) Provide anchoring trenches at the top and bottom of slopes to receive mats or netting. Bury at least the top and bottom ends of mat or netting, 4 inches or more wide, at top and bottom of slope. Ensure that mesh or netting is secure and will not wash out over time. Tamp trench full of soil. 4 inches from trench, secure mat or netting with appropriate staples at intervals of 10 inches.
         3) Overlap adjacent strips of mat or netting by not less than 4 inches.

E. Protection of Storm Water Drainage Inlets and Catch Basins:
   1. Protect each drainage inlet and catch basin that has potential to receive storm water runoff from exposed soils and does not discharge into a storm water settlement basin.
   2. Provide temporary inlet filter bags inside of drainage inlet or catch basin in accordance with inlet filter bag manufacturer's instructions. Secure inlet filter bag with the structure's grate or by other acceptable means.
   3. Inlet filter bags shall not pose any obstruction, above the preconstruction elevation of the drainage inlet or catch basin grate that would necessitate or require temporary barricades or warning lights.
   4. When removing sediment from inlet filter bags, do not dump filter bag's contents into the drainage inlet or catch basin. Promptly remove from drainage inlets and catch basins sediment accidentally dumped into the structure.
   5. Remove sediment from inlet filter bags, or replace inlet filter bags, when inlet filter bag is not more than half-full.

F. Temporary Settlement Basin:
   1. For constructing embankments comply with requirements in Division 31 Specifications on embankments, excavation, and fill.
   2. Overflow Weir and Discharge Pipe:
      a. Provide piping in accordance with manufacturer's instructions. Where permanent piping will be used for temporary settlement basin, provide piping in accordance with the Contract Documents and fully clean piping prior to Substantial Completion.
      b. Provide overflow weirs at elevation(s) shown or indicated on the Drawings. When not shown or indicated in the Contract Documents, discharge weir elevation(s) shall be in accordance with design by licensed, professional civil engineer retained by Contractor or Subcontractor. Such design and temporary construction shall avoid overtopping and overfilling of settlement basin without short-circuiting the settlement basin's hydraulic performance.
      c. Wrap and secure geotextile material specified for temporary silt fencing around discharge structures of temporary settlement basins

3. Crushed Stone and Riprap: Provide in accordance with Division 31 Specifications on excavation, fill, and riprap. Provide in areas of temporary settlement basin subject to erosion, and at upstream and downstream ends of each settlement basin's discharge piping.
4. Remove sediment when necessary or required, based on accumulation of material.
5. When temporary settlement basin is no longer required, remove the temporary settlement basin discharge weir, discharge piping, and spillway, fill the temporary settlement basin to required grade in accordance with requirements of Division 31 Specifications on excavation and fill, and provide landscaping in accordance with the Contract Documents.

G. Filter Bag on Dewatering Pump Discharge:
1. Provide dewatering of excavations in compliance with Section 31 23 05 – Long Form – Excavation And Fill and Section 31 23 19 - Dewatering.
2. Locate filter bags and temporary pump discharge lines to avoid interfering with the public, use of private and public property, and Owner's and facility manager's operations. Relocate filter bags and appurtenances when necessary or required.
3. Filter bag discharge shall be directed to appropriate storm water drainage route. Do not discharge into roads, driveways, access roads, parking areas, other travelled ways, or overland. When temporary settlement basin is used, locate filter bags to discharge to temporary settlement basin when practicable.
4. Provide filter bag on discharge of each dewatering pump drawing from an excavation or other area with exposed soil.
5. Securely attach filter bag to pump discharge pipe or hose.
6. Maintain, clean out, and replace filter bags as necessary or required.

H. Temporary Stone Construction Entrance:
1. Where shown on the Drawings, and where construction vehicles will regularly transition to paved surfaces from unstabilized surfaces, provide temporary stone construction entrance. Contractor vehicles and mobile construction equipment and machinery shall use temporary stone construction entrances.
2. Provide temporary stone construction entrances of the width, length, and thickness shown or indicated on the Drawings. When not shown or indicated on the Drawings, temporary stone construction entrance shall be not less than 50 feet long, by 20 feet wide, by 8 inches deep.
3. Installation:
   a. Ensure that subgrade under each temporary stone construction entrance is suitably dense for the intended purpose and dry. Suitably prepare subgrade as necessary for temporary stone construction entrance.
   b. Provide on subgrade a layer of geotextile separation fabric, installed in accordance with geotextile separation fabric manufacturer's recommendations for separation.
   c. Provide stone on installed geotextile separation fabric. Grade the stone for passage of vehicles.
4. Maintenance:
   a. Maintain temporary stone construction entrance at not less than the minimum required thickness. Add stone as required to maintain thickness.
   b. When upper layer of temporary stone construction entrance becomes contaminated with soil, mud, or other material, remove the contaminated material and replace with clean stone.
   c. Using water to wash down temporary construction entrance or paved areas onto which soil material has been tracked is unacceptable.

3.8 REMOVAL OF TEMPORARY CONTROLS

A. Removals – General:
1. Unless otherwise indicated elsewhere in this Section in requirements for respective temporary controls, upon completion of the associated Work and when temporary controls are no longer necessary, remove temporary controls and restore the Site to condition in accordance with the Contract Documents; if condition is not shown or indicated, restore the Site to pre-construction condition.

2. After soils are permanently stabilized, remove from the Site temporary erosion and sediment controls.

END OF SECTION

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SECTION 01 58 13
TEMPORARY PROJECT SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Requirements for:
      a. Temporary signs, installed outdoors, indicating the Project's name and principal participants.

B. Scope:
   1. Contractor shall furnish, install, maintain, and remove temporary, outdoor signage in accordance with this Section. Provide labor, materials, tools, equipment, and other services and incidentals necessary and required for temporary Project signage
   2. Obtain and pay for required permits and approvals from authorities having jurisdiction.
   3. Requirements for permanent signage are in Section 10 14 00 – Identification Devices, and elsewhere in the Contract Documents.
   4. Do not erect or display any other temporary signage at the Site or adjacent areas without Owner's approval.

C. Related Requirements:
   1. Section 01 55 13 - Vehicular Access and Parking.
   2. Section 01 71 33 - Protection of the Work and Property.
   3. Section 10 14 00 - Identification Devices.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Logos: Where temporary Project signage requires logos of Owner, funding or financing entity (if any), Engineer, or other consultants retained by Owner, obtain Electronic Document file of such graphic(s) from Engineer.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Sign Painter/Preparer:
      a. Shall be a professional in the type of Work required, regularly engaged in work similar to that required.
      b. Responsible for:
         1) Preparing layout Shop Drawings for temporary Project signage.
         2) Furnishing temporary Project signage layout, graphics, color, text, and overall appearance of temporary project signage.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Layout of each temporary sign required under this Section:
         1) Show and indicate layout, text, font, text size, colors, graphics (if any).
         2) Such Shop Drawings shall be in color accurately representing scale and colors of proposed temporary Project signage.
         3) Specifically indicate font(s), text size, and colors.
      b. Construction and erection details for temporary Project signage:
         1) Show and indicate type and grade of materials, including temporary signage panel, trim, principal supports, foundation, and bracing.

2) Show and indicate installation details, including depth of embedment in ground and attachment hardware.
3) Engineer's approval of Shop Drawings for temporary Project signs will not address construction or erection means and methods or temporary sign's structural viability or ability to withstand required forces.

2. Product Data:
   a. Product data and specifications for finishes proposed for use, when requested by Engineer.
3. Samples:
   a. Submit color Samples when requested by Engineer.

PART 2 - PRODUCTS

2.1 MATERIALS AND CONSTRUCTION

A. Performance and Design Criteria:
   1. Temporary signs, including sign panels, supports, bracing, and foundations, shall withstand sustained winds of 75 miles per hour.

B. Temporary Signage Required: Provide the following temporary signs:
   1. Site Informational Temporary Signage:
      a. Provide temporary signage as necessary and required for construction site operations and controlling traffic at the Site.
      b. Requirements for temporary, onsite signage for construction vehicular traffic and parking are in Section 01 55 13 – Vehicular Access and Parking.
      c. Requirements for temporary signage related to safety and protection are in Section 01 71 33 – Protection of the Work and Property.

C. Materials and Fabrication:
   1. Sign Panel:
      a. Temporary signs shall be 3/4-inch thick, new A-B Grade, exterior type, APA MDO plywood both sides, unless otherwise shown or indicated in the Contract Documents.
      b. Provide temporary signs with trim, mitered on edges.
   2. Supports and Bracing:
      a. Provide supports and bracing as necessary and required to adequately support and brace temporary signs to comply with this Section's performance and design criteria.
      b. Unless otherwise shown or indicated in the Contract Documents, principal upright supports for temporary signage shall be not less than nominal 4-inch by 4-inch pressure-treated lumber.
      c. When not shown or indicated in the Contract Documents, embed principal upright supports for temporary signage not less than 4 feet in ground.

D. Finishing:
   1. Paint all surfaces of temporary signage, including panels, supports, bracing, and other surfaces, with material suitable for long-term exposure to sunlight and weather without fading for duration of the Project.
   2. At minimum, provide prime coat and finish coat: exterior, semi-gloss, enamel.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation:
   1. Location:
      a. Location of temporary signage shall be as shown or indicated on the Contract Documents, or as directed by Engineer. Temporary signage shall be plainly visible to vehicular traffic.

b. Unless expressly shown or indicated otherwise in the Contract Documents, Contractor shall select locations for temporary signage for: construction vehicular traffic and parking, traffic control for public and non-construction vehicles, safety and protection, and others.

2. Install temporary signage in a neat, professional manner, straight, level, plumb, consistent with the performance and design criteria indicated in this Section.

3.2 MAINTENANCE AND REMOVAL

A. Maintenance:
   1. Maintain temporary signage so that signs are clean, legible, upright, plumb, and level.
   2. Cut grass, weeds, and other plants so that temporary signage is not covered or obscured.
   3. Promptly repair and repaint damaged, faded, or marred temporary signage.
   4. Relocate temporary signage as necessitated by progress of the Work.
   5. Maintain required temporary signage through Substantial Completion of the entire Project.

B. Removal:
   1. Remove temporary signage prior to final inspection of the Work, or when directed by Engineer.
   2. Entirely remove all elements of temporary signage, including supports, foundations, bracing, and other elements.
   3. After removal, restore the area at and adjacent to temporary signage as required by the Contract Documents. When the Contract Documents do not expressly show or indicate the required restoration, restore to preconstruction conditions or better.

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SECTION 01 61 00
COMMON PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Common requirements for materials and equipment.
   2. Compatibility of materials and equipment.

1.2 REQUIREMENTS FOR MATERIALS AND EQUIPMENT

A. Unless otherwise indicated in the Contract Documents, furnish materials and equipment that:
   1. have not previously been incorporated into another project or facility; and.
   2. have not changed ownership after initial shipment from the manufacturer's factory or facility; and.
   3. if stored since their manufacture or fabrication, have, while in storage, been properly maintained and serviced in accordance with the manufacturer's recommendations for long-term storage; submit documentation as required by Engineer that such maintenance and service has been performed; and.
   4. that the item(s) have not been subject to degradation or deterioration since manufacture; and.
   5. are the current model(s) or type(s) furnished by the Supplier.

B. To the extent possible, furnish from a single source those materials and equipment that are of the same generic kind.

C. Furnish materials and equipment complete with accessories, trim, finish, fasteners, and other items shown, indicated, or required for a complete installation for the indicated use and performance.

D. Standard Items: When available, and unless custom or nonstandard options are specified or indicated, furnish standard materials and equipment of types that have been produced and used successfully in similar situations on other projects.

E. Visual Matching: Where required in the Contract Documents, furnish materials and equipment that match (as determined by Engineer) referenced existing construction, and mock-ups and Sample(s) approved by Engineer.

F. Where the Contract Documents include the phrase "as selected" for color of materials or equipment, finish pattern, option, or similar phrase, furnish materials and equipment selected by Engineer as follows:
   1. Standard Range: Where the Contract Documents include the phrase "standard range of colors, patterns, textures" or similar wording, furnish color, pattern, density, or texture selected by Engineer from manufacturer's product line that does not include premium items.
   2. Full Range: Where the Contract Documents include the phrase "full range of colors, patterns, textures" or similar wording, Engineer will select color, pattern, density, or texture from manufacturer's entire product line, including standard and premium items.

1.3 COMPATIBILITY

A. Similar materials and equipment by the same Supplier shall be compatible with each other, unless otherwise indicated in the Contract Documents or approved by Engineer.

B. Furnish materials and equipment compatible with items previously selected or installed on the Project.

END OF SECTION

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SECTION 01 61 03
EQUIPMENT - BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Requirements of this Specification Section apply to all equipment provided on the Project including those found in other Divisions even if not specifically referenced in individual "Equipment" Articles of those Specification Sections.

B. Related Sections include but are not necessarily limited to:
   1. Section 01 81 10 - Wind and Seismic Design Criteria.
   2. Section 03 15 19 - Anchorage to Concrete.
   3. Section 03 31 30 - Concrete, Materials and Proportioning.
   4. Section 05 50 00 - Metal Fabrications.
   5. Section 07 92 00 - Joint Sealants.
   6. Section 09 96 00 - High Performance Industrial Coatings.
   7. Section 10 14 00 - Identification Devices.
   8. Section 26 29 23 - Variable Frequency Drives - Low Voltage.
   9. Section 40 05 00 - Pipe and Pipe Fittings - Basic Requirements.
   10. Section 40 61 13 - Process Control System General Requirements.
   11. Section 40 67 00 - Control System Equipment Panels and Racks.
   12. Section 40 73 00 - Pressure Instrumentation

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Bearing Manufacturers Association (ABMA).
   2. American Gear Manufacturers Association (AGMA).
   3. American Petroleum Institute
      a. API 686 - Recommended Practice for Machinery Installation and Installation Design
   4. ASTM International (ASTM):
      a. E1934, Standard Guide for Examining Electrical and Mechanical Equipment with Infrared Thermography.
      b. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
   5. Hydraulic Institute (HI):
      a. 9.6.4, Rotodynamic Pumps for Vibration Measurements and Allowable Values.
   6. International Electrotechnical Commission (IEC).
   7. Institute of Electrical and Electronics Engineers, Inc. (IEEE).
   8. International Organization for Standardization (ISO):
      a. 1940, Mechanical Vibration - Balance Quality Requirements for Rotors in a Constant (Rigid) State - Part 1: Specification and Verification of Balance Tolerances.
      b. 21940-11, Mechanical Vibration - Rotor Balancing - Part 11: Procedures and Tolerances for Rotors with Rigid Behavior.
   9. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
      b. ICS 6, Enclosures for Industrial Control and System.
      c. MG 1, Motors and Generators.
   10. InterNational Electrical Testing Association (NETA):
      a. ATS, Acceptance Testing Specification for Electrical Power Distribution Equipment and Systems.
   11. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC):
   12. National Institute for Certification in Engineering Technologies (NICET).

13. National Institute of Standards and Technology (NIST).
14. Occupational Safety and Health Administration (OSHA):
    a. 29 CFR 1910, Occupational Safety and Health Standards, referred to herein as OSHA Standards.
15. Underwriters Laboratories, Inc. (UL).
    a. 508, Standard for Safety Industrial Control Equipment.
    b. 508A, Standard for Safety Industrial Control Panels.
    c. 698A, Standard for Industrial Control Panels Relating to Hazardous (Classified) Locations.
16. Vibration Institute.

B. Supplier's Vibration Analyst:
    1. Supplier's vibration analyst shall prepare pre-Shop Drawing vibration analysis of equipment.
    2. Where required, Supplier's vibration analyst shall be either equipment manufacturer's qualified employee or independent business entity whose sole business, or principal part of its business, is evaluating and determining natural frequencies of rotating equipment.
    3. Shall possess not less than 10 years' relevant experience.
    4. Supplier's Vibration Analyst's Professional Engineer:
        a. Vibration analysis shall be performed by, or under the direct, personal supervision of, professional engineer licensed and registered in the same jurisdiction as the Site experienced in preparing finite element analyses, rotordynamic analyses, and experimental modal analysis similar to that required for the Work.
        b. Professional engineer shall possess not less than five years' combined experience in field testing and data analysis for vibration analysis.
        c. Vibration analysis professional engineer's seal and signature, with indication of date seal and signature were applied to the subject document, shall clearly appear on all results and reports furnished as Submittals.

C. Field Vibration Testing Subcontractor:
    1. Field vibration testing Subcontractor shall, where required by the Contract Documents, perform vibration testing of equipment installed at the Site and perform associated vibration analyses.
    2. Vibration testing Subcontractor shall be an independent entity that has performed as its sole business, or principal part of its business, for not less than 10 years, inspection, testing, calibrating, adjusting equipment and systems, and performing vibration testing of equipment.
    3. Entities whose principal business is one or more of the following are not considered independent vibration testing entities and, therefore, shall not be field vibration testing Subcontractor:
        a. Motor sales, service, or repairs.
        b. Process equipment sales, service, or repairs.
    4. Acceptable entities include, but are not necessarily limited to::
        a. AVS Engineering: https://www.avsengineering.net/
        b. Engineering Testing Services: https://etestinc.com/
        c. Maritech, LLC: http://www.maritech-llc.com/contact.html
        d. Mechanical Solution, Inc. (MSI) www.mechsol.com
        e. Or equal.
    5. Field vibration testing Subcontractor must have an established program for monitoring and testing equipment calibration, with accuracy traceable in an unbroken chain, in accordance with NIST requirements.
    6. Field Personnel: Each person employed for field vibration testing on the Work shall possess not less than the following qualifications:
        a. Three years' field experience covering all phases of field vibration testing and data gathering.

b. Current, valid Vibration Category II certification from Vibration Institute or a licensed, registered professional engineer who need not be licensed and registered in the same jurisdiction as the Site.

7. Analysis Personnel: Personnel performing analysis for field vibration testing Subcontractor shall possess not less than the following qualifications:
   a. Five years' combined field testing and data analysis experience.
   b. Current, valid Vibration Category III certification from the Vibration Institute or a professional engineer licensed and registered in in the same jurisdiction as the Site. Where required by Laws and Regulations, field vibration analysis report shall be sealed, signed, and dated by professional engineer who personally prepared, or exercised personal, supervisory control over subordinates in preparing, the field vibration analysis report.
8. Analysis Equipment: Field vibration testing Subcontractor shall have access to and use, where appropriate, the following testing equipment, properly maintained and calibrated:
   a. Impact Hammer:
      1) Frequency Range: 1 kHz.
      2) Range (5v output) 5,000 pounds-force (22,200 newtons).
      3) Hammer sensitivity (approx.) 1mV/lbf (0.23 mV/N)
   b. Analyzer:
      1) Frequency Range: 1 Hz to 10,000Hz.
      2) Frequency Accuracy: 0.02 percent.
      3) Non-Integrated Spectral Amplitude Accuracy: 5 percent, 3 Hz to 65 Hz.
      4) Single Integrated Spectral Amplitude Accuracy: 5 percent, 10 Hz to 20 Hz.
      5) Supports measurements of acceleration, velocity, and displacement.
   c. Vibration Sensor:
      1) Sensitivity: ±5 percent = 100 mV/g
      2) Acceleration Range: ±5 g.
      3) Amplitude Nonlinearity: ±1 percent
      4) Frequency Response: ±10Hz to 7kHz (±3 dB)
   d. Data logging equipment for simultaneous recording of the following data points:
      1) Vibration in the X, Y, and axial planes (for all pumps pursuant to ANSI/HI Standard).
      2) Digital tachometer recording RPM.
      3) Discharge Pressure Transmitter
         a) Accuracy: 0.3 percent of range
         b) Fluid Temperature Range: 32 to 100 DegF
      4) Suction Pressure Transmitter (when other than submersible pump or vertical turbine (suspended) pump.
         a) Accuracy 0.35 percent of range.
         b) Fluid Temperature Range: 32 to 100 DegF.
         c) For submersible pumps and vertical turbine (suspended) type pumps, suction liquid surface level signal from Site's monitoring and control system (e.g., plant PLC/SCADA system).
      5) For pumps, pumping rate (flow) signal from Site's monitoring and control system (e.g., plant PLC/SCADA system)
      6) Equipment/motor bearing temperature signal from Site's monitoring and control system (e.g., plant PLC/SCADA system)).
      7) Pump/motor vibration signal from Site's monitoring and control system (e.g., plant PLC/SCADA system).

D. Infrared Thermography Testing Program:
   1. Testing firm:
      a. An independent firm performing, as the sole or principal part of its business for a minimum of 10 years, the inspection, testing, calibration, and adjusting of systems.
      b. Must have an established monitoring and testing equipment calibration program with accuracy traceable in an unbroken chain, according to NIST.

2. Field personnel:
    a. Minimum of one year field experience covering all phases of field thermography testing and data gathering.
    b. Supervisor certified by NETA or NICET.
3. Analysis personnel:
    a. Minimum three years combined field testing and data analysis experience.
    b. Supervisor certified by NETA or NICET.

E. Electrical Equipment and Connections Testing Program:
1. Qualification requirements as specified in section 26 08 13 - Acceptance Testing.

F. Miscellaneous:
1. A single manufacturer of a "product" shall be selected and utilized uniformly throughout Project even if:
    a. More than one manufacturer is listed for a given "product" in Specifications.
    b. No manufacturer is listed.
2. Equipment, electrical assemblies, related electrical wiring, instrumentation, controls, and system components shall fully comply with specific NEC requirements related to area classification and to NEMA 250 and NEMA ICS 6 designations shown on Electrical Power Drawings.
3. Variable speed equipment applications: The driven equipment manufacturer shall have single source responsibility for coordination of the equipment and VFD system and verify their compatibility.

1.3 DEFINITIONS

A. Product: Manufactured materials and equipment.

B. Major Equipment Supports - Supports for Equipment:
1. Located on or suspended from elevated slabs with supported equipment weighing 2000 pounds or greater, or;
2. Located on or suspended from roofs with supported equipment weighing 500 pounds or greater, or;
3. Located on slab-on-grade or earth with supported equipment weighing 5000 pounds or more.

C. Equipment:
1. One or more assemblies capable of performing a complete function.
2. Mechanical, electrical, instrumentation or other devices requiring an electrical, pneumatic, electronic or hydraulic connection.
3. Not limited to items specifically referenced in "Equipment" articles within individual Specifications.

D. Installer or Applicator:
1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
2. Installer and applicator are synonymous.

E. Baseplate or equipment base plate or machine base
1. Are fabricated frames of structural shapes and plates with enough strength and sturdiness to serve as the surface to which other equipment is attached to and supported by. Baseplates can be directly mounted and grouted to concrete equipment support bases or machined and bolted to a sole plate.

F. Sole plate
1. A thick steel machined plate that is attached to and grouted to a concrete equipment support base.
2. Base plates are bolted to a sole plate when a sole plate is specified and/or provide.

1.4 SUBMITTALS

A. Shop Drawings:
   1. General for all equipment:
      a. Data sheets that include manufacturer's name and complete product model number.
         1) Clearly identify all optional accessories that are included.
      b. Acknowledgement that products submitted comply with the requirements of the standards referenced.
      c. Manufacturer's delivery, storage, handling, and installation instructions.
      d. Equipment identification utilizing numbering system and name utilized in Drawings.
      e. Equipment installation details:
         1) Location of anchorage.
         2) Anchorage setting templates.
         3) Manufacturer's installation instructions.
      f. Equipment area classification rating.
      g. Shipping and operating weight.
      h. Equipment physical characteristics:
         1) Dimensions (both horizontal and vertical).
         2) Materials of construction and construction details.
      i. Equipment factory primer and paint data.
      j. Manufacturer's recommended spare parts list.
      k. Equipment lining and coatings.
      l. Equipment utility requirements include air, natural gas, electricity, and water.
      m. Ladders and platforms provided with equipment:
         1) Certification that all components comply fully with OSHA requirements.
         2) Full details of construction/fabrication.
         3) Scaled plan and sections showing relationship to equipment.
   2. Mechanical and process equipment:
      a. Operating characteristics:
         1) Technical information including applicable performance curves showing specified equipment capacity, rangeability, and efficiencies.
         2) Brake horsepower requirements.
         3) Copies of equipment data plates.
      b. Piping and duct connection size, type and location.
      c. Equipment bearing life certification.
      d. Equipment foundation data:
         1) Equipment center of gravity.
         2) Criteria for designing vibration, special or unbalanced forces resulting from equipment operation.
         3) Type, size, and materials of construction of anchorage.
         4) Data required by Section 03 15 19 Anchorage to Concrete for anchor rod design.
   3. Electric motor:
      a. Motor manufacturer and model number.
      b. Complete motor nameplate data.
      c. Weight.
      d. NEMA design type.
      e. Enclosure type.
      f. Frame size.
      g. Winding insulation class and temperature rise.
      h. Starts per hour.
      i. Performance data:
         1) Guaranteed minimum efficiencies at 100 percent, 75 percent, and 50 percent of full load.
         2) Guaranteed minimum power factor at 100 percent, 75 percent, and 50 percent of full load.

3) Locked rotor and full load current at rated terminal voltage and minimum permissible or specified terminal voltage.
4) Starting, full load, and breakdown torque at rated terminal voltage and minimum permissible or specified terminal voltage.

j. Bearing data and lubrication system.

k. Natural frequency calculations for:
1) Completed assembly including but not limited to the equipment base, rotating piece of equipment, and the rotating piece of equipment driver.
2) Individual piece of rotating equipment.
3) Equipment driver and connected gear reducer, if applicable.

l. Thermal protection system including recommended alarm and trip settings for winding and bearing RTD's.

m. Fabrication and/or layout drawings:
1) Dimensioned outlined drawing.
2) Connection diagrams including accessories (strip heaters, thermal protection, etc.).

n. Certifications:
1) When utilized with a reduced voltage starter, certify that motor and driven equipment are compatible.
2) When utilized with a variable frequency controller, certify motor is inverter duty and the controller and motor are compatible.
a) Include minimum speed at which the motor may be operated for the driven machinery.

o. Electrical gear:
1) Unless specified in a narrow-scope Specification Section, provide the following:
a) Equipment ratings: Voltage, continuous current, kVa, watts, short circuit with stand, etc., as applicable.
2) Control panels:
a) Panel construction.
b) Point-to-point ladder diagrams.
c) Scaled panel face and subpanel layout.
d) Technical product data on panel components.
e) Panel and subpanel dimensions and weights.
f) Panel access openings.
g) Nameplate schedule.
h) Panel anchorage.
i) Short Circuit Current Rating (SCCR) nameplate marking per NFPA 70. Include any required calculations.

4. Systems schematics and data:
a. Provide system schematics where required in system specifications.
1) Acknowledge all system components being supplied as part of the system.
2) Utilize equipment, instrument and valving tag numbers defined in the Contract Documents for all components.
3) Provide technical data for each system component showing compliance with the Contract Document requirements.
4) For piping components, identify all utility connections, vents and drains which will be included as part of the system.

5. For factory painted equipment, provide paint submittals in accordance with Section 09 96 00.

6. Qualifications for:
a. Natural frequency analysis firm and personnel.
b. Vibration testing firm and personnel.
c. Infrared thermography testing firm and personnel.
d. Electrical equipment and connections testing firm and personnel.

7. Equipment Monitoring and Testing plans, in accordance with PART 3 of this Specification Section:

a. Natural frequency analysis and calculations.
b. Vibration testing.
c. Thermography testing.
d. Electrical equipment and connection testing.

B. Factory Test Reports:
1. Natural frequency bump test reports where required for rotating equipment.
a. Minimum characteristics of impact hammer.
1) Frequency Range 1 kHz.
2) Range (5v output) 5,000 pounds-force (22,200 N).
3) Hammer Sensitivity (7pprox.) 1 mV/lbf (0.23 mV/N).
4) Resonant Frequency 12 kHz
2. Motor, equipment and final assembled equipment including motor.
a. Determine natural frequency of assembled motor prior to shipping to equipment manufacturer or job site.
1) Individual motor fastened to an "infinitely rigid" mass at the same bolt circle as the final assembled equipment.
b. Determine natural frequency of the pump.
1) Pump fastened to an "infinitely rigid" mass at the same bolt circle as the final assembled equipment.
c. Determine natural frequency of the pump/motor assembly.
1) Pump/motor assembly fastened to an "infinitely rigid" mass at the same bolt circle as the final field assembled equipment.
d. For this use, the "infinitely rigid" mass shall be at least 10 times the weight of the equipment being tested.
3. Submit natural frequency report(s) for approval prior to shipment.
4. Equipment performance tests.
a. As listed in individual equipment specifications.

C. Contract Closeout Information:
1. Operation and Maintenance Data:
a. See Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

D. Informational Submittals:
1. Notification, at least one week in advance, that testing will be conducted at factory.
2. Certification from equipment manufacturer that all manufacturer-supplied control panels that interface in any way with other controls or panels have been submitted to and coordinated with the supplier/installer of those interfacing systems.
3. Submit sample Manufacturer's Field Service Report (MFSR). Report shall use manufacturer's standard report or use the form in the Exhibits and have at least the following information:
a. Certification that equipment has been installed properly, has been initially started up, has been calibrated and/or adjusted as required, and is ready for operation.
b. Certification for major equipment supports that equipment foundation design loads shown on the Drawings or specified have been compared to actual loads exhibited by equipment provided for this Project and that said design loadings are equal to or greater than the loads produced by the equipment provided.
c. Motor test reports.
d. Field noise testing reports if such testing is specified.
e. Preliminary field quality control testing format to be used as a basis for final field quality control reporting.
f. Provide three bound final written reports documenting natural frequency testing, vibration monitoring and testing for specified equipment.
1) Include the acceptance criteria of all equipment tested.
2) Provide individual tabbed sections for information associated with each piece of tested equipment.

g. Certification prior to Project closeout that electrical panel drawings for manufacturer-supplied control panels truly represent panel wiring including any field-made modifications.
h. Testing and monitoring reports in accordance with PART 3 of this Specification Section.
i. Certification that driven equipment and VFD are compatible.

4. Submit completed Manufacturer's Field Service Report (MFSR) for each piece of equipment supplied.

E. Refer to Section 01 81 33 – Cyber Security Requirements for required cyber security related submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Motors:
a. ABB Baldor-Reliance.
b. General Electric.
c. Hyundai Heavy Industries.
d. Marathon Electric.
e. Siemens.
f. TECO-Westinghouse.
g. Toshiba U.S.
h. U.S. Motors, Nidec Motor Corporation.
i. WEG.

2.2 MANUFACTURED UNITS

A. Electric Motors:
1. Where used in conjunction with adjustable speed AC or DC drives, provide motors that are fully compatible with the speed controllers.
2. Design for frequent starting duty equivalent to duty service required by driven equipment.
3. Design for full voltage starting.
4. Design bearing life based upon actual operating load conditions imposed by driven equipment.
5. Size for altitude of Project.
6. Furnish with stainless steel nameplates which include all data required by NEC Article 430.
7. Use of manufacturer's standard motor will be permitted on integrally constructed motor driven equipment specified by model number in which a redesign of the complete unit would be required to provide a motor with features specified.
8. AC electric motors less than 1/3 hp:
a. Single phase, 60 Hz, designed for the supply voltage shown on the Drawings.
b. Permanently lubricated sealed bearings conforming to ABMA standards.
c. Built-in manual reset thermal protector or integrally mounted manual motor starter with thermal overload element with stainless steel enclosure.
9. AC electric motors 1/3 to 1 hp:
a. Single or 3 PH, 60 Hz, designed for the supply voltage shown on the Drawings.
b. Permanently lubricated sealed bearings conforming to ABMA standards.
1) For single phase motors, provide built-in manual reset thermal protector or integrally mounted manual motor starter with thermal overload element.
10. AC electric motors 1-1/2 to 10 hp:
a. Single or 3 PH, 60 Hz, designed for the supply voltage shown on the Drawings.
b. Permanently lubricated sealed bearings conforming to ABMA standards.

c. For vertical motors provide 15-year, average-life thrust bearings conforming to ABMA standards.

11. AC electric motors greater than 10 hp:
    a. Single or 3 PH, 60 Hz, designed for the supply voltage shown on the Drawings.
    b. Oil or grease lubricated antifriction bearings conforming to ABMA standards.
        1) Design bearing life for 90 percent survival rating at 50,000 hours of operation for motors up to and including 100 hp.
        2) For motors greater than 100 hp, design bearing life for 90 percent survival rating at 100,000 HRS of operation.
    c. For vertical motors provide 15-year, average-life thrust bearings conforming to ABMA standards.
    d. Thermal protection:
        1) For motors 50 hp and above controlled from a variable frequency drive and for all other motors 100 hp and above, provide one of the following:
            a) Integral thermal detectors (thermostat) per phase with normally closed contacts wired in series that will open on overtemperature
            b) Resistance type temperature detector (RTD) complete with monitor and alarm panel having a normally closed contact that will open on overtemperature.
                (1) Two thermal sensing devices per phase in each phase hot-spot location.
                (2) Monitor and alarm panel:
                    (a) For constant speed motors, install panel in and energize from the motor starter equipment.
                    (b) For variable speed motors, install panel in and energize from the variable speed drive equipment.
12. Severe duty motor to have the following minimum features:
    a. All cast iron construction.
    b. Gasketed conduit box.
    c. Epoxy finish for corrosion protection.
    d. Hydroscopic varnish on windings for corrosion protection.
    e. Drain plug and breather.

B. NEMA Design Squirrel Cage Induction Motors:
1. Provide motors designed and applied in compliance with NEMA and IEEE for the specific duty imposed by the driven equipment.
2. Motors to meet NEMA MG 1 (NEMA Premium) efficiencies.
3. Do not provide motors having a locked rotor kVA per HP exceeding the NEMA standard for the assigned NEMA code letter.
4. For use on variable frequency type adjustable speed drives, provide:
    a. Induction motors that comply with NEMA MG 1, Part 31.
    b. Nameplate identification meeting NEMA MG 1 Part 31 requirements.
    c. Insulated drive end bearing on all motors.
    d. Insulated non-drive end bearings, at a minimum, on all motors with horizontal shaft 100 hp and larger.
    e. An insulated bearing carrier on the non-drive end for vertical shaft motors 100 hp and larger.
    f. Shaft grounding ring on all motors:
        1) Factory installed, maintenance free, circumferential, bearing protection ring with conductive microfiber shaft contacting material.
        2) Electro Static Technology AEGIS SGR Bearing Protection Ring or approved equal.
        3) For motors in Class I, Division 2, hazardous classified areas, furnish explosion proof motors if required to provide at least Division 2 approval with specified shaft grounding ring.
    g. Have the following minimum turndown ratio without the use of additional cooling, such as a blower, to provide continuous supply of cooling air over the motor. Furnish greater turndown ratio if specified in the individual equipment specifications.

1) Variable torque: 10:1.
2) Constant torque: 6:1.

5. Design motor insulation in accordance with NEMA standards for Class F insulation with Class B temperature rise above a 40 degrees C ambient.
6. Design motors for continuous duty.
7. Size motors having a 1.0 service factor so that nameplate HP is a minimum of 15 percent greater than the maximum HP requirements of the driven equipment over its entire operating range.
   a. As an alternative, furnish motors with a 1.15 service factor and size so that nameplate HP is at least equal to the maximum HP requirements of the driven equipment over its entire operating range.
   b. Some applications may be specifically exempted from this service factor requirement in the individual equipment specifications.
8. Motor enclosure and winding insulation application:
   a. The following shall apply unless modified by specific Specification Sections:

MOTOR LOCATION	MOTOR ENCLOSURE / WINDING INSULATION
Unclassified Indoor Areas	TEFC, Standard Insulation
Wet indoor Areas	TEFC, Standard Insulation
Wet outdoor Areas	TEFC, Severe/ Chemical Duty
Corrosive Areas	TEFC, Severe/ Chemical Duty
Class I, Division 1 Areas	Explosion Proof, Approved for Class I Division 1 Locations
Class II, Division 1 Areas	Explosion Proof, Approved for Class II Division 1 Locations
Class I or Class II, Division 2 Areas	TEFC, Severe/ Chemical Duty , Approved for Class I, Division 2 Locations; Furnish explosion proof if required to meet shaft grounding requirements in this section.

NOTE: Provide TENV motors in the smaller horsepower ratings where TEFC is not available.
Motor Locations are defined on the Electrical Drawings.

9. Provide oversize conduit box complete with clamp type grounding terminals inside the conduit box.
10. Balance motors to ISO G2.5 level.
    a. Submit prior to shipping to equipment manufacturer or job site.

C. Submersible Motors: Refer to individual narrow-scope Specification Sections for submersible motor requirements.

D. V-Belt Drive:
1. Provide each V-belt drive with sliding base or other suitable tension adjustment.
2. Provide V-belt drives with a service factor of at least 1.6 at maximum speed.
3. Provide static-proof belts.

E. Vibration Isolators:
1. Provide all equipment subject to vibration with restrained spring type vibration isolators or pads according to the manufacturer's written recommendation.

F. Space Heaters:
1. Silicone rubber strip type, 120 V rated.
2. Provide where specifically shown on the Drawings and/or in the individual equipment specifications.

2.3 COMPONENTS

A. Gear Drives and Drive Components:

1. Size drive equipment capable of supporting full load including losses in speed reducers and power transmission.
2. Provide nominal input horsepower rating of each gear or speed reducer at least equal to nameplate horsepower of drive motor.
3. Design drive units for 24-hour continuous service, constructed so oil leakage around shafts is precluded.
4. Utilize gears, gear lubrication systems, gear drives, speed reducers, speed increasers and flexible couplings meeting applicable standards of AGMA.
5. Gear reducers:
    a. Provide gear reducer totally enclosed and oil lubricated.
    b. Utilize antifriction bearings throughout.
    c. Provide worm gear reducers having a service factor of at least 1.20.
    d. Furnish other helical, spiral bevel, and combination bevel-helical gear reducers with a service factor of at least 1.50.

2.4 ACCESSORIES

A. Guards:
1. Provide each piece of equipment having exposed moving parts with full length, easily removable guards, meeting OSHA requirements.
2. Interior applications:
    a. Construct from 304 stainless steel rolled to conform to shaft or coupling surface.
    b. Utilize non-flattened type 16 GA galvanized steel with nominal 1/2 inches spacing.
    c. Connect to equipment frame with hot-dip galvanized bolts and wing nuts.
3. Exterior applications:
    a. Construct from 16 GA stainless steel or aluminum.
    b. Construct to preclude entrance of rain, snow, or moisture.
    c. Roll to conform to shaft or coupling surface.
    d. Connect to equipment frame with stainless steel bolts and wing nuts.

B. Anchorage:
1. Cast-in-place anchorage:
    a. Provide ASTM F593, Type 316 stainless steel anchorage for all equipment.
    b. Configuration and number of anchor bolts shall be per manufacturer's recommendations.
    c. Provide two nuts for each bolt.
2. Drilled anchorage:
    a. Adhesive anchors per Section 03 15 19.
    b. Epoxy grout per Section 03 31 30.
    c. Threaded rods same as cast-in-place.

C. Data Plate:
1. Attach a stainless steel data plate to each piece of rotary or reciprocating equipment.
2. Permanently stamp information on data plate including manufacturer's name, equipment operating parameters, serial number and speed.

D. Gages:
1. Provide gages in accordance with Section 40 73 00.
2. Provide at the following locations:
    a. Inlet and outlet of all reciprocating, centrifugal and positive displacement mechanical and process equipment.
    b. At locations identified on Drawings.
3. Utilize tapping sleeves for mounting per Section 40 05 00.

E. Lifting Eye Bolts or Lugs:
1. Provide on all equipment 50 pounds or greater.
2. Provide on other equipment or products as specified in the narrow-scope Specification Sections.

2.5 FABRICATION

A. Design, fabricate, and assemble equipment in accordance with modern engineering and shop practices.

B. Manufacture individual parts to standard sizes and gages so that repair parts, furnished at any time, can be installed in field.

C. Furnish like parts of duplicate units to be interchangeable.

D. Ensure that equipment has not been in service at any time prior to delivery, except as required by tests.

E. Furnish equipment which requires periodic internal inspection or adjustment with access panels which will not require disassembly of guards, dismantling of piping or equipment or similar major efforts.
   1. Quick opening but sound, securable access ports or windows shall be provided for inspection of chains, belts, or similar items.

F. Provide common, lipped base plate mounting for equipment and equipment motor where said mounting is a manufacturer's standard option.
   1. Provide drain connection for 3/4 inches PVC tubing.

G. Machine the mounting feet of rotating equipment.

H. Fabricate equipment which will be subject to Corrosive Environment in such a way as to avoid back-to-back placement of surfaces that cannot be properly prepared and painted.
   1. When such back-to-back fabrication cannot be avoided, provide continuous welds to seal such surfaces from contact with corrosive environment.
   2. Where continuous welds are not practical, after painting seal the back-to-back surfaces from the environment in accordance with Section 07 92 00.

I. Natural frequency/critical speed:
   1. All rotating parts accurately machined and in as near perfect rotational balance as practicable.
   2. Excessive vibration is sufficient cause for equipment rejection.
   3. Ratio of all rotative speeds to natural frequency/critical speed of a unit or components: Greater than 1.2.

J. Equipment Base
   1. Adequate grout and vent openings to allow grout to flow under entire base.

K. Control Panels Engineered and Provided with the Equipment by the Manufacturer:
   1. Manufacturer's standard design for components and control logic unless specific requirements are specified in the specific equipment Specification Section.
   2. NEMA or IEC rated components are acceptable, whichever is used in the manufacturer's standard engineered design, unless specific requirements are required in the specific equipment Specification Section.
   3. Affix entire assembly with a UL 508A or UL 698A label "Listed Enclosed Industrial Control Panel" prior to delivery.
      a. Control panels without an affixed UL 508A or UL 698A label shall be rejected.
   4. Provide equipment or control panels with Short Circuit Current Rating (SCCR) labeling as required by NFPA 70 and other applicable codes.
      a. Determine the SCCR rating by one of the following methods:
         1) Method 1: SCCR rating meets or exceeds the available fault current of the source equipment when indicated on the Drawings.
         2) Method 2: SCCR rating meets or exceeds the source equipment's Amp Interrupting Current (AIC) rating as indicated on the Drawings.
         3) Method 3: SCCR rating meets or exceeds the calculated available short circuit current at the control panel.

b. The source equipment is the switchboard, panelboard, motor control center or similar equipment where the control panel circuit originates.
c. For Method 3, provide calculations justifying the SCCR rating. Utilize source equipment available fault current or AIC rating as indicated on the Drawings.

2.6 SHOP OR FACTORY PAINT FINISHES

A. Electrical Equipment:
1. Provide factory-applied paint coating system(s) for all electrical equipment components except those specified in Section 09 96 00 to receive field painting.
a. Field painted equipment: See Section 09 96 00 for factory applied primer/field paint compatibility requirements.

B. Field paint other equipment in accordance with Section 09 96 00.
1. See Section 09 96 00 for factory applied primer/field paint compatibility requirements.

2.7 SOURCE QUALITY CONTROL

A. Motor Tests:
1. Test motors in accordance with NEMA and IEEE standards.
2. Provide routine test for all motors.
3. The Owner reserves the right to select and have tested, either routine or complete, any motor included in the project.
a. The Owner will pay all costs, including shipping and handling, for all motors successfully passing the tests.
b. Pay all costs, including shipping and handling, for all motors failing the tests.
c. If two successive motors of the same manufacturer fail testing, the Owner has the right to reject all motors from that manufacturer.

B. Balance:
1. Unless specified otherwise, for all equipment 10 hp or greater, all rotating elements in motors, pumps, blowers, and centrifugal compressors shall be fully assembled, including coupling hubs, before being statically and dynamically balanced. Balance all rotating elements to the following criteria, per ISO 21940-11:

$$Uper = \frac{G \; x \; 6.015 \; x \; W/2}{N}$$

Where:
Uper = Permissible residual unbalance for each correction plane in ounce-inches (OZ-IN). See ISO 21940-11 for acceptable values.
G = ISO Balance Quality Grade Number, per ISO 21940-11
W = Rotor weight in pounds
N = Maximum continuous operating RPM

a. Where specified, balancing reports, demonstrating compliance with this requirement, shall be submitted as product data.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install equipment as shown on the Drawings and other Contract Documents, in accordance with manufacturer's written instructions, and in accordance with Laws and Regulations. Where the Contract Documents, manufacturer's written instructions, or Laws and Regulations conflict, obtain interpretation or clarification from Engineer before proceeding.

B. Utilize appropriate templates for anchorage placement for equipment installed on concrete.

C. Equipment Drainage Discharges:

1. For equipment having drainage requirements, such as seal water, provide 3/4-inch copper, PVC, or clear plastic tubing from drainage discharge at equipment base to nearest floor drain or equipment drain. Do not discharge liquid across floors.
2. Furnish and install bell up at each equipment base.
3. Route equipment drainage piping clear of major traffic areas, to discharge to locations approved by Engineer. To extent practical, avoid creating tripping hazards.

D. Coordination of Equipment Supports and Bases with Structures:
1. Do not construct foundations until major equipment supports are approved by Engineer.

E. Equipment Lubrication Points:
1. Extend all non-accessible or difficult-to-access lubrication fittings to reasonably accessible locations to facility operation and maintenance personnel without use of ladders or elevating devices, by providing stainless steel tubing (of appropriate wall thickness for the service and application) to a location which allows easy access of fittings from closest operating floor level.

F. Concrete Equipment Support Bases:
1. Install level in both directions, with acceptable vertical tolerance of 1/4-inch±.
2. At anchorage locations, install bases flat and level.

G. Machine Bases / Sole Plates:
1. Grease or tape anchorages and jack screws to inhibit grout from adhering to bolts and other anchors.
   a. Jack screws number and size by equipment manufacturer.
      1) Jack screw
         a) Type 304 stainless steel minimum
         b) 0.5 inches diameter, minimum
      2) Jack Screw Pad
         a) 2 inch diameter, minimum
         b) Anchored in place with a structural epoxy adhesive.
2. Install machine base of rotating equipment on equipment base.
3. Level in both directions using jack screws, with a machinist level, according to machined surfaces on base. Base shall be level within vertical tolerance of the lesser of (a) 0.005 inch per foot with no more than 0.0005 inches difference between any two points, or (b) equipment manufacturer's written instructions.
4. Level machine base on equipment base and align couplings between driver and driven equipment.

H. Couplings for Rotating Equipment:
1. Align in annular and parallel positions.
   a. For equipment rotating at 1200 rpm or less, align both annular and parallel within 0.001 inch tolerance for couplings four-inch size and smaller.
   b. Couplings larger than four-inch size: Increase tolerance 0.0005 inch per inch of coupling diameter above four-inch; for example: for six-inch coupling, tolerance is 0.002 inch. For 10 inch coupling, required tolerance is 0.004 inch.
   c. For equipment rotating at speeds greater than 1200 rpm, tolerance for both annular and parallel positions shall be rate of 0.00025 inch (or less) per inch of coupling diameter.
2. If equipment is furnished by manufacturer as mounted unit , verify factory alignment after installation at the Site. Realign if as necessary, in accordance with equipment manufacturers' written instructions, to provide required factory tolerance..
3. Inspect surfaces for runout before attempting to trim or align units.

I. Grouting:
1. Level onto equipment base with jack screws in accordance with the Contract Documents, provide a dam or formwork around base to contain grout between equipment base and equipment support pad.
2. Preparation:

a. Extend dam or formwork to cover leveling shims and blocks.
b. Anchor sleeves:
    1) Required for equipment (Pumps, Mixers, Blowers) greater than 50 hp
    2) If anchor sleeves were used, fill voids in anchor sleeves with foam or room temperature vulcanizing (RTV) silicone to keep grout from filling sleeves.
c. Do not use nuts below the machine base to level the unit.
d. Saturate top of roughened concrete surface with water before grouting.

3. Grout Installation:
    a. Install grout until entire space under machine base is completely filled to underside of base. Voids are unacceptable.
    b. Puddle grout by working a stiff wire through the grout and vent holes, to ensure grout is installed properly and to release air entrained in grout or base cavity.
4. After Grout Installation:
    a. When grout is sufficiently hardened, remove dam or formwork and finish exposed grout surface to fine, smooth surface.
    b. Completely cover exposed grout surfaces with wet burlap and keep covering sufficiently wet to prevent too-rapid evaporation of water from grout.
    c. Check for voids by tapping along the top deck of the mounting plate. A solid thud indicates grout-filled areas while a drum-like hollow sound indicates a void requiring filling.
        1) Void areas are to be filled by drilling 1/8 inches NPT holes in opposite corners of each void area. Grout to be pumped into one void with a grout gun until grout emerges from the other vent hole.
    d. When grout is fully hardened (after not less than seven days), remove jack screws, and tighten nuts on anchor bolts and similar anchors to required torque.
    e. Inspect and verify levelness of machine base and, if not in accordance with requirements, remedy by removing base and reinstalling in accordance with the Contract Documents.
    f. Inspect driver-driven equipment for proper alignment. When not in accordance with requirements, remedy so that the Work is not defective.

3.2 INSTALLATION CHECKS

A. For all equipment specifically required in detailed specifications, secure services of experienced, competent, and authorized representative(s) of equipment manufacturer to visit site of work and inspect, check, adjust and approve equipment installation.
    1. In each case, representative(s) shall be present during placement and start-up of equipment and as often as necessary to resolve any operational issues which may arise.

B. Secure from equipment manufacturer's representative(s) a written report certifying that equipment:
    1. Has been properly installed and lubricated.
    2. Is in accurate alignment.
    3. Is free from any undue stress imposed by connecting piping or anchor bolts.
    4. Has been operated under full load conditions and that it operated satisfactorily.
        a. Secure and deliver a field written report to Owner immediately prior to leaving jobsite.

C. No separate payment shall be made for installation checks.
    1. All or any time expended during installation check does not qualify as Operation and Maintenance training or instruction time when specified.

3.3 IDENTIFICATION OF EQUIPMENT AND HAZARD WARNING SIGNS

A. Identify equipment and install hazard warning signs in accordance with Section 10 14 00.

3.4 FIELD PAINTING AND PROTECTIVE COATINGS

A. For required field painting and protective coatings, comply with Section 09 96 00, High Performance Industrial Coatings.

3.5 WIRING CONNECTIONS AND TERMINATION

A. Clean wires before installing lugs and connectors.

B. Coat connection with oxidation eliminating compound for aluminum wire.

C. Terminate motor circuit conductors with copper lugs bolted to motor leads.

D. Tape stripped ends of conductors and associated connectors with electrical tape.
   1. Wrapping thickness shall be 150 percent of the conductor insulation thickness.

E. Connections to carry full ampacity of conductors without temperature rise.

F. Terminate spare conductors with electrical tape.

3.6 FIELD QUALITY CONTROL

A. General:
   1. Furnish equipment manufacturer's field quality control services and testing as specified in the individual equipment Specification Sections.
   2. Execute pre-demonstration requirements in accordance with Section 01 75 00.
   3. Perform and report on all tests required by the equipment manufacturer's Operation and Maintenance Manual.
   4. Provide testing for all equipment furnished or installed as part of the Work.
   5. Repair or replace equipment shown to be out of range of the acceptable tolerance until the equipment meets or exceeds acceptable standards.
   6. Equip testing and analysis personnel with all appropriate project related reference material required to perform tests, analyze results, and provide documentation including, but not limited to:
      a. Contract Drawings and Specifications.
      b. Related construction change documentation.
      c. Approved Shop Drawings.
      d. Approved Operation and Maintenance Manuals.
      e. Other pertinent information as required.

B. Equipment Monitoring and Testing Plans:
   1. Approved in accordance with Shop Drawing submittal schedule.
   2. Included as a minimum:
      a. Qualifications of firm, field personnel, and analysis personnel doing the Work.
      b. List and description of testing and analysis equipment to be utilized.
      c. List of all equipment to be testing, including:
         1) Name and tag numbers identified in the Contract Documents.
         2) Manufacturer's serial numbers.
         3) Other pertinent manufacturer identification,

C. Instruments Used in Equipment and Connections Quality Control Testing:
   1. Minimum calibration frequency:
      a. Field analog instruments: Not more than 6 months.
      b. Field digital instruments: Not more than 12 months.
      c. Laboratory instruments: Not more than 12 months.
      d. If instrument manufacturer's calibration requirements are more stringent, those requirements shall govern.
   2. Carry current calibration status and labels on all testing instruments.
   3. See individual testing programs for additional instrumentation compliance requirements.

D. Testing and Monitoring Program Documentation:
   1. Provide reports with tabbed sections for each piece of equipment tested.
   2. Include all testing results associated with each piece of equipment under that equipment's tabbed section.
      a. Include legible copies of all forms used to record field test information.

3. Prior to start of testing, submit one copy of preliminary report format for Engineer review and comment
    a. Include data gathering and sample test report forms that will be utilized.
4. In the final report, include as a minimum, the following information for all equipment tested:
    a. Equipment identification, including:
        1) Name and tag numbers identified in the Contract Documents.
        2) Manufacturer's serial numbers.
        3) Other pertinent manufacturer identification,
    b. Date and time of each test.
    c. Ambient conditions including temperature, humidity, and precipitation.
    d. Visual inspection report.
    e. Description of test and referenced standards, if any, followed while conducting tests.
    f. Results of initial and all retesting.
    g. Acceptance criteria.
    h. "As found" and "as left" conditions.
    i. Corrective action, if required, taken to meet acceptance.
    j. Verification of corrective action signed by the Contractor, equipment supplier, and Owner's representative.
    k. Instrument calibration dates of all instruments used in testing.
5. Provide three (3) bound final reports prior to Project final completion.

E. Electrical Equipment and Connections Testing Program:
1. Perform testing on Electrical equipment, connections, and motors in accordance with 26 08 13 - Acceptance Testing.

F. Other Testing:
1. Perform tests and inspections not specifically listed but required to assure equipment is safe to energize and operate.
2. Subbase that supports the equipment base and that is made in the form of a cast iron or steel structure that has supporting beams, legs, and cross members that are cast, welded, or bolted shall be tested for a natural frequency of vibration after equipment is mounted.
    a. The ratio of the natural frequency of the structure to the frequency of the disturbing force shall not be between 0.5 and 1.5.

G. Infrared Thermography Testing Program:
1. Perform infrared thermography testing for equipment specified in the individual equipment specifications and for equipment listed here during the Equipment Demonstration Period.
    a. Perform on all rotating and reciprocating equipment having drivers 25 hp or greater.
2. Additional requirements for infrared thermography monitoring and testing equipment:
    a. Temperature range: -10 to 350 degrees C.
    b. Accuracy: ±2 percent or 2 degrees C, whichever is greater.
    c. Repeatability: ±1 percent or 1 degree C, whichever is greater.
    d. Temperature indication resolution: 0.1 degrees C.
    e. Minimum focus distance: 0.3 meters.
    f. Output in color palettes: JPEG, BMP, or other digital format compatible with Windows.
3. Perform inspection per ASTM E1934.
    a. Operate VFD driven equipment at 100 percent speed during thermographic inspection.
4. Acceptability of electrical connections and components based on temperature comparison between components and ambient air temperatures not greater than 10 degrees C per ASTM E1934.
5. Acceptability of motors and equipment bearings based on temperature rise not greater than 5 DEGC above the equipment and/or bearing manufacturers published criteria.

H. Equipment Field Vibration Monitoring and Testing Program:

1. Perform vibration monitoring and testing for equipment specified in other Divisions during the Equipment Demonstration Period.
2. Perform field vibration testing on each item of rotating and reciprocating equipment having driver 20 HP and greater.
3. Acceptability of equipment conditions, except pumps, based on ISO 1940-1 Balance Quality Grade G6.3 criteria.
4. Acceptability of pumping equipment to be based on current ANSI/HI criteria:
   a. ANSI/HI 11.6-2012 for Submersible Pumps in a Wet-pit or Dry-pit configuration.
   b. ANSI/HI 9.6.4-2016 for all other centrifugal pumps.
5. Utilize an Engineer approved 3rd party testing agency to perform vibration monitoring and testing on equipment.
6. For variable speed equipment provide vibration testing at no more than 3 percent increments of maximum speed throughout entire operating range.
7. Provide machinery condition diagnosis based on an acceptable machinery vibration severity guide or machinery fault guide analysis provided by the testing agency.
8. Tolerances for pumping equipment shall be per HI published standards.
9. Repair or replace equipment shown to be out of range of the specified tolerance until the equipment meets the specified normal operation range required in the machinery fault guide analysis.
10. Document testing with written report.
    a. Report to include initial testing results, acceptance criteria, corrective action taken to meet acceptance, verification of corrective action and acceptance report and baseline.
    b. Natural frequency of installed equipment utilizing an impact hammer.
    c. Report to include graphical plots of vibration signature for each test point at a scale which illustrates all vibration levels greater than 0.025 ips RMS.

3.7 DEMONSTRATION

A. Demonstrate equipment in accordance with Section 01 75 00.

3.8 ABBREVIATION TABLE

A. As indicated on the Drawings.

3.9 CLOSEOUT ACTIVITIES

A. Refer to Section 01 81 33 – Cyber-Security Requirements for cyber security related closeout requirements.

END OF SECTION

EXHIBIT A

MANUFACTURER FIELD SERVICE REPORT

This field service report is generic in nature. An electronic copy of this form will be furnished upon request from the Engineer. This report is to reflect that all requirements of the Operations and Maintenance Manual and the individual equipment specification requirements have been performed for the installation and operation and also to provide a baseline for amperage draw for each phase, vibration readings, rotation, alignment and all other applicable tests required to insure that the equipment has been installed properly. A MFSR will be required for each individual piece of equipment requiring a MFSR.

Definitions of Reports:

Initial service report: Required for construction preparations. Equipment delivered to site is in good condition and conforms to specification requirements. Anchor bolts, hardware and ancillary items (piping, flanges, conduits, fuel/power supply) are compatible with equipment.

Interim service report: Required for equipment installation onto base or foundation. Piping connections, electrical and control connections or structural attachment are complete. For equipment stored on site over four weeks, interim service report will document that manufacturer's long-term storage procedures have been incorporated and equipment has not been damaged, nor coatings deteriorated.

Final service report is to be completed when equipment can be started, electrical amperage and voltage draw measured, cold and hot alignments performed, vibration testing and monitoring performed and the equipment is found to be in compliance with Manufacturer's operating parameters and the requirements of the individual equipment specifications.

PROJECT: _____

Report Status:

Initial Service Report completed and submitted on _____

Interim Service Report completed and submitted on _____

Final Service Report completed and submitted on _____

Commencement of Warranty _____

I Description

A. Equipment Name and Identification: _____

_____

B. Serial Number: _____

C. Specification Section Number: _____

D. Manufacturer: _____

E. Representative: _____

F. Type of Service: Initial [_____] Interim [_____] Final [_____]

II General Review

A. The above referenced equipment/material/supplies have been inspected, checked, and adjusted. Yes [_____] No [_____]

Summary: _____

_____

B. The above referenced equipment/material/supplies were placed upon properly prepared or suitable substrate. N/A [_____] Yes [_____] No [_____]

Summary: _____

_____

C. The above referenced equipment/material/supplies are free from any undue stress imposed by any connected piping, anchor bolts or any other load. N/A [_____] Yes [_____] No [_____]

Summary: _____

_____

D. The above referenced equipment/material/supplies have operated under design conditions. N/A [_____] Yes [_____] No [_____]

Summary: _____

_____

E. The above referenced equipment/material/supplies have been installed in accordance with the manufacturer's recommendations and the Procurement Documents, require no corrective work, and are hereby approved. Yes [_____] No [_____]

Summary: _____

_____

F. The above referenced equipment/material/supplies are acceptable to the manufacturer as installed providing the following corrective action(s) are performed:

1. _____
2. _____
3. _____
4. _____
5. _____

III Inspection Checklist

Item	Acceptable (Yes/No)	Readings/Comments
Bearings (1)		
Belts (tension reading)		
Lubrication Levels		
Vibration (1) (2) (MILS/SEC)		
Infrared Thermography (1) (2)		
Starting AMPS		
Full Load AMPS		
Volts		
Rotation		
Jacket Temperature (DEGF)		
Seal Water Flow Rate (GPH or GPM)		
Seal Water Pressure (PSI)		
O-rings/Packing		
Alignment (1)		
Anchor Bolts		

Item	Acceptable (Yes/No)	Readings/Comments
Anchor Bolt Torque		
Grout		
Substrate Approval		
Sound level (4 feet from unit) (1) (dB)		
Other		

(1) Inspection or testing reports must be attached.
(2) Provide vibration testing and monitoring procedures for Engineer's review and approval prior to testing.

IV O&M Manuals

A. The O&M manual as presented contains all information required for proper operation, maintenance, and instruction of this system. N/A [_____] Yes [_____] No [_____]

Summary: _____

_____

V Preventive Maintenance

A. The preventive maintenance summary outlined in the O&M manual is acceptable for operation of the system throughout the warranty period. N/A [_____] Yes [_____] No [_____]

Summary: _____

_____

VI Operator Training/Classroom Instruction

A. Training and instruction have been performed in accordance with the requirements of the Procurement Documents. N/A [_____] Yes [_____] No [_____]

B. Final Training/Classroom Instruction Completed on: _____

Summary: _____

_____

VII Remarks

_____

VIII Certification

I hereby certify, that I, [_____], am a duly authorized representative of the manufacturer, that I am empowered by the manufacturer to inspect, approve, and operate his equipment, and that I am authorized to make recommendations required to assure that the equipment furnished by the manufacturer is complete and operational, except as modified herein. I also certify that all information contained herein is true and accurate.

By: _____
(Authorized Representative)

For: _____

Date: _____

IX Acknowledgments

By: _____

For: _____
(Contractor)

Date: _____

By: _____

For: _____
(Engineer)

Date: _____

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SECTION 01 62 00
PRODUCT OPTIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Contractor's options for selecting materials and equipment.
   2. Requirements for consideration of "or equal" materials and equipment.

1.2 CONTRACTOR'S PRODUCT OPTIONS

A. For materials and equipment specified only by reference standard or description, without reference to Supplier, furnish materials and equipment complying with such reference standard and descriptive requirements in the Contract Documents, by a Supplier or from a source that complies with the Contract Documents.

B. For materials and equipment specified by naming one or more items or Suppliers, furnish the named materials and equipment that comply with the Contract Documents, unless an "or equal" or substitute item is approved by Engineer.

C. For materials and equipment specified by naming one or more items or Suppliers and the term, "or equal", when Contractor proposes a material or equipment item or Supplier as an "or equal", submit to Engineer a request for approval of an "or equal" item or Supplier.

D. For materials and equipment specified by naming only one item or manufacturer and followed by words indicating that no substitution or "or equal" is allowed, there is no option and no "or equals" or substitutes will be allowed or approved.

1.3 "OR EQUAL" ITEMS

A. Procedure: The following augments the requirements of the General Conditions, as may be modified by the Supplementary Conditions:
   1. For proposed materials and equipment, whether indicated by name in the Contract Documents, and considered by Contractor as an "or equal" in accordance with the General Conditions, Contractor shall request in writing Engineer's approval of each proposed "or equal".
   2. Request for approval of an "or equal" item shall accompany the Shop Drawing, product data Submittal, or Sample for the proposed item. Engineer may reject or otherwise not approve or accept any such request or Submittal that is incomplete.
   3. Indicate on the Schedule of Submittals which Submittals were for proposed "or equals" and which were approved as "or equals".
   4. Clearly indicate in the associated Submittal transmittal whether the Submittal includes request for approval of a proposed "or equal".
   5. Comply with the Contract Documents' requirements to clearly indicate all proposed deviations from the requirements of the Contract Documents. Where the Contract Documents do not otherwise require such indication, Contractor shall indicate in detail, both in the Submittal for the "or equal" item and in separate, written correspondence, each proposed deviation from the requirements of the Contract Documents.
   6. Requirements for furnishing information and documents related to proposed "or equals" shall be furnished with the initial Submittal for that item and for all subsequent re-Submittals, if any.
   7. Engineer's approval, if any, of a proposed "or equal" will be indicated by the Engineer's approval of the associated Shop Drawing, product data Submittal, or Sample, as applicable, unless otherwise indicated on the associated Submittal.

8. Should Engineer reject or otherwise not approve a proposed "or equal", Contractor may propose the item as a substitute, subject to the Contract Documents' requirements concerning requests for approval of substitute items or procedures.

B. Contractor's request for approval of each proposed "or equal" shall include:
   1. Contractor's written request that the proposed item be considered as an "or equal" in accordance with the General Conditions and this Specifications section.
   2. Contractor's certifications required in the General Conditions.
   3. Documentation adequate to demonstrate to Engineer that proposed item does not require extensive revisions to the Contract Documents, that proposed item is consistent with the Contract Documents, and that proposed item will produce results and performance required in the Contract Documents, and that proposed item is compatible with other portions of the Work.
   4. Detailed comparison of significant qualities of proposed item with the materials and equipment and Suppliers named in the Contract Documents. Significant qualities include attributes such as performance, weight, size, durability, corrosion resistance in the service environment, visual and textural effect and attributes, and specific features and requirements shown or indicated.
   5. Evidence that proposed item's manufacturer will furnish warranty equal to or better than that specified, if any.
   6. List of similar installations for completed projects with project names and addresses, and names, address, telephone number, and e-mail address of design professionals and owners, when requested by Engineer.
   7. Samples, when requested by Engineer.
   8. Other information requested by Engineer.

C. When used in the Contract Documents, the terms "or equal", "or-equal", and "or approved equal" have the same meaning and refer to materials or equipment proposed by Contractor for Engineer's approval as equivalent to materials or equipment indicated in the Contract Documents using the name of specific manufacturers or products. Such materials or equipment shall be incorporated into the Work only after being duly approved in writing by Engineer.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

SECTION 01 64 00
OWNER-FURNISHED PRODUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Requirements and procedures for Owner-furnished materials and equipment to be installed by Contractor, including:
      a. Items purchased by Owner under one or more separate procurement contracts.
      b. Handling and storage of Owner-furnished items.

B. Scope:
   1. Contractor shall provide labor, materials, tools, equipment, services, and incidentals shown, specified, and necessary for accepting, handling, insuring, storing, and maintaining as required, installing, checking out, starting-up, and completing Owner-furnished materials and equipment in accordance with the Contract Documents.

1.2 OWNER FURNISHED MATERIALS AND EQUIPMENT

A. Items of equipment and materials to be furnished by Owner for installation by Contractor are indicated below.
   1. Furnished under one or more procurement contracts separately entered into by Owner (as "buyer") with a seller:
      a. Transformer T-11, Switchboard SWBD-3101, and MCC-3101.
   2. Items will be delivered FOB to the Site unless otherwise coordinated by the Owner.

B. Availability of Owner-Furnished Materials and Equipment:
   1. Owner-furnished materials and equipment will be available to Contractor starting on:
      a. Items Obtained via Procurement Contracts: On the date(s) or time(s) indicated for delivery as set forth in the associated procurement contract.

C. Availability of Procurement Contract Documents:
   1. An electronic copy of the procurement contract documents was distributed with the construction Bidding Documents. Should such copy not be available to Contractor, an electronic copy, in portable document format (PDF), of the procurement contract documents is available from Engineer upon request. Contractor is responsible for printing and binding paper copies of the procurement contract documents needed by Contractor.

D. For Owner-furnished materials and equipment, Owner will provide updated probable delivery dates of the materials and equipment included in the procurement contract upon request from the Contractor.

E. Owner's Responsibilities:
   1. Within 20 days after the Effective Date of the Contract, Owner will arrange for and deliver to Contractor an electronic copy (in portable document format; PDF) of all available seller's shop drawings and other submittals as reviewed by Engineer or Owner. Such submittals, whether approved or otherwise, are not part of the Contract Documents.
   2. Owner (or Engineer, on behalf of Owner) will advise Contractor of the anticipated delivery date 10 days prior to scheduled delivery. Upon telephone advisory from seller's shipping entity/carrier, Owner (or Engineer, on behalf of Owner) will give Contractor approximately 24 hours' advance notification, by telephone, of scheduled delivery.
   3. Owner shall arrange and pay for delivery to the Site of Owner-furnished materials and equipment obtained via procurement contracts.
   4. Upon delivery, Owner (who may be accompanied by Engineer, at Owner's option) shall inspect, jointly with Contractor, the materials and equipment delivered by seller. Where

appropriate, Owner will arrange with seller to have seller's representative present at the delivery point to assist in visually inspecting the delivered materials and equipment.

5. The Owner will submit to seller claims for damage incurred in transit to the delivery location and shall replace damaged, defective, or nonconforming items of Owner-furnished materials and equipment obtained via procurement contract.
6. The Owner shall pay for services of seller's factory-trained representative to furnish consultation and advice during installation of associated Owner-furnished materials and equipment, to inspect, check, and approve installation before operation, and to furnish technical advice and direction during start-up and field quality control activities for Owner-furnished materials and equipment. Extent to which services of seller's representative will be provided during installation will be in accordance with the procurement contract documents.
7. If services of seller's representative beyond the scope of such services set forth in the procurement contract document is desired by Contractor, or if such services are necessary as a result of defective Work by Contractor, Contractor shall arrange and pay for such services of seller's representative.
8. After Substantial Completion, Owner will operate and maintain the items obtained via procurement contract and coordinate directly with seller regarding matters of routine maintenance. the Owner will communicate directly with seller regarding warranty-related matters.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Contractor shall review installation procedures for Owner-furnished materials and equipment and coordinate installation of items to be installed with or before Owner-furnished materials and equipment.

B. Scheduling:
   1. Contractor shall schedule and perform the Work to coordinate with anticipated delivery dates for Owner-furnished materials and equipment, as indicated in Owner's procurement contract(s) therefor.
   2. Where Owner will furnish services of a manufacturer's representative for Owner-furnished materials and equipment, schedule and perform the Work in accordance with scheduling constraints of manufacturer's representative.
   3. Contractor shall comply with the Contract Time indicated in the Contract Documents.

1.4 HANDLING AND STORAGE

A. Handling:
   1. Contractor shall handle Owner-furnished materials and equipment in accordance with the Contract Documents and the item manufacturer's written instructions. Handle so that warranties in effect are not voided.

B. Storage:
   1. Contractor shall store Owner-furnished materials and equipment in accordance with the Contract Documents and the item manufacturer's instructions. Store so that warranties in effect are not voided.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

SECTION 01 65 00
PRODUCT DELIVERY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. General requirements for:
      a. Coordination of deliveries.
      b. Preparing materials and equipment for shipping from the production or fabrication facility, including packaging.
      c. Shipment.
      d. Delivery of materials and equipment to the Site.
      e. Inspection upon delivery and remedy of damaged, deteriorated, or otherwise defective items, and remedy of missing or lost items.

B. Scope:
   1. Contractor shall make all arrangements for packaging, shipping, delivering, inspecting upon delivery, and unloading upon delivery materials and equipment necessary and required for the Work.
   2. Contractor shall provide all labor, materials, equipment, tools, incidentals, and services necessary to have materials and equipment properly packaged, shipped, and delivered to the Site, and all related Work required by the Contract Documents.

C. Related Requirements: Include but are not limited to:
   1. Section 01 29 76 - Progress Payment Procedures.
   2. Section 01 35 43.13 - Environmental Procedures for Hazardous Materials.
   3. Section 01 66 00 - Product Storage and Handling Requirements.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. To extent practicable, coordinate shipping and delivery of materials and equipment with anticipated shipping requirements, such as allowing sufficient time for customs inspections on international shipments, availability of shipping services and facilities, and seasonal concerns (such as shipments that may be influenced by major tropical storms and predictable, typical weather).
   2. Coordinate shipping and delivery of materials and equipment to the Site and other locations where such items may be stored prior to delivery to the Site. Coordinate such shipments and deliveries with the progress of the Work and status of adequate facilities, whether temporary storage or permanent installation locations, necessary to properly store and safeguard materials and equipment to be incorporated into the Work.
   3. Where possible, deliver to the Site materials and equipment as close as possible to when such items will be incorporated into appropriately protected, permanent installation location.

1.3 PREPARATION FOR SHIPMENT

A. Factory Assembly:
   1. When practical, factory-assemble materials and equipment. Mark or tag separate parts and assemblies to facilitate field assembly.

B. Temporary Protection:
   1. Appropriately cover, with strippable, protective coating or other material, machined parts and unpainted, uncoated, or unprotected surfaces subject to damage or deterioration caused by weather elements or environment,
   2. To extent practical, strippable, removable, disposable protective materials shall be recyclable.

3. To extent practical, strippable, removable, and disposable protective items shall be type resulting in minimum waste and cleanup upon removal.
4. Protection of Electrical Equipment, Instrumentation and Controls, Items with Computer Chips Solid-State Devices, and Other Electronics:
    a. Provide appropriate temporary protection of electrical equipment, microprocessors, and other electronics from humidity, moisture, and corrosion by appropriate packaging, protection, desiccants, and volatile corrosion inhibitor (VCI) blocks.
    b. Immediately prior to shipment, provide new, fresh desiccants and ensure integrity of other protective materials.

C. Packaging:
1. Package materials and equipment to facilitate handling, and protect materials and equipment from damage during shipping, handling, and storage.
2. Mark, label, or tag, on outside of each package, crate, and container, to indicate associated:
    a. Purchase order number.
    b. Bill of lading number.
    c. Delivery address (including facility name, where applicable).
    d. Owner's contract designation or Project name.
    e. Contractor name.
    f. Purchasing Subcontractor's name (as applicable).
    g. Contents by name and designation within the Work (for example, "Influent Pump No. 1"),
    h. Approximate weight of container, crate, package, including packaging.
    i. Special instructions for handling and protection during shipment and unloading.
    j. Comply with Section 01 35 43.13 - Environmental Procedures for Hazardous Materials, when materials or equipment contain Constituents of Concern.
3. The Site may be listed as the "ship to" or "delivery" address; but Owner or facility manager shall not be listed as recipient of shipment unless otherwise directed in writing by Engineer.
4. Truthfully and accurately mark, label, or tag items for shipment and delivery.
5. Include complete packing lists and bills of materials with each shipment.
6. Protect materials and equipment with appropriate, temporary packaging or protection when such items may rotate or move during shipment.
7. Protect materials and equipment from exposure to weather elements, adverse environments, and keep thoroughly dry and dust-free. Protect painted surfaces against impact, abrasion, discoloration, and other damage and deterioration.
8. Lubricate bearings and other items requiring lubrication, in accordance with manufacturer's written instructions.

1.4 SHIPPING

A. Notification of Shipments:
1. Keep Engineer, Owner, and Resident Project Representative informed of delivery of all materials and equipment to be incorporated into the Work.
2. Upon receipt of Supplier's advance notice of shipment, not less than seven days prior to delivery of materials and equipment at the Site or Contractor's storage location, furnish Resident Project Representative written notice of anticipated delivery date and specific location (at the Site or Contractor's storage location, as applicable).

B. Do not ship materials and equipment until:
1. Related Shop Drawings, product data, Samples, shop testing plan Submittals, and other Submittals required by the Contract Documents are approved by Engineer, including, but not necessarily limited to, all Action Submittals associated with the materials and equipment being delivered.
2. Manufacturer's written instructions for handling, storing, and installing the associated materials and equipment have been submitted to and accepted by Engineer, in accordance with the Specifications.

3. Results of source quality control activities (factory testing and inspections), when required by the Contract Documents for the subject materials or equipment, have been submitted to and accepted by Engineer.
4. Facilities required for handling materials and equipment, in accordance with the Contract Documents and manufacturer's instructions, are in place and available at the delivery location.
5. Required storage facilities and protection measures have been provided.

C. Loss or Damage During Shipment:
1. Unless otherwise indicated in the Contract Documents (whether expressly or in provisions regarding builder's risk insurance), Contractor is responsible for all loss, damage, and deterioration to materials and equipment incurred during shipment and delivery.
2. Contractor is not eligible for additional Contract Times or increase in the Contract Price due to delays or costs incurred due to loss, damage, or deterioration during shipment, unless Owner was responsible for shipping the subject materials or equipment to the Site or other delivery location.

1.5 DELIVERY

A. Scheduling and Timing of Deliveries:
1. Arrange deliveries of materials and equipment in accordance with the Progress Schedule accepted by Engineer and in ample time to facilitate inspection and observation prior to installation.
2. Schedule deliveries to minimize space required for, and duration of, storage of materials and equipment at the Site or other delivery location, as applicable.
3. Coordinate deliveries to avoid conflicting with the Work and conditions at the Site, and to accommodate the following:
a. Work of other contractors at or adjacent to the Site, Owner, , and others.
b. Storage space limitations.
c. Availability of appropriate construction equipment and machinery, tools, and qualified personnel for inspecting, unloading, and handling materials and equipment.
d. Owner's use of premises.
4. Deliver materials and equipment to the Site during regular working hours.
5. Deliver materials and equipment to avoid delaying the Work and the Project.

B. Deliveries:
1. Provide Contractor's telephone number to shipper; do not provide Owner's telephone number to shipper or carrier.
2. Arrange for deliveries while Contractor's personnel are at the Site. Contractor shall receive and coordinate shipments upon delivery. Shipments delivered to the Site when Contractor is not present will be refused by Owner, and Contractor shall be responsible for the associated delays and costs, including demurrage.
3. Comply with Section 01 35 43.13 – Environmental Procedures for Hazardous Materials, as applicable.

C. Containers and Marking:
1. Have materials and equipment delivered in manufacturer's original, unopened, labeled containers.
2. Clearly mark partial deliveries of component parts of materials and equipment to identify materials and equipment, to allow easy accumulation of parts, and to facilitate assembly.

D. Inspection of Materials and Equipment Upon Delivery:
1. Immediately upon delivery, visually but critically inspect shipment to verify that:
a. Materials and equipment comply with the Contract Documents and approved or accepted (as applicable) Submittals.
b. Quantities are correct.
c. Materials and equipment are undamaged and of required quality.
d. Containers and packages are intact and labels are complete and legible.

2. Eligibility for Payment:
    a. Materials and equipment are not eligible for payment until duly inspected and determined to be in accordance with the Contract Documents and Engineer-approved Submittals, without damage or deterioration.
    b. No payment can be made for damaged, deteriorated, or otherwise defective items.
    c. No payment can be made for missing or lost items.
    d. Other provisions of the Contract Documents may establish other preconditions for payment for delivered material and equipment, including Section 01 29 76 – Progress Payment Procedures.
3. Damaged, Deteriorated, and Otherwise Defective Items:
    a. Promptly remove from the Site damaged, deteriorated, or defective materials and equipment and expedite delivery of new, undamaged materials and equipment.
    b. Promptly remedy incomplete or lost materials and equipment.
    c. Furnish materials and equipment in accordance with the Contract Documents, to avoid delaying progress of the Work.
    d. Promptly advise Engineer in writing: (1) when damaged, deteriorated, incomplete, or otherwise defective materials and equipment are delivered, and (2) associated impact on the Progress Schedule.

E. Contractor's Handling of Materials and Equipment Upon Delivery:
1. Provide construction equipment and machinery, tools, and qualified personnel necessary to unload and handle materials and equipment, including those furnished by Owner, by methods that prevent damaging, defacing, and soiling materials and equipment and packaging.
2. Comply with Section 01 66 00 – Product Storage and Handling Requirements.
3. Provide additional protection during unloading and handling as necessary to prevent scraping, marring, and otherwise damaging materials and equipment and adjacent surfaces.
4. Unload and handle materials and equipment by methods that prevent bending, warping, and overstressing.
5. Lift heavy components only at designated lifting points.
6. Unload and handle materials and equipment in safe manner and as recommended by manufacturer to prevent damage. Do not drop, roll, or skid materials and equipment off delivery vehicles or at other times during unloading and handling.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

SECTION 01 66 00
PRODUCT STORAGE AND HANDLING REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. General requirements for:
      a. Payment considerations for stored materials and equipment.
      b. Handling of materials and equipment.
      c. Storage of materials and equipment, including:
         1) General provisions for storage.
         2) Storage locations.
         3) Protection of stored items.
         4) Storage of items containing Constituents of Concern.
         5) Outdoor, uncovered storage.
         6) Outdoor, covered storage.
         7) Fully-protected storage.
         8) Removal of temporary storage facilities and restoration of storage areas.
      d. Maintenance of storage.

B. Scope:
   1. Contractor shall provide all labor, materials, equipment, tools, services, lands, and incidentals necessary and required to store and handle materials and equipment to be incorporated into the Work, and other materials and equipment at the Site, adjacent areas, and offsite storage areas.
   2. Comply with Section 01 71 33 - Protection of the Work and Property, relative to handling and storing materials and equipment.

C. Related Requirements: Include but are not limited to:
   1. Section 01 29 76 - Progress Payment Procedures.
   2. Section 01 35 43.13 - Environmental Procedures for Hazardous Materials.
   3. Section 01 55 13 - Vehicular Access and Parking.
   4. Section 01 57 05 - Temporary Controls.
   5. Section 01 65 00 - Product Delivery Requirements.
   6. Section 01 71 33 - Protection of the Work and Property.

1.2 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment:
   1. Materials and equipment delivered but not suitably stored and protected will not be eligible for payment.
   2. Engineer may recommend reduction in payment, and Owner may reduce payments to Contractor ("set-offs") by an appropriate amount when stored items are subsequently revealed to be improperly stored or protected.
   3. Payment for Suitably Stored Items:
      a. Requirements for payment for materials and equipment delivered and suitably stored, but not yet incorporated into the Work, are in the General Conditions, as may be modified by the Supplementary Conditions, and Section 01 29 76 - Progress Payment Procedures.
      b. Materials and equipment delivered and suitably stored, but not yet incorporated into the Work, will not be eligible for payment until the inspection upon delivery, required in Section 01 65 00 - Product Delivery Requirements, is completed and Engineer concurs that such items generally appear to be in good condition, in accordance with the Contract Documents, and are of the required quality and quantity.

1.3 SUBMITTALS

A. Informational Submittals: Submit the following:
   1. Affidavits of Inspection and Maintenance Performed on Mechanical and Electrical Equipment in Long-Term Storage:
      a. Submit in accordance with requirements of Article 3.1 of this Section.
   2. Other Records of Inspection and Maintenance of Stored Materials and Equipment:
      a. Establish and maintain such records as required by this Section.
      b. Submit to Engineer or Owner (as applicable) within three days of Contractor's receipt of such request.

1.4 HANDLING

A. Contractor's Handling of Materials and Equipment – General:
   1. Handle materials and equipment to be incorporated into the Work in accordance with the Contract Documents and manufacturer's written instructions.
   2. During handling and assembling of materials and equipment:
      a. Maintain validity of manufacturers' warranties.
      b. Comply with:
         1) Section 01 65 00 - Product Delivery Requirements.
         2) Section 01 71 33 - Protection of the Work and Property.
      c. Do not drop, drag (without appropriate rollers or skids), or scrape materials and equipment.
      d. Use proper construction equipment and machinery, and tools, operated by sufficient number of qualified personnel.
      e. Maintain materials and equipment in neutral position.
      f. Do not exert undue stress on materials and equipment.
      g. Do not deform, bend, or damage materials and equipment.
      h. Do not deform or mar shafts, bearings, or other parts.

B. Additional Requirements for Hoisting and Lifting:
   1. When lifting or hoisting, support materials and equipment from appropriate lifting points using proper hooks and suitable nylon lifting straps, chains, and cables. Do not mar or scrape surfaces of materials and equipment during handling.
   2. Do not support rigging from building or structure without written approval of Engineer.
   3. Contractor is responsible for and shall remedy damage to building, structure, and existing equipment, resulting from Contractor's operations, in accordance with Section 01 71 33 - Protection of the Work and Property.

1.5 STORAGE

A. Storage – General:
   1. Contractor shall make all arrangements and provide all measures necessary and required for, and pay all costs associated with, storing materials and equipment.
   2. Store materials and equipment in accordance with the Contract Documents and manufacturer's written instructions. In event of conflict between the Contract Documents and manufacturer's written instructions regarding storage and protection, comply with the more-stringent, more-protective requirements.
   3. Comply with Section 01 71 33 - Protection of the Work and Property.
   4. Records:
      a. Establish and maintain up-to-date account of materials and equipment in storage, to facilitate preparation of progress payment requests, if the Contract Documents provide for payment for materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing.
      b. Submit affidavits of inspection and maintenance of mechanical and electrical equipment in long-term storage in accordance with this Section's Article 3.1 ("Maintenance of Storage").

5. Arrange stored materials and equipment to allow easy access for observation or inspection by Owner, Engineer, Resident Project Representative (RPR),, Owner-hired testing and inspection entities, and authorities having jurisdiction.
6. Inspect and maintain stored materials and equipment in accordance with this Section's Article 3.1 ("Maintenance of Storage").

B. Storage Location:
   1. Area(s) available at the Site for storing materials and equipment are addressed in Section 01 14 19 - Use of Site.
   2. When onsite storage is insufficient, Contractor shall provide additional lands for storage facilities as necessary and required for the Work.
   3. Restrictions on Storage Locations:
      a. Do not store materials or equipment in structures being constructed unless approved by Engineer in writing.
      b. Do not use lawns, landscaped areas, or private property for storage without written permission of property owner.
      c. Comply with:
         1) Section 01 14 19 - Use of Site.
         2) Section 01 55 13 - Vehicular Access and Parking.
         3) Section 01 71 33 - Protection of the Work and Property.

C. Protection of Stored Items – General:
   1. Store materials and equipment indicated below to ensure preservation of quality and fitness for intended uses in the Work, including proper protection against damage and deterioration resulting from: water (including precipitation, flood, and other), moisture, humidity, wind, dust, freezing, and outdoor ambient air high temperature as high as 110 degrees F. Temperature and humidity inside crates, containers, storage structures, and packaging may be significantly higher than outdoor ambient air temperature.
   2. Store in indoor, climate-controlled storage all materials and equipment subject to damage or deterioration by water, moisture, humidity, heat, cold, and other elements, unless otherwise acceptable to Owner and Engineer.
   3. Do not open manufacturer's crates, containers, and packaging until time of installation, unless recommended by the manufacturer or otherwise required in the Contract Documents.
   4. Store all materials and equipment off the ground (or floor) on raised supports such as skids or pallets.
   5. Electrical Equipment, Instrumentation and Controls, Items Containing Computer Chips, Solid-State Devices, and Other Electronics:
      a. Contractor shall obtain, coordinate, and comply with specific temperature, humidity, and environmental limitations on materials and equipment, because temperature inside cabinets and components stored in warm temperatures can approach 200 degrees F.
      b. Protect from water, moisture, humidity, dust, heat, cold, and other potentially harmful elements and environments. Space heaters provided in equipment shall be connected and operating at all times until equipment is connected to active, permanent, electrical power.
      c. Provide inside each electrical panel, control panel, and other enclosures with electronic device(s) each of the following: (1) desiccant, (2) volatile corrosion inhibitor (VCI) blocks, (3) moisture indicator, and (4) maximum- and minimum-indicating thermometer.
      d. Check panels and equipment not less than once per month. Replace desiccant, VCI, and moisture indicator the earlier of: (1) as often as necessary, or (2) every six months.
      e. Establish and maintain certified record of daily maximum and minimum temperature and humidity in storage facility. Such records shall be available for Engineer's and Owner's inspection upon request. Certified record of monthly inspection, noting maximum and minimum temperature for month, condition of desiccant, VCI, and moisture indicator, shall be available to Engineer and Owner upon request..
   6. Finished Surfaces:

a. Protect finished surfaces against impact, abrasion, discoloration, and other damage.
b. Remedy, in accordance with requirements of item manufacturer and finishing system manufacturer damaged, marred, or deteriorated finishes, to Engineer's satisfaction.

7. Contractor is fully responsible for loss, damage, and deterioration, including theft and vandalism, to stored materials and equipment.

D. Storage of Materials or Equipment Containing Constituents of Concern:
1. Prevent contamination of personnel, storage areas, the Site, and adjacent areas.
2. Comply with Laws and Regulations, Section 01 35 43.13 - Environmental Procedures for Hazardous Materials, and other provisions of the Contract Documents relative to Constituents of Concern and Hazardous Environmental Conditions.

E. Uncovered Storage:
1. The following materials may be stored outdoors without cover on supports, so there is no contact with the ground:
a. Reinforcing steel.
b. Precast concrete materials.
c. Structural steel.
d. Metal stairs.
e. Handrails and railings.
f. Grating.
g. Checker plate.
h. Metal access hatches, such as floor doors, roof hatches, and the like.
i. Castings.
j. Fiberglass items.
k. Rigid electrical conduit, except PVC-coated conduit.
l. Fencing intended for permanent, outdoor installation.
m. Piping, except PVC or chlorinated PVC (CPVC) pipe.

F. Covered Storage:
1. The following materials and equipment may be stored outdoors on supports and completely covered with covering impervious to water:
a. Grout and mortar materials.
b. Masonry units.
c. Metal decking.
d. Rough lumber.
e. Soil materials and granular materials such as aggregate.
f. PVC and CPVC pipe.
g. PVC-coated electrical conduit.
h. Filter media.
2. Properly and fully secure covers against coming loose in strong winds.
3. Install coverings properly sloped to prevent accumulation of water.
4. Loose Soil Material and Loose Granular Material:
a. Store such materials in well-drained areas.
b. Prevent mixing of such materials with foreign matter. Provide underlying separation layer or store on solid, impervious surface, where appropriate.
c. Provide temporary erosion and sediment controls for stockpiled soil materials in accordance with Section 01 57 05 - Temporary Controls.

G. Fully-Protected Storage:
1. Store all materials and equipment not indicated in the provisions above regarding uncovered storage and covered storage on supports, in buildings, trailers, or other suitable temporary storage facility with concrete or wood flooring, solid and impervious roof, and fully closed walls on all sides.
2. Covering with visqueen plastic sheeting or similar material in storage space without floor, roof, and walls is unacceptable.

3. Provide heated storage for materials and equipment that could be damaged or deteriorate by low temperatures or freezing.
4. Provide air-conditioned storage for materials and equipment that could be damaged or deteriorate by high temperature or humidity.
5. Protect mechanical and electrical equipment from being contaminated by dust, dirt, and moisture.
6. Maintain temperature and humidity at levels recommended by materials and equipment manufacturers.
7. Prevent infestation of stored items by pests and rodents. Promptly and properly remedy such infestation when apparent.

H. Removal of Temporary Storage Facilities and Restoration of Storage Areas:
1. Completely remove temporary storage facilities when no longer necessary for the Work.
2. Restore areas used for storage and areas occupied by temporary storage facilities, in accordance with the Contract Documents, including Section 01 71 33 - Protection of the Work and Property.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 MAINTENANCE OF STORAGE

A. On a scheduled basis, periodically inspect stored materials and equipment to ensure that:
1. Condition and status of storage facilities is adequate to provide required storage conditions.
2. Required environmental conditions are maintained on continuing basis.
3. Materials and equipment exposed to weather elements or other environment are not adversely affected.

B. Mechanical and Electrical Equipment in Long-Term Storage:
1. Meaning of the term "long-term storage' is as established in written instructions of manufacturer of associated materials or equipment.
2. Mechanical and electrical equipment requiring long-term storage shall have complete manufacturer's written instructions for servicing each item, with notice of enclosed instructions shown on exterior of crate, container, or packaging.
3. Frequency of inspections and maintenance of stored items shall be in accordance with manufacturer's written instructions.
4. For mechanical equipment with bearings and shafts, manually rotate shaft during inspection and maintenance, as recommended by equipment manufacturer.
5. Space heaters that are part of electrical equipment shall be connected and operated continuously until equipment is connected to permanent electrical power supply.
6. Other requirements for maintenance during storage of electrical equipment, instrumentation and controls, items with computer chips, solid-state devices and other electronics are in this Section's provision on general protection during storage.

C. Documentation of Storage:
1. Include in each monthly pay application a report of of the following work signed by Contractor:
a. Summary of maintenance and inspection was performed on materials and equipment in long-term storage.
b. Date of inspection.
c. Personnel involved and employer of each.
d. Condition of storage environment.
e. Specific stored items inspected, equipment condition, problems observed, problems corrected, maintenance tasks performed, and other relevant information.
f. Evidence of insurance of stored materials with owner named as insured.

g. Photos of stored materials and storage environment.
h. Signature of Contractor's person responsible for the inspection and maintenance.
i. Signed statement by items' manufacturer indicating whether storage conditions and tasks performed are suitable for continued compliance with manufacturer's warranties.

END OF SECTION

SECTION 01 71 14
MOBILIZATION AND DEMOBILIZATION

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Construction mobilization and demobilization.

B. Scope:
   1. Contractor shall provide all labor, materials, equipment, tools, services, and incidentals to perform mobilization and demobilization for the Work.
   2. This Section is general and does not necessarily indicate all activities required for mobilization and demobilization, which may be indicated in other parts of the Contract Documents.,

C. Related Requirements: Include, but are not necessarily limited to:
   1. Section 01 14 19 - Use of Site.
   2. Section 01 22 00 - Measurement and Payment.
   3. Section 01 29 73 - Schedule of Values.
   4. Section 01 55 13 - Access Roads and Parking.
   5. Section 01 57 05 - Temporary Controls.
   6. Section 01 71 33 - Protection of the Work and Property.
   7. Section 01 74 00 - Cleaning.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment:
   1. Where costs of mobilization and demobilization are to be included in a specific bid/pay item, such item is indicated in the Contract, including Section 01 22 00 - Measurement and Payment.
   2. Where the Contract does not expressly require costs for mobilization and demobilization are to be under specific bid/pay item(s), Contractor may allocate such costs among bid/pay items as Contractor deems appropriate.
   3. Where mobilization and demobilization are to be part of a larger lump sum bid/pay item, limitations on eligibility for payment of mobilization and demobilization costs are indicated in Section 01 29 73 - Schedule of Values.

B. If costs for mobilization, demobilization, or both change because of Contract modifications, include the total cost of such changes to mobilization and demobilization in Change Proposal submitted for each associated change. Make no subsequent claim, whether via Change Proposal, Claim, or dispute, for additional compensation for mobilization, demobilization, or both.

1.03 MOBILIZATION AND DEMOBILIZATION

A. Do not commence mobilization at the Site or other areas until:
   1. The Contract is signed by both parties and is effective.
   2. Required insurance documentation, performance bond, and payment bond have been submitted by Contractor and accepted by Owner, and builder's risk insurance complying with the Contract Documents is furnished and in place, and documentation thereof accepted by the parties.
   3. Conditions, if any, of Owner-issued Notice to Proceed, if any, have been complied with by the applicable party.
   4. Preconstruction conference(s), including items on agenda for site mobilization matters, is completed.
   5. Preconstruction photographic documentation is obtained and submitted in accordance with the Contract Documents.

6. Required permits for site disturbance are obtained in accordance with the Contract Documents.
7. Where mobilization requires site clearing Work, required prerequisites for site clearing Work, including required Submittals, are properly furnished and completed.

B. Mobilization Work includes, but is not limited to:
1. Establishing vehicular access and parking in accordance with Section 01 55 13 - Vehicular Access and Parking.
2. Establishing temporary controls in accordance with Section 01 57 05 - Temporary Controls and establishing and initial compliance with security for the Site.
3. Establishing Contractor's staging and laydown areas, in accordance with Section 01 14 19 - Use of Site.
4. Establishing temporary utilities and temporary facilities in accordance with the Contract Documents.
5. Establishing required and necessary temporary project signage.
6. Other mobilization Work required by the Contract Documents, including Section 01 22 00 - Measurement and Payment, and Section 01 29 73 - Schedule of Values.

C. Demobilization Work includes, but is not limited to:
1. Removing from the Site and other areas Contractor's temporary utilities, temporary facilities, temporary signage, temporary security measures; construction equipment, machinery, and tools; unused items of materials and equipment; and other items.
2. Final restoration and repair of damage caused by Contractor, in accordance with Section 01 71 33 - Protection of the Work and Property.
3. Final cleaning in accordance with Section 01 74 00 - Cleaning.
4. Other demobilization Work required by the Contract Documents, including Section 01 22 00 - Measurement and Payment, and Section 01 29 73 - Schedule of Values.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION - (NOT USED)

SECTION 01 71 33
PROTECTION OF THE WORK AND PROPERTY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. General requirements for protecting the Work and property, including:
      a. Accessing or entering property.
      b. Temporary barricades and temporary warning lights and signs.
      c. Responsibility to remedy damaged property.
      d. Protecting natural habitats, including trees, plants, lawns and meadows, and wildlife.
      e. Protecting Underground Facilities.
      f. Protecting existing surface structures.
      g. Protecting floors, walls, and roofs.
      h. Protecting other installed items and landscaping.

B. Scope:
   1. This Section augments requirements of the General Conditions as may be modified by the Supplementary Conditions regarding protection of the Work and property, including Underground Facilities.
   2. Contractor shall provide all labor, materials, equipment, tools, services, and incidentals necessary and required for protecting the Work and property in accordance with the Contract Documents.

C. Related Requirements: Include, but are not necessarily limited to:
   1. Section 01 57 05 - Temporary Controls.
   2. Section 01 65 00 - Product Delivery Requirements.
   3. Section 01 66 00 - Product Storage and Handling Requirements.
   4. Section 01 74 00 - Cleaning.

1.2 PROTECTION - GENERAL

A. Contractor shall provide all precautions and programs and perform all actions necessary to protect personnel health and safety, and to protect the Work and all public and private property and facilities from damage, in accordance with the Contract Documents, Laws and Regulations, and other applicable requirements.

B. To prevent damage, injury, and loss, Contractor's actions shall include the following:
   1. Providing measures for safety of all personnel at and adjacent to the Site, whether engaged in performing the Work, operating or maintaining the facility, or performing other functions for Owner or others.
   2. Storing construction equipment, machinery, tools, and similar items, materials and equipment to be incorporated into the Work, supplies, and other items in an orderly, safe manner that does not unduly interfere with progress of the Work or work of others, including Owner and facility manager (if other than Owner).
   3. Suitably storing materials and equipment to be incorporated into the Work, in accordance with the Contract Documents, including Section 01 66 00 - Product Storage and Handling Requirements.
   4. Placing upon the Work or any part thereof only loads consistent with the safety and integrity of that portion of the Work and existing construction and facilities.
   5. Frequently removing and disposing of rubbish, scrap materials, and debris, in accordance with the Contract Documents, including Section 01 74 00 - Cleaning, resulting from Contractor's operations.
   6. Providing temporary controls, including controlling pests and rodents, in accordance with the Contract Documents, including Section 01 57 05 - Temporary Controls.

PART 2 - PRODUCTS

2.1 TEMPORARY BARRICADES

A. General:
   1. Temporary barricades shall be of materials that are either new or of good quality and sufficient for the intended purpose, exposure, and duration of use.
   2. Provide temporary barricades of sturdy materials of grade, thickness, and durability sufficient for the probable loads to which they will be subject. Temporary barricades intended for fall prevention, such as railings and handrails on temporary stairs and temporary walkways and at openings, shall be in accordance with Laws and Regulations, including the applicable building and safety codes.
   3. Color: Use appropriately colored and reflective barricades, or paint barricades accordingly, to be visible at night and during periods of low visibility.
   4. Where owner of transportation right-of-way or transportation facility having jurisdiction or other authority having jurisdiction requires compliance with standards more stringent than the Contract Documents, comply with both the Contract Documents and requirements of the authorities having jurisdiction.

PART 3 - EXECUTION

3.1 ACCESSING OR ENTERING PROPERTY

A. General:
   1. Use and occupy only lands and easements furnished by Owner, unless appropriate consent from property owner and occupants is obtained by Contractor.
   2. The foregoing applies to personnel, construction equipment and machinery, tools, vehicles, materials or equipment to be incorporated into the Work, supplies, temporary facilities, and other items or obstructions.
   3. Limitations, if any, on accessing the Site are indicated in Section 01 55 13 - Vehicular Access and Parking.

3.2 BARRICADES

A. Temporary Barricades and Temporary Warning Lights and Signs - General:
   1. All Work Areas:
      a. Provide temporary barricades, warning lights, and warning signs for both indoor and outdoor Work, in accordance with Laws and Regulations and requirements of owners of affected property and facilities.
      b. Warning Lights and Signage: From 30 minutes before terrestrial sunset to 30 minutes after terrestrial sunrise, provide and maintain not less than one temporary flashing light at each vehicle barricade and at other barriers and barricades as necessary.
      c. Provide temporary barriers where shown or indicated, and where necessary to protect persons and property. At minimum, provide temporary barriers for all excavations that remain open during non-working hours.
      d. Promptly replace temporary barricades that are damaged or are otherwise no longer capable of serving their intended function.
   2. Where the Work is performed on or adjacent to roadway, access road, other area travelled by motor vehicles, railroad, or similar transportation right-of-way, or public place:
      a. Provide temporary barricades, temporary fences, temporary guard rails, temporary lights and warning signs, temporary danger signals, and other precautions for protecting persons, property, vehicles, and the Work.
      b. Provide sufficient temporary barricades to keep vehicles from being driven on or into excavations and the Work under construction.
      c. Comply with Section 01 55 13 - Vehicular Access and Parking.
   3. Temporary Barriers for Areas Not Subject to Vehicular Traffic:
      a. Provide temporary barriers around:

1) Openings.
2) Scaffolding.
3) Temporary stairs and ramps.
4) Around excavations.
5) Around elevated walkways, slabs, and platforms.
6) Other areas that may present a fall-hazard or hazard to persons and property.

b. Provide appropriate temporary barriers, warning signs and, where necessary, warning lights, at ground level and other low elevations, and at higher elevations. Protect persons and property from fall-hazards and protect persons and property at lower elevations from falling objects.

4. Duration of Temporary Barriers, Barricades, Signs, and Warning Lights:
   a. Contractor's responsibility for maintaining temporary barriers, barricades, signs, and warning lights shall continue until the associated Work is substantially complete in accordance with the Contract Documents, unless other provision for protection are agreed to by the parties.
   b. After Substantial Completion, protect Work and property during periods when Contractor is onsite: completing the remaining Work, performing correction period work, and performing warranty work.

3.3 RESPONSIBILITY TO REMEDY DAMAGED PROPERTY

A. Contractor to Remedy Damage:
   1. Contractor has full responsibility for preserving public and private property and facilities on and adjacent to the Site.
   2. Direct or indirect damage done by, or on account of, any act, omission, neglect (including inadvertent acts), or misconduct by Contractor (including any person or entity for whom contractor is responsible) in performing the Work, shall be promptly remedied by Contractor, at Contractor's expense, in accordance with the Contract Documents.
   3. If the Contract Documents do not show or indicate the required restoration, or remedy, restore or remedy the damage to condition equal or better than that existing before damage was done.

B. Owner May Remedy:
   1. Should Contractor fail to protect and safeguard property and the Work after requests from Engineer or Owner, Owner reserves the right to implement measures to protect property and the Work.
   2. Cost of such Owner-implemented measures shall be paid by Contractor. Owner may deduct from payments due Contractor such amounts as set-offs in accordance with the Contract Documents.
   3. Such right, however, does not obligate Owner or Engineer to continuously monitor or have responsibility for protection of property and the Work, which responsibility is exclusively Contractor's.
   4. In exercising its rights under this provision, Owner will endeavor to give Contractor sufficient notice to allow Contractor to remedy the damage or defect within a reasonable time. However, if Owner or Engineer deems that the situation requires prompt remedy, Owner may act as quickly as Owner deems appropriate, without infringing on or mitigating Owner's rights under this provision and elsewhere in the Contract Documents

3.4 PROTECTION OF NATURAL HABITATS

A. Tree and Plant Protection:
   1. Protect existing trees, shrubs, and plants on or adjacent to the Site, shown or designated to remain in place, against unnecessary cutting, breaking, damage, and skinning of trunk, branches, bark, and roots.
   2. Protect irrigation servicing existing trees, shrubs, and plants on or adjacent to the Site that remain in place.
   3. Do not store materials or equipment or park construction equipment, machinery, or vehicles within foliage drip lines.

4. In areas subject to traffic, provide temporary fencing or temporary barricades to protect trees and plants.
5. Burning is not allowed at or adjacent to the Site, including burning, in open fires or otherwise, trees, plants, debris, or other combustible materials.
6. Within the limits of the Work, water trees and plants that are to remain, to maintain their health during construction operations.
7. Cover exposed roots with burlap, and keep such burlap continuously wet. Cover exposed roots with earth as soon as possible. Protect root systems from mechanical damage and damage by storm water runoff, erosion, flooding, and noxious materials in solution.

B. Coordinate the Work in this Article with the following Specifications:
1. Section 31 10 00 - Site Clearing.

C. Remedy of Damaged Trees:
1. If branches are damaged, prune branches immediately and protect as indicated below.
2. If bark on trunk or major branches is scraped or damaged, using a sharp knife or other suitable cutting implement, clean the edge of the wound, leaving the bark smooth and tight against the wood. Avoid exposing more live tissue and do not remove too much healthy bark. Apply material indicated below.
3. After pruning and cutting back damaged wood and bark, protect cut or damaged wood by applying emulsified asphaltic sealant specifically manufactured for sealing pruned and damaged trees. Apply sealant in accordance with sealant manufacturer's instructions, in manner acceptable to Engineer and tree owner.
4. When directed by Engineer, remove and dispose of (at location away from the Site) damaged trees and plants (and parts thereof) that die or suffer permanent injury, and replace each such damaged tree and plant with new tree or plant of equal or better species and quality.

D. Protection of Lawns and Meadows:
1. Protect lawns and meadows from unnecessary damage during performance of the Work.
2. To extent practicable, do not drive vehicles, construction equipment, machinery, or wheeled items such as carts and wheelbarrows, across lawns and meadows.
3. When existing lawn or meadow areas are disturbed, promptly stabilize exposed soil in accordance with Section 01 57 05 - Temporary Controls.
4. Remedy damaged lawns and meadows in accordance with the Contract Documents. If not otherwise addressed in the Contract Documents, restore to preconstruction condition or better with the same or substantively similar species.

E. Protection of Wildlife:
1. To extent practicable, avoid harming wildlife and damaging or destroying wildlife habitats, except for areas where the Work is to be located.
2. In the event a threatened or endangered species is discovered at the Site for which provisions was not otherwise provided, stop work in the vicinity and immediately orally advise Engineer by telephone or in-person, promptly followed by written notice in accordance with the Contract's provisions for notice for differing Site conditions. If species is not threatened or endangered, promptly resume work; no change in Contract Price or Contract Times is due for misidentification of threatened or endangered species.
3. Contractor is not responsible for wholesale inventorying or Site-wide evaluation of wildlife at the Site, except as indicated in the paragraph immediately above this paragraph.

3.5 PROTECTION OF UNDERGROUND FACILITIES

A. General:
1. Underground Facilities known to Owner and Engineer, except laterals or services to individual structures or properties, such as water, wastewater, storm water, gas and fuel, hydronic, steam, electric, and communications laterals or services, are shown on the Drawings. Information shown for Underground Facilities is the best available to Engineer

but, in accordance with the General Conditions, as may be modified by the Supplementary Conditions, is not guaranteed to be correct or complete.

2. Comply with Laws and Regulations regarding notification of utility owners prior to performing the Work, including necessary "call before you dig" notifications.
3. Contractor shall explore ahead of trenching and excavating Work and shall sufficiently uncover Underground Facilities that will or may interfere with the Work to determine their location, to prevent damage to Underground Facilities, and to prevent service interruption to structures and properties served by Underground Facilities.
4. If Contractor damages an Underground Facility, Contractor shall promptly restore the damaged Underground Facility in accordance with requirements of the owner of the damaged facility and the Contract Documents. If the Contract Documents do not address repair or remedy of the damaged facility, restore to not less than preconstruction condition.
5. Necessary changes in the location of the Work may be directed by Engineer to avoid Underground Facilities not shown or indicated on the Contract Documents.
6. If permanent relocation of an existing Underground Facility is required and is not otherwise shown or indicated in the Contract Documents, Contractor may be directed in writing to perform the required work. When such relocation Work results in a change in the Contract Price, Contract Times, or both, the associated Contract modification procedures and payment for such Work shall be in accordance with the Contract Documents.

B. Protection of Underground Facilities under Roads and Parking Areas:
   1. Provide temporary, heavy-duty steel roadway plates to protect existing manholes, handholes, valve boxes, vaults, and other Underground Facilities near to, or visible at, the ground surface.
   2. Avoid imparting heavy loads, especially transitory loading (such as heavy truck traffic), vibration forces, and impact loads on Underground Facilities that are close to the ground surface and below-grade work areas. Provide temporary bridging or other appropriate protection where traffic must pass over Underground Facilities in close proximity to the ground surface.

C. Temporary Support of Underground Facilities:
   1. Where Contractor exposes or excavates around or under one or more existing Underground Facilities, provide appropriate and adequate temporary supports for the associated Underground Facilities.
   2. Do not allow Underground Facilities exposed by Contractor's operations to remain exposed without temporary support necessary to properly protect the Underground Facility. Where joint of Underground Facility is exposed by excavation, provide temporary support for each exposed joint and other temporary support as necessary.
   3. Design of Temporary Supports:
      a. Where necessary or where expressly required by the Contract Documents, retain services of professional engineer registered in the state of the project site, to design the temporary supports. Such professional engineer shall be experienced with the type and size of subject Underground Facility, structural engineering, and geotechnical engineering sufficient for the foundations of the temporary supports.
      b. Temporary supports are not delegation of professional design responsibility unless expressly so indicated in the Contract Documents.
      c. Responsibilities of Contractor's professional engineer shall include, but are not necessarily limited to, the following:
         1) Advising Contractor on investigations necessary to obtain information for design of temporary supports. Reviewing and considering results of such investigations in the design of temporary supports.
         2) Visiting the Site to make personal observations as needed.
         3) Identify appropriate design criteria for temporary supports.
         4) Preparing necessary calculations, design drawings, and design specifications (sealed and signed when required by Contract or Laws or Regulations), appropriately based on the associated soil conditions and subsurface conditions,

considering the consequences of failure of the temporary supports and associated potential for damage or failure of the existing subject Underground Facility.

5) Design temporary supports with a safety factor of not less than 2.0.
6) Review and approve or take other appropriate action on submittals of shop drawings and product data for the temporary supports and related materials.
7) Make periodic visits to the Site during erection of the temporary supports and at appropriate intervals thereafter to inspect the temporary supports during performance of other, adjacent Work.
8) Issue to Contractor written recommendations for repairs and improvements necessary for the proper protection of the associated Underground Facility.
9) Submit to Contractor detailed, written recommendations for backfilling the excavation underneath and adjacent to the Underground Facility and for removing the temporary supports.

d. Contractor shall comply with the professional engineer's design of the temporary supports.
e. Owner may require and, in such event, Contractor shall submit, design documents, shop drawings, product data, and reports by Contractor-hired professional engineer. Do not submit such documents to Engineer. When such documents are furnished to Owner, the Owner has no obligation to perform any review of such documents and Owner's possession of such documents does not impart on Owner or Engineer any responsibility for or professional liability associated with design of such temporary supports and consequences of implementing such designs. Owner and Engineer are not obligated in any way to implement recommendations of Contractor's professional engineer.

3.6 PROTECTION OF EXISTING SURFACE STRUCTURES

A. General:
1. Surface structures are existing buildings, structures, and other facilities at or extending above ground surface, including their foundations and any extension below ground surface. Surface structures include, but are not limited to, buildings, tanks, walls, bridges, roads, dams, channels, open drainage routes, exposed piping and utilities, poles, exposed wires and cabling, posts, signs, markers, curbs, walks, fencing, and other facilities visible at or above ground surface.
2. Protect surface structures as necessary and promptly remedy damage and defects resulting or arising from Contractor's operations. Unless expressly shown or indicated otherwise in the Contract Documents, protect such items regardless of whether shown or indicated on the Drawings or elsewhere in the Contract Documents.
3. Protection of Overhead Utilities:
   a. Protect visible, overhead utilities, including electrical power, communications, and piped utilities, and related supports, regardless of whether such items are shown or indicated in the Contract Documents.
   b. When required by the Contract Documents or when acceptable to owner of such utility or facility, temporarily relocate overhead utilities or facilities as necessary perform the Work.
   c. Provide temporary barriers, barricades, and warning signs identifying overhead utilities within reach of Contractor's construction equipment, machinery, or operations.

B. Temporary Removals of Surface Structures:
1. Existing surface facilities, including but not limited to guard rails, handrails, posts, guard cables, signs, poles, markers, curbs, and fencing, that are temporarily removed to facilitate the Work shall be replaced and restored promptly after the associated Work is performed.
2. Replace and restore such items in accordance with the Contract Documents. If not addressed in the Contract Documents, replace and restore such items to preconstruction condition or better.
3. Remedy damage to all items temporarily removed and later replaced and restored.
4. All such temporary relocations, replacement, and restoration is at Contractor's cost.

C. Protection of Surface Structures:
   1. Sustain in their original location and protect from direct and indirect injury all surface structures located within or adjacent to the Site. Such sustaining and supporting shall be done carefully and as required by the party owning or controlling such structure or facility.
   2. Before proceeding with the Work of sustaining and supporting such structure or facility, Contractor shall, upon Engineer's request, promptly satisfy Engineer that methods and procedures to be used have been approved by party owning the surface structure or facility.
   3. Regardless of approval or acceptance by owner of property, structure, or facility, responsibility for protecting the Work and property is solely Contractor's.

3.7 PROTECTION OF FLOORS, WALLS, AND ROOFS

A. General:
   1. Use proper protective covering when moving equipment, handling materials or other loads, when painting, handling mortar or grout, and when cleaning walls, ceilings, or structure contents.
   2. Use metal pans to collect oil and cuttings from piping, conduits, and rod threading machines, and under metal cutting machines.
   3. Maintain at the Site and use spill kits and absorbent pads for remedying spills.
   4. Do not load concrete floors less than 28 days after concrete placement without Engineer's written permission.
   5. Do not load slabs, floors, walls, or roofs more than their design loading.
   6. Do not load roofs without Engineer's written permission.
   7. Restrict access to roofs, and keep Contractor's workers and personnel off existing roofs, except as necessary for the Work.
   8. If access to roofs is necessary, roofing, parapets, openings, and all other construction on or adjacent to roof shall be protected with suitable plywood, barricades, or other appropriate means.

3.8 PROTECTION OF INSTALLED MATERIALS, EQUIPMENT, AND LANDSCAPING

A. General:
   1. Protect existing facilities and installed Work to prevent damage from subsequent operations.
   2. Remove protective items when no longer needed, prior to Substantial Completion of the associated Work.
   3. Where work will continue in adjacent area(s) after Substantial Completion of a portion of the Work, protect the substantially completed Work until all work in the area is complete.

B. Control traffic (foot traffic, wheeled items such as carts, vehicles, and other traffic) to prevent damage to equipment, materials, and surfaces.

C. Coverings:
   1. Provide temporary coverings to protect materials and equipment from damage.
   2. Cover: projections, wall corners and jambs, sills, and soffits of openings, in areas used for traffic and for passage of materials and equipment in subsequent work.
   3. Fasten protective items without harming the Work. Use tape or adhesives that do not leave residue when removed.

END OF SECTION

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SECTION 01 73 20
OPENINGS AND PENETRATIONS IN CONSTRUCTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Methods of installing and sealing openings and penetrations in construction.

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 05 50 00 - Miscellaneous Metals.
   2. Section 07 62 00 - Flashing and Sheet Metal.
   3. Section 07 92 00 - Joint Sealants.
   4. Section 09 96 00 - High Performance Industrial Coatings.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. A36, Standard Specification for Carbon Structural Steel.
      b. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
      c. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
      d. A312, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
      e. A351, Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
      f. A554, Standard Specification for Welded Stainless Steel Mechanical Tubing.
      g. A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
      h. A666, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
      i. A995, Castings, Austenitic-Ferritic (Duplex) Stainless Steel, for Pressure-Containing Parts.
   2. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC):
         1) Article 501, Class I Locations.
      b. 90A, Standard for Installation of Air Conditioning and Ventilating Systems.
      c. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).

1.3 DEFINITIONS

A. Corrosive Areas: For the purpose of this specification section, the following areas are defined as corrosive:
   1. All wastewater containing structures.

B. Hazardous Areas: Areas shown in the Contract Documents as having Class I or Class II area classifications.

C. Washdown Areas: Areas having floor drains or hose bibbs.

1.4 SUBMITTALS

A. Shop Drawings:
   1. For each structure provide dimensioned or scaled (minimum 1/8 inches = 1 foot) plan view drawings containing the following information:
      a. Vertical and horizontal location of all required openings and penetrations.

b. Size of all openings and penetrations.
c. Opening type.
d. Seal type.

2. Manufacturer's installation instructions for standard manufactured products.

1.5 SITE CONDITIONS

A. Refer to the Project Geotechnical Report in the Appendices for water table levels used for this Project.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Pipe Sleeves:
1. Areas listed as Corrosive Areas in PART 1:
a. Stainless steel, Type 316L.
b. Penetrations 24 inches diameter or less: ASTM A269, ASTM A312 or ASTM A554, Schedule 40.
c. Penetrations larger than 24 inches diameter: Stainless steel, ASTM A666, Minimum 1/4 inches thickness.
2. All other Areas:
a. Steel, Hot-dipped galvanized after fabrication.
b. Penetrations 24 inches diameter or less: ASTM A53, Schedule 40.
c. Penetrations larger than 24 inches diameter: ASTM A36, Minimum 1/4 inches thickness.

B. Backing Rod and Sealant: See Specification Section 07 92 00.

C. Modular Mechanical Seals:
1. Acceptable manufacturers:
a. Link-Seal.
2. 316 stainless steel bolts, nuts and washers.

D. Sheet Metal Sleeves:
1. Areas listed as Corrosive Areas in PART 1: Stainless steel: ASTM A240, Type 316L.
2. All other areas: Galvanized steel: ASTM A653, G90.
3. Minimum 12 GA.

E. Commercial Wall Castings:
1. Ductile iron, ASTM A536.
2. Grade equal to connecting piping system.

PART 3 - EXECUTION

3.1 FABRICATION

A. Fabricate pipe sleeves in accordance with Specification Section 05 50 00.

B. Fabricate sheet metal sleeves in accordance with Specification Section 07 62 00.

C. Provide waterstop plate/anchor flange for piping, ducts, castings and sleeves cast-in-place in concrete.
1. For fabricated units, weld plate to sleeve, pipe, or ductwork.
2. For commercial castings, cast water stop/anchor with wall pipe.
3. Plate is to be same thickness as sleeve, pipe, casting or ductwork.
4. For fabricated units, diameter of plate or flange to be 4 inches larger than outside diameter of sleeve, pipe or ductwork.
5. For commercial castings, waterstop/anchor size to be manufacturer standard.
6. Provide continuous around entire circumference of sleeve, pipe, or ductwork.

D. Factory or shop-coat painted components in accordance with Specification Section 09 96 00.

3.2 INSTALLATION AND APPLICATION

A. Seal openings and penetrations in non-fire-resistance-rated construction in accordance with Specification Section 07 92 00.

B. Obtain prior approval from Engineer when any opening larger than 100 square inches must be made in existing or newly completed construction.

C. Perform HVAC penetrations in accordance with NFPA 90A.

D. Perform electrical penetrations in accordance with NFPA 70, Article 501.

E. When mechanical or electrical work cannot be installed as structure is being erected, provide and arrange for building-in of boxes, sleeves, insets, fixtures or devices necessary to permit installation later.
   1. Lay out chases, holes or other openings which must be provided in masonry, concrete or other work.

F. Where pipes, conduits or ducts pass through floors in washdown areas, install sleeves with top 3 IN above finish floors.
   1. In non-washdown areas, install sleeves with ends flush with finished surfaces.

G. Size sleeves, blockouts and cutouts which will receive sealant seal such that free area to receive sealant is minimized and seal integrity may be obtained.

H. For insulated piping and ducts, size sleeves, blockouts and cutouts large enough to accommodate full thickness of insulation.

I. Where pipes, conduits or ducts pass through grating, provide banding at the entire perimeter of the opening.
   1. Metal grating: See Specification Section 05 50 00.

J. Where pipes, conduits or ducts are removed where passing through grating:
   1. Metal grating:
      a. Provide banding at perimeter and cover opening with 1/4 inches plate of the same material of the grating.
      b. See Specification Section 05 50 00.

K. Do not cut into or core drill any beams, joists, or columns.

L. Do not install sleeves in beams, joists, or columns.

M. Do not install recesses in beams, joists, columns, or slabs.

N. Field Cutting and Coring:
   1. Saw or core drill with non-impact type equipment.
   2. Mark opening and drill small 3/4 inches or less holes through structure following opening outline.
   3. Sawcut opening outline on both surfaces.
      a. Knock out within sawcuts using impact type equipment.
      b. Do not chip or spall face of surface to remain intact.
      c. Do not allow any overcut with saw kerf.

O. Precast-Prestressed Concrete Construction:
   1. Do not cut openings or core drill vertically or horizontally through stems of members.
   2. Do not locate or install sleeves or recess sleeves vertically or horizontally through or in stems of members.
   3. Cast openings and sleeves into flanges of units.
   4. Cast openings larger than 6 inches in diameter or 6 inches maximum dimension in units at time of manufacture.

5. Cast openings smaller than 6 inches in diameter or 6 inches maximum dimensions in flanges of units at time of manufacture or field cut.

P. Where alterations are necessary or where new and old work join, restore adjacent surfaces to their condition existing prior to start of work.

Q. Where area is blocked out to receive sheet metal sleeve at later date:
   1. If blockout size is sufficient to allow placement, utilize dowels for interface of initially placed concrete and sleeve encasement concrete which is placed later.
      a. Size blockout based on sleeve size required plus 4 to 6 inches each side of sleeve for concrete encasement.
      b. Provide #4 dowels at 12 inches spacing along each side of blockout with minimum of two dowels required per side.
   2. If blockout size is not sufficient to allow placement of dowels, provide keyway along all sides of blockout.
      a. Size blockout based on sleeve size required plus 2 to 4 inches each side of sleeve for concrete encasement.

R. For interior wall applications where backer rod and sealant are specified, provide backer rod and sealant at each side of wall.

S. Use full depth expanding foam sealant for seal applications where single or multiple pipes, conduits, etc., pass through a single sleeve.

T. Do not make duct or conduit penetrations below high water levels when entering or leaving tankage, wet wells, or other water holding structures.

U. Modular Mechanical Seals:
   1. Utilize one seal for concrete thickness less than 8 inches and two seals for concrete, 8 inches thick or greater.
   2. Utilize two seals for piping 16 inches diameter and larger if concrete thickness permits.
   3. Install seals such that bolt heads are located on the most accessible side of the penetration.

V. Backer Rod and Sealant:
   1. Install in accordance with Specification Section 07 92 00.
   2. Provide backer rod and sealant for modular mechanical seal applications.
      a. Apply on top side of slab penetrations and on interior, dry side wall penetrations.

3.3 SCHEDULES – NOT USED

SECTION 01 73 29
CUTTING AND PATCHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. General requirements for cutting and patching Work.

B. Scope:
   1. Contractor shall perform cutting and coring, and rough and finish patching of holes and openings in existing construction.
   2. Provide cutting, coring, fitting, and patching, including attendant excavation and fill, required to complete the Work, and to:
      a. remove and replace defective Work;
      b. remove samples of installed Work as specified or required for testing;
      c. remove construction required to perform required alterations or additions to existing construction;
      d. uncover the Work for Engineer's observation of covered Work, testing, or inspection by testing entities, or observation by authorities having jurisdiction;
      e. connect to completed Work not performed in proper sequence;
      f. remove or relocate existing utilities and piping that obstruct the Work in locations where connections are to be made;
      g. make connections or alterations to existing or new facilities.

C. Related Requirements:
   1. Section 03 31 30 - Concrete, Materials and Proportioning.
   2. Section 03 35 00 - Concrete Finishing and Repair of Surface Defects.
   3. Section 09 96 00 - High Performance Industrial Coatings.
   4. Section 31 23 05 - Excavation and Fill

1.2 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Cutting and Patching Request:
      a. Submit written request to Engineer, well in advance of executing cutting or alteration that affects one or more of the following:
         1) Design function or intent of Project.
         2) Work of Owner or other contractors retained by Owner.
         3) Structural capacity or integrity of an element of the Project, building, or structure.
         4) Integrity or effectiveness of weather-exposed or moisture-resistant elements or systems.
         5) Efficiency, operational life, maintenance, or safety of operational elements.
         6) Visual qualities of elements that will be exposed to view after completion of the Work.
      b. Request shall include:
         1) Identification of Project and Contract designation.
         2) Description of affected Work of Contractor and work of others (if any) retained by Owner.
         3) Necessity for cutting.
         4) Effect on work or operations of Owner and other contractors (if any) retained by Owner, and on structural and weatherproof integrity of Project, building, or structure.
         5) Description of proposed Work, indicating: scope of cutting and patching; trades that will execute the cutting and patching Work; materials and equipment to be

used; extent of refinishing; schedule of operations; alternatives (if any) to cutting and patching, and net effect on aesthetics following completion of finishing Work.
6) Indication of entity responsible for cost of cutting and patching, when applicable.
7) Written permission of other prime contractors (if any) whose work will or may be affected.

2. Recommendation Regarding Cutting and Patching:
   a. Should conditions of work or schedule indicate a change of materials or specified methods, furnish Submit written recommendation to Engineer including:
      1) Conditions indicating change.
      2) Recommendations for alternative materials or alternatives to specified methods.
      3) Material manufacturer's printed recommendations for the proposed product and recommendations of manufacturer's technical representative for the specific application(s). The latter shall be on technical representative's letterhead and shall explicitly indicate the Project and specific cutting and patching application(s) to which the recommendation(s) apply.
      4) Items required with request for approval of substitute, in accordance with the substitution request requirements of the Contract Documents.
3. Product Data:
   a. Submit manufacturer's published data for the protective compound to be applied to core-drilled surfaces and cut concrete surfaces.
   b. When not required under other Specifications sections, submit manufacturer's published data on materials to be used for finishing around the cut or patched area(s), together with indication of the location(s) where each is proposed for use.
   c. Furnish Submittals for patching materials under the associated Specifications section. Submittal to include letter of recommendation from product manufacturer's technical representative indicating on technical representative's letterhead, explicitly indicating:
      1) Project name and facility name;
      2) specific cutting and patching application(s) to which the recommendations apply;
      3) that product manufacturer's technical representative has personally observed and is familiar with conditions in the work area(s) of the subject cutting and patching;
      4) materials that are the subject of the Submittal are appropriate for the condition(s) of the proposed patch and will remain durable in the patch's final exposure upon Substantial Completion; and.
      5) patching material manufacturer's technical representative's recommendations for surface preparation, installation of patching material(s), and curing.

B. Informational Submittals: Submit the following:
   1. Written Notification of Cutting and Patching:
      a. Notify the Engineer of the day and time that the construction associated with cutting and patching will be uncovered to allow for observation. Do not begin cutting or patching operations until approved by Engineer.
   2. X-ray Investigations:
      a. Proposed method of investigation. Submit and obtain Engineer's acceptance prior to performing x-ray inspections.
      b. Report of x-ray evaluation of slabs, floors, and walls to be cut or core drilled.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General:
   1. Provide materials that comply with the Contract Documents.
   2. If not shown or indicated in the Contract Documents, use materials identical to existing materials affected by cutting and patching Work.

3. For exposed surfaces, use materials that visually match existing adjacent surfaces to fullest extent possible. If identical materials are unavailable or cannot be used, provide materials whose installed performance will equal or surpass that of existing materials.
4. Replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, using materials that do not void required or existing warranties.

B. Compound Applied to Core-Drilled Surfaces and Cut Concrete Surfaces:
1. After core-drilling or saw-cutting (as applicable) and before installing the utility or equipment through the penetration, coat exposed concrete and exposed steel with solvent-free, two-component, protective, epoxy resin coating.
2. Color shall approximate the finish color of the existing surface to be coated.
3. Product and Manufacturer: Subject to compliance with the Contract Documents, the following products and manufacturers are acceptable:
a. Sikagard 62, by Sika Corporation.
b. Or equal.

C. Grout Materials:
1. Comply with Section 03 31 30 - Concrete, Materials and Proportioning.

D. Epoxy Bonding Adhesive:
1. Provide two-component, moister-insensitive adhesive manufactured for the purpose of bonding fresh concrete to hardened concrete.
2. Comply with Section 03 31 30 - Concrete, Materials and Proportioning.
3. Product and Manufacturer: Subject to compliance with the Contract Documents, the following products and manufacturers are acceptable:
a. Euco No.452 MV by Euclid Chemical Co.
b. Sikadur 32, Hi-Mod by Sika Corporation.
c. Or equal.

E. Epoxy Patch Material:
1. Engage the manufacturer's representative to observe and recommend a suitable patching material of the actual construction conditions.
2. Subject to compliance with the Contract Documents, the following products and manufacturers are acceptable:
a. Depth of patch greater than 3/4 inches:
1) Five Star MP Epoxy Patch.
2) Or equal.
b. Depth of patch between 1/8 inches and 3/4 inches:
1) Five Star Fluid Epoxy.
2) Or equal

PART 3 - EXECUTION

3.1 EXAMINATION

A. General:
1. Examine surfaces to be cut or patched, and conditions under which cutting or patching will be performed before starting cutting or patching Work.
2. Report unsatisfactory or questionable conditions to Engineer in writing.
3. Do not proceed with cutting or patching Work until unsatisfactory conditions are corrected.

B. Non-Destructive Investigation:
1. In advance of cutting or coring through existing slabs or walls, use x-ray or other non-destructive methods accepted by Engineer to determine location of reinforcing steel, electrical conduits, and other items embedded in slabs and walls.
2. Submit to Engineer written report of findings of evaluation.

3. Perform x-ray investigation and submit results to Engineer sufficiently in advance of cutting Work to allow time to identify and implement alternatives, if changes to the Work are necessary because of conduit or other features in floor or wall.

3.2 PREPARATION

A. Provide temporary support required to maintain structural integrity of facilities, to protect adjacent work from damage during cutting, and to support the element(s) to be cut.

B. Protection of Existing Construction during Cutting and Patching:
   1. Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project and facility that will be exposed during cutting and patching operations.
   2. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
   3. Do not cut existing pipe, conduit, ductwork, or other utilities serving facilities scheduled to be removed or relocated until provisions have been made to bypass them.

3.3 CUTTING AND PATCHING – GENERAL

A. Perform cutting and coring in such manner that limits extent of patching required.

B. Structural Elements:
   1. Do not cut or patch structural elements in manner that would change the element's structural load-carrying capacity as load deflection ratio.

C. Operating Elements:
   1. Do not cut or patch operating elements in manner that would reduce their capacity to perform as intended.
   2. Do not cut or patch operating elements or related components in manner that would increase maintenance requirements or decrease operational life or safety.

D. Replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, using methods that do not void required or existing warranties.

E. Provide adequate temporary covering over openings (whether cut or core-drilled) where not in use. Avoid creating tripping hazards for openings provided in floors and slabs.

3.4 CORING

A. Use core-drilling to make penetrations through concrete and masonry walls, slabs, or arches, unless otherwise accepted by Engineer in writing.

B. Coring:
   1. Perform coring with non-impact rotary tool using diamond core-drills. Size holes for pipe, conduit, sleeves, equipment or mechanical seals, as required, to be installed through the penetration.
   2. Do not core-drill through electrical conduit or other utilities embedded in walls or slabs without approval of Engineer. To extent possible, avoid cutting reinforcing steel in slabs and walls.

C. Protection:
   1. Protect existing equipment, utilities, and adjacent areas from water and other damage caused by or resulting from core-drilling operations.
   2. After core-drilling and before installing the utility or equipment through the penetration, coat exposed concrete and steel with protective coating material indicated in Paragraph 2.1.B of this Specification Section. Apply protective coating in accordance with manufacturer's instructions.

D. Cleaning:
   1. After core-drilling, vacuum or otherwise remove slurry and tailings from the work area.

3.5 CUTTING

A. General:
   1. Cut existing construction using methods least-likely to damage elements retained and adjoining construction and that provide proper surfaces to receive subsequent installation or repair.
   2. In general, use hand tools or small power tools suitable for sawing or grinding. When possible, avoid using hammering and avoid chopping. Carefully chip out concrete where necessary and as indicated in the Contract Documents.
   3. Cut holes and slots as small as possible, neatly to the size required, and with minimum disturbance of adjacent surfaces.
   4. Prior to starting cutting, provide adequate bracing of area to be cut.
   5. To avoid marring existing finished surfaces, cut or drill from exposed or finished side into concealed side.
   6. Use equipment of adequate size to remove the cut panel or "coupon".

B. Concrete and Masonry:
   1. Cut through concrete and masonry using concrete wall saw with diamond saw blades.
   2. On both sides of the element being cut, provide for control of slurry generated during sawing.
   3. Concrete Cutting:
      a. Make openings by sawing through existing concrete. Core drill with 6 inches diameter core at the corners of openings to avoid overcutting at corners.
      b. When the cut-out concrete or "coupon" cannot be removed in one piece, or where concrete is too thick for saw to penetrate fully, break out concrete after initial saw cuts.
      c. Where saw cutting is not possible:
         1) Make openings by drilling holes around perimeter of required opening and subsequently carefully chip out concrete.
         2) Holes shall be sufficient in quantity to prevent damage to remaining concrete.
   4. Sizing and Repair of Cut Concrete Surfaces:
      a. Where reinforcing steel is cut, such as for openings indicated on the Drawings, remove existing reinforcing steel back to 1.5 inches below concrete surface. When using heat or torching to remove ends of reinforcing steel, remove adjacent, heat-damaged concrete prior to patching. Sides of resulting hole to be patched shall be approximately perpendicular to finished concrete surface. Provide bonding adhesive on surfaces of resulting holes and fill resulting holes with non-shrink grout in accordance with the Contract Documents.
      b. Oversize required openings in existing concrete by one inch on all sides and build back to required opening size by providing epoxy grout bonded to existing concrete.
      c. Where oversizing the cut opening by one inch is not possible, cut the opening to the required dimensions. After cutting concrete and before installing subsequent construction on or through the opening, coat exposed concrete and steel with protective coating material indicated in Paragraph 2.1.B of this Specifications Section. Apply protective coating in accordance with manufacturer's instructions.
      d. Where indicated, finish remaining surfaces as indicated in Section 03 35 00 - Concrete Finishing and Repair of Surface Defects.

3.6 PATCHING

A. General:
   1. Patch large openings to be filled with concrete in accordance with the Contract Documents. Before installing new concrete, apply bonding adhesive indicated in Paragraph 2.1 of this Specifications section in accordance with manufacture's recommendations.
   2. Where large openings to be filled with concrete are indicated on the Drawings as requiring reinforcing steel, provide reinforcing steel as shown and indicated in the Contract Documents. Where openings in existing reinforced concrete are larger than 2 feet in diameter or 2 feet by 2 feet and the Drawings or elsewhere in the Contract Documents do

not expressly require reinforcing steel for the opening, submit a request for interpretation to Engineer and obtain Engineer's response before proceeding.

3. Where concrete infill or grout repair materials are not used, patch using epoxy patch material indicated in Paragraph 2.1.D of this section unless otherwise indicated on Drawings.
4. Patch construction by filling, repairing, refinishing, closing-up, and similar operations following performance of other Work.
5. Patch with durable seams that are as inconspicuous as possible. Provide materials and comply with installation requirements indicated in the Contract Documents and the published installation instructions of the material's manufacturer.
6. Patch to provide airtight and watertight connections to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
7. Where feasible, test patched areas to demonstrate integrity of installation.

B. Restoration:
   1. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in manner that eliminates evidence of patching and refinishing.
   2. For continuous surfaces, refinish to nearest intersection.
   3. For an assembly, refinish the entire unit that was patched.
   4. Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

3.7 CLEANING

A. Cleaning and Restoration:
   1. Perform cleaning promptly after associated cutting, coring, and patching.
   2. Clean areas and spaces where cutting, coring, or patching were performed.
   3. Clean piping, conduit, and similar constructions before applying paint or other finishing materials.
   4. Restore damaged coverings of pipe and other utilities to original condition.

END OF SECTION

SECTION 01 74 00
CLEANING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Requirements for keeping the Site free of accumulations of waste materials during construction ("progress cleaning").
   2. Cleaning for Substantial Completion and prior to final inspection (collectively, "closeout cleaning").

B. Scope:
   1. Contractor shall perform cleaning during the Project, including progress cleaning, as condition precedent to Substantial Completion, upon completion of the Work, and as required by the General Conditions, as may be modified by the Supplementary Conditions, this Specifications section, and elsewhere in the Contract Documents.
   2. Maintain in a clean manner the Site, the Work, and areas adjacent to or affected by the Work.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. National Fire Protection Association (NFPA):
      a. 241, Safeguarding Construction, Alteration, and Demolition Operations.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 PROGRESS CLEANING

A. General:
   1. Clean the Site, work areas, and other areas occupied by Contractor not less than weekly. Dispose of waste materials in accordance with the General Conditions, as may be modified by the Supplementary Conditions, and the following:
      a. Comply with NFPA 241 for removing combustible waste materials and debris.
      b. Do not hold non-combustible materials at the Site more than three days if the ambient air temperature is expected to rise above 80 degrees F. When ambient air temperature is less than 80 degrees F, dispose of non-combustible materials within seven days of their generation.
      c. Provide suitable containers for storage of waste materials and debris. Avoid generation of odors and creation of nuisances.
      d. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately.

B. Site:
   1. Keep outdoor, dust-generating areas wetted down or otherwise control dust emissions.
   2. Not less than weekly, brush-sweep roadways and paved areas at the Site and adjacent areas used by construction vehicles or otherwise affected by construction activities.
   3. Comply with dust control requirements of Section 01 57 05 - Temporary Controls.

C. Work Areas:
   1. Clean areas where the Work is in progress to maintain an extent of cleanliness necessary for proper execution of the Work and safety of personnel.

2. Remove liquid spills promptly. Where spills may have harmful effects on health, safety, protection of facilities, or the environment, immediately report spills to Owner, Engineer, and authorities having jurisdiction, in accordance with the Contract Documents and Laws and Regulations.
3. Where dust would impair proper execution of or quality of the Work, broom-clean or vacuum entire work area, as necessary.
4. Concealed Spaces: Remove waste material and debris from concealed spaces before enclosing the space.

D. Installed Work:
1. Keep installed Work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of installed materials and equipment, using only cleaning agents and methods specifically recommended by material or equipment Supplier.
2. If Supplier does not recommend specific cleaning agents or methods, use cleaning agents and methods that are not hazardous to health and property and that will not damage or mar exposed surfaces.

E. Exposed Surfaces:
1. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration until Substantial Completion.

F. Cutting and Patching:
1. Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, tailings and cuttings, and similar materials.
2. Comply with Section 01 73 29 - Cutting and Patching, regarding cleaning during and after cutting and patching Work.
3. Thoroughly clean piping, ductwork, conduits, and similar features before applying patching material, paint, or other finishing materials.
4. Restore damaged insulation and coverings on piping, cutwork, and similar items to its pre-construction condition.

G. Cleaning of Hydraulic Structures:
1. Clean hydraulic structures that will contain fluid, such as tanks and channels, in accordance with this Specifications section and Section 01 45 25 - Testing and Disinfecting Hydraulic Structures.
2. Do not perform field quality control activities such as testing tanks, channels, and other hydraulic structures for leakage or disinfecting (where applicable), and do not apply for inspection for Substantial Completion for hydraulic structures, until the associated hydraulic structures are clean and free of all waste materials, and ready for intended use.

H. Waste Disposal:
1. Properly dispose of waste materials (including surplus materials, debris, rubbish, and other waste) off the Site.
2. Do not burn or bury waste materials at the Site.
3. Remove waste material and rubbish from excavations before backfilling.
4. Do not discharge volatile or hazardous substances, such as mineral spirits, oil, or paint thinner, into storm sewers, gutters, sanitary sewers, or other location in the environment. Dispose of such materials in accordance with Laws and Regulations.
5. Do not discharge wastes to surface waters, drainage routes, or groundwater.
6. Contractor is solely responsible for complying with Laws and Regulations regarding storing, transporting, and disposing of waste generated by Contractor's operations or brought to the Site by Contractor.

I. During handling and installation of materials and equipment, clean and protect construction in progress and adjoining materials and equipment already in place. Apply protective covering where necessary or required for protection from damage or deterioration, until Substantial Completion.

J. Clean completed construction as frequently as necessary throughout the construction period.

3.2 CLOSEOUT CLEANING

A. Complete the following prior to requesting inspection for Substantial Completion:
   1. Clean and remove from the Site waste material (including rubbish and debris) and other foreign and undesirable items and substances.
   2. Sweep broom-clean paved areas suitable for access by vehicles.
   3. Remove spills and stains or petroleum, oils, solvents, other chemicals, and other foreign and undesirable deposits.
   4. Hose-clean sidewalks and loading areas.
   5. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
   6. Surface waterways and drainage routes (including storm sewers, gutters, and ditches) shall be open and clean.
   7. Repair pavement, roads, sod, and other areas affected by construction operations and restore to specified condition; if condition is not specified, restore to preconstruction condition.
   8. Clean exposed exterior and interior hard-surfaced finishes to dirt-free condition, free of spatter, grease, stains, fingerprints, films, and similar foreign and undesirable substances.
   9. Clean, wax, and polish wood, vinyl, and painted floors.
   10. Remove waste material and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, and similar spaces.
   11. In unoccupied spaces, sweep concrete floors broom clean.
   12. Clean transparent materials, including mirrors and glazing in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials.
   13. Remove non-permanent tags and labels.
   14. Surface Finishes:
      a. Touch-up and otherwise repair and restore chipped, scratched, dented or otherwise marred surfaces to specified finish and match adjacent surfaces.
      b. Do not paint over "UL" or similar labels, including mechanical and electrical nameplates.
   15. Wipe surfaces of mechanical and electrical equipment, and similar equipment. Remove excess lubrication, paint, and mortar droppings, and other foreign or undesirable substances.
   16. Clean plumbing fixtures to sanitary condition, free of stains, including stains resulting from water exposure.
   17. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
   18. Clean lighting fixtures, lamps, globes, and reflectors to function with full efficiency. Replace temporary lamps provided in permanent fixtures. Replace existing lighting fixture components that are burned out or noticeably dimmed from use during construction. Replace defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
   19. Leave the Site clean, and in neat, orderly condition, satisfactory to Owner and Engineer.

B. Complete the following prior to requesting final inspection:
   1. After Substantial Completion of all the Work, following completion of items of incomplete or damaged Work ("punch list Work"), clean "punch list Work areas in accordance with Paragraph 3.2.A of this Specifications Section.
   2. Remove field offices, Contractor's storage sheds, and remaining stockpiles and clean all such areas in accordance with Paragraph 3.2.B of this Specifications Section, and in accordance with Contract Documents for landscaping and restoration.

END OF SECTION

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SECTION 01 75 00
CHECKOUT AND START-UP PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Administrative and procedural requirements for checkout and startup of equipment, systems, and facilities.

B. Scope:
   1. Contractor shall initially check out, start up, and place equipment and systems installed under the Contract into successful operation, in accordance with the material and equipment manufacturers' written instructions, Suppliers' recommendations at the Site, and the Contract Documents.
   2. Provide the following:
      a. All labor, tools, materials, and equipment required to complete equipment and system checkout and startup.
      b. Chemicals, lubricants, and other required operating fluids necessary for checkout, startup, and initial operation of the Work.
      c. Filters and other temporary or consumable items necessary for checkout, startup, and initial operation of the Work.
      d. Fuel, electricity, water, and other temporary utilities and temporary facilities necessary for checkout and startup of equipment and systems, unless otherwise specified.
   3. The General Conditions, as may be modified by the Supplementary Conditions, and Section 01 77 19 - Closeout Requirements, address requirements for documenting Substantial Completion.

C. Related Sections include but are not necessarily limited to:
   1. Section 01 78 23 - Operation and Maintenance Data
   2. Section 01 61 03 - Equipment - Basic Requirements.
   3. Section 01 77 19 - Closeout Requirements.
   4. Section 01 79 23 - Instruction of Operations and Maintenance Personnel.
   5. Section 40 61 13 - Process Control Systems - General Requirements.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate checkout and startup with other contractors, as necessary.
   2. Do not start up equipment or system(s) for continuous operation until all components of that equipment item or system, including instrumentation and controls, have been tested to the extent practicable and proven to be operable as intended by the Contract Documents.
   3. Subject to the constraints of this Specifications section, Owner will furnish sufficient personnel to assist Contractor in starting up equipment and system(s), but responsibility for proper operation of the Work is Contractor's.
   4. Supplier shall be present during checkout, startup, and initial operation, unless otherwise acceptable to Engineer or otherwise required by the Contract Documents.
   5. For startup of heating equipment, air conditioning equipment, and other equipment and systems that provide temperature control, that are dependent upon the time of year, return to the Site at beginning of next heating or cooling season (as applicable) to recheck and start the appropriate equipment and system(s).
   6. Do not start up equipment and system(s), without submitting acceptable preliminary operations and maintenance manuals by Contractor in accordance with the Contract Documents.

B. Checkout and Startup Planning Meeting:

1. Contractor, with appropriate Subcontractors and Suppliers, shall attend and participate in a meeting with Owner, and Engineer to discuss planning, scheduling, and coordination of checkout and startup activities.
2. Upon mutual concurrence of Owner, Engineer, and Contractor, meeting may be concurrent with the training scheduling planning meeting required in Section 01 79 23 – Instruction of Operations and Maintenance Personnel.
3. Meeting shall be held by the earlier of: (1) not less than 60 days prior to first scheduled training session for the equipment and system(s) to be checked out and started-up, and (2) not less than 60 days prior to the checkout and startup of the associated equipment and system(s).
4. Attend meeting prepared to knowledgably and effectively discuss:
    a. Status of the Work and schedule-to-complete for requirements prerequisite to checkout and startup.
    b. Schedule for and status of training required for each equipment item and system.
    c. Schedule for checkout, startup, and field quality control activities for the subject Work.
    d. Status and quantities of required consumables, lubricants, and utility services necessary for checkout and startup.
5. Meeting will be chaired by Engineer. Engineer will prepare and distribute a record of topics discussed and decisions made during the meeting. If meeting is concurrent with the training planning meeting required under Section 01 79 23 - Instruction of Operations and Maintenance Personnel, Contractor shall chair and prepare minutes of the training scheduling planning portion of the meeting and furnish its draft minutes to Engineer to incorporate into the overall minutes.
6. Comply with decisions made at the meeting and the Contract Documents.

C. Sequencing:
1. Comply with Section 01 14 16 - Coordination with Owner's Operations, regarding staging (phasing) of the Work and allowable shutdowns.

D. Scheduling:
1. Progress Schedule:
    a. Clearly indicate in the Progress Schedule planned and actual dates for checkout, startup, and field quality control activities, including all demonstration testing activities addressed in this Specifications section and elsewhere in the Contract Documents. Separately indicate checkout, startup, and field quality control activities for each equipment item and system.
    b. Perform startup and field quality control activities on the associated, scheduled dates, unless otherwise acceptable to Owner and Engineer.
2. Restrictions for Scheduling:
    a. Checkout of materials, equipment, and systems by Contractor that do not involve or require Owner's personnel may be performed at any time during normal working hours. Where required by the Contract Documents or requested by Engineer, perform checkout in the presence of Engineer or Resident Project Representative (RPR).
    b. Startup, including initial operation of materials, equipment, and systems, shall not be initiated on: Monday, Friday, Saturday, Sunday, Owen's holidays, the day immediately prior to a holiday, or the day immediately following a holiday, unless otherwise acceptable to Owner and Engineer.
    c. Unless otherwise indicated in the Contract Documents or acceptable to Owner and Engineer, perform all startup during normal working hours of the day shift.
    d. To the extent practicable, where extended-duration startup or field quality control activities are required by the Contract, avoid having such activities extend into evening, night, weekend, or holiday hours.
    e. Owner reserves the right to require a minimum seven days' notice of rescheduled startup when Contractor cannot perform the associated activities as scheduled.
3. Operation and Maintenance Data:
    a. Comply with Section 01 78 23 - Operation and Maintenance Data.

b. A preliminary copy of all operation and maintenance manuals shall be received by Engineer prior to the start of the demonstration period.

4. Training:
   a. Comply with Section 01 79 23 - Instruction of Operations and Maintenance Personnel.
5. Spare Parts, Tools, and Extra Materials.
   a. Comply with Section 01 78 43 - Spare Parts and Extra Materials, for furnishing spare parts, tools, and extra materials to Owner and for documenting Owner's receipt of such items.
   b. Deliver to Owner (as applicable) all required spare parts, tools, and extra materials prior to commencing the demonstration period, unless earlier delivery is required elsewhere in the Contract Documents.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Do not start up equipment or systems or place into initial operation until required operating permits are obtained from authorities having jurisdiction.
   2. Where Owner (with or without assistance of Engineer) has applied for and obtained initial approvals or permits necessary for operation, Contractor shall furnish information and assistance to Owner or Engineer for Owner to secure final approvals from authorities having jurisdiction for required operating permits.

B. Qualifications:

1.4 DEFINITIONS

A. The following defined terms are used in this Specifications Section:
   1. Instrumentation Supplier: Entity retained by Contractor, Subcontractor, or Supplier to furnish instrumentation or controls that will be part of the completed Work, including manufacturers, manufacturer representatives, wholesalers, retailers, and others, including entities retained to perform systems integration Work.
   2. Pre-Demonstration Period: The period, of unspecified duration after initial construction and installation activities during which Contractor, with assistance from manufacturer's representatives, performs in the following sequence:
      a. Finishing type construction work to ensure the Project has reached a state of Substantial Completion.
      b. Equipment start-up.
      c. Personnel training.
   3. Demonstration Period: A period of time, of specified duration, following the Pre-Demonstration Period, during which the Contractor initiates process flow through the facility and starts up and operates the facility, without exceeding specified downtime limitations, to prove the functional integrity of the mechanical and electrical equipment and components and the control interfaces of the respective equipment and components comprising the facility as evidence of Substantial Completion.

1.5 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Data collection and reporting log for each required Demonstration Period.

B. Informational Submittals: Submit the following:
   1. Progress Schedules indicating dates for checkout, startup, and field quality control activates.
   2. Completed checkout and startup log required in Paragraph 3.2.C of this Specifications section.
   3. Manufacturer's installation check letters (also known as Manufacturer's Field Services Report) required in Paragraph 3.2.C of this Specifications section.
   4. Instrumentation Supplier's Instrumentation Installation Certificate, required in Paragraph 3.2.C of this Specifications section.

5. Letter verifying completion of all pre-demonstration startup activities, required in Paragraph 3.2.C of this Specifications section.
6. Report of data collected during each required Demonstration Period.
7. Qualifications Statements:
   a. Qualifications, including resume' and copy of license, of Contractor-retained licensed operator.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 CHECKOUT AND STARTUP – GENERAL

A. Facility Startup Divided into Two Periods:
   1. Pre-Demonstration Period including:
      a. Obtain Engineer's approval or acceptance (as applicable) of Submittals required prior to checkout and startup, including all Shop Drawings, Samples, source quality control (shop testing) Submittals, preliminary operation and maintenance manuals, and other Submittals required by the Contract Documents, other than Submittals that cannot be furnished until after startup.
      b. Complete the Work to a point ready for checkout and startup, including operation available in all manual, automatic, and other modes.
      c. Checkout and initial field quality control activities that can be performed prior to startup of the equipment or system.
      d. Startup of the associated Work.
      e. Field quality control activities for the subject Work as indicated elsewhere in the Specifications and other Contract Documents, other than this section.
      f. Training of operations and maintenance personnel.
   2. Demonstration Period, including:
      a. Demonstration of functional integrity of equipment or system.

3.2 PRE-DEMONSTRATION PERIOD

A. Prior to the Pre-Demonstration Period, complete the Work to the point where it is ready for checkout and startup.

B. Checkout.
   1. Comply with Section 01 61 03 - Equipment - Basic Requirements, including provisions concerning installation checks

C. Startup:
   1. Comply with requirements for startup of materials, equipment, and systems indicated in the associated Specification sections and elsewhere in the Contract Documents.
   2. Prepare the Work so it will operate properly and safely and be ready to demonstrate functional integrity during the Demonstration Period.
   3. Perform startup to extent possible without introducing process flow.
   4. Introduce process flow to complete startup where indicated in Section 01 14 16 – Coordination with Owners Operations.
   5. Procedures include but are not necessarily limited to the following:
      a. Test or check and correct deficiencies of:
         1) Power, control, and monitoring circuits for continuity prior to connection to power source.
         2) Voltage of all circuits.
         3) Phase sequence.
         4) Cleanliness of connecting piping systems.
         5) Alignment of connected machinery.
         6) Vacuum and pressure of all closed systems.

7) Lubrication.
8) Valve orientation and position status for manual operating mode.
9) Tankage for integrity using plant clean nonpotable water.
10) Pumping equipment using plant nonpotable water.
11) Instrumentation and control signal generation, transmission, reception, and response.
a) Comply with Section 40 61 13 - Process Control System General Requirements.
12) Tagging and identification systems.
13) Proper connections, alignment, calibration and adjustment.

b. Calibrate safety equipment.
c. Manually rotate or move moving parts to assure freedom of movement.
d. "Bump-start" electric motors to verify proper rotation.
e. Perform other tests, checks, and activities required to make the Work ready for Demonstration Period.
f. Checkout and Startup Log:
1) Prepare a log showing each equipment item and system requiring checkout and startup. Indicate in the log activities to be accomplished during checkout and startup.
2) Provide a place for Contractor to record date and person performing required checkout and startup. Indicate associated date(s), personnel, and employer of each.
3) Submit completed checkout and startup log to Engineer and obtain Engineer's acceptance.

6. Obtain Suppliers' certifications of the installed and operational Work, without restrictions, and submit to Engineer:
a. Manufacturer's installation check letters (sometimes referred to as Manufacturer's Field Services Report).
b. Instrumentation Supplier's Instrumentation Installation Certificate.
7. Letter verifying completion of all pre-demonstration startup activities including receipt of all specified items from Suppliers as final item prior to initiation of Demonstration Period.
8. Personnel Training:

3.3 DEMONSTRATION PERIOD

A. Demonstration Period – General:
1. Demonstrate the operation and performance of mechanical, electrical, instrumentation, and control interfaces of the Work undergoing the Demonstration Period, in accordance with the Contract Documents.
2. Duration of Demonstration Period: 120 consecutive hours.
3. If, during the Demonstration Period, the aggregate time used for repair, alteration, or unscheduled adjustments to any part of the Work that renders the affected Work inoperative or operation outside of recommended ranges exceeds 10% of the Demonstration Period, the demonstration of operation and performance will be deemed unacceptable and Contractor shall provide appropriate adjustments and remedies and re-perform the Demonstration Test, at no additional cost to Owner, until acceptable results are obtained. Re-performance of the Demonstration Period shall comply with the same requirements as the original Demonstration Period.
4. Perform the demonstration of operation and performance of the Work under full operational conditions.
5. Owner's Personnel:
a. Owner will make available operations personnel to make process decisions affecting facility performance and compliance with applicable operating permits.
b. Owner's assistance will be available only for process decisions.
c. Contractor will perform all other functions associated with the Demonstration Period including but not limited to equipment operation and maintenance until successful completion of the Demonstration Period in accordance with the Contract Documents.

6. Owner reserves the right to simulate operational variables, equipment failures, routine maintenance scenarios, and similar actions and events during the Demonstration Period to verify the operation and performance of the Work in automatic, manual, and other types of operating modes, backup systems, and alternate operating modes.
7. Prior to Starting Demonstration Period:
    a. Prepare data collection and reporting log for sampling, analytical data, and data to be obtained by manually recording data from field or panel indicators. Not less than 30days prior to the start of the Demonstration Period, submit the data collection and reporting log to Engineer for acceptance.
8. Timing of Start and End of Demonstration Period:
    a. Schedule the end of the Demonstration Period at a convenient time such as midnight, so the Owner can assume operational responsibility on a new day beginning immediately after completion of the Demonstration Period.
    b. Time of beginning and ending Demonstration Period shall be agreed upon by Contractor, Owner, and Engineer in advance of initiating Demonstration Period.

B. Demonstration Period, Evaluation, and Acceptance:
1. Throughout the Demonstration Period, provide knowledgeable personnel to answer Owner's questions, provide final field instruction on select systems (where appropriate) and to respond to problems or failures of the Work.
2. Responsibilities for Sampling and Data Collection:
    a. Use the data collection and reporting log format accepted by Engineer. Indicate data clearly and legibly.
3. Responsibilities for Data Reporting:
    a. Submit data collected to Engineer for evaluation of acceptability of results.
4. Data Evaluation:
    a. Engineer, in consultation with Owner as necessary, will evaluate the data collected during the Demonstration Period and other information obtained during the Demonstration Period for compliance with the Contract Documents.
    b. Engineer will advise Contractor in writing of whether the data and information obtained indicate that the Demonstration Period was successfully completed.

END OF SECTION

SECTION 01 77 19
CLOSEOUT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Administrative and procedural requirements for:
   1. Substantial Completion.
   2. Final inspection.
   3. Request for final payment and acceptance of the Work.

1.2 SUBSTANTIAL COMPLETION

A. Substantial Completion – General:
   1. Prior to requesting inspection for Substantial Completion, perform the following for the substantially completed Work:
      a. Materials and equipment for which Substantial Completion is requested shall be fully ready for their intended use, including full operating and monitoring capability in automatic, manual, and other operating modes set forth in the Contract Documents.
      b. Permanent provisions for safety and protection, shown and indicated in the Contract Documents and associated with the substantially completed Work or for personnel accessing and using the substantially completed Work, shall be in place and ready for their intended use.
      c. Complete field quality control Work, including inspections and testing at the Site, indicated in Specifications sections for individual materials and equipment items and related Contract Documents. Submit results of, and obtain Engineer's acceptance of, field quality control tests and inspections required by the Contract Documents.
      d. Complete checkout and startup in accordance with Section 01 75 00 - Checkout and Startup Procedures, requirements of the Specifications for the various materials and equipment in the substantially completed Work, and related Contract Documents.
      e. Cleaning for Substantial Completion shall be completed in accordance with Section 01 74 00 - Cleaning.
      f. Spare parts, tools, and extra materials shall be delivered and accepted in accordance with the Contract Documents and documentation of Owner's acceptance thereof has been submitted to Engineer in acceptable form in accordance with Section 01 78 43 - Spare Parts and Extra Materials.
      g. Training of the facility's operations and maintenance personnel shall be completed in accordance with the Contract Documents, including Section 01 79 23 - Instruction of Operations and Maintenance Personnel.
      h. Submit and obtain Engineer's acceptance of final operations and maintenance manuals in accordance with Section 01 78 23 - Operation and Maintenance Data.
      i. Obtain and submit to Engineer all required permits, inspections, and approvals of authorities having jurisdiction for the substantially completed Work to be occupied and used by Owner.
      j. Complete other tasks that the Contract requires be completed prior to Substantial Completion.
   2. Procedures for requesting and documenting Substantial Completion are in the General Conditions, as may be modified by the Supplementary Conditions.
   3. Sample letter for Contractor's request for inspection for Substantial Completion is attached to this Specifications section. Use the model language of the sample letter, modified to suit the Project and the needs of Contractor's request.
   4. Unless decided otherwise by Owner and Engineer, form of certificate of Substantial Completion will be EJCDC C-625, "Certificate of Substantial Completion" (2018 edition or later), prepared by Engineer.

5. Refer to the Agreement and Section 01 29 76 - Progress Payment Procedures, for requirements regarding consent of surety to partial release of or reduction in retainage.

1.3 FINAL INSPECTION

A. Final Inspection – General:
   1. Prior to requesting final inspection, verify that all the Work is fully complete and ready for final payment. Partial checklist for this purpose is attached to this Specifications section.
   2. Sample letter for Contractor to request final inspection is attached to this Specifications section. Use the model language of the sample letter, modified to suit the Project.
   3. Procedures for requesting and documenting the final inspection are in the General Conditions, as may be modified by the Supplementary Conditions, and as augmented in this Specifications section.

1.4 REQUEST FOR FINAL PAYMENT AND ACCEPTANCE OF THE WORK

A. Procedure:
   1. After successful completion of the final inspection, submit request for final payment in accordance with the Agreement and General Conditions, as may be modified by the Supplementary Conditions, and using procedure specified in Section 01 29 76 - Progress Payment Procedures, and this Specifications section.
   2. Acceptance of the Work:
      a. Upon Engineer's concurrence that the Work is complete and ready for final payment (as a result of the final inspection and other communications between the parties and Engineer) and receipt of the final Application for Payment, accompanied by other required Contract closeout documentation, all in accordance with the Contract Documents, Engineer will issue to Owner and Contractor a notice of acceptability of the Work, in accordance with the General Conditions, as may be modified by the Supplementary Conditions.
      b. Unless decided otherwise by Owner and Engineer, form of acceptance will be EJCDC C-626, "Notice of Acceptability of Work", (2018 edition or later).
      c. Nothing other than receipt of such notice of acceptability from Engineer constitutes acceptance of the Work.
      d. Receipt of Engineer's notice of acceptability of the Work does not relieve Contractor of Contractor's continuing obligations under the Contract, including correction period obligations, warranty obligations, indemnification obligations, insurance requirements, and Contractor's other obligations following acceptance of the Work by Engineer and final payment. Such obligations shall commence and remain in effect as indicated elsewhere in the Contract Documents.

B. Request for final payment shall include:
   1. Documents required for progress payments in Section 01 29 76 - Progress Payment Procedures.
   2. Documents required in the General Conditions, as may be modified by the Supplementary Conditions.
   3. List, on Contractor's letterhead, of all Change Proposals, Claims, and disputes that Contractor believes are unsettled. If there are no such Change Proposals, Claims, or disputes, so indicate in writing.
   4. Consent of Surety to Final Payment:
      a. Acceptable form includes AIA G707, "Consent of Surety to Final Payment" (1994 or later edition), or other form acceptable to Owner.
   5. Releases of Liens:
      a. Submit complete and legally effective releases (satisfactory to Owner) of all Liens filed in connection with the Work, regardless of whether such Lien was filed by Contractor, Subcontractor, or Supplier.
      b. Each release of Lien shall be signed by an authorized representative of the entity submitting the release of Lien, and shall include Contractor's, Subcontractor's, or Supplier's (as applicable) corporate seal, when applicable.

6. Waivers of Lien Rights:
    a. Submit legally binding waivers of rights to file Liens, acceptable to Owner, as required in the General Conditions (as may be modified by the Supplementary Conditions) from Contractor and each Subcontractor and Supplier that furnished or provided labor, material, or equipment totaling $1,000 or more for the Work.
    b. Furnish final list of Subcontractors and Suppliers indicating final amount of the associated subcontract or purchase order for each. Include on the list all lower-tier Subcontractors and Suppliers retained by higher-tier Subcontractors and Suppliers. Prepare the list using the form included in Section 01 29 76 - Progress Payment Procedures.
    c. Each waiver of Lien rights shall be signed by an authorized representative of the entity submitting waiver of Lien rights, and shall include Contractor's, Subcontractor's, or Supplier's (as applicable) corporate seal, when applicable.
    d. Waiver of Lien rights may be conditional upon receipt of final payment.
    e. Required Affidavits: Submit the following:
        1) Affidavit of payment of debts and claims, submitted by Contractor. Acceptable form includes AIA G706, "Contractor's Affidavit of Payment of Debts and Claims" (1994 or later edition), or other form acceptable to Owner, and;
        2) Affidavit of release of Liens, submitted by Contractor. Acceptable form includes AIA G706A, "Affidavit of Release of Liens" (1994 or later edition).
        3) Each affidavit shall be signed by an authorized representative of Contractor and shall bear Contractor's corporate seal, as applicable.
    f. In the event Contractor is unable to obtain one or more required waivers of Lien rights, recourse is set forth in the General Conditions, as may be modified by the Supplementary Conditions.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 ATTACHMENTS

A. The documents listed below, following this Specification section's "End of Section" designation, are part of this Specifications section:
    1. Sample letter for Contractor's use in requesting inspection for Substantial Completion (two pages).
    2. Sample partial checklist to identify readiness for final inspection (four pages).
    3. Sample letter for Contractor's use in requesting final inspection (one page).

B. In the model language of the attached sample letters for Contractor to request inspection for Substantial Completion and the final inspection, italicized language in brackets, e.g., "[insert date]" indicates instructions to the drafter of the letter and often indicates specific information to be inserted by Contractor; do not include bracketed, italicized text in the final version of the letter(s) prepared for the Project. Non-italicized language in brackets is optional language; use the appropriate language to complete the actual letter for the Project and edit where required to suit the specific circumstances.

END OF SECTION

SAMPLE LETTER FOR CONTRACTOR'S USE IN REQUESTING INSPECTION FOR SUBSTANTIAL COMPLETION

SENT VIA E-MAIL AND U.S. CERTIFIED MAIL/RETURN RECEIPT REQUESTED

[Date]

[Name of Engineer's contact person]
HDR
[Street address]
[City, state, postal code]

Subject:
[Project name, Contract designation]
Request for Inspection for Substantial Completion

Dear [addressee]:

In our opinion, [all of] [or] [a portion of] the Work under the above-referenced Contract is substantially complete as of [insert month, day, year on which Substantial Completion was achieved]. [The specific portion of the Work that we believe is substantially complete is [insert identification of that portion of the Work that is substantially complete].]

Enclosed is our listing of uncompleted Work items ("punch list"). In accordance with Paragraph 15.03.A of the General Conditions, we hereby request: (1) That the Engineer schedule and perform the inspection for Substantial Completion as soon as possible, and (2) Issuance of the certificate of Substantial Completion.

In accordance with Paragraph 15.03.D of the General Conditions, upon Substantial Completion, we propose the following relative to apportionment of responsibilities between the Owner and the Contractor:

1. Security, Protection, Insurance:
    a. Site Security: [insert proposal; address whether Owner or Contractor will be responsible for security of the Site].
    b. Protection of the Substantially Completed Work: [insert proposal; address whether Owner or Contractor will be responsible for protection].
    c. Property Insurance: [insert proposal; typically Owner assumes responsibility for property insurance upon Substantial Completion]
2. Operation and Maintenance:
    a. Operation: [insert proposal; address whether Owner or Contractor will be responsible for operating the substantially completed Work].
    b. Maintenance: [insert proposal; address whether Owner or Contractor will be responsible for maintaining the substantially completed Work].
3. Utilities: [for each of the following, indicate whether Owner or Contractor will be responsible for utilities and services, or whether responsibility will be shared; if shared, indicate proposed cost-sharing]
    a. Electricity: [insert proposal].
    b. Natural Gas/Fuel/Heating: [insert proposal].
    c. Water Supply: [insert proposal].

d. Wastewater: [insert proposal].

e. Communications (Telephone, Internet, Video): [insert proposal].

In accordance with Paragraph 15.08.A of the General Conditions, we understand that the Contract's correction period for the Work covered by the certificate of Substantial Completion commences on the Substantial Completion date documented in said certificate. [Drafter: Also see Paragraph 15.04 ("Partial Utilization") of the General Conditions and, where necessary, edit this paragraph of the letter accordingly.]

Should you have questions or comments regarding this notice, please contact [the undersigned] [or] [insert other contact person's name], at [insert telephone number and e-mail address].

Sincerely,

[Contractor's company name]

[Signatory name]
[Signatory's title]

Attachments:
Preliminary list of uncompleted Work items ("punch list"; [##] pages)

Copies:
[Owner's project manager]

SAMPLE PARTIAL CHECKLIST TO IDENTIFY READINESS FOR FINAL INSPECTION

Project: [_____]
Contract: [_____]
Contractor: [_____]

Item No./Description	Completed/Date		In Progress	Not Started	Not Applicable	Target Date	Responsible Entity/Person
1. All Submittals, including all Shop Drawings and Samples, approved or accepted by Engineer	☐		☐	☐	☐		
Remarks:							
1. Final services completed by Suppliers, including submittal of "Manufacturer Field Service Report" in Section 01 61 03 Equipment - Basic Requirements	☐		☐	☐	☐		
Remarks:							
2. Final Work completed by Subcontractors	☐		☐	☐	☐		
Remarks:							
3. Permits closed out and regulatory compliance transitioned from construction to operations	☐		☐	☐	☐		
Remarks:							
4. All outstanding change issues are addressed and all Change Proposals submitted	☐		☐	☐	☐		
Remarks:							
5. All Change Proposals and Claims are resolved	☐		☐	☐	☐		

Item No./Description	Completed/Date		In Progress	Not Started	Not Applicable	Target Date	Responsible Entity/Person
Remarks:							
6. All defective Work of which Contractor is aware has been corrected in accordance with the Contract Documents	☐		☐	☐	☐		
Remarks:							
7. Issues related to Constituents of Concern and potential Hazardous Environmental Condition have been fully addressed	☐		☐	☐	☐		
Remarks:							
8. All spare parts, tools, and extra materials have been furnished in accordance with the Contract Documents, and documentation thereof submitted to Engineer	☐		☐	☐	☐		
Remarks:							
9. All final operations & maintenance manuals have been submitted and accepted by Engineer	☐		☐	☐	☐		
Remarks:							
10. Manufacturer warranties and software license(s) furnished	☐		☐	☐	☐		
Remarks:							
11. Instruction and training of operations and maintenance personnel is complete and records of training submitted	☐		☐	☐	☐		

Item No./Description	Completed/Date		In Progress	Not Started	Not Applicable	Target Date	Responsible Entity/Person
Remarks:							
12. MBE/WBE/DBE/VBE compliance report(s) submitted (when applicable)	☐		☐	☐	☐		
Remarks:							
13. All field engineering Submittals, including survey data, furnished	☐		☐	☐	☐		
Remarks:							
14. All Work on "punch list" is complete in accordance with the Contract Documents	☐		☐	☐	☐		
Remarks:							
15. All record documents submitted to and accepted by Engineer	☐		☐	☐	☐		
Remarks:							
16. Contractor is fully demobilized from the Site	☐		☐	☐	☐		
Remarks:							
17. All Site restoration is complete	☐		☐	☐	☐		
Remarks:							
18. Final cleaning of all work areas is complete	☐		☐	☐	☐		
Remarks:							
19. Releases of Liens and waivers of Lien rights (or acceptable	☐		☐	☐	☐		

Item No./Description	Completed/Date		In Progress	Not Started	Not Applicable	Target Date	Responsible Entity/Person
alternative) obtained from Subcontractors and Suppliers							
Remarks:							
20. Evidence of Contractor liability insurance furnished for correction period	☐		☐	☐	☐		
Remarks:							
21. All other required Contract closeout documents obtained	☐		☐	☐	☐		
Remarks:							
Remarks:							
22. All other Work and documentation required prior to final payment is complete and provided in accordance with the Contract Documents	☐		☐	☐	☐		
Remarks:							

SAMPLE LETTER FOR CONTRACTOR'S USE IN REQUESTING FINAL INSPECTION

SENT VIA E-MAIL AND U.S. CERTIFIED MAIL/RETURN RECEIPT REQUESTED

[Date]

[Name of Engineer's contact person]
HDR
[Street address]
[City, state, postal code]

Subject:
[Project name, Contract designation]
Request for Final Inspection

Dear [addressee]:

The Work under the above-referenced Contract is complete and ready for final payment as of [insert month, day, year on which final completion was achieved]. In accordance with Paragraph 15.05 of the General Conditions, we hereby request that the Engineer schedule and perform the final inspection as soon as possible. Upon successful completion of the final inspection, we will submit our final Application for Payment accompanied by the required Contract closeout documentation in accordance with the Contract Documents.

Should you have questions or comments regarding this notice, please contact [the undersigned] [or] [insert other contact person's name], at [insert telephone number and e-mail address].

Sincerely,

[Contractor's company name]

[Signatory name]
[Signatory's title]

Attachments:
None

Copies:
[Owner's project manager]

SECTION 01 78 23
OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Requirements for Contractor-furnished, manufacturers' operation and maintenance (O&M) data, including:
      a. Required operation and maintenance data groupings into operation and data manuals and timing of such Submittals.
      b. Requirements for paper copies of operation and maintenance data and related Electronic Documents.
      c. Content of operation and maintenance data Submittals.

B. Scope:
   1. Contractor shall submit operation and maintenance data, and related information, in accordance with this Section and requirements elsewhere in the Contract Documents, as instructional and reference information for use by: (a) Owner's operation and maintenance personnel, and (b) others retained by or working for Owner.
   2. In addition to operation and maintenance data expressly required elsewhere in the Contract Documents, also submit operation and maintenance data for:
      a. All equipment and systems, including facility equipment, conveying equipment, fire suppression systems, plumbing equipment, HVAC equipment, electrical equipment, communications equipment, electronic safety and security systems, utility equipment, transportation equipment, and process equipment, and other equipment.
      b. Valves, gates, actuators, and related accessories.
      c. Instrumentation and control devices and systems.
      d. Building materials, systems, and finishes that need post-construction troubleshooting, cleaning, or maintenance, such as roofing, doors, windows, louvers, flooring, paint and coatings, other finishes, and other items.

C. Related Requirements:
   1. Section 01 31 26 - Electronic Communication Protocols.
   2. Section 01 33 00 - Submittal Procedures.
   3. Section 01 75 00 - Checkout and Startup Procedures.
   4. Section 01 78 36 - Warranties.

1.2 SUBMITTALS

A. Closeout Submittals: Submit the following:
   1. Operation and Maintenance Data:
      a. Submit operation and maintenance data, required by the Contract Documents. Coordinate required groupings of submittals for equipment such as instrumentation and controls, electrical gear and HVAC equipment, with Engineer and Owner prior to preparing and transmitting such Submittal.
      b. For each required operation and maintenance manual Submittal, furnish preliminary Submittal and final Submittal. Timing of preliminary and final operation and maintenance manual Submittals, and differences between preliminary and final Submittals, are indicated in this Section.

B. Timing of Submittals and Quantity Required:
   1. Preliminary Operation and Maintenance Manual Submittals:
      a. Paper Copies: None
      b. Electronic Documents: In accordance with Section 01 31 26 - Electronic Communication Protocols.

c. Submit to entity indicated in Section 01 33 00 – Submittal Procedures, by the earlier of: 90 days following approval of Shop Drawings and product data Submittals, or 14 days prior to starting training of operation and maintenance personnel, or 14 days prior to field quality control testing at the Site.
d. Do not perform checkout, startup, and training without Engineer's acceptance of preliminary operation and maintenance data Submittals for the associated Work.

2. Final Operation and Maintenance Manual Submittals: Furnish final Submittal prior to Substantial Completion of the associated Work, unless submittal is required prior to an interim Milestone.
   a. Paper Copies: None.
   b. Electronic Documents: In accordance with Section 01 31 26 - Electronic Communication Protocols.
   c. Work will not be eligible for Substantial Completion until associated, required final operation and maintenance data Submittals are accepted by Engineer.
   d. If Contractor (whether via Subcontractor or Supplier), revises program code or configuration files between acceptance of Submittal by Engineer and end of the Contract's correction period and Contractor's general warranty obligation, furnish updated program code and configuration files to Owner. Before modifying program code and configuration files after Substantial Completion, verify with facility manager that Owner- or facility manager modifications of program code or configuration files were incorporated into the modified files, subject to the provisions of this Section.

1.3 PAPER COPIES OF O&M MANUALS – NOT USED

1.4 ELECTRONIC DOCUMENTS O&M MANUALS

A. Electronic Documents of Operation and Maintenance Manuals:
   1. Each Electronic Document copy of operation and maintenance data shall include all information included in the corresponding paper copy.
   2. Submit Electronic Documents operation and maintenance data in accordance with Section 01 31 26 - Electronic Communication Protocols, and Section 01 33 00 - Submittal Procedures.
   3. File Format:
      a. Unless otherwise required by Section 01 31 26 - Electronic Communication Protocols, or Section 01 33 00 - Submittal Procedures, operation and maintenance data Electronic Documents shall be "portable document format" (PDF) files.
      b. Electronic Documents shall be electronically searchable upon delivery.
      c. Electronic Documents shall not be password-protected and shall not be protected against Owner's or facility manager's copying and printing such files for Owner's or facility manager's use in operating and maintaining the facility.
      d. Electronic Documents shall open to its first page.
      e. Submit each operation and maintenance manual as a single Electronic Document file, unless file size is over-large, in which case divide into as few separate files, each with similar filename, as possible.
      f. Within each Electronic Document, provide bookmarks for the following:
         1) Each chapter and subsection indicated in the corresponding printed copy document's table of contents.
         2) Each figure.
         3) Each table.
         4) Each appendix and attachment.

1.5 CONTENT OF OPERATION AND MAINTENANCE MANUALS

A. Operation and Maintenance Manual Content – General:
   1. Prepare each operation and maintenance manual specifically for the Project. Include in each manual all pertinent instructions, as-constructed drawings as applicable, bills of materials, technical information, installation and handling requirements, maintenance and repair instructions, and other information required for complete, accurate, and comprehensive data

for safe and proper operation, maintenance, and repair of materials and equipment furnished for the Project. Include in manuals specific information required in the Specification Section for the material or equipment, data required by Laws and Regulations, and data required by authorities having jurisdiction.

2. Provisions of this Article were written for equipment. Where operation and maintenance data are required for building products, such as finishes, openings, thermal and moisture protection, and similar items, comply with this Article to the extent practical and reasonable for the associated item.
3. Completeness and Accuracy:
    a. Operation and maintenance manuals that include language stating or implying that the manual's content may be insufficient or stating that the manual's content is not guaranteed to be complete and accurate are unacceptable.
    b. Operation and maintenance manuals shall be complete and accurate.
    c. Operation and maintenance manuals shall indicate the specific alternatives and features furnished, and the specific operation and maintenance provisions for the material or equipment furnished.
4. Provide dividers and Include manufacturer's information, diagrams, schematics, and equipment cutaways. Avoid submitting catalog excerpts unless they are the only document available showing identification or description of component of the equipment. Where published documents, included in operation and maintenance data, pertain to multiple models or types, mark the literature to indicate specific material or equipment supplied. Marking may be in the form of checking, arrows, or underlining to indicate pertinent information, or by crossing out or other means of obliterating information that does not apply to the materials and equipment furnished.
5. Identify each equipment item consistent with names and identification numbers shown or indicated in the Contract Documents, rather than manufacturer's model numbers.
6. Neatly type data not furnished in computer-printed text. Handwriting, except for strikeouts, arrows, and the like, is unacceptable.
7. Include copy of warranty in accordance with the Contract Documents, including Section 01 78 36 - Warranties.
8. Include copy of proposed service contract, when applicable.
9. When copyrighted material is used in operation and maintenance manuals, obtain copyright holder's written permission to use such material in the operation and maintenance manual.

B. Differences Between Preliminary and Final Operation and Maintenance Manuals:
    1. In preliminary operation and maintenance manuals, include flysheet or placeholder for information to be included in final operation and maintenance manual Submittal.
    2. In final operation and maintenance manuals, include information such as the following, as applicable for the associated materials and equipment:
        a. Equipment data that requires collection after startup, for example: (1) system and equipment balancing reports, including those for HVAC systems; and (2) final settings for electrical switchgear, automatic transfer switches, and circuit breakers: and (3) materials and equipment field testing results.
        b. Equipment startup reports and Suppliers' field service reports (the latter on form in Section 01 75 00 - Checkout and Startup Procedures).

C. Initial Documents in Operation and Maintenance Manuals:
    1. Table of Contents:
        a. Provide table of contents in each volume of each operation and maintenance manual.
        b. In table of contents and not less than once in each chapter or section, identify materials and equipment by their functional names. Thereafter, abbreviations and acronyms may be used if their meaning is clearly indicated in a table bound at or near beginning of each volume. Using material or equipment model or catalog designations for identifying items is unacceptable.
    2. Equipment Record:

a. Provide "Equipment Record" section of operation and maintenance manual immediately following the table of contents. "Equipment Record" section is not required for operation and maintenance data for other than equipment (such as building materials and finishes).
b. Provide "Equipment Record" on forms included as this Section's Attachments 1, 2, and 3.
c. For instrumentation and control equipment, International Society of Automation (ISA) data sheets are acceptable in lieu of the forms included as this Section's Attachments 1, 2, and 3.
d. This Section's Attachments 1, 2, and 3 are available from Engineer as "fillable PDF forms".
e. Complete in detail each section of "Equipment Record". Merely referencing the associated equipment's operation and maintenance data for nameplate, maintenance, spare parts, lubricants, or other required information, is unacceptable.
f. For equipment or systems with multiple, separate components (for example, motor and gearbox), fully completed "Equipment Record" is required for each component.
g. Operation and maintenance data Submittals without complete and accurate "Equipment Record" sheets are unacceptable.

3. Supplier's Field Service Reports:
a. Include in final operation and maintenance manuals copies of associated Supplier's field services reports in accordance with Section 01 75 00 - Checkout and Startup Procedures.
b. Include Supplier's completed field service reports in operation and maintenance manual in section immediately following "Equipment Record" section.

D. Operation and Maintenance Instructions:
1. Safety Considerations:
a. Submit written descriptions of safety considerations relating to operation and maintenance procedures for materials and equipment.
b. Describe safety devices and alarms provided with materials and equipment and proper operation and use.
c. Indicate procedures for proper, safe operating and maintenance of materials and equipment furnished, including manufacturer's recommended personal protection equipment, apparatus, and devices not furnished under the Contract.
d. Describe recommended safety-related training for personnel operating and maintaining the subject materials or equipment.
e. Include in appendix to operation and maintenance manual manufacturers' relevant safety data sheets (SDS).
f. Engineer's review of operation and maintenance data expressly does not extend to adequacy, completeness, and accuracy of SDS or other safety and protection practices and procedures indicated in the operation and maintenance data.

2. Operation:
a. Include in operation and maintenance data Submittals complete, detailed written operating instructions for each material or equipment item including: function; operating characteristics; limiting conditions; and regulation and control. Also include, as applicable, written descriptions of alarms generated by equipment and proper responses to such alarm conditions.
b. Include pre-startup instructions and checklists and complete startup instructions for each material and equipment item.
c. Indicate recommended operating instructions for all operating modes and conditions, with associated recommendations for safe operation.
d. Explain available controls and instrumentation and associated function(s).
e. Indicate required shutdown checklists and procedures for: normal shutdown, emergency shutdown, and long-term shutdowns.
f. Troubleshooting instructions.

3. Maintenance – General:

a. Include in operation and maintenance data complete, written instructions for necessary and recommended maintenance, including mechanical maintenance and electrical/instrumentation and controls maintenance, as applicable.
b. Include in operation and maintenance data complete instructions for necessary assembly, disassembly, installation, re-installation, storage, and shipping for materials and equipment.
c. Tools: Include list of required maintenance tools and equipment.
d. Spare Parts and Extra Materials:
    1) Submit complete instructions for ordering replaceable parts, including reference numbers (such as shop order number or serial number) that will expedite the ordering process.
    2) Submit manufacturer's recommended inventory levels for spare parts, extra stock materials, and consumable supplies for the initial two years of operation. Consumable supplies are items consumed or worn by operation of materials or equipment, and items used in maintaining the operation of material or equipment, including items such as lubricants, seals, reagents, and testing chemicals used for calibrating or operating the equipment. Include estimated delivery times, shelf-life limitations, and special storage requirements.
    3) Also refer to this Article's provision, "Bills of Materials", below, for additional requirements regarding ordering replacement parts.

4. Routine and Preventative Maintenance:
    a. Submit complete, detailed, written instructions for routine and preventive maintenance including all information and instructions to keep materials, equipment, and systems properly lubricated, adjusted, and maintained so that materials, equipment, and systems function economically throughout their expected service life. Instructions shall include:
        1) Written explanations with illustrations for each routine and preventive maintenance task such as inspection, adjustment, anchor bolt torque checks, lubrication, calibration, cleaning, replacement of filters, and the like.
        2) Recommended schedule for each routine and preventive maintenance task.
        3) Lubricants:
            a) Provide lubrication charts indicating recommended types of lubricants, frequency of application or change, and where each lubricant is to be used or applied.
            b) Table of alternative lubricants.
5. Major Maintenance:
    a. Include detailed, written instructions and illustrations for required periodic (non-routine, non-preventative) maintenance.
    b. Indicate relative level of training and expertise required to perform such maintenance and recommended tools and equipment.
6. Special Maintenance:
    a. Include maintenance instructions for long-term shutdowns and storage.

E. Bills of Materials:
1. Include in operation and maintenance manuals complete bills of material or parts lists for materials and equipment furnished. Lists or bills of material may be furnished on a per-drawing or per-equipment assembly basis. Bills of material shall indicate:
2. Manufacturer's name, physical address, telephone number, internet website address.
3. Manufacturer's local service representative's or local parts supplier's name, physical address, telephone number, internet website address, and e-mail addresses.
4. Manufacturer's shop order and serial number(s) for materials, equipment or assembly furnished.
5. For each part or piece include the following information:
    a. Parts cross-reference number. Cross-reference number shall be used to identify the part on assembly drawings, Shop Drawings, or other type of graphic illustration where the part is clearly shown or indicated.
    b. Part name or description.

c. Manufacturer's part number.
d. Quantity of each part used in each assembly.
e. Current unit price of the part at the time the operation and maintenance manual is submitted. Price list shall be dated.

F. Record Copy of Shop Drawings, Product data, and Other Previously Approved and Accepted Submittals:
1. Submit original-quality copies of each approved and accepted (as applicable) Shop Drawing, product data Submittal, written results of source quality control activities, and other Submittals, updated to indicate as-installed condition. Do not include prior Submittals that were not approved or were not accepted. Reduced drawings are acceptable only when reduction is to not less than one-half original size and all lines, dimensions, lettering, and text are completely legible on the reduction.

G. Electrical Schematics, Diagrams, and Information:
1. Submit complete electrical schematics and wiring diagrams, including complete point-to-point wiring and wiring numbers or colors between all terminal points.
2. Include as-constructed drawings of layouts of electrical panels (such as switchgear and motor control centers) and control panels.

H. NFPA 70 (National Electric Code) Documentation:
1. Include in operation and maintenance manuals for electrically powered equipment documented calculations of: (1) arc-fault current, equipment available fault current and (2) short-circuit current rating (SCCR), provided as part of equipment Submittals.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 ATTACHMENTS

A. The following, bound after this Section's "End of Section" designation, are part of this Section:
1. Attachment 1 - Equipment Data and Spare Parts Summary form (one page)
2. Attachment 2 - Recommended Maintenance Summary form (one page)
3. Attachment 3 - Lubrication Summary form (one page)

END OF SECTION

ATTACHMENT 1

Equipment Record

Equipment Data and Spare Parts Summary

Project Name	Specification Section:
Equipment Name	Year Installed:
Project Equipment Tag No(s).	
Equipment Manufacturer	Project/ Order No.
Address	Phone
Website / Web Site / E-mail	
Local Representative/Service Center	
Address	Phone
Website	E-mail

MECHANICAL NAMEPLATE DATA

Equip.		Serial No.		
Make		Model No.		
ID No.	Frame No.	HP	RPM	Cap.
Size	TDH	Imp. Size	CFM	PSI
Other:				

ELECTRICAL NAMEPLATE DATA

Equip.				Serial No.				
Make				Model No.				
ID No.	Frame No.	HP	V.	Amp.	Hertz	PH	RPM	SF
Duty	Code	Ins. Cl.	Type	NEMA	C Amb.	Temp. Rise	Rating	
Other:								

SPARE PARTS PROVIDED PER CONTRACT

Part No.	Part Name	Quantity

RECOMMENDED SPARE PARTS

Part No.	Part Name	Quantity

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ATTACHMENT 2

Equipment Record

Recommended Maintenance Summary

Equipment Description	Project Equip. Tag No(s).	

RECOMMENDED BREAK-IN MAINTENANCE (FIRST OIL CHANGES, ETC.)	INITIAL COMPLETION * FOLLOWING START-UP							
	D	W	M	Q	S	A	RT	Hours

RECOMMENDED PREVENTIVE MAINTENANCE	PM TASK INTERVAL *							
	D	W	M	Q	S	A	RT	Hours

* D = Daily W = Weekly M = Monthly Q = Quarterly S = Semiannual A = Annual Hours = Run Time Interval

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ATTACHMENT 3

Equipment Record

Lubrication Summary

Equipment Description	Project Equip. Tag No(s).

Lubricant Point						
Lubricant Type		Manufacturer	Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

Lubricant Point						
Lubricant Type		Manufacturer	Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

Lubricant Point						
Lubricant Type		Manufacturer	Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

Lubricant Point						
Lubricant Type		Manufacturer	Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

Lubricant Point						
Lubricant Type		Manufacturer	Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

Lubricant Point						
Lubricant Type		Manufacturer	Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

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SECTION 01 78 36
WARRANTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. General requirements for warranties required in the various Specifications.
   2. Provisions addressing:
      a. Suppliers' standard warranties.
      b. Suppliers' special or extended warranties.
      c. Implied warranties.
      d. Commencement and duration of warranties.

1.2 SUBMITTALS

A. General:
   1. For each item of equipment furnished under the Contract, submit Supplier's standard warranty, regardless of whether such warranty or Submittal thereof is required by the associated Specifications for that item. Submit such warranties for materials where such Submittal is required in the Specifications for the material.
   2. For each item of material or equipment where Supplier's special (or extended) warranty is required by the Contract Documents, submit appropriate special warranty that complies with the Contract Documents.
   3. Supplier's warranties shall be specifically endorsed to Owner, Contractor, and the entity purchasing the item (if other than Contractor) by the entity issuing such warranty.
   4. Submit Suppliers' standard warranties and special warranties as Submittals in accordance with the Schedule of Submittals accepted by Engineer.

1.3 CONTRACTOR'S GENERAL WARRANTY AND CORRECTION PERIOD OBLIGATIONS

A. Contractor's General Warranty and Guarantee: Comply with requirements of the General Conditions, as may be modified by the Supplementary Conditions.

B. Contractor's Warranty of Title: Comply with requirements of the General Conditions, as may be modified by the Supplementary Conditions.

C. Correction Period: Comply with requirements of the General Conditions, as may be modified by the Supplementary Conditions.

1.4 SUPPLIERS' WARRANTIES FOR MATERIALS AND EQUIPMENT

A. Warranty Types:
   1. Required by the General Conditions:
      a. Warranties specified for materials and equipment shall be in addition to, and run concurrent with, Contractor's general warranty and guarantee and requirements for the Contract's correction period.
      b. Disclaimers and limitations in specific materials and equipment warranties do not limit Contractor's general warranty and guarantee, nor does such affect or limit Contractor's performance obligations under the correction period.
   2. Material or equipment manufacturer's standard warranty is pre-printed, written warranty published by item's manufacturer and specifically endorsed by manufacturer to the entities indicated in this Specifications Section's Article 1.2.
   3. Special warranty is written warranty that either extends the duration of material or equipment manufacturer's standard warranty or provides other, increased rights to Owner and other beneficiaries (if any) of such warranty. Where the Contract Documents indicate

specific requirements for warranties that differ from the manufacturer's standard warranty for that item, special warranty is implied.

B. Requirements for Special Warranties:
   1. Submit written special warranty document that contains appropriate provisions and identification, ready for signature by material or equipment manufacturer, Owner, and other beneficiaries indicated in Article 1.2 of this Specifications Section. Submit draft warranty with Submittals required prior to fabrication and shipment of the item from the Supplier's facility.
   2. Manufacturer's Standard Form: Modified to include Project-specific information and properly signed by product manufacturer and other entities as appropriate.
   3. Specified Form: When specified forms for special warranties are included in the Contract Documents, prepare written document, properly signed by item manufacturer, Owner, and other beneficiaries indicated in Article 1.2 of this Specifications Section, using the required form.
   4. Refer to the Specifications for content and requirements for submitting special warranties.

1.5 IMPLIED WARRANTIES

A. Warranty of Title and Intellectual Property Rights:
   1. Except as may be otherwise indicated in the Contract Documents, implied warranty of title required by Laws and Regulations is applicable to the Work and to materials and equipment incorporated therein.
   2. Provisions on intellectual property rights, including patent fees and royalties, are in the General Conditions, as may be modified by the Supplementary Conditions.

B. Warranty of Merchantability:
   1. Notwithstanding any other provision of the Contract to the contrary, implied warranties of merchantability required by Laws and Regulations apply to the materials and equipment incorporated into the Work.

C. Warranty of Fitness-for-Purpose:
   1. Implied warranty of fitness-for-purpose for materials and equipment to be incorporated into the Work, for which specific material or features are indicated in the Contract Documents, is hereby disclaimed by Owner and Contractor.
   2. When Supplier is aware of, or has reason to be aware of, specified materials or features of the Work that are contrary to the intended use, purpose, service, application, or environment in which the material or item will be used, submit request for interpretation in accordance with Section 01 26 00 - Contract Modification Procedures. Where appropriate, such request for interpretation shall indicate the apparent discrepancy and propose appropriate, alternative materials or equipment.

1.6 COMMENCEMENT AND DURATION OF WARRANTIES

A. Commencement of Warranties:
   1. Contract correction period and Contractor's general warranty commence as indicated in the General Conditions, as may be modified by the Supplementary Conditions.
   2. Suppliers' standard warranties and special warranties commence running on the date that the associated item is certified by Engineer as substantially complete in accordance with the Contract Documents. In no event shall special warranties commence running prior to Engineer's review and acceptance of special warranty Submittal for the item.
   3. Implied warranties commence in accordance with Laws and Regulations.

B. Duration of Warranties:
   1. Duration of correction period is set forth in the General Conditions, as may be modified by the Supplementary Conditions.
   2. Duration of Contractor's general warranty and guarantee is in accordance with Laws and Regulations.

3. Duration of Suppliers' standard warranties is in accordance with the applicable standard warranty document accepted for the Project by Engineer.
4. Duration of required Suppliers' special warranties shall be in accordance with the requirements of the Contract Documents for the subject item.
5. Duration of implied warranties shall be in accordance with Laws and Regulations.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

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SECTION 01 78 39
PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Requirements for Project record documents, to supplement record documents requirements of the General Conditions, as may be modified by the Supplementary Conditions.
   2. Contractor's Superintendent's Daily Record of Activities.

B. Scope:
   1. Contractor shall provide all labor, materials, equipment, and services to establish, maintain, continuously update, and submit to Engineer Project record documents and Daily Record in accordance with the Contract Documents.

C. Related Sections include but are not necessarily limited to:
   1. Section 01 29 73 - Schedule of Values.
   2. Section 01 29 76 - Progress Payment Procedures.
   3. Section 01 31 26 - Electronic Communication Protocols.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Obtain necessary field measurements and record all data required for Project record documents before covering up the Work or building on subsequent phases of the Work.
   2. Promptly after obtaining measurements and information, record the data and information on Project record documents.
   3. Where a licensed, registered professional land surveyor is retained on the Project, whether by Contractor or others, to perform field measurements and record other data for as-constructed Project or Site conditions, coordinate with such entity and schedule and perform the Work accordingly. Allow surveyor sufficient time and proper conditions for performing surveyor's work. Assist the surveyor as necessary in performance of surveyor's responsibilities.

B. Monthly Status Evaluation:
   1. Not less than once per month, as a condition precedent to submitting Application for Payment, Contractor's site superintendent will meet with either Engineer or Resident Project Representative (RPR) at the Site to review status of Contractor's Project record documents and Daily Records.
   2. When Engineer or RPR directs corrections to Project record documents, promptly make such corrections on the Project record documents. Engineer's or RPR's directions or lack thereof do not in any way relieve or mitigate Contractor's sole responsibility for the accuracy, completeness, and clarity of Project record documents.
   3. Requirements for review of record documents status as a condition precedent to progress payments is in Section 01 29 73 - Schedule of Values, and Section 01 29 76 - Progress Payment Procedures.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Recorder of Changes and Field Conditions on Project Record Documents:
      a. Contractor's staff at the Site shall include not less than one person with suitable training and drafting (drawing) experience to record on the Project record documents changes made and field conditions encountered.

b. Recorder of changes and field conditions on the Project record documents shall possess not less than two semesters of drafting (drawing) training in a classroom, either in high school, college, or bona-fide vocational school.
c. Upon Engineer's request, submit name of proposed recorder at the Site, resume', or list of relevant experience, and copy of credentials of completion of such drafting (drawing) course(s).
d. If original recorder of changes and field conditions is replaced, promptly advise Engineer and RPR in writing and submit to Engineer qualifications of proposed replacement.

B. Samples of Similar Prior Work:
1. Submit Samples of the personal work of Contractor's designated recorder of changes and field conditions on the Project record documents from not less than two prior projects of similar type(s) of work at the Work. Submit copies of not less than two marked-up drawings from each prior project and copies of two pages of marked-up specifications from each prior project.
2. Samples shall be in the same form as proposed for the Project record documents. For example, where Contractor intends to submit hand-drawn mark-ups of the Drawings and Specifications, Samples shall be copies of hand-drawn markups. Where Contractor intends to submit Project record documents in native (executable) file format (such as CAD files), Samples shall be developed using the same software to be used in preparing the Project record documents.
3. If original recorder of changes and field conditions is replaced by Contractor, replacement recorder shall provide the same standard of work on Project record documents as indicated in the approved Samples.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
1. Samples:
a. Sample of field-recorded project record documents from prior projects, in accordance with this Specifications section's "Quality Assurance" Article, to establish quality and style for markups of Project record documents. Submit within 15 days of the date the Contract Times commence running.

B. Informational Submittals: Submit the following:
1. Qualifications Statements:
a. When requested by Engineer, submit qualifications of proposed recorder of changes and field conditions for Project record documents at Contractor's field office at the Site. Qualifications shall comply with the "Quality Assurance" Article of this Specifications section.
2. Daily Records:
a. Shall include all activities by the Contractor and their subcontractors on the jobsite in a format to be approved by Owner or RPR. This record will include but is not limited to; project information, day, Weather conditions, list of subcontractor or self-performance teams, the number and type of construction personnel for each sub-subcontractor or self-performances team, a description of all activities by each Sub-subcontractor or Self-Team, a list of all equipment using at the job site, list of all material delivery, a list of any problems encountered, any other significant activity that occurs. A copy of each daily report shall be uploaded to the Project Website no later than 9:00 a.m. of the following workday. Failure to deliver daily reports is subject to withholding of the monthly progress payment.

C. Closeout Submittals: Submit the following:
1. Record Documentation:
a. Prior to readiness for final payment, submit to Engineer one copy of Project's final record documents and obtain Engineer's acceptance of same. Submit complete record documents; do not make partial Submittals without Engineer's concurrence.

b. Submit the following Project record documents:
   1) Record Drawings, including those issued via Addenda, Change Orders, Work Change Directives, Field Orders, and allowance authorizations.
   2) Record project manual, including Specifications, indicating changes made via Addenda, Change Orders, Work Change Directives, Field Orders, and allowance authorizations.
c. Submit record documents with transmittal letter on Contractor's letterhead in accordance with requirements in Section 01 33 00 - Submittal Procedures.

2. Certifications:
   a. Record documents Submittal shall include certification, with original signature of official authorized to sign legally binding contracts on behalf of Contractor, reading as follows:
      1) (Contractor's legal/contractual entity name) has maintained, continuously updated, and submitted Project record documentation in accordance with the General Conditions and Supplementary Conditions, Section 01 78 39 - Project Record Documents, and other elements of Contract Documents, for the Site name and Project name. We certify that each record document submitted is complete, accurate, and legible relative to the Work performed under our Contract, and that the record documents comply with the requirements of the Contract Documents.

         By: [_____] (signature)
         Print Name: [_____]
         Title: [_____]

1.5 MAINTENANCE OF RECORD DOCUMENTS

A. Maintain in Contractor's field office, in clean, dry, legible condition, complete sets of the following record documents:
   1. Drawings, Specifications, and Addenda;
   2. Shop Drawings, Samples, and other Submittals, including records of test results, approved or accepted as applicable, by Engineer;
   3. Change Orders, Work Change Directives, Field Orders, allowance authorizations;
   4. copies of all interpretations and clarifications issued;
   5. photographic documentation;
   6. survey data; and
   7. all other documents pertinent to the Work.

B. Provide files and racks for proper storage and easy access to Project record documents. File record documents in accordance with the edition of the Construction Specification Institute's *MasterFormat* used for organizing the project manual, unless otherwise accepted by Engineer or RPR.

C. Promptly make Project record documents available for observation and review upon request of Engineer, RPR, or Owner.

D. Do not use Project record documents for any purpose other than serving as Project record. Do not remove Project record documents from Contractor's field office without Engineer's approval.

1.6 RECORDING INFORMATION ON PROJECT RECORD DOCUMENTS

A. Recording Changes, Field Conditions, and Other Information – General:
   1. At the start of the Project, label each record document to be submitted as, "PROJECT RECORD" using legible, printed letters. Letters on record copy of the Drawings shall be two inches high.
   2. Keep record documents current consistent with the progress of the Work. Make entries on record documents within two working days of receipt of information required to record the change, field condition, or other pertinent information.

3. Do not permanently conceal the Work until required information has been recorded for Project record documents.
4. Accuracy of record documents shall be such that future searches for items shown on the record documents may rely reasonably on information obtained from Engineer-accepted Project record documents.
5. Marking of Entries:
    a. Use erasable, colored pencils (not ink or indelible pencil) for marking changes, revisions, additions, and deletions to Project record documents.
    b. Clearly describe the change by graphic line and make notations as required. Use straight edge to mark straight lines. Writing shall be legible and sufficiently dark to allow scanning of record documents into legible electronic files in "portable document format" (.PDF) files.
    c. Date each entry on record documents.
    d. Indicate changes by drawing a "cloud" around the change(s) indicated.
    e. Mark initial revisions in red. In the event of overlapping changes, use different colors for subsequent changes.

B. Drawings:
1. Record changes on copy of the Drawings. Submittal of Contractor-originated or -produced drawings as a substitute for recording changes on a copy of the Drawings is unacceptable.
2. Record changes on plans, sections, elevations, schematics, schedules, and details as required for clarity, accuracy, and completeness, making reference dimensions and elevations (to Project datum) for complete record documentation.
3. Record actual construction including:
    a. Depths of various elements of foundation relative to Project datum.
    b. Horizontal and vertical location of Underground Facilities referenced to permanent surface improvements and Project elevation datum. For each Underground Facility, including pipe fittings, show and indicate dimensions to not less than two permanent, visible surface improvements.
    c. Location of exposed utilities and appurtenances concealed in construction, referenced to visible and accessible features of structure and, where applicable, to Project elevation datum.
    d. Changes in structural and architectural elements of the Work, including changes in reinforcing.
    e. Field changes of dimensions, arrangements, and details.
    f. Changes made in accordance with Addenda, Change Orders, Work Change Directives, Field Orders, and allowance authorizations.
    g. Changes in details on the Drawings. Submit additional details prepared by Contractor when required to document such changes.
4. Recording Changes for Schematic Layouts:
    a. In some cases on the Drawings, arrangements of conduits, circuits, piping, ducts, and similar items are shown schematically and are not intended to portray physical layout. For such cases, the final physical arrangement shall be determined by Contractor subject to acceptance by Engineer.
    b. Record on the Project record documents all revisions to schematics on the Drawings, including: piping schematics, ducting schematics, process and instrumentation diagrams, control and circuitry diagrams, electrical one-line diagrams, motor control center layouts, and other schematics when included in the Drawings. Show and indicate actual locations of equipment, lighting fixtures, in-place grounding system, and other pertinent data.
    c. When dimensioned plans and dimensioned sections or elevations on the Drawings show the Work schematically, indicate on the Project record documents, by dimensions accurate to within one inch in the field, centerline location of items of Work such as conduit, piping, ducts, and similar items
        1) Clearly identify each item of the Work by accurate notations such as "cast iron drain", "rigid electrical conduit", "copper waterline", and similar descriptions.

2) Show by symbol or by note the vertical location of each item of the Work; for example, "embedded in slab", "under slab", "in ceiling plenum", "exposed", and similar designations. For piping not embedded, also indicate elevation dimension relative to Project elevation datum.
3) Descriptions shall be sufficiently detailed to be related to the Specifications.

d. Engineer may furnish written waiver of requirements relative to schematic layouts shown on plans, sections, and elevations when, in Engineer's judgment, dimensioned layouts of Work shown schematically will serve no useful purpose. Do not rely on such waiver(s) being issued.

5. Supplemental Drawings:
   a. In some cases, drawings produced during construction by Engineer or Contractor supplement the Drawings and shall be included with Project record documents submitted by Contractor. Supplemental record drawings shall include drawings or sketches that are part of Change Orders, Work Change Directives, Field Orders, and allowance authorizations and that cannot be incorporated into the Drawings because of space limitations.
   b. Supplemental drawings submitted with record drawings shall be integrated with the Drawings and include necessary cross-references between drawings. Supplemental record drawings shall be on sheets the same size as the Drawings.
   c. When supplemental drawings developed by Contractor using computer-aided drafting/design (CAD), building information models (BIM), or civil information models (CIM) software are to be included in record drawings, submit electronic files for such drawings in accordance with Section 01 31 26 – Electronic Communication Protocols, as part of record drawing Submittal. Label such files, "Supplemental Record Drawings", including with Contractor's name, Project name, and Contract designation.

C. Specifications and Addenda:
   1. Mark each Specifications section to record:
      a. Manufacturer, trade name, catalog number, and Supplier of each material and equipment item furnished.
      b. Changes made by Addendum, Change Orders, Work Change Directives, Field Orders, and allowance authorizations.

1.7 ELECTRONIC DOCUMENTS FURNISHED BY ENGINEER

A. CAD, BIM, or CIM files of the Drawings will be furnished by Engineer upon the following conditions:
   1. Contractor shall submit to Engineer a letter on Contractor letterhead requesting CAD, BIM, or CIM files of the Drawings and indicating specific definition(s) or description(s) of how such Electronic Documents will be used by Contractor, and specific description of benefits to Owner (including credit proposal, if applicable) if the request is granted.
   2. Engineer does not guarantee that Electronic Documents are available in the format(s) requested by Contractor. Some projects may have Drawings developed using only CAD software instead of BIM or CIM software. Engineer will not create BIM or CIM files for Contractor if such files do not already exist.
   3. Contractor shall sign Engineer's standard agreement with Contractor for for release of Electronic Documents and shall abide by the provisions of such agreement for release of Electronic Documents.
   4. Layering system incorporated in CAD, BIM, and CIM files shall be maintained as transmitted by Engineer. CADD, BIM, and CIM files transmitted by Engineer containing cross-referenced files shall not be bound by Contractor. Drawing cross-references and paths shall be maintained. If Contractor alters layers or cross-reference files, Contractor shall restore all layers and cross-references prior to submitting Project record documents to Engineer.
   5. Contractor shall submit Project record drawings to Engineer in same CAD, BIM, or CIM format that files were furnished to Contractor.

B. Microsoft Word files of Specifications:
   1. Requirements for Engineer's potential release of word processing files of the Specifications or other written documents in native format are the same as those for Drawings.
   2. When Specifications are released in native format, Contractor shall submit record specifications in the same format, with all changes tracked using Microsoft Word's "track changes" feature.
   3. Do not modify the formatting of the native files furnished by Engineer. If formatting changes are made without Engineer's authorization, remedy the formatting to the same condition and status as when the files were first delivered to Contractor. Such remedy shall be at Contractor's expense.
   4. Comply with all requirements of this Specifications section regarding record specifications.
   5. After delivery of record specifications Submittal to Engineer, delete from Contractor's files the native word processing files. Contractor may retain a PDF version of such files for Contractor's records.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

SECTION 01 78 43
SPARE PARTS AND EXTRA MATERIALS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Administrative and procedural requirements for furnishing spare parts, extra materials, maintenance supplies, and special tools required for maintenance (collectively, "spare parts and extra materials") required by the Contract Documents.

B. Scope:
   1. Contractor shall furnish spare parts, extra materials, and associated information, for materials and equipment furnished in accordance with the Contract Documents. Furnish such items in accordance with the requirements of this Specifications section and the Specifications sections in which such items are indicated.
   2. Contractor is fully responsible for loss and damage to spare parts and extra materials until such items are received by Owner.
   3. Promptly replace spare parts and extra materials furnished by Owner to Contractor for use in remedying defective Work.

C. List of Spare Parts and Extra Materials:
   1. With the Shop Drawings and product data Submittals for each Specifications section, submit a complete listing of spare parts and extra materials necessary for maintenance for two years of operation, together with unit prices in current United States funds, and source(s) of supply for each.
   2. Also include listing of spare parts and extra materials, with pricing and sources, in the operations and maintenance data submitted in accordance with Section 01 78 23 - Operation and Maintenance Data.

1.2 SUBMITTALS

A. Maintenance Material Submittals: Furnish and submit the following:
   1. Spare Parts and Extra Materials:
      a. Furnish to Owner in accordance with requirements of this Specifications section, and the Specifications section in which the spare parts and extra materials are specified.
   2. Transfer Documentation: For each delivery of spare parts and extra materials, submit to Engineer the following:
      a. Submit, on Contractor's letterhead, a letter of transmittal for spare parts and extra materials furnished under each Specifications section. Letter of transmittal shall accompany spare parts and extra materials. Do not furnish letter of transmittal separate from associated spare parts and extra materials.
      b. Furnish three original, identical, signed letters of transmittal for each delivery of spare parts and extra materials furnished under each Specifications section. Upon delivery of specified quantities and types of spare parts and extra materials to Owner, designated person from Owner will countersign each original letter of transmittal indicating Owner's receipt of spare parts and extra materials in the quantity, type, and quality required by the Contract Documents. Owner or facility manager will retain one fullysigned original, Contractor shall submit one fully signed original to Engineer. Contractor shall retain one fully signed original for Contractor's records.
      c. Letter of transmittal shall include the following:
         1) Information required for letters of transmittal in Section 01 33 00 - Submittal Procedures.

2) Transmittal shall list spare parts and extra materials furnished under the associated Specifications section. Indicate each individual part, material, equipment item, tool, and product and the associated quantity furnished.
3) Include space for countersignature by Owner as follows: space for signature, space for printed name, space for signatory's title, and date.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Packaging and Labeling of Spare Parts and Extra Materials:
   1. Furnish spare parts and extra materials in manufacturer's unopened cartons, boxes, crates, or other original, protective covering suitable for preventing corrosion and deterioration.
   2. Protect and package spare parts and extra materials for maximum shelf life normally anticipated by manufacturer.
   3. Packaging of spare parts and extra materials shall be clearly marked and identified with name of manufacturer, applicable material or equipment, part number, part description, and part location in the equipment or system.

B. Storage Prior to Delivery to Owner:
   1. Prior to furnishing spare parts and extra materials to Owner, store spare parts and extra materials in accordance with the Contract Documents and manufacturers' written recommendations.

C. Procedure for Delivery to Owner:
   1. Deliver spare parts and extra materials to Owner's permanent storage rooms at the Site or area(s) at the Site designated by Owner.
   2. When spare parts and extra materials are delivered, Contractor and Owner will mutually inventory the spare parts and extra materials delivered to verify compliance with the Contract Documents regarding quantity, part numbers, and quality.
   3. Additional procedures for delivering spare parts and extra materials to Owner, if required, will be developed by Engineer and complied with by Contractor.
   4. Contractor shall reimburse Owner for all costs and expenses incurred by Owner, including professional services, for delivery of inadequate, incorrect, or defective spare parts and extra materials. Owner may withhold such amounts from payments due Contractor via set-offs in accordance with the Contract Documents.

D. Delivery Time and Eligibility for Payment:
   1. Deliver to Owner spare parts and extra materials prior to date of Substantial Completion for materials and equipment associated therewith.
   2. Do not deliver spare parts and extra materials before commencing startup for associated material or equipment.
   3. Spare parts and extra materials are not eligible for payment until delivered to Owner or facility manager and Contractor's receipt of Owner's countersignature on letter of transmittal as required in this Specifications section.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

SECTION 01 79 23
INSTRUCTION OF OPERATION AND MAINTENANCE PERSONNEL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Administrative and procedural requirements for instruction of operation and maintenance personnel.
   2. Qualifications requirements for Suppliers' training personnel.
   3. General requirements for training.
   4. Schedule of required training sessions.

B. Scope:
   1. Contractor shall furnish services of Suppliers' operation and maintenance training specialists to instruct Owner's personnel in recommended operating and maintenance procedures for materials and equipment furnished, in accordance with the Contract Documents.
   2. Each Supplier shall provide a combination of classroom and field training at the Site, unless otherwise required elsewhere in the Contract Documents.
      Owner reserves the right to record training sessions on video for Owner's later use in instructing Owner's personnel.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Scheduling of Training Sessions:
   1. General:
      a. Contractor shall coordinate training services with checkout, startup, and initial operation of materials and equipment on days and times, and in manner, acceptable to Owner, in accordance with the Contract Documents.
      b. Training may be required outside of normal business hours to accommodate schedules of operation and maintenance personnel. Provide training services at the required days and times at no additional cost to Owner.
   2. Prerequisites to Training:
      a. Training of facility operation and maintenance personnel shall commence after preliminary operation and maintenance data has been submitted and accepted by Engineer, and the Work required in Section 01 75 00, Checkout and Startup Procedures, is complete.
      b. At option of Owner or Engineer, training may be allowed to take place before, during, or after checkout and startup of materials and equipment.
   3. Training Schedule Submittal:
      a. Training Schedule Required: Contractor shall prepare and submit proposed training schedule for review and acceptance by Engineer and Owner. Proposed training schedule shall show and indicate all training required in the Contract Documents and shall demonstrate compliance with specified training requirements relative to number of hours of training for various elements of the Work, number of training sessions, and scheduling.
      b. Training Schedule Coordination: When Project has multiple prime contracts, prime Contractors shall comply with this Specifications section. All prime Contractors shall coordinate with the General Contractor in developing a single training schedule Submittal for the entire Project, to be submitted by General Contractor. All prime Contractors shall implement training in accordance with the approved training schedule.
      c. Timing of Training Schedule Submittal: Submit initial training schedule not less than 60 days before scheduled start of first training session. Submit final training schedule,

incorporating revisions in accordance with Engineer's comments, not later than 30 days prior to starting the first training session.

d. Owner reserves the right to modify personnel availability for training in accordance with process or emergency needs at the facility.

B. Training Scheduling Conference:

1. Prior to preparing initial training schedule Submittal, schedule and hold training scheduling conference at the location where progress meetings are held, to review:
   a. Training requirements indicated in the Contract Documents.
   b. Work to be completed prior to commencing training.
   c. Work progress and Progress Schedule relative to startup and training.
   d. Scheduling constraints for Owner's personnel, relative to days and times of training sessions.
   e. Preferred days for training.
   f. Location where training will be performed and facilities available.
   g. Required Submittals relative to training.
   h. Other issues relative to training of operation and maintenance personnel.
2. Attendance is mandatory for the following:
   a. Contractor's project manager.
   b. Contractor's Site superintendent.
   c. Project manager of Subcontractors responsible for furnishing materials and equipment for which training of operation and maintenance personnel is required.
   d. Suppliers invited by Contractor.
   e. Engineer.
   f. Resident Project Representative (RPR).
   g. Owner's Site Representative (OSR).
   h. Facility manager's staff responsible for training coordination, and staff responsible for scheduling operation and maintenance personnel.
3. If additional information must be developed to adequately cover agenda items, reconvene conference as soon as possible.
4. Contractor shall prepare minutes summarizing the discussions of conference, decisions made, and agreements and disagreements, and distribute the minutes to each conference attendee and others as appropriate.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Supplier's Instructors:
   a. Shall be factory-trained by manufacturer of material or equipment.
   b. Supplier's instructors shall be proficient and experienced in performing training of the types required.
   c. Instructors shall be proficient, clear, and easily understandable in spoken and written English language.
   d. Qualifications of instructors are subject to acceptance by Engineer. If Engineer does not accept qualifications of proposed instructor, provide services of replacement instructor with acceptable qualifications.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:

1. Training Schedule: Detailed schedule of training sessions, demonstrating compliance with number of training sessions, hours required in the Contract Documents, and complying with the Contract Times. Submit training schedule Submittals in accordance with time frames specified in this Specifications section.

B. Informational Submittals: Submit the following:

1. Lesson Plan: Acceptable lesson plan for training on each material or equipment item, in accordance with Table 01 79 23-A and the Contract Documents. Lesson plan shall comply

with requirements of this Specifications section as may be supplemented by Specifications sections where materials and equipment are specified. Include with lesson plan copy of handouts that will be used during training sessions. Submit lesson plan Submittals in accordance with time frames specified in this Specifications section.

2. Qualifications:
   a. Credentials of Supplier's proposed operation and maintenance instructor(s). Credentials shall demonstrate compliance with requirements of this Specifications section and shall include brief resume' and specific details of instructor's operating, maintenance, and training experience relative to the specific material and equipment for which instructor will provide training.
3. Minutes of training scheduling conference.

C. Closeout Submittals: Submit the following:
   1. Trainee sign-in sheets for each training session. Submit to Owner's training coordinator with copy to Engineer.

1.5 LESSON PLAN

A. Supplier's lesson plan shall describe specific instruction topics, system components for which training will be provided, and training procedures. Handouts, if any, to be used in training shall be included with the lesson plan. Describe in lesson plan "hands-on" demonstrations planned for training sessions.

B. Submit acceptable lesson plan not less than 21 days prior to starting associated training.

C. Indicate in lesson plan estimated duration of each training segment.

D. Lesson plan shall include the following:
   1. Material and Equipment Overview (required for all types of operation and maintenance training):
      a. Describe material and equipment's operating (process) function and performance objectives.
      b. Describe material and equipment's fundamental operating principles and dynamics.
      c. Identify equipment's mechanical, electrical, and electronic components and features. Group related components into subsystems and describe function of subsystem and subsystem's interaction with other subsystems.
      d. Identify all support materials and equipment associated with operation of subject equipment, such as air intake filters, valve actuators, motors, and other appurtenant items and equipment.
      e. Identify and describe safety precautions and potential hazards related to operation.
      f. Identify and describe in detail safety and control interlocks.
   2. Operations Personnel Training:
      a. Material and Equipment Overview: As described in Paragraph 1.5.D.1 of this Specifications section.
      b. Operation:
         1) Describe operating principles and practices.
         2) Describe routine operating, startup, and shutdown procedures.
         3) Describe abnormal or emergency startup, operating, and shutdown procedures that may apply.
         4) Describe alarm conditions and responses to alarms.
         5) Describe routine monitoring and recordkeeping procedures.
         6) Describe recommended housekeeping procedures.
      c. Troubleshooting:
         1) Describe how to determine if corrective maintenance or an operating parameter adjustment is required.
   3. Mechanical Maintenance Training:
      a. Material and Equipment Overview: As described in Paragraph 1.5.D.1 of this Specifications section.

b. Material and Equipment Preventive Maintenance:
    1) Describe preventative maintenance inspection procedures required to:
        a) Inspect materials and equipment in operation.
        b) Identify potential trouble symptoms and anticipate breakdowns.
        c) Forecast maintenance requirements (predictive maintenance).
    2) Define recommended preventative maintenance intervals for each component.
    3) Describe lubricant and replacement part recommendations and limitations.
    4) Describe appropriate cleaning practices and recommend intervals.
    5) Identify and describe use of special tools required for maintenance of materials and equipment.
    6) Describe component removal, installation, and disassembly and assembly procedures.
    7) Perform "hands-on" demonstrations of preventive maintenance procedures.
    8) Describe recommended measuring instruments and procedures, and provide instruction on interpreting alignment measurements, as appropriate.
    9) Define recommended torquing, mounting, calibrating, and aligning procedures, tolerances, and settings, as appropriate.
    10) Describe recommended procedures to check and test equipment following corrective maintenance.
c. Troubleshooting:
    1) Define recommended systematic troubleshooting procedures.
    2) Provide component-specific troubleshooting checklists.
    3) Describe applicable materials and equipment testing and diagnostic procedures to facilitate troubleshooting.
    4) Describe common corrective maintenance procedures with "hands-on" demonstrations.

4. Instrumentation/Controls and Electrical Maintenance Training:
    a. Materials and Equipment Overview: As described in Paragraph 1.5.D.1 of this Specifications section.
    b. Preventative Maintenance and Troubleshooting of Instrumentation and Control Systems: Engineer may grant waiver(s) to allow all training for a given system to be at the location of Owner's training facility.
    c. Preventative Maintenance and Troubleshooting of Other Electrical Systems: In accordance with requirements for Paragraph 1.5.D.3 of this Specifications section.

1.6 TRAINING AIDS

A. Supplier's instructor(s) shall incorporate training aids as appropriate to assist in the instruction. Provide handouts of text, tables, graphs, and illustrations as required. Other appropriate training aids include:
    1. Audio-visual aids, such as videos, Microsoft PowerPoint presentations, overhead transparencies, posters, drawings, diagrams, catalog sheets, or other items.
    2. Equipment cutaways and samples, such as spare parts and damaged equipment.
    3. Tools, such as repair tools, customized tools, and measuring and calibrating instruments.

B. Handouts:
    1. Supplier's instructor(s) shall distribute and use descriptive handouts during training. Customized handouts developed especially for training for the Project are encouraged.
    2. Photocopied handouts shall be good quality and completely legible.
    3. Handouts shall be coordinated with the instruction, with frequent references made to the handouts.
    4. Provide not less than 15paper copies of each handout for each training session.

C. Audio-Visual Equipment: Training provider shall provide audio-visual equipment required for training sessions. If suitable equipment is available at the Site, Owner may make available facility's existing audio-visual equipment; however, do not count on facility's existing audio-

visual equipment, if any, being available. Audio-visual equipment that training provider shall provide, as required, includes:

1. Laptop computer, presentation software, and suitable projector.
2. Power cords, power strips/surge protectors.
3. As required, extension cords, HDMI cables and other video cabling, and spare bulb for projector.
4. Laser pointer/slideshow remote controller with extra batteries.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 TRAINING DELIVERY

A. Training Delivery – General:

1. Instructors shall be fully prepared for the training sessions. Training delivery shall be communicative, clear, and proceed according to lesson plan accepted by Engineer, with lesson content appropriate for trainees. If Owner or Engineer deems that training delivery does not comply with the Contract Documents, training shall be postponed, rescheduled, and re-performed in acceptable manner at no additional cost to Owner.
2. Trainee Sign-in Sheets: In format acceptable to Owner, furnish sign-in sheet for trainees for each session. Sign-in sheets shall include the Project name; materials, equipment, or system for which training was provided; and type of training (e.g., operations, mechanical maintenance, instrumentation/controls and electrical maintenance, or other), and full name and operator license number (when applicable) of each trainee. Upon completion of training, submit copy of each sign-in sheet as indicated in Article 1.4 of this Specifications section.

B. "Hands-on" Demonstrations:

1. Supplier's instructor(s) shall present "hands-on" demonstrations of operation and maintenance of materials and equipment for each training session, in accordance with lesson plan accepted by Engineer.
2. Contractor and manufacturer shall furnish tools necessary for demonstrations.

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SECTION 01 81 10
WIND AND SEISMIC DESIGN CRITERIA

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. The following types of design criteria for the Project, including Work designed by (a) Engineer and (b) delegated design professional(s) retained by Contractor, Subcontractor, or Supplier and submitted for Engineer's approval under the Contract:
      a. Wind loading.
      b. Seismic.

B. Scope:
   1. Certain Work, expressly indicated, shall be designed, fabricated, and installed in accordance with the wind and seismic requirements of this Section and Laws and Regulations (including applicable building codes).
   2. This Section applies to all the Work. Where wind and seismic design criteria indicated in this Section conflict with wind and seismic design criteria set forth elsewhere in the Contract Documents, the more-stringent loading and requirements shall govern, unless clarified in writing by Engineer. Obtain Engineer's written interpretation or clarification of conflicts prior to performing the subject design and other associated Work.
   3. Contractor shall provide all labor, materials, equipment, tools, professional services, and incidentals to provide wind and seismic design for the Work.
   4. Such Work includes, but is not necessarily limited to, the following:
      a. Anchorage of mechanical and electrical equipment and systems.
      b. Anchorage of supports for piping, electrical conduits and cable trays, and similar Work.
      c. Work requiring delegated professional design for the final, completed Project.

C. Related Requirements: Include but are not necessarily limited to:
   1. Section 01 35 73 - Delegated Design Procedures.
   2. Section 40 05 07 – Pipe Support Systems.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate all wind and seismic design required of Contractor for the Work.

1.3 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society of Civil Engineers / Structural Engineering Institute (ASCE/SEI):
      a. 7-16, Minimum Design Loads and Associated Criteria for Buildings and Other Structures.
   2. When referenced standards conflict, the most-stringent governs, unless specifically indicated otherwise in the Contract Documents or unless approved otherwise in writing by the Engineer.

1.4 SUBMITTALS

A. Action Submittals: Submit the following as part of the Submittals required in Divisions 02-49 Specifications that require wind and seismic delegated designs:
   1. Delegated Design Professional's "Instruments of Service" Submittals:
      a. Delegated design professional's "certification of compliance" required by Section 01 35 73 - Delegated Design Procedures, regarding structural calculations:
         1) Indicate compliance with performance and design criteria indicated in the Contract Documents.

2) Indicate compliance with specific reference standards indicated in the building code and the associated Contract Documents.
3) Indicate other information required for "certification of compliance" in accordance with Section 01 35 73 - Delegated Design Procedures.

B. Informational Submittals: Submit the following as part of the Submittals required in Divisions 02-49 Specifications that require wind and seismic delegated designs:
1. Delegated Design Professional's Calculations:
a. Such calculations shall include delegated design professional's seal, signature, and date and are to indicate the following, which will not be reviewed by Engineer except for the limited purposes indicated in Section 01 35 73 - Delegated Design Procedures:
1) Indicate basis of design and lateral analysis as necessary and required to derive each loading and to indicate system stability, including compatibility of deflections and compatibility with allowable soil parameters, as applicable.
2) Indicate design load to each connection to structure (where connection will attach to or interface with, or supported by, elements designed by Engineer).
3) Indicate and provide complete lateral load resisting system that transfers all wind and seismic loads through load path to ground.
2. Shop Drawings and Product Data Approved by Delegated Design Professional: The following are required but will be reviewed by Engineer only for the limited purposes indicated in Section 01 35 73 - Delegated Design Procedures:
a. Shop Drawings showing and indicating proposed wind and seismic controls Work designed by delegated design professional.
b. Product data showing and indicating proposed wind and seismic controls Work designed by delegated design professional.

PART 2 - PRODUCTS

2.1 GENERAL DESIGN CRITERIA FOR WIND AND SEISMIC

A. This Article 2.1 applies to wind and seismic design criteria.

B. Design by delegated design professional retained by Contractor, Subcontractor, or Supplier shall comply with:
1. Performance and design criteria indicated in the applicable Contract Documents, including this Section.
2. Laws and Regulations, including applicable building code.
3. Applicable reference standards indicated in the Contract Documents.

C. Risk Category: III.
1. Design in accordance with building code load combinations for, at Contractor's option, either service level or factored level.
2. Mechanical and electrical equipment and systems loads are dead loads, except where mechanical elements, such as piping and tanks, are filled with material such as liquid or slurry (in which case the dead load of the pipe's or vessel's contents shall also be included).

2.2 WIND DESIGN CRITERIA

A. Wind Design Load Criteria:
1. Basic Design Wind Speed: V = 111 miles per hour.
2. Allowable Stress Design wind speed: V_{ASD} = 86 miles per hour
3. Exposure Category: C.
4. Building description for wind design is Enclosed.

B. Wind forces must be resisted by direct load transfer through fasteners to wind-resisting elements. Do not use connections that employ friction to transfer wind forces.

2.3 SEISMIC DESIGN CRITERIA

A. Seismic Design Load Criteria:

1. Design spectral acceleration at short period: S_{DS} = 0.095g.
2. Design spectral acceleration at 1-second period: S_{D1} = 0.056g.
3. Importance Factor: Ie = 1.25.
4. Seismic Design Category: A.
5. Component or system amplification factor, (a_P) and component response modification factor (R_P): In accordance with ASCE 7-16, Tables 13.5-1 and 13.6-1.
6. Component Importance Factor:
   a. All Components: I_P = 1.00.

B. Seismic forces must be resisted by direct load transfer through fasteners to seismic-resisting elements. Do not use connections that employ friction to transfer seismic forces.

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

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SECTION 01 81 33
CYBER SECURITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. General requirements for cyber security measures applicable to all the Work.
   2. Requirements to furnish to Owner copy of code and configuration files, passwords, physical keys for monitoring and control systems, and configuration files in accordance with the Contract Times and other requirements of the Contract Documents.
   3. General requirements for microprocessor-based equipment.

B. Scope:
   1. This Section indicates cyber security requirements applicable to all equipment, controls, devices, and other items furnished to Owner and Owner-furnished items modified as part of the Work, containing microprocessor-based systems and that will be (as part of the Work) or can be (in the future, not as part of the Project) connected to Owner's network or the Internet. Such items include but are not limited to the following: programmable logic controllers (PLC), programmable automation controllers (PAC), remote terminal units (RTU), distributed control units (DCU), direct digital controls (DDC), operator interface terminals (OIT), and human-machine interfaces (HMI).
   2. This Section applies regardless of whether the subject items were furnished or modified by Contractor, Subcontractor, or Supplier of any tier.

C. Related Requirements: Include, but are not necessarily limited to:
   1. Section 01 31 26 - Electronic Communication Protocols.

1.2 REFERENCES

A. Terminology:
   1. Terminology indicated below are not defined terms and are not indicated with initial capital letters, but when used in this section have the meaning indicated below:
      a. "Code and configuration files" mean any and all code or equipment configuration backup files, whether created by or for Contractor, Supplier, or Subcontractor, needed for Owner or facility manager to restore equipment and systems to final condition of equipment and systems prevailing at the time of Substantial Completion. Code and configuration files do not include original equipment manufacturer (OEM) software's underlying proprietary code such as firmware or operating system code. For example, for variable frequency drives (VFD), the configuration file of parameters of each individual VFD furnished or modified under the Project is required However, the OEM's source code that runs the VFD firmware need not be furnished to Owner or facility manager.

1.3 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings: Submit the following before furnishing to Engineer Shop Drawings and product data Submittals for such devices under other Divisions of the Specifications.
      a. Preliminary asset inventory of networked components furnished as part of the Work or modified as part of the Work:
         1) Notwithstanding the requirements of Section 01 31 26 – Electronic Communication Protocols, submit in native (executable) Microsoft Excel spreadsheet format.
         2) Coordinate with the Owner or Engineer to determine the preferred method of delivery to assure security of information contained in asset inventory.

3) Submittals shall include the following for each device:
   a) Device identification designation.
   b) Manufacturer.
   c) Model number.
   d) Device use description.

b. Network Diagrams:
   1) Notwithstanding the requirements of Section 01 31 26 – Electronic Communication Protocols, submit in native (executable) file format, and the format required by Section 01 31 26 – Electronic Communication Protocols.
   2) Coordinate with Owner, facility manager (if other than Owner), or Engineer to determine the preferred method of delivery to assure security of information contained in network diagrams.
   3) Logical Network Diagram(s): Show information flow through network(s), and include:
      a) Major network devices, subnets, and virtual local area networks (VLAN).
      b) Include all wireless communication devices.
      c) Indicate the following information for each networked device:
         (1) Device identification designation.
         (2) Device description.
         (3) Manufacturer and model number.
         (4) MAC address.
         (5) IP address.
         (6) Ports and Protocols
   4) Physical Network Diagram(s): Show all physical network components, ports, protocols, connections, and cables. Show or indicate all wireless communication devices.
   5) Draft software and configuration files for all programmable or configurable devices

B. Close-out Submittals: Submit the following:
   1. Password Turnover: Furnish Submittal and obtain Owner's acceptance of the following not later than requesting inspection for Substantial Completion:
      a. Coordinate with Owner to securely transmit directly to Owner list of usernames and passwords applied to replace factory and Supplier's defaults.
   2. Final Network-Capable Device Asset Inventory: Furnish, as unlocked, editable Microsoft Excel file listing all network-capable devices furnished or modified under this Section. List shall include: Obtain Engineer's acceptance of required Submittal not later than requesting inspection for Substantial Completion.
      a. Device identification designation.
      b. Device location (in network and physical location).
      c. Manufacturer name.
      d. Product name and model designation.
      e. Manufacturer's serial number on device.
      f. MAC address (when device is IP-addressable).
      g. IP address (when device is IP-addressable).
      h. Edition or revision number of installed firmware or operating system.
   3. Backup of application software prepared specifically for the Project: Furnish directly to Owner via secure transmission method acceptable to Owner Electronic Document copy of each software application and equipment configuration file necessary for Owner to restore system functionality after a system disaster or other such event. Obtain Engineer's acceptance of the following Submittals promptly after factory acceptance testing and prior to delivery of factory-tested items to the Site:
      a. Software source code prepared specifically for the Project for each PLCs HMI, OIT, and other such devices.
      b. Configuration files, encryption information, and other sensitive information for the Work.

c. Code and systems shall not be hidden or protected by encryption, passwords, or other means without furnishing such passwords or access to Owner's or facility manager's (if other than Owner), designated personnel.

4. Record Documentation: Obtain Engineer's acceptance of the following Submittals promptly after factory acceptance testing and prior to delivery of factory-tested items to the Site. Include copies of record documentation Submittals accepted by Engineer in final operation and maintenance manuals required.
   a. As-Manufactured Network Diagrams
5. The Work will not be eligible for inspection for Substantial Completion until all Closeout Submittals required under this Section, are acceptable to Owner or Engineer, as applicable. If code and configuration files are modified for any reason following Substantial Completion, furnish revised code and configuration files prior to requesting inspection for final completion.

1.4 COPIES OF PROGRAM CODE AND CONFIGURATION FILES

A. Copies of Program Code and Configuration Files – General:
   1. Submit as Electronic Documents only. Paper Submittals are not required for program code and configuration files.
   2. Files shall be securely transferred with limited distribution as requested by Owner to protect sensitive information. Provide proof of file transfer for Submittal record purposes.
   3. In accordance with the Contract Documents, following Substantial Completion, Owner and facility manager, if any, shall have right to: (a) modify program code and configuration files, (b) update software and firmware, (c) revise system security settings, such as passwords, IP addresses, and other security settings, and (d) implement related modifications, without restriction or interference from Contractor, Subcontractor, Supplier, and others.
   4. Owner and facility manager, if any, agree to use program code and configuration files only with Owner's facilities, as may be transferred to Owner's successors and assigns.
   5. Owner and facility manager, if any, will not be subject to any Supplier-requested non-disclosure agreement that is not part of the Contract Documents.
   6. Engineer will not distribute program code and configuration files obtained under the Project, except in exchanging such files with Owner, facility manager, or their successors and assigns. Engineer will not be party to any Supplier-requested non-disclosure agreement.

B. Configuration Files:
   1. Submit copies of system configuration files prepared for the Project, such as setpoints for programmable controllers, facility SCADA display configurations, and similar configuration files.
   2. Submit as separate files configuration files for each separate control and monitoring device for which configuration files are furnished. Clearly distinguish the device(s) associated with each file.
   3. Contractor (including Subcontractors and Suppliers) is not responsible for configurations and control setpoints subsequently changed by Owner, facility manager, or others for whom either is responsible, when such changes were not in accordance with Supplier's written recommendations and operation and maintenance instructions.

C. Program Code:
   1. Submit copies of program code for programmable logic controllers (PLC), human-machine interfaces (HMI), operator interface terminals (OIT), and other programmable controllers, subject to the following:
      a. Submit only program code prepared specifically for the Project, including facility-specific program code. Program code normally furnished by equipment manufacturers for operation of their own equipment and systems is exempt from this provision and need not be submitted.
      b. Third-party, licensed, commercially available software (such as, but not limited to, Microsoft operating system software sold at retail, commercial SCADA system

software platforms, and PLC programming software) is excluded from requirements of this Article. Furnish copies of commercially available, licensed, third-party software, where required, in accordance with the Contract Documents.

2. Submit annotated copies of complete PLC software programs:
   a. In native-format file including all applicable formats (e.g., ladder logic, function block diagram, sequential function chart, instruction list, structured text) in which the code is normally furnished.
   b. In PDF-format file with fully annotated PLC code that can be read without the native configuration and programming environment.
3. Format Requirements:
   a. For ladder diagram logic, include complete cross-referencing of all logic elements. Annotate elements with clearly understandable tags or descriptive labels.
   b. For function block diagram, label each function block with understandable tags or descriptive labels. Indicate purpose and action of each function block.
   c. For sequential function chart, indicate extensive comments for each step to describe program step function.
   d. For instruction list and structured text, indicate extensive comments for each program line to describe program line function.
4. Submit complete PLC, PAC, DCU, DDC, RTU, and similar items, listing of all input/output address assignments, tag assignments, and pre-set constant values, with functional point descriptions.
5. Submit complete manufacturer's program code manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND SYSTEMS

A. Controls:
   1. Equipment furnished shall be current and not be obsolete or subject to a manufacturer's end-of-life notice of less than two years after Substantial Completion.
   2. Submit Suppliers' end-of-life notices, if any, for equipment as part of Shop Drawing or product data Submittal for the subject item.
   3. Demands for non-disclosure agreements (NDAs) or other measures that would restrict or prevent Owner and facility manager (if other than Owner) from obtaining or using information, licenses, operational and performance data, and software are unacceptable.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Installing the Work constitutes Contractor's approval of conditions existing at the time the Work is performed, including, where applicable, existing code and configuration files that affect the Work associated with cyber-security procedures.

3.2 INSTALLATION

A. Installation Requirements:
   1. Limit distribution of information on Owner's and facility manager's (if other than Owner) system to the fewest number of essential personnel necessary. Do not make such information available, in any way, on systems or media that may be accessible by others.

3.3 REMOTE ACCESS TO INSTALLED EQUIPMENT AND SYSTEMS

A. Requesting Remote Access - General:
   1. Unless expressly indicated otherwise in the Contract Documents, remote access devices for interaction with programmable devices are unacceptable during construction or operation.
   2. Where remote access is requested, furnish appropriate written request, to Owner, through Engineer, requesting access, indicating desired methods of access, reason for remote access

(i.e., programming, view only data, emergency support, or other, specifically indicated reason).

3. Coordinate with Owner and facility manager, through Engineer, to identify acceptable access method, if any, consistent with Owner's and facility manager's, cyber-security risk tolerance.

3.4 CONTRACTOR'S ONSITE ACCESS TO FACILITY NETWORKS

A. Contractor's Onsite Access to Facility Networks – General:
   1. Devices, whether laptop computers, tablets, or others, owned or operated by Contractor, Subcontractor, or Supplier, used for programming and startup of programmable devices that are part of the Work,] will not be allowed to connect to Owner's programmable device network.
   2. When Contractor Devices are Allowed to Connect Onsite:
      a. All devices shall have current antimalware definitions prior to being brought to the Site.
      b. Devices used for programming and startup of programmable devices that are part of the Work shall not utilize cellular communications for any purpose while connected to the facility's equipment, system, or network.
      c.

3.5 CLOSEOUT ACTIVITIES

A. Upon Substantial Completion:
   1. Update firmware of programmable devices to Supplier's current version.
   2. Owner and facility manager (if other than Owner) shall receive full access and use of equipment and system monitoring and control capabilities, including: Software installed on PLCs, OITs, networking and communications equipment, gateways, and HMI code (including fully documented contractor programming source code).
   3. In addition, upon Owner's issuance of payment to Contractor and Contractor's acceptance thereof for the equipment and systems, including code and configuration files:
      a. Ownership transfers to Owner upon Owner's payment (and Contractor's acceptance thereof) of 100 percent of the value assigned the associated item in the Schedule of Values accepted by Engineer, minus retainage Owner is entitled to withhold under the Contract and minus other set-offs (expressly applicable to the subject equipment) under the Contract.
      b. Internal function blocks and code prepared specifically for the Project shall become Owner's property for exclusive use by Owner and facility manager (if other than Owner) at the Site. Such rights shall transfer to Owner's successors and assigns, if any, and if such equipment is relocated by Owner to a different site or facility, whether or not at the same address as the Site.
      c. Owner has the right to modify, either via Owner's or facility manager's employees or by a third-party systems integrator retained by either Owner or facility manager, code and configuration files developed specifically for the Project, as well as hardware furnished as part of the Work.
      d. Originator or developer of code and configuration files shall fully release claims to ownership of the intellectual property, trade secrets, or sensitive information for the furnished equipment and systems, as may be claimed by such entity.
   4. Owner and facility manager (if other than Owner) shall have the right to modify, enhance or make changes to equipment as deemed necessary or desired by Owner, including hardware, software, networking settings, passwords or other information or settings that Owner or facility manager changes for maintenance, upgrade, or cybersecurity reasons. Owners or facility managers exercising such rights: (a) shall be in accordance with equipment manufacturer's written operation and maintenance data and shall not serve to void applicable warranties in effect; and (b) do not apply to modifications made by Owner or facility manager to Supplier's standard software code not prepared specifically for the Project.

B. Usernames and Passwords:

1. Change Supplier's default usernames and passwords in coordination with requirements of Owner's or facility manager's (as applicable) personnel.
2. Remove each username and password established or used by Contractor, Subcontractor, or Supplier prior to Substantial Completion of equipment or system.

C. Programmable Operator Interface Terminals (OIT) and Other Graphical Interface Terminals:
1. For equipment that supports multiple levels of security, configure the following security levels:
   a. View.
   b. Operate.
   c. Supervisor.
   d. Administrator.
2. For equipment that supports only view/operate levels of security, provide password protection and furnish directly to Owner or facility manager (as applicable) passwords necessary to operate functions.
3. Coordinate directly with Owner and facility manager passwords and furnish password turn-over Submittal required in this Section's "Submittals" Article.

END OF SECTION

SECTION 02 41 00
DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. General provisions applicable to all demolition and removals.
   2. Civil/site demolition and removals.
   3. Architectural and structural demolition and removals.
   4. Mechanical demolition and removals
   5. Electrical demolition and removals.
   6. Disposal of demolition debris, materials, and equipment.

B. Scope:
   1. Contractor shall provide all labor, materials, equipment, tools, and incidentals as shown, specified and required for demolition, removals, and disposal Work.
   2. The Work under this Specifications section includes, but is not necessarily limited to:
      a. Demolition and removal of existing materials and equipment as shown or indicated in the Contract Documents. The Work includes demolition of structural concrete, foundations, walls, doors, windows, structural steel, metals, roofs, masonry, attachments, appurtenances, piping, electrical and mechanical systems and equipment, pavement, curbs, sidewalks, gutters, fencing, and similar existing materials, equipment, and items.
      b. Demolition and removal of all above-grade piping and facilities and Underground Facilities underneath, building(s) and structures shown or indicated for demolition, unless the Underground Facilities or above-grade facilities are shown or indicated as to remain (for example, where the Drawings indicate extents of demolition to terminate at a stated depth).
      c. Remove from slabs, foundations, walls, and footings that are to be demolished all utilities and appurtenances embedded in such construction.
   3. Demolitions and removals indicated in other Specifications sections shall comply with requirements of this Specifications section.
   4. Perform demolition Work within areas shown or indicated.
   5. Pay all costs associated with transporting and, as applicable, disposing of materials and equipment resulting from demolition and removals Work.
   6. Where specifically indicated on the Drawings or in the specifications, deliver demolished materials to be retained by Owner to the indicated locations.

C. Related Requirements:
   1. Section 31 10 00 - Site Clearing.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. National Fire Protection Association (NFPA):
      a. 241, Safeguarding Construction, Alteration, and Demolition Operations.

B. Regulatory Requirements:
   1. Demolition, removals, and disposal Work shall be in accordance with 29 CFR 1926.850 through 29 CFR 1926.860 (Subpart T – Demolition), and all other Laws and Regulations.
   2. Comply with requirements of authorities having jurisdiction.

C. Qualifications:

1. Electrical Removals: Entity and personnel performing electrical removals shall be electrician(s) legally qualified to perform electrical construction and electrical work in the jurisdiction where the Site is located.
2. Plumbing Removals: Entity and personnel performing plumbing removals shall be plumber(s) legally qualified to perform plumbing construction and plumbing work in the jurisdiction where the Site is located.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Comply with Section 01 14 16 - Coordination with Owner's Operations.
   2. Review procedures under this and other Specifications sections and coordinate the Work that will be performed with or before demolition and removals.

1.4 SUBMITTALS

A. Informational Submittals: Submit the following:
   1. Procedure Submittals:
      a. Demolition and Removal Plan: Not less than ten days prior to starting demolition Work, submit acceptable plan for demolition and removal Work, including:
         1) Plan for coordinating shut-offs, capping, temporary services, and continuing utility services.
         2) Other proposed procedures as applicable.
         3) Equipment proposed for use in demolition operations.
         4) Recycling/disposal facility(ies) proposed, including facility owner, facility name, location, and processes. Include copy of appropriate permits and licenses, and compliance status.
         5) Planned demolition operating sequences.
         6) Detailed schedule of demolition Work in accordance with the Schedule accepted by Engineer.
         7) List of materials to be retained for Owner with handling, processing, and delivery location details, as applicable.
   2. Notification of Intended Demolition Start: Submit in accordance with Paragraph 3.1.A of this Specifications Section.
   3. Field Quality Control Test Results:
      a. Results of megger-testing of existing motors to remain Owner's property.
   4. Qualifications Statements:
      a. Name and qualifications of entity performing electrical removals, including copy of licenses required by authorities having jurisdiction.
      b. Name and qualifications of entity performing plumbing removals,

1.5 SITE CONDITIONS

A. Owner makes no representation of condition or structural integrity of area(s) to be demolished or where removals are required by the Contract Documents.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 PREPARATION

A. Notification:
   1. Not less than 48 hours prior to commencing demolition or removal, advise Engineer in writing of planned start of demolition Work. Do not start removals without permission of Engineer.
   2. Where demolition or removals has potential to affect adjacent properties, occupants, streets, or other public thoroughfare, transportation facilities, and utilities, furnish required notices

to owners and occupants of properties, buildings, and structures that may be affected by the demolition of removal.

3. In accordance with Laws and Regulations, furnish to authorities having jurisdiction, including emergency services as necessary, appropriate notices of planned demolition and removals.
4. Submit to Engineer copies of notices furnished to adjacent property owners, occupants, and authorities having jurisdiction.

B. Protection of Adjacent Areas and Facilities:
   1. Perform demolition and removal Work in manner that prevents damage and injury to property, structures, occupants, the public, and facilities. Do not interfere with use of, and free and safe access to and from, structures and properties unless allowed by the Contract Documents otherwise allowed in writing by Owner.
   2. Closing or obstructing of roads, drives, sidewalks, and passageways adjacent to the Work is not allowed unless specifically required to perform the work or indicated otherwise in the Contract Documents. Conduct the Work with minimum interference to vehicular and pedestrian traffic. Any roadway closures are subject to Owner approval and require 30 day minimum notice.
   3. Provide temporary partitions between demolition work areas and (a) areas that will be occupied during demolition and removals, and (b) areas accessible to the public or visitors. Temporary partitions shall be sturdy, braced plywood in good condition, of dimensions sufficient to adequately screen demolition work from view of occupants, public, and visitors. Maintain temporary partitions in place until demolition and removals work in the subject area is complete or until other Work requires removal of temporary partitions.
   4. Provide appropriate temporary barriers, lighting, sidewalk sheds, and other necessary protection.
   5. Repair damage to facilities that are to remain which such damages results from Contractor's operations.

C. Existing Utilities: In addition to requirements of the General Conditions, Supplementary Conditions, and Division 01 Specifications, perform the following:
   1. Should unforeseen, unknown, or incorrectly shown or indicated Underground Facilities be encountered, Contractor responsibilities shall be in accordance with the General Conditions as may be modified by the Supplementary Conditions. Cooperate with utility owners in keeping adjacent services and facilities in operation.
   2. Sanitary Sewerage: Before proceeding with demolition, locate and cap all sewer lines and service laterals discharging from the building or structure being demolished.
   3. Storm Water Sewerage: Existing storm water system shall remain in place until demolition of existing building or structure is complete. Upon completing demolition, cut and cap storm sewerage at locations shown on the Drawings. Remove existing storm water piping and related structures between points of cutting, and backfill, restore to grade, and stabilize the area over the removed facilities in accordance with the Contract Documents.
   4. Water Piping and Related Facilities: Before proceeding with demolition, locate and cap all potable and non-potable waterlines and service laterals serving the building or structure being demolished. Ensure compliance with Laws and Regulations regarding water quality.
   5. Other Utilities: Before proceeding with demolition, locate and cap as required all other utilities, such as fuel and gas; compressed air; heating, ventilating, and air conditioning; electric; and communications; and service laterals serving the building or structure being demolished.
   6. Shutdown of utility services shall be coordinated by Contractor, assisted by Owner as required relative to contacting utility owners.

D. Remediation:
   1. If unanticipated Hazardous Environmental Condition is believed to be encountered during demolition and removals, comply with requirements of the General Conditions, as may be modified by the Supplementary Conditions.

3.2 DEMOLITION - GENERAL

A. Locate construction equipment used for demolition Work and remove demolished materials and equipment to avoid imposing excessive loading on supporting and adjacent walls, floors, framing, facilities, and Underground Facilities.

B. Pollution Controls:
   1. Use water sprinkling, temporary enclosures, and other suitable methods to limit emissions of dust and dirt to lowest practical level. Comply with Section 01 57 05 - Temporary Controls, and Laws and Regulations.
   2. Do not use water when water may create hazardous or objectionable conditions such as icing, flooding, or pollution.
   3. Clean adjacent structures, facilities, properties, and improvements of dust, dirt, and debris caused by demolition Work, in accordance with the General Conditions and Section 01 74 00 - Cleaning.

C. Explosives:
   1. Explosives are not allowed at the Site. Do not use explosives for demolition and removal Work.

D. Comply with Section 01 73 29 - Cutting and Patching and NFPA 241.

E. Building or Structure Demolition and Removals:
   1. Unless otherwise approved by Engineer, proceed with demolition from top of structure to the ground. Complete demolition Work above each floor or tier before disturbing supporting members of lower levels.
   2. Demolish concrete and masonry in small sections.
   3. Remove structural framing members and lower to ground using hoists, cranes, or other suitable methods. Do not throw or drop to the ground.
   4. Break up and remove foundations, mats, and slabs-on-grade unless otherwise shown or indicated as remaining in place.
   5. Temporary Bracing and Supports:
      a. Provide temporary bracing and supports sufficient to maintain safety, stability, and resist all loads to which the structure may be subject during demolition and removals, until entirety is permanently removed or permanently stabilized.
      b. Temporary bracing and supports shall be sufficient for associated dead load, live load, transient loading, and dynamic loads such as wind, seismic, and other loads to which the temporary bracing or support may be subject.
      c. Where appropriate, retain a professional structural engineer, duly licensed and registered in the same jurisdiction as the Site, to design temporary bracing and supports.

F. Finishing of Surfaces Exposed by Removals: Unless otherwise shown or indicated in the Contract Documents, surfaces of walls, floors, ceilings, and other areas exposed by removals, and that will remain as finished surfaces, shall be repaired and re-finished with materials that match existing adjacent surface, or as otherwise approved by Engineer.

3.3 STRUCTURAL REMOVALS

A. Remove structures to lines and grades shown or indicated, unless otherwise directed by Engineer. Where limits are not shown or indicated, limits shall be four inches outside item to be installed. Removals beyond limits shown or indicated shall be at Contractor's risk and expense and such excess removals shall be reconstructed to satisfaction of Engineer without additional cost to Owner.

B. Recycling and Reuse of Demolition Materials:
   1. All concrete, brick, tile, masonry, roofing materials, reinforcing steel, structural metals, miscellaneous metals, plaster, wire mesh, and other items contained in or upon building or structure to be demolished shall be removed, transported, and disposed of away from the Site, unless specifically required otherwise in the Drawings or Specifications or unless otherwise approved by Engineer.

2. Do not use demolished materials as fill or backfill adjacent to structures, in pipeline trenches, or as subbase under structures or pavement.

C. After removing concrete and masonry walls or portions thereof, mats, slabs, and similar construction that ties in to the Work or to existing construction, neatly repair the junction point to leave exposed only finished edges and finished surfaces.

D. Where parts of existing structures are to remain in service following demolition, remove the portions shown or indicated for removal, repair damage, and leave the building or structure in proper condition for the intended use.
   1. Remove concrete and masonry to the lines shown or indicated by sawing, drilling, chipping, and other suitable methods. Leave the resulting surfaces true and even, with sharp, straight corners that will result in neat joints with new construction and be satisfactory for the purpose intended.
   2. Do not damage reinforcing bars beyond the area of concrete and masonry removal. Do not saw-cut beyond the area to be removed.
   3. Reinforcing bars that are exposed at surfaces of removed concrete and masonry that will not be covered with new concrete or masonry shall be removed to 2 inches below the final surface. Repair the resulting hole, with repair mortar for concrete and grout for masonry, to be flush with the surface.
   4. Where existing reinforcing bars are shown or indicated to extend into new construction, remove existing concrete so that reinforcing bars are clean and undamaged.

E. Removal of Anchorages and Protruding Metals:
   1. Where equipment or material anchored to concrete or masonry are removed and anchors are not to be re-used, and where existing metals (and to be removed) protrude from concrete, remove the anchors and other metal to not less than 2 inches beneath surface of concrete or masonry member. Repair the resulting hole, using repair mortar for concrete and grout for masonry, to be flush with the surface.
   2. Alternately, when the anchor is stainless steel, the anchor may be cut flush with the surface of the concrete or masonry, when so approved by Engineer.

F. Jambs, sills and heads of windows, passageways, doors, or other openings (as applicable) cut-in to the Work or to existing construction shall be dressed with masonry, concrete, or metal to provide smooth, finished appearance.

G. Where anchoring materials, including bolts, nuts, hangers, welds, and reinforcing steel, are required to attach the Work to existing construction, provide such materials under this Specifications section, unless specified elsewhere in the Contract Documents.

3.4 MECHANICAL REMOVALS

A. Mechanical demolition and removal Work includes dismantling and removing existing:
   1. Piping systems and ductwork systems.
   2. Mechanical equipment and appurtenances.
   3. Mechanical elements of instrumentation and control systems, such as sensors and transmitters and similar items.
   4. Mechanical removals include cutting and capping as required, except that cutting of existing piping and ductwork to make connections is included under Section 01 73 29 - Cutting and Patching; Specifications sections in which requirements for coordination with Owner's operations are indicated; and applicable Specifications of Division 21 - Fire Suppression, Division 22 - Plumbing, Division 23 - Heating, Ventilating, and Air Conditioning, Division 40 - Process Interconnections, and others as applicable.
   5. Mechanical removals as required herein apply to systems exposed to view, hidden from view, and Underground Facilities. Mechanical removals may require work in spaces that may be classified confined spaces.

B. Life-Safety Systems:

1. Retain existing life-safety systems, including but not limited to fire suppression systems, in place for as long as possible prior to performing associated demolition and removals.
2. Where demolishing buildings or structures equipped with life-safety systems, remove or deactivate life-safety systems only in the area where active demolition operations are in progress.

C. Demolition and Removals of Piping, Ductwork, and Similar Items:
   1. Scope:
      a. Safety purge piping and tanks (as applicable) of chemicals, fuel, solids, liquids, and gases (as applicable) and make safe for removal and capping. Discharge contents of existing piping appropriately while avoiding damaging property; restricting access to or use of property; and cresting unsafe, unsanitary, nuisances, and noisome conditions.
      b. To the extent shown or indicated, remove existing piping conveying water (potable and non-potable), waste and vent, fuel (liquids and gases), heating fluids (such as water-glycol solutions), chemicals, solids and slurries, sludge, wastewater, other fluids, and processes gases, and other piping.
      c. Remove piping to the nearest structurally sound (or "solid") piping support, and provide caps on ends of remaining piping.
      d. Where piping to be demolished passes through existing walls to remain, cut off and cap pipe on each side of the wall.
   2. Caps, Closures, Blind Flanges, and Plugs – General (All Piping and Ducts):
      a. Provide closure pieces, such as blind flanges and caps, where shown or required to complete the Work.
      b. Where used in this Specifications section, the term "cap" means the appropriate type closure for the piping or ductwork being closed, including caps, blind flanges, and other closures.
      c. Caps shall be compatible with the piping or ductwork on which the cap is installed, fluid-tight and gastight, and appropriate for the fluid or gas conveyed in the pipe or duct.
      d. Unless otherwise shown or indicated, caps shall be mechanically fastened, fused, or welded to pipe or duct. Plug piping with means other than specified in this Specifications section only when expressly so shown or indicated in the Contractor Documents or when allowed by Engineer.
      e. Concrete is an acceptable method of plugging abandoned buried piping. Concrete plugs shall be to a minimum depth of two (2) pipe diameters.
   3. Underground Facilities:
      a. When Underground Facilities are altered or removed, properly cut and cap piping left in place, unless otherwise shown or indicated.
   4. Waste and Vent Piping; Ductwork:
      a. Remove waste and vent piping, and ductwork to extent shown and cap as required.
      b. Where demolished vent piping, stacks, and ductwork passes through existing roofing, patch the roof with the same or similar materials as existing, and fully compatible with ensign materials. Completed patch shall be watertight and comply with roofing manufacturer's recommendations.
   5. Potable Water Piping; Plumbing; Fire Suppression Piping and Systems; Heating Piping:
      a. Modifications to potable water piping, fire suppression systems, other plumbing piping, and heating system piping shall comply with Laws and Regulations.
      b. All portions of potable water systems that have been modified or opened shall be hydrostatically tested and disinfected in accordance with the Contract Documents, and Laws and Regulations. Hydrostatically test other, normally-pressurized, plumbing and fire suppression piping and heating piping systems.

D. Equipment Demolition and Removals:
   1. To the extent shown or indicated and as required for the Work, remove existing mechanical equipment, including (but not limited to):

a. Facility equipment, such as food service equipment, laundry equipment, dumbwaiters, and similar facility items.
b. Conveying equipment such as elevators, escalators, and similar general-use conveying systems.
c. Fire suppression and plumbing equipment.
d. Heating, ventilating, and air conditioning equipment.
e. Standby power generators.
f. Security systems equipment.
g. Transportation-related equipment.
h. Flow control gates and valves.
i. Hoisting equipment.
j. Bulk materials conveying equipment.
k. Process heating and cooling equipment.
l. Blowers, compressors, air filters, air dryers, and similar equipment.
m. Pumps.
n. Tanks.
o. Process equipment, including purification equipment, pollution control and solid waste equipment, and treatment process equipment.
p. Turbines.
q. Appurtenances (including motors, drive systems, controls, cooling water and seal water systems) as shown, indicated, and required for completion of the Work.

2. Where required, disassemble equipment to avoid imposing excessive loading on supporting walls, floors, framing, facilities, and Underground Facilities. Disassemble equipment as required for access through and egress from building or structure. Disassembly and removal shall comply with Laws and Regulations. Provide required means to remove equipment from building or structure.
3. Remove control panels, operator stations, and instruments associated with equipment being removed, unless shown or indicated otherwise.
4. Tanks and Equipment Containing Process Material:
   a. Purge contents in accordance with Paragraph 3.5.A of this Specifications Section and other requirements of the Contract Documents, as applicable.
   b. When removing generators, remove associated fuel storage tanks unless otherwise indicated to remain.
   c. Where contents of tank or equipment item may pose a potential hazard, such as hydrocarbon fuels or chemicals, properly dispose of contents in accordance with Laws and Regulations and the Contract Documents.
   d. Where tank or equipment contains wastewater or liquid sludge, and the Site is a wastewater treatment facility, transport and dispose of stored contents onsite at location acceptable to Owner and facility manager (if other than Owner) unless otherwise indicated in the Contract Documents. If Site is other than a wastewater treatment facility, dispose of contents appropriately in accordance with Laws and Regulations.
   e. Where tank or equipment contains solid or slurry-type material, remove, handle, and transport the contents and appropriately dispose of the materials offsite in accordance with Laws and Regulations, unless otherwise indicated in the Contract Documents.
5. Remove equipment supports as applicable, anchorages, base, grout, and piping. Remove anchorage systems in accordance with the "Structural Removals" Article in this Specifications section.
6. Remove small-diameter piping back to header unless otherwise indicated.
7. Remove access platforms, ladders, and stairs related to equipment being removed, unless otherwise shown or indicated.
8. Instrumentation and Control Systems Removal:
   a. Remove instrumentation and controls equipment in accordance with this Specifications section's requirements for mechanical removals and electrical removals.
9. Reuse and Sale of Removed Equipment:
   a. Entities indicated below may be interested in acquiring removed equipment:

1) D.H. Griffin Companies Used Equipment Sales division, Greensboro, North Carolina.
2) EcReCon, Inc., Penn's Grove, New Jersey.
3) Federal Equipment Company, Cleveland, Ohio.
4) Phoenix Equipment Corporation, Red Bank, New Jersey.

b. Comply with this Specifications section's "Disposal of Demolition Debris" Article for restrictions on sales of removed items.

3.5 ELECTRICAL REMOVALS

A. Electrical demolition Work includes removing existing:
1. Disconnecting cabling from motors, electrical sources, control panels, control stations, instrumentation and control items, and similar devices and equipment.
2. Conduits, raceways, cable trays, hangers and supports, cabling, and related items.
3. Switches, panelboards, control stations, and similar items.
4. Transformers, distribution switchboards, control panels, motors, starters, variable speed controllers, and similar items.
5. Lighting fixtures and related items.
6. Utility poles, site lighting standards, and overhead cabling.
7. Appurtenances and miscellaneous electrical equipment, as shown, specified, or required.

B. Electrical Removals – General:
1. Comply with Laws and Regulations, including the National Electric Code.
2. Lock Out and Tagging:
a. Contractor shall lock out and tag circuit breakers and switches operated by Owner and shall verify that affected cabling are de-energized to ground potential before commencing electrical removals Work.
b. Upon completion of electrical removals Work, remove the locks and tags and promptly advise Owner's representative and Owner that existing facilities are available for use.
3. Remove existing electrical equipment, fixtures, and systems to avoid damaging systems to remain, to keep existing systems in operation, and to maintain integrity of grounding systems.
4. Disconnect and remove motors, control panels, and other electrical gear where shown or indicated.
5. Store removed motors, microprocessors and electronics, and other electrical gear to be reused in accordance with its manufacturer's recommendations and requirements of the Contract Documents.

C. Motor Control Centers and Switchgear:
1. Remove or modify motor control centers and switchgear as shown or indicated.
2. Modified openings shall be cut square and dressed smooth to dimensions required for installation of equipment.

D. Removal of Cabling, Conduits, Raceways and Similar Items:
1. Verify the function of each cable before disconnecting and removing.
2. Remove cabling, conduits, hangers and supports, and similar items back to the power source or control panel, unless otherwise shown or indicated.
3. Remove cabling, conduits, and similar items where shown or indicated for removal. Abandoned conduits concealed in floor, ceiling slabs, or in walls shall be cut flush with the slab or wall (as applicable) at point of entrance, suitably capped, and the area repaired in a flush, smooth manner acceptable to Engineer.
4. Disassemble and remove exposed conduits, junction boxes, other electrical appurtenances, and their supports.
5. Repair all areas of the Work to prevent rusting on exposed surfaces.
6. Underground Electric:
a. Conduits in Underground Facilities not scheduled for reuse shall be suitably capped watertight where each enters building or structure to remain.

b. Where shown or indicated, remove direct-burial cabling. Openings in buildings for entrance of direct-burial cabling shall be patched with repair mortar or other material approved by Engineer for such purpose, and made watertight.

E. Electrical Service Entrances and Outdoor, Overhead Electrical Utilities:
1. Existing poles and overhead cabling shall be removed or abandoned as shown and specified.
2. Completely remove from the Site poles not owned by electric utility, including site lighting standards and appurtenances, shown or indicated for removal.
3. Existing substation(s) and poles owned by electric utility will be removed by the electric utility.
4. Make necessary arrangements with electric utility owner for removal of utility owner's transformers and metering equipment after new electrical system has been installed and energized.

F. Lighting fixtures, wall switches, receptacles, starters, and other miscellaneous electrical equipment, not designated as remaining as Owner's property, shall be removed and properly disposed off-Site as required in accordance with Laws and Regulations.

3.6 DEMOLITION OF SITE IMPROVEMENTS

A. Pavement, Sidewalks, Curbs, and Gutters:
1. Demolition of asphalt or concrete pavement, sidewalks, curbs, and gutters, as applicable, shall terminate at cut edges. Edges shall be linear and have a vertical cut face.
2. To cut pavement, sidewalks, curbs, and gutters, use machinery or tools that provides a smooth-cut edge, appropriate for the required. Where cut edges are not smooth, repair the cut edge to remain to provide a smooth, even appearance.

B. Fencing, Guardrails, and Bollards:
1. Remove to the limits shown or indicated on the Drawings.
2. Completely remove below-grade posts and concrete.

C. Manholes, Vaults, Chambers, and Handholes:
1. Remove to the limits shown or indicated on the Drawings.
2. If not shown or indicated on the Drawings, remove to not less than five feet below finished grade indicated on the Drawings.

D. Underground Facilities Other than Manholes, Vaults, Chambers, and Handholes:
1. Remove to the extent shown or indicated on the Drawings.
2. Unless otherwise shown or indicated, cap ends of piping to remain in place in accordance with the "Mechanical Removals" Article in this Specifications section.

E. Landscaping: Comply with Section 31 10 00 - Site Clearing.

F. Other Site Improvements: When the Contract Documents require removal of other site improvements not addressed above, copy with Contract requirements for removal of buildings or structures.

3.7 DISPOSAL OF DEMOLITION DEBRIS

A. Disposal – General:
1. Promptly remove from the Site all debris, waste, rubbish, material, and equipment resulting from demolition and removal operations. Promptly upon completion of demolition and removal operations, remove from the Site construction equipment used in demolition Work.
a. Demolished materials specifically indicated on the Drawings or in the Specifications to be retained for the Owner shall be delivered a location at the Site chosen by the Owner during Construction.
2. Do not sell at the Site demolition materials or removed equipment. If materials, equipment or debris will be sold by Contractor, remove the items from the Site and perform the sale or transaction elsewhere, in accordance with Laws and Regulations.
3. Cleaning and Removal of Debris: Comply with the General Conditions, Supplementary Conditions, and Section 01 74 00 - Cleaning.

B. Transportation and Disposal:
   1. Non-Hazardous Materials, Equipment, and Debris: Properly transport and dispose of non-hazardous demolition materials, equipment, and debris at appropriate landfill or other suitable location, in accordance with Laws and Regulations. Non-hazardous material does not contain Constituents of Concern such as (but not limited to) asbestos, PCBs, petroleum, hazardous waste, radioactive material, or other material designated as hazardous in Laws or Regulations.
   2. Hazardous Materials, Equipment, and Debris: When handling and disposal of items containing Constituents of Concern is included in the Work, properly transport and dispose of such items in accordance with the Contract Documents and Laws and Regulations.

C. Submit to Engineer information required in this Specification Section on proposed facility(ies) where demolition materials, equipment, and debris will be recycled. Upon request, Engineer or Owner, shall be allowed to visit recycling facility(ies) to verify adequacy and compliance status. During such visits, recycling facility operator shall cooperate and assist Engineer and Owner.

END OF SECTION

SECTION 03 01 30
REPAIR AND REHABILITATION OF EXISTING CONSTRUCTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Preparation and assessment of existing concrete for repair and rehabilitation:
      a. Concrete removal for repairs.
      b. Preparation of exposed reinforcing steel.
   2. Repair of damaged (and deteriorated) concrete.
      a. Application of repair mortar.
      b. Repair of exposed items embedded in concrete.

B. Scope:
   1. Contractor shall provide all materials, equipment, labor, tools, services, and incidentals necessary to repair and rehabilitate existing concrete, whether damaged or deteriorated, at locations shown on the Drawings or at locations indicated by Engineer, in accordance with the Contract Documents.
   2. Surface repairs of new concrete Work are addressed in Section 03 35 00 - Concrete Finishing and Repair of Surface Defects.
   3. Repair of cracks in concrete existing prior to the Contract is addressed in Section 03 64 23 - Crack Repair and Injection.

C. Related Requirements: Include but are not necessarily limited to:
   1. Section 03 15 19 - Anchorage to Concrete.
   2. Section 03 21 00 - Reinforcement.
   3. Section 03 35 00 - Concrete Finishing and Repair of Surface Defects.
   4. Section 03 64 23 - Crack Repair and Injection.

1.2 PRICE AND PAYMENT PROCEDURES

A. Unit Prices:
   1. The Work of this Section is United Price Work unless otherwise shown or indicated. Work covered by this Section but not eligible for payment under Unit Price Work bid/pay items shall be performed at Contractor's expense.
   2. Bid/pay item classifications of Unit Price Work addressed in this Section are indicated in the Bid Form, the Agreement (or an exhibit thereto), and Section 01 22 00 - Measurement and Payment.
   3. Unit Price Work of this Section is classified as follows:
      a. Concrete Surface Repair - Type I (Thin): Repair of spalled, delaminated, or deteriorated concrete up to 1.5 inches deep below concrete's original surface.
      b. Concrete Surface Repair - Type II (Moderate): Repair of spalled, delaminated, or deteriorated concrete greater than 1.5 inches deep to 3 inches below original concrete surface.
      c. Concrete Surface Repair - Type III (Severe): Repair of spalled, delaminated, or deteriorated concrete greater than 3 inches below original concrete surface.

B. Measurement:
   1. Criteria for measurement for payment of this Section's Unit Price Work are in the General Conditions (as may be modified by the Supplementary Conditions), Section 01 22 00 - Measurement and Payment, and this Section.
   2. Quantities of this Section's Unit Price Work:
      a. Unit Price Work of this Section shall be measured for payment prior to commencement of the associated Work in each work area.
      b. Work not measured in advance for payment will not be eligible for payment by Owner.

c. Engineer will observe the associated concrete repair and rehabilitation Work performed. Such Work shall be in accordance with the Contract Documents for to such Work to be eligible for payment by Owner, even when such Work was measured (for payment) in advance.

3. Repair of new concrete Work provided by Contractor is not eligible for payment under the Unit Price Work bid/pay items covered by this Section. Such repairs are included in the Work of the associated bid/pay item under which the subject new concrete Work was provided.

1.3 REFERENCES

A. Terminology:

1. This provision indicates terminology used in this Section and in other Contract Documents that coordinate with this Section. Such terminology may or may not be indicated using initial capital letters and, when used in relation to the Work of this Section, have the meanings indicated below.
2. "Existing concrete damage" means damage to existing concrete surfaces deeper than 1/8 inches, such as:
   a. Concrete corrosion.
   b. Corroded items embedded within concrete or through the concrete surface.
   c. Spalls.
   d. Cracking at depth and arrangement that, in Engineer's sole opinion, cannot be repaired in accordance with Section 03 64 23 - Crack Repair and Injection.
3. "Installer" means the entity installing or applying repair materials at the Site. The terms "installer" and "applicator" have the same meaning. Installer or applicator may be Contractor or Subcontractor.
4. "MPII" means, "manufacturer's printed installation instructions".
5. "Rehabilitation" means repairing and restoring concrete to structurally-sound, durable condition suitable for the structure's intended purpose as determined by Engineer, including repair of existing concrete damage in accordance with this Section and other applicable provisions of the Contract Documents.
6. "Water-bearing structure" means concrete structure with a surface that is normally, or may be, in contact with water or process fluids or slurries during typical operation of the completed Project, including, but not limited to: tanks, channels, wet wells, distribution chambers, dams, and the like. Also, where specifically indicated on the Drawings, "water-bearing structures" includes basements and structures extending below the ordinary, wet-season groundwater surface.
7. Other terminology used in this Section is consistent with terminology of ACI CT.

B. Reference Standards:

1. American Concrete Institute (ACI):
   a. CT, Concrete Terminology.
   b. 117, Specification for Tolerances for Concrete Construction and Materials.
   c. 308, Standard Practice for Curing Concrete.
2. ASTM International (ASTM):
   a. C109, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens).
   b. C150, Standard Specification for Portland Cement.
   c. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
   d. C881, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
   e. C882, Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear.
   f. C1315, Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.

g. C1583, Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method).
h. D4258, Standard Practice for Surface Cleaning Concrete for Coating.
i. D4259, Standard Practice for Abrading Concrete.

3. International Concrete Repair Institute (ICRI).
   a. 310.1R, Guide for Surface Preparation.
   b. 310.1R, Guide for Surface Preparation for the Repair of Deteriorated Concrete Resulting from Steel Corrosion.
4. Society for Protective Coatings/NACE International (SSPC/NACE):
   a. SP 13/NACE No. 6, Surface Preparation of Concrete.

1.4 QUALITY ASSURANCE

A. Qualifications:
   1. Installer:
      a. Installer of materials for rehabilitation of existing concrete shall possess not less than five years of relevant experience performing concrete rehabilitation of similar type, scope, and complexity to that required for this Project.
      b. Certification or Approval by Materials Manufacturer:
         1) Installer (as either business entity or individual) of materials associated with rehabilitation of existing concrete shall be certified or expressly approved in writing, by manufacturer of materials to be provided.
         2) As an option, installer may be certified or approved, in writing, at the Site during initial Work of this Section, in accordance with this Section's Paragraph 3.4.D.
      c. Submit documentation of qualifications and experience in sufficient detail to demonstrate to Engineer's satisfaction compliance with requirements of this Section's qualifications requirements.
   2. Structural Concrete Repairer:
      a. This provision is in addition to qualifications requirements applicable to installers of the Work under this Section. This provision applies to business entities physically performing rehabilitation of structural concrete.
      a. Entity performing structural concrete repair Work shall have not less than two years active membership in good standing in International Concrete Repair Institute (ICRI).
      b. Structural concrete repairer shall have not less than five years' current, relevant experience in repairing and rehabilitating concrete structures in facilities of generally similar environmental exposures as the Work of this Section for this Project
      c. Submit documentation of qualifications and experience in sufficient detail to demonstrate to Engineer's satisfaction compliance with requirements of this Section's qualifications requirements.

B. Mock-Ups:
   1. Mock-ups are Samples that, when approved by Engineer, indicate minimum standard of quality for the associated Work. Standard of quality of mock-ups shall be not less than that required by the Contract Documents.
   2. If so approved by Engineer, mock-ups may become part of completed Work.
   3. Maintain, segregate, identify, and protect mock-ups during performance of the Work to allow Engineer to readily compare the Work with approved mock-up.
   4. When mock-up is not part of the completed Work, remove mock-ups when directed by Engineer. If mock-up is part of the completed Work, remove protection and indication of mock-up when so directed by Engineer.
   5. Provide mock-up for each type of concrete rehabilitation required by this Section for which the Contract has an associated bid/pay item, including finish.
   6. Size of each mock-up shall be acceptable to Engineer. Concrete surface repair mock-ups shall be not less than 2 feet by 2 feet each.
   7. Where mock-ups will be part of the completed Work, Contractor and Engineer will jointly select the location of each mock-up.

8. Concrete surface repair mock-ups shall include:
   a. Sample of patched tie or bughole.
   b. Sample of mortar repair.
9. Also provide concrete surface repair mock-up of wall having polymer-modified cementitious coating.
   a. Mock-up shall be stepped to show surface preparation, repairs and coating in all stages of application.
10. Mock-up areas shall be readily identifiable during construction. Provide appropriate temporary signage indicating status as mock-up and protect the mock-up.

1.5 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Schedule (table) indicating, for each type of concrete rehabilitation Work required by this Section, the material type and product manufacturer proposed for each application.
   2. Product Data:
      b. Manufacturer's published, technical data for each manufactured material proposed for use in the Work of this Section.
      c. Manufacturer's written certification that proposed materials comply with associated reference standards cited in this Section.
   3. Samples:
      a. Advise Engineer in writing when required mock-ups will be provided and the location proposed for each.
   4. Test Procedures:
      e. Procedure for pre-repair condition survey required in this Section's Article 3.1, including method for recording results of survey.
      f. Written method of performing pull-off testing of repair material and testing equipment information and accessory materials proposed for use in testing.

B. Informational Submittals: Submit the following:
   1. Certifications:
      a. Laboratory test reports (for previously-tested materials identical to those to be furnished) and material manufacturer's certificates verifying that ingredients comply with the Contract Documents and have a minimum of six months' residual shelf life at the time of shipment to the Site.
      b. Certification from Supplier stating that material is suitable for the intended use on this Project.
      c. Certification that materials proposed for use are compatible with each other, when such materials will contact each other, and will not interfere with bonding of future floor or wall finishes.
   2. Test and Evaluation Reports:
      a. Results of pre-rehabilitation condition survey required in this Section's Article 3.1.
   3. Manufacturer's Instructions:
      a. Manufacturer's instructions for all concrete rehabilitation materials, for handling, storing, and installing materials.
   4. Qualifications Statements:
      a. Installer: Documentation of qualifications in accordance with this Section's "Quality Assurance" Article.
      b. Manufacturer's written approval of installer or certification of training performed at the Site in accordance with Paragraph 3.4.D of this Section.
         1) Affidavit, signed by either materials manufacturer or by installer's business entity, indicating that manufacturer of rehabilitation materials has instructed installer in proper handling and installation of each rehabilitation material to be used in the Work.
      c. Entity performing structural concrete repair Work.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with material manufacturer's written instructions and recommendations regarding delivery, handling, and storage or materials to be incorporated into the Work.

B. Storage:
   1. Store materials in tightly-sealed, original containers, off the ground and in dry location with humidity controls.
   2. Do not store in direct sunlight.
   3. Protect materials from temperature extremes and avoid freezing temperatures.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Anti-Corrosion Bonding Agent:
      a. Sika Corporation.
      b. Euclid Chemical Company.
      c. Or equal.
   2. Epoxy Bonding Adhesive:
      a. Sika Corporation.
      b. Euclid Chemical Company.
      c. Or equal.
   3. Repair Mortar:
      a. Euclid Chemical Company.
      b. Five Star Products, Inc.
      c. Sika Corporation.
      d. Or equal.

2.2 MATERIALS

A. Bonding Agents:
   1. Bonding agents and adhesives shall have pot life that allows proper placement of new material against existing material in accordance with manufacturer's written instructions.
   2. For repair of existing concrete damage, when no reinforcing steel is exposed, and where specifically shown or indicated on the Drawings, use epoxy bonding adhesive.
   3. For repair of existing concrete damage, when reinforcing steel is exposed, and where specifically shown or indicated on the Drawings, use anti-corrosion bonding agent.
   4. For repair of new concrete: Comply with Section 03 35 00 - Concrete Finishing and Repair of Surface Defects.

B. Water:
   1. Potable.
   2. Clean and free from deleterious substances.
   3. Free of oils, acids and organic matter.

C. Reinforcing Steel: In accordance with 03 21 00 - Reinforcement.

D. Anti-Corrosion Bonding Agent:
   1. Three-component, moisture tolerant, cementitious bonding agent manufactured for purpose of bonding fresh concrete to hardened concrete and providing anti-corrosion coating to embedded reinforcing materials.
      a. Sika Armatec 110 EpoCem by Sika Corporation.
      b. Duralprep A.C. by Euclid Chemical Company.
      c. Or equal.

E. Epoxy Bonding Adhesive:
   1. For use where bonding new concrete or patch material to existing concrete.

2. Two-component, moisture insensitive adhesive manufactured for purpose of bonding fresh concrete to hardened concrete.
   a. Sikadur 32 Hi-Mod LPL by Sika Corporation.
   b. Euco No. 452 MV by Euclid Chemical Company.
   c. Or equal.

F. Repair Mortar:
1. Pre-packaged cement-based, modified (polymer or latex) product specifically formulated for repair of concrete surface defects, with the following properties:

Physical Property	Value	ASTM Standard
Compressive strength (minimum)		C109
at one day	2000 psi	
at 28 days	6000 psi	
Bond strength (minimum)		C882 (*)
at 28 days	1800 psi	

(*) Modified for use with repair mortars.

2. Trowelable, selection based on horizontal, vertical, or overhead application.
3. Where the least dimension of the placement, in width or thickness, exceeds 1.5 inches, repair mortar shall be extended by addition of aggregate per MPII.
4. Acceptable Products:
   a. Five Star Structural Concrete by Five Star Products, Inc.
   b. SikaRepair SHA, SikaTop 123 Plus, SikaTop 111 Plus by Sika Corporation.
   c. Verticoat by Euclid Chemical Company.
   d. Or equal.

G. Epoxy Coating:
1. See Specification Section 09 96 00.

PART 3 - EXECUTION

3.1 PREPARATION AND ASSESSMENT

A. As indicated in Article 1.1 of this Section, repair of surface defects in new concrete provided under the Contract and repair of cracks in concrete are addressed in other Specification Sections.

B. Condition Survey:
1. Contractor, Owner's Site Representative and Engineer shall jointly perform condition survey of each existing concrete structure included in the scope of the concrete repair Work before scheduling and performing the associated repair Work.
2. Contracting and payment for specialty inspections and tests by third-parties will be by Owner.
3. Prior to Condition Survey:
   a. Submit to Engineer, and obtain Engineer's acceptance, of procedure for performing condition survey. Indicate proposed date(s) of the condition survey and other procedures for inspecting and documenting extent of concrete repair Work to be performed.
   b. Prior to the condition survey, power-wash all concrete surfaces within the scope of the concrete repair Work. Power-wash at not less than 4,000 psi using orbital nozzle.
4. Condition survey shall include, but is not necessarily limited to:
   a. Visual inspection for:
      1) Cracks.
      2) Leakage and efflorescence.

3) Scaling.
4) Spalling
5) Exposed reinforcing.
6) Previous repairs.

5. Results of Condition Survey:
   a. Submit written results of condition survey to Engineer promptly following the condition survey at the Site.
   b. Condition survey results shall clearly indicate the location, nature, size, length, width, and depth of all deficiencies in existing concrete in the area(s) surveyed.
   c. Engineer will use results of condition survey to determine extent of repair Work required.
6. Engineer's Direction to Contractor:
   a. After consulting with Owner as necessary, Engineer will transmit to Contractor written direction on extent of concrete repairs required.
   b. Engineer will issue such direction promptly after Engineer's receipt of acceptable results of condition survey. Allow in the Progress Schedule 21 days for issuance of Engineer's written direction.
   c. Where such Work would either exceed Contract quantities of associated Unit Price Work or requires Work not in the Contract's bid/pay items, an appropriate Contract modification will be issued.

C. Concrete Removal:
1. Remove all loose and unsound concrete from areas to be repaired, in accordance with ICRI Guideline 310.1R, as modified by the Contract Documents.
2. Removals:
   a. At areas of damage or deterioration of existing concrete, saw-cut the perimeter of unsound concrete surface areas, to depth of not less than 1/2 inches.
   b. Saw-cuts to be perpendicular to or slightly undercutting existing concrete surface. Concrete removal boundaries shall be straight and aligned parallel to opposite boundary edges resulting in repair areas that are approximately rectangular.
   c. Remove all existing concrete from within the saw-cut repair boundary to of not less than 1/2 inches.
   d. Featheredges are unacceptable.
3. Clean surfaces of repair areas in accordance with ASTM D4258 to remove dust, dirt, grease, and other contaminants prior to abrasive blasting, chipping, grinding or wire brushing.
4. Abrasive-blast surfaces in accordance with ASTM D4259 and SSPC SP 13/NACE No. 6 to completely open defects down to sound concrete and remove laitance.
5. Chip concrete substrate to obtain a surface profile of 1/16 inches to 1/8 inches deep with new fractured aggregate surface. The area to be repaired shall not be less than 1/2 inches in depth.
6. Concrete removal shall extend along any exposed existing reinforcing to locations along the bar that are free of bond inhibiting corrosion and where the bar is well-bonded to surrounding concrete.
7. Rinse surface with clean water and allow surface water to evaporate prior to repairing the surface.

D. Preparing Exposed Steel Reinforcing:
1. Clean and prepare exposed embedded steel reinforcing in accordance with ICRI Guideline 310.1R and the Contract Documents.
2. Where one-half or more of the steel reinforcing diameter is exposed, either by existing conditions or concrete removal, bond between concrete and steel reinforcing is inhibited or lost completely, or corrosion is present, remove concrete to provide not less than 1 inch clearance around the entire perimeter and along the entire exposed length of the steel reinforcing.
3. If existing, exposed steel reinforcing is cut through, cracked, or cross-sectional area is reduced by more than 10%, provide new steel reinforcing bar the same size as existing steel

reinforcing. Lap the new bar with existing in accordance with ACI requirements. Coat all new and existing steel reinforcing with anti-corrosion bonding agent, as specified in this Section. Abrasive-blast exposed reinforcing to remove contaminants and corrosion to provide white-metal, bright steel finish.

3.2 INSTALLATION AND APPLICATION

A. Environmental Conditions for Installation:
   1. Comply with material manufacturer's written instructions for substrate temperature and moisture content, ambient temperature, and ambient humidity, ventilation, and other conditions affecting performance of concrete repair materials.
   2. Do not repair existing concrete damage when ambient temperature is or is expected to be below 50 degrees F. If necessary to maintain the progress Schedule, enclose and heat area to between 50 and 70 degrees F during repair of surface defects and curing of patching material. Use only indirect fired heating using clean-burning fuel.
   3. If proper environmental conditions do not comply with the Contract Documents and manufacturer's instructions, do not perform the Work until such conditions are acceptable. Provide means to bring conditions into compliance by providing temporary environmental controls, enclosures, and other temporary construction and temporary facilities.
   4. Contractor is not eligible for changes in Contract Times or Contract Price for delays or costs incurred to bring environmental conditions for installation into compliance.

B. Existing Concrete Damage Repair:
   1. Type I Repair:
      a. Provide epoxy bonding adhesive and repair mortar.
   2. Type II Repair:
      a. Provide epoxy bonding adhesive, if no reinforcing steel is exposed. Use anti-corrosion bonding agent, if reinforcing steel is exposed.
      b. Prepare exposed reinforcing steel in accordance with Paragraph 3.1.D of this Section.
      c. Provide repair mortar:
         1) Provide 3/8 inches aggregate in accordance with MPII.
   3. Type III Repair:
      a. Provide anti-corrosion bonding agent.
      b. Prepare exposed steel reinforcement per the requirements of Paragraph 3.1.D of this Section.
      c. Provide new adhesive anchor dowels as shown on the Drawings.
      d. Provide repair mortar:
         1) Provide 3/8 inches aggregate in accordance with MPII.

C. Repair Mortar Application:
   1. Comply with MPII for mixing and placement of repair mortar.
   2. After initial mixing of repair mortar, do not introduce additional water to change consistency. Discard repair mortar if consistency becomes too stiff to place.
   3. Place repair mortar to not less than recommended minimum thickness indicated in the MPII and in no event less than 3/8 inches.
      a. Apply repair mortar in accordance with the following minimum requirements:
         1) Not less than 3/8 inches over existing sound, exposed coarse aggregate.
         2) Not less than 2 inches of cover (unless otherwise required) over exposed reinforcing steel.
   4. At horizontal applications, repair mortar shall be screeded and bullfloated to the proper elevation, to ensure all surface moisture will drain freely and properly without puddle areas.
   5. Provide repair mortar in even, uniform plane to restore the concrete member to its original surface finish and plane.
      a. Tolerance for being out-of-plane shall be such that gap between a 1 foot straight edge and repair mortar surface shall not exceed 1/4 inches, and gap between a 4 feet straight edge and repair mortar surface shall not exceed 3/8 inches. This shall apply to straight edges placed in any orientation at any and all location on the repair mortar surface.

6. Prevention of Drying:
    a. Prevent exposed plastic mortar surfaces from drying. Provide windbreaks, foggers, and evaporation retarders, as necessary, during finishing.
    b. Foggers shall maintain humidity at height of 2 feet to 3 feet above surface of concrete.
    c. If necessary, apply evaporation retarder between finishing operations.
7. Repair mortar shall receive smooth, steel troweled finish.

D. Repair of Exposed Embedded Items in Concrete:
1. This provision addresses repair and rehabilitation of corroded metal items embedded in existing concrete and to other locations as expressly shown or indicated on the Drawings. Existing concrete damage by corrosion of embedded metal shall be repaired in accordance with this Section's Paragraph 3.2.B.
2. Preparation:
    a. Fully expose extent of metal corrosion within each embedded item by chipping to sound material. Where specifically shown or indicated on the Drawings, completely remove exposed metal item to extent shown or indicated.
    b. Prepare exposed reinforcing steel attached to or adjacent to embedded, corroded metal items in accordance with this Section's Paragraph 3.1.D.
    c. If existing concrete has been removed during chipping and repair of metal item, prepare repair area in accordance with this Section's Paragraph 3.1.C.
    d. Remove corrosion on embedded metal item and corrosion on exposed reinforcing steel by abrasive blasting to a white-metal finish.
3. Repair:
    a. Where no existing concrete has been removed or damaged adjacent to embedded metal item:
        1) On surface of embedded metal item, provide two coats of epoxy coating in accordance with coating manufacturer's recommendations.
            a) Color of First Coating: Red.
            b) Color of Second Coating: Gray.
        2) Before applying second coat, allow first coat of epoxy coating to fully cure in accordance with coating manufacturer's recommendations.
    b. Where areas of existing concrete have been removed or damaged adjacent to embedded metal item:
        1) Patch area of removed or damaged concrete in accordance with this Section's Paragraph 3.2.B.
        2) Provide on surface of embedded metal item two coats of epoxy coating in accordance with coating manufacturer's recommendations.
            a) Color of First Coat: Red.
            b) Color of second Coat: Gray.
        3) Before applying second coating, allow first coat of epoxy coating to fully cure in accordance with coating manufacturer's recommendations.

E. Extend existing construction joints through concrete repairs.

F. For repairs of existing concrete damage, finish of repaired areas shall match the finish of existing adjacent concrete surface.

3.3 CURING

A. Curing of Repair Mortar:
1. Perform curing of repair mortar immediately after final finishing.
2. Perform curing by combination of covering repair Work with wet burlap and applying liquid membrane-forming curing compound.
3. Employ methods and sequence to maintain moisture for not less than seven days.

3.4 FIELD QUALITY CONTROL

A. Field Tests:
1. In-Situ Pull-Off Tests:

a. Perform in-situ pull-off tests on repaired areas at locations indicated by Engineer.
   1) Perform not less than one pull-off test, in accordance with ASTM C1583, for each surface (wall, roof, floor, and other). In event of unacceptable pull-off test, repair the defective Work in accordance with the Contract Documents and perform additional test(s) at location(s) indicated by Engineer.
b. Submit written results of testing, indicating: date of test, entity performing testing, personnel present during testing, time of test, location of test, pertinent results recorded, and other relevant observations.
c. Criteria for Acceptance: Pull-off test will be deemed as passing (acceptable results) when failure occurs within the existing concrete substrate (cohesive concrete failure). If failure occurs at the joint surface with existing concrete (bond failure), within the repair material, or at connection to testing device, pull-out test will be deemed as passing (acceptable results) when the unit tensile stress acting on the core cross section at failure exceeds 300 psi. If failure occurs within the repair material, additional test samples of the repair material in the area of the test shall be taken for compressive testing to verify strength of repair material.
d. Remedy all damage resulting from in-situ testing, in accordance with the Contract Documents.

B. Observations and Inspections:
   1. Owner's Site Representative will witness surface preparation, substrate moisture conditions, and installation of materials indicated in this Section. Such observations do not relieve Contractor from obligation to comply with the Contract Documents.
   2. Owner-retained special inspector shall be present while material manufacturer's technical representatives are at the Site instructing Contractor's structural concrete repair personnel, and installers in the use of the associated material(s).

C. Defective Work:
   1. Defective Repair:
      a. Any and all repairs are defective Work when one or more of the following occurs:
         1) Pull-off test fails.
         2) When grout cube tests yield results less than 3500 psi for repair mortars in seven days.
         3) Repair is not properly finished and in accordance with specified tolerances.
      b. Promptly remove and remedy defective concrete repair Work in accordance with the Contract Documents.
   2. Damaged Work:
      a. Before acceptance of the Work (following final inspection in accordance with the General Conditions and other Contract Documents), neatly repair damaged surfaces, corners of concrete, and finish.
      b. When performing surface remedial repairs, finish areas to smooth, dense watertight condition.
      c. Replace unsatisfactory concrete patching Work.
   3. Corrective Work:
      a. If correction of defective Work (under this Section) is necessary, remove defective Work. Key area to be remedied, clean, and soak surface with water and patch with approved materials. Patch concrete to match existing adjacent concrete surfaces.
      b. Clean surface cavities resulting from form ties, other holes, honeycomb spots, broken corners and edges, and other effects. Saturate with water and point with a mortar of patching material paste. Comply with patching material manufacturer's recommendations concerning placement, pot life, and curing.
      c. Tolerance deviations and other surface defects may also be corrected, when approved by Engineer, by grinding high areas of swales.
      d. Where remedial work is unsatisfactory, completely remove such Work and replace with new Work in accordance with the Contract Documents.

4. Special inspection of remedial work is required. Special inspection will be performed after completion of surface preparation and during installation of remedial Work. Refer to Section 01 45 33 - Code Required Special Inspections and Procedures, for additional requirements.

D. Suppliers' Services:
   1. Manufacturers' factory-trained technical representatives of concrete repair materials shall be at the Site prior to and during first installation of the materials furnished under this Section to review surface preparation, surface moisture conditions and adhesion testing, and proposed installation methods. Compensation for which is part of the associated unit price for such Work.

END OF SECTION

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SECTION 03 05 05
CONCRETE TESTING AND INSPECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Contractor requirements for testing of concrete and grout.
   2. Definition of Owner provided testing.
   3. Acceptance criteria for concrete.
   4. Materials and concrete testing as required to establish concrete mix design.
   5. Testing of concrete during construction for compliance with Contract Documents.
   6. In-place testing of concrete, if required.

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 03 21 00 - Reinforcement.
   2. Section 03 31 30 - Concrete, Materials and Proportioning.
   3. Section 03 31 31 - Concrete Mixing, Placing, Jointing and Curing.

1.2 RESPONSIBILITY AND PAYMENT

A. Owner will hire an independent Testing Agency/Service Provider to perform the following testing and inspection and provide test results to the Engineer and Contractor.
   1. Testing and inspection of concrete and grout produced for incorporation into the work during the construction of the Project for compliance with the Contract Documents.
   2. Additional testing or retesting of materials occasioned by their failure, by test or inspection, to meet requirements of the Contract Documents.
   3. Strength testing on concrete required by the Engineer or Special Inspector when the water-cement ratio exceeds the water-cement ratio of the typical test cylinders.
   4. In-place testing of concrete as may be required by Engineer when strength of structure is considered potentially deficient.
   5. Other testing services needed or required by Contractor such as field curing of test specimens and testing of additional specimens for determining when forms, form shoring or reshoring may re-removed.
   6. Owner will pay for services defined in Paragraph 1.2A.1.

B. Hire a qualified testing agency to perform the following testing and provide test results to the Engineer.
   1. Testing of materials and mixes proposed by the Contractor for compliance with the Contract Documents and retesting in the event of changes.
   2. Additional testing and inspection required because of changes in materials or proportions requested by Contractor.
   3. Pay for services defined in Paragraphs 1.2B.1. and 1.2B.2.
   4. Reimburse Owner for testing services defined in Paragraphs 1.2A.2., 1.2A.3., 1.2A.4. and 1.2A.5.

C. Duties and Authorities of Testing Agency/Service Provider:
   1. Any Testing Agency/Service Provider or agencies and their representatives retained by Contractor or Owner for any reason are not authorized to revoke, alter, relax, enlarge, or release any requirement of Contract Documents, nor to reject, approve or accept any portion of the Work.
   2. Testing Agency/Service Provider shall inform the Contractor and Engineer regarding acceptability of or deficiencies in the work including materials furnished and work performed by Contractor that fails to fulfill requirements of the Contract Documents.
   3. Testing Agency to submit test reports and inspection reports to Engineer and Contractor immediately after they are performed.

a. All test reports to include exact location in the work at which batch represented by a test was deposited.
b. Reports of strength tests to include detailed information on storage and curing of specimens prior to testing.

4. Owner retains the responsibility for ultimate rejection or approval of any portion of the Work.

1.3 QUALITY ASSURANCE

A. Referenced Standards:
1. American Concrete Institute (ACI):
a. 318, Building Code Requirements for Structural Concrete.
b. 350, Code Requirements for Environmental Engineering Concrete Structures and Commentary.
2. ASTM International (ASTM):
a. ASTM Cement and Concrete Reference Laboratory (CCRL).
b. C31, Standard Practice for Making and Curing Concrete Test Specimens in the Field.
c. C39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
d. C42, Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
e. C94, Standard Specification for Ready-Mixed Concrete.
f. C138, Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.
g. C143, Standard Test Method for Slump of Hydraulic-Cement Concrete.
h. C157 Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete.
i. C172, Standard Practice for Sampling Freshly Mixed Concrete.
j. C173, Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
k. C231, Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
l. C1019, Standard Test Method for Sampling and Testing Grout.
m. C1218, Standard Test Method for Water-Soluble Chloride in Mortar and Concrete.
n. E329, Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.

B. Qualifications:
1. Contractor's Testing Agency:
a. Meeting requirements of ASTM E329 and ASTM C94.
b. Provide evidence of recent inspection by CCRL of NBS, and correction of deficiencies noted.

C. Use of Testing Agency and approval by Engineer of proposed concrete mix design shall in no way relieve Contractor of responsibility to furnish materials and construction in full compliance with Contract Documents.

1.4 DEFINITIONS

A. Testing Agency/Service Provider: An independent professional testing/inspection firm or service hired by Contractor or by Owner to perform testing, inspection or analysis services as directed, and as provided in the Contract Documents.

1.5 SUBMITTALS

A. Shop Drawings:
1. Product technical data including:
a. Concrete materials and concrete mix designs proposed for use.

1) Include results of all testing performed to qualify materials and to establish mix designs.
2) Place no concrete until approval of mix designs has been received in writing.
3) Submittal for each concrete mix design to include:
   a) Sieve analysis and source of fine and coarse aggregates.
   b) Test for aggregate organic impurities.
   c) Proportioning of all materials.
   d) Type of cement with mill certificate for the cement.
   e) Brand, quantity and class of fly ash proposed for use along with other submittal data as required for fly ash by Specification Section 03 31 30.
   f) Slump.
   g) Brand, type and quantity of air entrainment and any other proposed admixtures.
   h) Shrinkage test results.
   i) Total water soluble chloride ion concentration in hardened concrete from all ingredients determined per ASTM C1218.
   j) 28-day compression test results and any other data required by Specification Section 03 31 30 to establish concrete mix design.

2. Certifications:
   a. Testing Agency qualifications.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 TESTING SERVICES TO BE PERFORMED SERVICE PROVIDER/TESTING AGENCY

A. The following concrete testing will be performed by the Service Provider/Testing Agency:
   1. Concrete strength testing:
      a. Secure concrete samples in accordance with ASTM C172.
         1) Obtain each sample from a different batch of concrete on a random basis, avoiding selection of test batch other than by a number selected at random before commencement of concrete placement.
      b. For each strength test, mold and cure cylinders from each sample in accordance with ASTM C31.
         1) Record any deviations from requirements on test report.
         2) Cylinder size: Per ASTM C31.
            a) 4 inch cylinders shall not be used for concrete mixes with maximum aggregate size larger than 1 inch.
            b) Use the same size cylinder for all tests for each concrete mix.
         3) Quantity:
            a) 6 inches diameter by 12 inches high: Five cylinders.
            b) 4 inches diameter by 8 inches high: Seven cylinders.
      c. Field cure one cylinder for the seven day test.
         1) Laboratory cure the remaining.
      d. Test cylinders in accordance with ASTM C39.
         1) 6 inch diameter cylinders:
            a) Test one field cured cylinder at seven days for information.
            b) Test two cylinders at 28 days for strength test result.
            c) At Contractor's option, test two cylinders at 56 days for strength test for concrete mix designs containing Type IL cement in lieu of testing at 28 days.
            d) Hold remaining cylinders in reserve.
         2) 4 inches diameter cylinders:
            a) Test one field cured cylinder at seven days for information.
            b) Test three cylinders at 28 days for strength test result.

c) At Contractor's option, test three cylinders at 56 days for strength test for concrete mix designs containing Type IL cement in lieu of testing at 28 days.
d) Hold remaining cylinders in reserve.

e. Strength test result:
1) Average of strengths of two, 6 inch diameter cylinders or three, 4 inch diameter cylinders from the same sample tested at 28 days or 56 days for concrete mix designs containing Type IL cement at Contractor's option.
2) If one cylinder in a test manifests evidence of improper sampling, molding, handling, curing, or testing, discard and test reserve cylinder(s); average strength of remaining cylinders shall be considered strength test result.
3) Should all cylinders in any test show any of above defects, discard entire test.

f. Frequency of tests:
1) Concrete fill: One strength test for each 60 CUYD or fraction thereof placed in any one day.
2) All other concrete:
a) One strength test to be taken not less than once a day, nor less than once for each 60 cubic yards or fraction thereof placed in any one day.
b) Once for each 5000 square feet of slab or wall surface area placed each day.
c) If total volume of concrete on Project is such that frequency of testing required in above paragraph will provide less than five strength tests for each concrete mix, tests shall then be made from at least five randomly selected batches or from each batch if fewer than five batches are provided.

2. Slump testing:
a. Determine slump of concrete sample for each strength test.
1) Determine slump in accordance with ASTM C143.
b. If consistency of concrete appears to vary, the Engineer or Owner's Representative shall be authorized to require a slump test for each concrete truck.
1) This practice shall continue until three consecutive batches are determined to be consistent and meet the slump requirements specified.

3. Air content testing: Determine air content of concrete sample for each strength test in accordance with ASTM C231, ASTM C173, or ASTM C138.
4. Temperature testing: Determine temperature of concrete sample for each strength test.
5. In-place concrete testing (if required).

3.2 SPECIAL INSPECTIONS

A. See Section 01 45 33.
1. Special Inspections listed are for the Contractor reference only and is not part of the Contract Documents.
2. It is included to assist the Contractor in understanding the Owner-provided Services so that those services may be factored into the Contractor's pricing and schedule.

B. Formwork Special Inspections:
1. Shape, location, and dimensions.
a. Inspect in accordance with dimensions and details on Drawings.
b. Frequency: Inspect prior to each concrete pour.

C. Reinforcing Special Inspections:
1. Reinforcing size, spacing, lap length and concrete cover.
a. Inspect in accordance with Drawings and Specification.
b. Frequency: Inspect prior to each concrete pour.
2. Reinforcing adhesive anchoring system:
a. Inspect in accordance with ICC-ES report.
b. Frequency:
1) Inspect all adhesive anchors for the first 4 hours of installation.
2) Inspect approximately 25% of adhesive anchors thereafter.

3) Additional inspection will be required for different installer or if the quality of installation appears to vary.

D. Mixing, Placing, Jointing, and Curing Special Inspections:
   1. Perform concrete tests per the requirements of this Specification Section.
   2. Verification of proper mix design.
      a. Frequency: Periodically, prior to each concrete pour.
   3. Proper concrete placement techniques.
      a. Inspect per requirements of Section 03 31 31.
      b. Frequency: During each concrete pour.
   4. Proper curing temperature and techniques.
      a. Inspect per requirements of Section 03 31 31.
      b. Frequency: Periodically, but not less than every third day.
   5. Joints:
      a. Inspect joints for proper joint type, dimensions, reinforcing, dowel alignment, surface preparation and location.
      b. Frequency: Prior to each concrete pour.
   6. Waterstops:
      a. Visually inspect waterstops for proper location, continuity, installation to prevent displacement, cleanliness and damage to waterstop.
      b. Frequency:
         1) Prior to each concrete pour.

E. Anchorage to Concrete Special Inspection:
   1. Post installed anchors as required by the building code, ICC-ES Evaluation Reports, and as specified by the Engineer.
      a. Frequency: Per ICC-ES Report.
   2. Cast-in-place concrete anchors, including anchor size, embedment, material and location.
      a. Frequency: Prior to each concrete pour.

3.3 SAMPLING ASSISTANCE AND NOTIFICATION FOR OWNER

A. To facilitate testing and inspection, perform the following:
   1. Furnish any necessary labor to assist Testing Agency in obtaining and handling samples at site.
   2. Provide and maintain for sole use of Testing Agency adequate facilities for safe storage and proper curing of test specimens on site for first 24 hours as required by ASTM C31.
   3. Take samples at point of placement into concrete member.

B. Notify Owner's Testing Agency sufficiently in advance of operations (minimum of 24 hours) to allow for assignment of personnel and for scheduled completion of quality tests.

3.4 ACCEPTANCE

A. Completed concrete work which meets applicable requirements will be accepted without qualification.

B. Completed concrete work which fails to meet one or more requirements but which has been repaired to bring it into compliance will be accepted without qualification.

C. Completed concrete work which fails to meet one or more requirements and which cannot be brought into compliance may be accepted or rejected as provided in these Contract Documents.
   1. In this event, modifications may be required to assure that concrete work complies with requirements.
   2. Modifications, as directed by Engineer, to be made at no additional cost to Owner.

D. Dimensional Tolerances:
   1. Formed surfaces resulting in concrete outlines smaller than permitted by tolerances shall be considered potentially deficient in strength and subject to modifications required by Engineer.

2. Formed surfaces resulting in concrete outlines larger than permitted by tolerances may be rejected and excess material subject to removal.
    a. If removal of excess material is permitted, accomplish in such a manner as to maintain strength of section and to meet all other applicable requirements of function and appearance.
3. Concrete members cast in wrong location may be rejected if strength, appearance or function of structure is adversely affected or misplaced items interfere with other construction.
4. Inaccurately formed concrete surfaces exceeding limits of tolerances and which are exposed to view, may be rejected.
    a. Repair or remove and replace if required.
5. Finished slabs exceeding tolerances may be required to be repaired provided that strength or appearance is not adversely affected.
    a. High spots may be removed with a grinder, low spots filled with a patching compound, or other remedial measures performed as permitted or required.

E. Appearance:
1. Concrete surfaces exposed to view with defects which, in opinion of Engineer, adversely affect appearance as required by specified finish shall be repaired by approved methods.
2. Concrete not exposed to view is not subject to rejection for defective appearance unless, in the opinion of the Engineer, the defects impair the long-term strength or function of the member.

F. High Water-Cement Ratio:
1. Concrete with water in excess of the specified maximum water-cement ratio will be rejected.
2. Remove and replace concrete with high water-cement ratio or make other corrections as directed by Engineer.

G. Strength of Structure:
1. Strength of structure in place will be considered potentially deficient if it fails to comply with any requirements which control strength of structure, including but not necessarily limited to following:
    a. Low concrete strength:
        1) Test results for standard molded and cured test cylinders to be evaluated separately for each mix design.
            a) Such evaluation shall be valid only if tests have been conducted in accordance with specified quality standards.
            b) For evaluation of potential strength and uniformity, each mix design shall be represented by at least three strength tests.
            c) A strength test shall be the average of two, 6 inches diameter cylinders or three, 4 inches diameter cylinders from the same sample tested at 28 days.
        2) Acceptance:
            a) Strength level of each specified compressive strength shall be considered satisfactory if both of the following requirements are met:
                (1) Average of all sets of three consecutive strength tests equal or exceed the required specified 28 day compressive strength.
                (2) No individual strength test falls below the required specified 28 day compressive strength by more than 500 psi.
    b. Reinforcing steel size, configuration, quantity, strength, position, or arrangement at variance with requirements in Specification Section 03 21 00 or requirements of the Contract Drawings or approved Shop Drawings.
    c. Concrete which differs from required dimensions or location in such a manner as to reduce strength.
    d. Curing time and procedure not meeting requirements of this Specification Section.
    e. Inadequate protection of concrete from extremes of temperature during early stages of hardening and strength development.

f. Mechanical injury, construction fires, accidents or premature removal of formwork likely to result in deficient strength.
g. Concrete defects such as voids, honeycomb, cold joints, spalling, cracking, etc., likely to result in deficient strength or durability.

2. Structural analysis and/or additional testing may be required when strength of structure is considered potentially deficient.
3. In-place testing of concrete may be required when strength of concrete in place is considered potentially deficient.
   a. Testing by impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer to determine relative strengths at various locations in the structure or for selecting areas to be cored.
      1) Such tests shall not be used as a basis for acceptance or rejection.
   b. Core tests:
      1) Where required, test cores will be obtained in accordance with ASTM C42.
         a) If concrete in structure will be dry under service conditions, air dry cores (temperature 60 to 80 degrees F, relative humidity less than 60%) for seven days before test then test dry.
         b) If concrete in structure will be wet or subjected to high moisture atmosphere under service conditions, test cores after immersion in water for at least 40 hours and test wet.
         c) Testing wet or dry to be determined by Engineer.
      2) Three representative cores may be taken from each member or area of concrete in place that is considered potentially deficient.
         a) Location of cores shall be determined by Engineer so as least to impair strength of structure.
         b) If, before testing, one or more of cores shows evidence of having been damaged subsequent to or during removal from structure, damaged core shall be replaced.
      3) Concrete in area represented by a core test will be considered adequate if average strength of three cores is equal to at least 85% of specified strength and no single core is less than 75% of specified strength.
      4) Fill core holes with non-shrink grout and finish to match surrounding surface when exposed in a finished area.
4. If core tests are inconclusive or impractical to obtain or if structural analysis does not confirm safety of structure, load tests may be required and their results evaluated in accordance with ACI 318, Chapter 20.
5. Correct or replace concrete work judged inadequate by structural analysis or by results of core tests or load tests with additional construction, as directed by Engineer, at Contractor's expense.
6. Contractor to pay all costs incurred in providing additional testing and/or structural analysis required.

H. Shrinkage Tests:
   1. Shrinkage tests shall be performed on all concrete with specified shrinkage limits in Specification Section 03 31 30. Shrinkage tests are required for mix design approval and for approval of concrete in the field.
      a. Mix design shrinkage test:
         1) The maximum concrete shrinkage limit for the laboratory mix design tests shall be as specified in Specification Section 03 31 30. Standard deviation shall be considered as specified in ASTM C157. The submitted mix design proportions must be the same proportions used for the laboratory mix design shrinkage test. Shrinkage test to indicate concrete meets the specified shrinkage limit.
         2) Concrete shrinkage for laboratory cast specimens for mix design approval shall conform to ASTM C157 inches its entirety.
            a) Laboratory cast specimens for mix design approval shall be stored as specified by ASTM C157 for Water Storage.

3) Laboratory cast specimens for mix design approval shall be stored as specified by ASTM C157 for Water Storage.

b. Field approval shrinkage tests:
   1) Required for the first field placement of each mix of concrete that is specified as requiring shrinkage testing in Specification Section 03 31 30.
   2) If excessive cracking or other symptoms that are potentially related to shrinkage occur during construction, Engineer may require additional field shrinkage tests during construction to verify compliance with these Specifications.
   3) The initial field shrinkage testing will establish a baseline for the shrinkage of the specified mixes that represents the concrete as placed and cured in the field
   4) Concrete test specimens for field shrinkage test shall be taken to the lab in their molds prior to 24 hours ±1/2 hour, whereupon they shall be removed from the molds and the initial comparator reading shall be taken in accordance with ASTM C157. Then the specimens shall be returned to the field and cured with the same curing method used in the field. At 28 days after casting of the field specimens, they will be considered to be cured for the purpose of this testing.
      a) Field test specimens shall be stored and comparator readings shall be made as specified for Air Storage in ASTM C157.

2. Shrinkage specimens shall be fabricated, cured, dried, and measured in accordance with ASTM C157 and as modified herein. All specimens shall 11-1/4 inches ±1/8 inches for an effective gauge length of 10 inches.
   a. Shrinkage specimens for mixes with 100% of the aggregate passing the 1 inch sieve shall be 3 inches by 3 inches in cross section.
   b. For mixes with aggregates larger than 1 inch and with 100% passing a 2 inches sieve, drying shrinkage specimens shall be 4 inches by 4 inches in cross section.
3. Report shrinkage test results at intervals as specified for the type of test, either laboratory or field, according to ASTM C157 and the type of storage, water or air respectively.
   a. The field test shrinkage shall not exceed the laboratory mix shrinkage requirement by more than 50% on the initial placement of each class of concrete required to be shrinkage tested.
   b. If the required field shrinkage limitation is not met, all aspects of concrete mixing, placing, sampling and curing will be subject to review. If this review points toward a solution, participate in a solution of making changes as required to establish compliance. These changes may include, but are necessarily limited to the following:
      1) Changing the curing methods.
      2) Changing the source of aggregates.
      3) Changing the amount of crushed or fractured coarse aggregate.
      4) Changing cement quantity and/or admixtures.
      5) Use of a shrinkage reducing admixture.
      6) Reducing water/cement ratio.
      7) Making changes to sampling practices
      8) Possible consideration by the Engineer of modifying the field shrinkage acceptance criteria.
      9) Other actions designed to minimize shrinkage and to provide better quality assurance.
4. Once the initial field shrinkage testing requirement is met, subsequent shrinkage testing, done, if needed, during the remainder of the construction period shall use the field test result from each initial field shrinkage test as a base line for acceptance.
   a. If the base line acceptance criteria is not met, then the provisions of Paragraph 3.3 H.6.b above shall be enacted to re-establish compliance.

END OF SECTION

SECTION 03 11 13
FORMWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Formwork requirements for concrete construction.

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 03 05 05 - Concrete Testing and Inspection.
   2. Section 03 31 31 - Concrete Mixing, Placing, Jointing, and Curing.
   3. Section 03 35 00 - Concrete Finishing and Repair of Surface Defects.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Concrete Institute (ACI):
      a. CT-13, Concrete Terminology.
      b. 117, Specification for Tolerances for Concrete Construction and Materials.
      c. 347R, Guide to Formwork for Concrete.

B. Qualifications:
   1. Formwork, shoring and reshoring to be designed by a licensed professional engineer currently registered or having a minimum of three years of experience in this type of design work.
      a. Above qualifications apply to slabs and beams not cast on the ground.

C. Miscellaneous:
   1. Design and engineering of formwork, shoring and reshoring as well as its construction is the responsibility of the Contractor.
   2. Design requirements:
      a. Design formwork for loads, lateral pressures and allowable stresses outlined in ACI 347R and for design considerations, wind loads, allowable stresses and other applicable requirements of the controlling local building code.
         1) Where conflicts occur between the above two standards, the more stringent requirements shall govern.
      b. Design formwork to limit maximum deflection of form facing materials reflected in concrete surfaces exposed to view to 1/240 of span between structural members.
   3. For slabs and beams not cast on the ground, develop a procedure and schedule for removal of shores and for calculating the loads transferred to the structure during this process in accordance with ACI 347R.
      a. Perform structural calculations as required to prove that all portions of the structure in combination with remaining forming and shoring system has sufficient strength to safely support its own weight plus the loads placed thereon. Calculations shall be performed by a licensed professional engineer.
      b. When developing procedure, schedule and structural calculations, consider the following at each stage of construction:
         1) The structural system that exists.
         2) Effects of all loads during construction.
         3) Strength of concrete.
         4) The influence of deformations of the structure and shoring system on the distribution of dead loads and construction loads.
         5) The strength and spacing of shores or shoring systems used, as well as the method of shoring, bracing, shore removal, and reshoring including the minimum time intervals between the various operations.

6) Any other loading or condition that affects the safety or serviceability of the structure during construction.

1.3 DEFINITIONS

A. Words and terms used in these Specifications are defined in ACI CT-13.

B. SCC: Self-Consolidating Concrete.

1.4 SUBMITTALS

A. Shop Drawings:
   1. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions for stay-in-place forms.
      c. Manufacturer and type of proposed form materials for stay-in-place forms.
      d. Manufacturer and type of proposed form ties.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Void forms:
      a. SureVoid Products, Inc.
      b. Deslauriers, Inc.
   2. Stay-in-place forms:
      a. Alabama Metal Industries Corporation.

2.2 MATERIALS

A. Forms for Surfaces Exposed to View:
   1. Wood forms:
      a. 5/8 or 3/4 inches 5-ply structural plywood of concrete form grade.
      b. Built-in-place or prefabricated type panel.
   2. Metal forms:
      a. Metal forms may be used except for aluminum in contact with concrete.
      b. Forms to be tight to prevent leakage, free of rust and straight without dents to provide members of uniform thickness.

B. Forms for Surfaces Not Exposed to View:
   1. Wood or metal sufficiently tight to prevent leakage.
   2. Do not use aluminum forms.

2.3 ACCESSORIES

A. Form Ties:
   1. Commercially fabricated for use in form construction.
      a. Field fabricated ties are unacceptable.
   2. Constructed so that ends or end fasteners can be removed without causing spalling at surfaces of the concrete.
   3. Embedded portion of ties to be not less than 1-1/2 inches from face of concrete after ends have been removed.
   4. Cone size:
      a. 3/4 inches minimum diameter cones on both ends.
      b. Depth of cone not to exceed the concrete reinforcing cover.
   5. Provide ties with built-in waterstops in all walls that will be in contact with process liquid during plant operation.

6. Through-wall ties that are designed to be entirely removed are not allowed in all walls that will be in contact with liquids during plant operation.

B. Void Forms:
   1. Continuous void forms.
   2. Specially designed and manufactured for the purpose of creating a void area directly under concrete members which will allow a space for soil vertical upward movement.
   3. Able to support the weight of concrete and construction loads to be placed thereon with no decrease in required void form depth.
   4. Constructed from double faced corrugated cardboard or fiberboard which is wax impregnated and laminated with moisture-resistant adhesive.
   5. Capable of resisting moisture with no loss of load carrying strength or change in depth or configuration.

C. Stay-In-Place Forms:
   1. Ribbed expanded metal leave-in-place concrete forms commercially fabricated to provide an intentionally rougher surface.
   2. Hot-dipped galvanized.
   3. Stay-in-place forms shall be sized to support wet concrete for the span and thickness indicated.

PART 3 - EXECUTION

3.1 PREPARATION

A. Form Surface Treatment:
   1. Before placing of reinforcing steel or concrete, cover surfaces of forms with an approved release material that will effectively prevent absorption of moisture and prevent bond with concrete, will not stain concrete or prevent bonding of future finishes.
      a. A field applied form release agent or sealer of approved type or a factory applied nonabsorptive liner may be used.
   2. Do not allow excess form release material to stand in puddles in forms nor in contact with hardened concrete against which fresh concrete is to be placed.

B. Apply form release material to minimize bugholes and pinholes. Follow manufacturer's printed installation instructions specific to the form facing material.

C. Provide temporary openings at base of column and wall forms and at other points where necessary to facilitate cleaning and observation immediately before concrete is placed, and to limit height of free fall of concrete to prevent aggregate segregation.
   1. Temporary openings to limit height of free fall of concrete shall be spaced no more than 8 feet apart.

D. Clean surfaces of forms, reinforcing steel and other embedded materials of any accumulated mortar or grout from previous concreting and of all other foreign material before concrete is placed.

3.2 ERECTION

A. Install products in accordance with manufacturer's instructions.

B. Tolerances:
   1. Conform to ACI 117.
   2. Variation from plumb:
      a. In lines and surfaces of columns, piers, walls, and in risers.
         1) Maximum in any 10 feet of height: 1/4 inches.
         2) Maximum for entire height: 1/2 inches.
      b. For exposed corner columns, control-joint grooves, and other exposed to view lines:
         1) Maximum in any 20 feet length: 1/4 inches.
         2) Maximum for entire length: 1/2 inches.

3. Variation from level or from grades specified:
    a. In slab soffits, ceilings, beam soffits and in arises, measured before removal of supporting shores.
        1) Maximum in any 10 feet of length: 1/4 inches.
        2) Maximum in any bay or in any 20 feet length: 3/8 inches.
        3) Maximum for entire length: 3/4 inches.
    b. In exposed lintels, sills, parapets, horizontal grooves, and other exposed to view lines:
        1) Maximum in any bay or in 20 feet length: 1/4 inches.
        2) Maximum for entire length: 1/2 inches.
4. Variation of linear structure lines from established position in plan and related position of columns, walls, and partitions:
    a. Maximum in any bay: 1/2 inches.
    b. Maximum in any 20 feet of length: 1/2 inches.
    c. Maximum for entire length: 1 inch.
5. Variation in sizes and location of sleeves, floor openings, and wall openings: Maximum of +1/2 inches.
6. Variation in horizontal plan location of beam, column and wall centerlines from required location: Maximum of +1/2 inches.
7. Variation in cross sectional dimensions of columns and beams and in thickness of slabs and walls: Maximum of -1/4 inches, +1/2 inches.
8. Footings and foundations:
    a. Variations in concrete dimensions in plan: -1/2 inches, +2 inches.
    b. Misplacement or eccentricity:
        1) 2% of footing width in direction of misplacement but not more than 2 inches.
    c. Thickness:
        1) Decrease in specified thickness: 5%.
        2) Increase in specified thickness: No limit except that which may interfere with other construction.
9. Variation in steps:
    a. In a flight of stairs:
        1) Rise: +1/8 inches.
        2) Tread: +1/4 inches.
    b. In consecutive steps:
        1) Rise: +1/16 inches.
        2) Tread: +1/8 inches.
10. Establish and maintain in an undisturbed condition and until final completion and acceptance of Project, sufficient control points and benchmarks to be used for reference purposes to check tolerances.
11. Regardless of tolerances listed allow no portion of structure to extend beyond legal boundary of Project.
12. To maintain specified tolerances, camber formwork to compensate for anticipated deflections in formwork prior to hardening of concrete.

C. Make forms sufficiently tight to prevent loss of mortar from concrete.

D. Place 3/4 inches chamfer strips in exposed to view corners of forms to produce 3/4 inches wide beveled edges.

E. At construction joints, overlap contact surface of form sheathing for flush surfaces exposed to view over hardened concrete in previous placement by at least 1 inch.
    1. Hold forms against hardened concrete to prevent offsets or loss of mortar at construction joint and to maintain a true surface.
    2. Where possible, locate juncture of built-in-place wood or metal forms at architectural lines, control joints or at construction joints.

F. Where circular walls are to be formed and forms made up of straight sections are proposed for use, provide straight lengths not exceeding 2 feet wide.

1. Brace and tie formwork to maintain correct position and shape of members.

G. Construct wood forms for wall openings to facilitate loosening, if necessary, to counteract swelling.

H. Anchor formwork to shores or other supporting surfaces or members so that movement of any part of formwork system is prevented during concrete placement.

I. Provide runways for moving equipment with struts or legs, supported directly on formwork or structural member without resting on reinforcing steel.

J. Provide positive means of adjustment (wedges or jacks) of shores and struts and take up all settlement during concrete placing operation.
   1. Securely brace forms against lateral deflection.
   2. Fasten wedges used for final adjustment of forms prior to concrete placement in position after final check.

K. Void Forms:
   1. After void forms are in place and before concrete is placed thereon, cover joints between abutting form sections and cover ends of forms to prevent intrusion of soil, concrete or any other materials.
   2. Install void forms in accordance with manufacturer's instructions.

L. Stay-In-Place Forms:
   1. Support stay-in-place forms as required to maintain the formwork in proper position.
   2. Stay-in-place forms may be used at the Contractor's option at:
      a. Slab-on-grade bulkhead locations.
         1) Hold the edge of stay-in-place forms back a minimum distance equal to the concrete clear cover to the slab reinforcing.
         2) Provide continuous PVC waterstop through stay-in-place forms for all water bearing concrete.
      b. Other locations approved by Engineer.

3.3 REMOVAL OF FORMS

A. No construction loads shall be supported on, nor any shoring removed from, any part of the structure under construction except when that portion of the structure in combination with remaining forming and shoring system has sufficient strength to safely support its weight and loads places thereon.

B. When required for concrete curing in hot weather, required for repair of surface defects or when finishing is required at an early age, remove forms as soon as concrete has hardened sufficiently to resist damage from removal operations or lack of support.

C. Remove top forms on sloping surfaces of concrete as soon as concrete has attained sufficient stiffness to prevent sagging.
   1. Perform any needed repairs or treatment required on such sloping surfaces at once, followed by curing specified in Specification Section 03 31 31.

D. Loosen wood forms for wall openings as soon as this can be accomplished without damage to concrete.

E. Formwork for columns, walls, sides of beams, and other parts not supporting weight of concrete may be removed as soon as concrete has hardened sufficiently to resist damage from removal.
   1. For walls of water containing structures, leave forms in place for a minimum of 72HRS.

F. Where no reshoring is planned, leave forms and shoring used to support weight of concrete in place until concrete has attained its specified 28-day compressive strength.
   1. Where a reshoring procedure is planned, supporting formwork may be removed when concrete has reached the concrete strength required by the formwork designer's structural calculations.

G. When shores and other vertical supports are so arranged that non-load-carrying form facing material may be removed without loosening or disturbing shores and supports, facing material may be removed when concrete has sufficiently hardened to resist damage from removal.

3.4 FIELD QUALITY CONTROL

A. Special Inspection:
   1. See Section 01 45 33.
   2. See Section 03 05 05.

END OF SECTION

SECTION 03 15 19
ANCHORAGE TO CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Requirements for anchorages in concrete, including: cast-in-place anchor bolts, anchor rods, reinforcing anchorage adhesive, and post-installed concrete anchors required for the Project but not specified elsewhere in the Contract Documents.
   2. Delegated design requirements for concrete anchors not expressly shown or indicated on the Drawings or elsewhere in the Contract Documents, including, but not limited to, anchorages in concrete for the following structural and nonstructural components:
      a. Structural members and accessories.
      b. Metal, wood, and plastic fabrications.
      c. Architectural Work, including building components, finishes, specials, facility equipment and conveying equipment, furnishings, and special construction Work.
      d. Mechanical and electrical Work, including process-mechanical Work, site and infrastructure Work, electrical Work, communications Work, electronic safety and security systems Work, and others.
      e. Fire suppression, plumbing, and HVAC Work.
      f. Other components requiring anchorages to concrete.

B. Related Requirements: Include but are not necessarily limited to:
   1. Section 01 35 73 - Delegated Design Procedures.
   2. Section 01 81 10 - Wind and Seismic Criteria
   3. Section 03 05 05 - Concrete Testing and Inspection.
   4. Section 40 05 07 - Pipe Support Systems.

1.2 REFERENCES

A. Definitions and Terminology:
   1. This provision presents definitions and terminology, which have the meanings indicated in this provision, applied to the singular or plural thereof, and without regard to use of initial capital letters.
      a. Adhesive Anchors:
         1) Post-installed anchors developing their strength primarily from chemical bond between the concrete and the anchor.
         2) Includes anchors using acrylics, epoxy and other similar adhesives.
      b. Anchor Bolt: Any cast-in-place anchorage that is made of a headed (i.e. bolt) material.
      c. Anchor Rod: Any cast-in-place or post-installed anchorage made from unheaded, threaded, rod or deformed bar material.
      d. Concrete Anchor: Generic term for either an anchor bolt or an anchor rod.
      e. Galvanizing: Hot-dip galvanizing in accordance with ASTM A123, ASTM A153 or ASTM F2329 with minimum coating of 2.0 ounces of zinc per square foot of metal (average of specimens) unless noted otherwise or dictated by reference standard.
      f. Hardware: As defined in ASTM A153 or ASTM F2329.
      g. MPII: Manufacturer's printed installation instructions.
      h. Mechanical Anchors:
         1) Post-installed anchors developing their strength from attachment other than thru adhesives or chemical bond to concrete.
         2) Includes expansion anchors, expansion sleeve, screw anchors, undercut anchors, specialty inserts and other similar types of anchorages.
         3) Drop-in anchors and other similar non-ICC ES approved anchors are unacceptable.

i. Post-Installed Anchor: Adhesive or mechanical anchor installed into previously placed and adequately cured concrete.

B. Reference Standards:
1. American Concrete Institute (ACI):
a. 318, Building Code Requirements for Structural Concrete and Commentary.
b. 350, Code Requirements for Environmental Engineering Concrete Structures and Commentary.
c. 355.2, Seismic Testing of Post-Installed Concrete and Masonry Anchors in Cracked Concrete.
d. 355.4, Qualification of Post-Installed Adhesive Anchors in Concrete.
2. American Concrete Institute/Concrete Reinforcing Steel Institute (ACI-CRSI):
a. Adhesive Anchor Installation Certification Program: Adhesive Anchor Installer.
3. American Institute of Steel Construction (AISC):
a. 303, Code of Standard Practice for Steel Buildings and Bridges.
4. ASTM International (ASTM):
a. A36, Standard Specification for Carbon Structural Steel.
b. A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
c. A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
d. A153, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
e. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
f. A496, Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
g. A563, Standard Specification for Carbon and Alloy Steel Nuts.
h. A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
i. F436, Standard Specification for Hardened Steel Washers.
j. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
k. F594, Standard Specification for Stainless Steel Nuts.
l. F1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
m. F2329, Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners
5. International Code Council Evaluation Service (ICC-ES):
a. AC193, Acceptance Criteria for Mechanical Anchors in Concrete Elements.
b. AC308, Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.
c. ESR-3298, Dewalt PURE110+ Epoxy Adhesive Anchor System and Post-Installed Reinforcing Bar Connection System in Cracked and Uncracked Concrete.
d. ESR-3814, Hilti HIT-RE500 V3 Adhesive Anchors and Post-Installed Reinforcing Bar Connections in Cracked and Uncracked Concrete.
e. ESR-4057, Simpson Strong-Tie SET-3G Epoxy Adhesive Anchors for Cracked and Uncracked Concrete.
f. ESR-4266, Hilti Kwik Bolt TZ2 Carbon and Stainless Steel Anchors in Cracked and Uncracked Concrete.
g. ESR – 4868, Hilti HIT-HY 200 V3 Adhesive Anchors and Post Installed Reinforcing Bar Connections in Concrete.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
1. For post-installed anchors and other anchorages installed in existing concrete, comply with Section 01 73 29 - Cutting and Patching.
2. Comply with coordination requirements in Section 01 35 73 - Delegated Design Procedures.

B. Pre-Design Conference:
   1. Pre-design conference for anchorages to concrete (where such anchorages are delegated design Work) is not required.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Code-required Special Instructions:
      a. Special Inspection is required in accordance with the building code for all concrete anchorages.
      b. Notify the Special Inspector that an inspection is required prior to concrete placement (or during post-installed anchorage installation).
      c. See the "Field Quality Control" Article in "Part 3 – Execution" of this Section for additional requirements.

B. Qualifications:
   1. Delegated Design Professional:
      a. Delegated design professional's qualifications and responsibilities shall be in accordance with Section 01 35 73 - Delegated Design Procedures.
   2. Installer:
      a. Installer for post-installed anchors shall be trained by the manufacturer or certified by a training program approved by the Engineer.
      b. Installer for adhesive anchors installed in horizontal, upward incline, or overhead applications shall be certified by ACI-CRSI Adhesive Anchor Installation Certification Program.

1.5 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Submit schedule (table or listing) of types, sizes (diameter, length, embedment length), material, finish, and proposed manufacturers of anchorages to concrete to be provided. Apportion by Project-specific application (for example, "Anchorages for cooling water pumps in basement") and indicate where anchorages are fully-designed by Engineer and those for which final design was prepared by delegated design professional.
      b. Engineer's approval of such Shop Drawing will be only for anchorages fully designed by Engineer. For anchorages for which final design is by delegated design professional, include on such Shop Drawing delegated design professional's approval stamp.
   2. Product Data: Submit as Action Submittals product data for anchorages to concrete fully designed by Engineer. For anchorages to concrete for which final design is by delegated design professional, submit as Informational Submittals bearing approval stamp of delegated design professional.
      a. Manufacturer's express, written acknowledgement that proposed items comply with referenced standards indicated in this Section and, as applicable, by delegated design professional.
      b. Manufacturer published data and information for each anchor.
         1) Clearly indicate items that are proposed for the Work. Neatly strike out or obscure materials and products not proposed.
      c. Manufacturer's published installation instructions and instructions for code-required special inspections and tests.
      d. Post-Installed Anchors: In addition, submit for each post-installed anchor system current ICC-ES report , indicating the following:
         1) Manufacturer's certification that anchors comply with requirements indicated in the Contract Documents.
         2) Performance data indicating that anchor is approved by its manufacturer for use in cracked concrete.
         3) Seismic design categories for which anchor system is approved by ICC-ES report.

e. Anchorage layout drawings and details:
   1) Drawings showing location, configuration, spacing and edge distance.

3. Delegated Design Professional's Instruments of Service Submittals: Submit, in accordance with this Section and Section 01 35 73 – Delegated Design Procedures, for each anchorage to concrete for which final design is by delegated design professional:
   a. Certification of compliance, in accordance with Section 01 35 73 – Delegated Design Procedures. Indicate design tension and shear loads used for anchor design.
   b. Delegated design professional's drawings.
   c. Delegated design professional's specifications, if any, when prepared by delegated design professional.
   d. Post-Installed Anchors (for which final design is by delegated design professional): Submittal shall also include the following for post-installed anchors for which final design was by delegated design professional:
      1) Show diameter, embedment depth and edge distance of each anchor.
      2) Indicate compliance with ACI 318 Chapter 17, and ACI 350-20 Appendix E.
      3) Type of post-installed anchor system used.
         a) Provide manufacturer's ICC-ES report for the following:
            (1) Mechanical anchorage per ICC-ES AC193.
            (2) Adhesive anchorage per ICC-ES AC308.
4. Samples:
   a. Submit representative Samples of anchorages to concrete, when requested by Engineer. Engineer's approval of Samples will be for type and finish only.

B. Informational Submittals: Submit the following:
1. Shop Drawings and Product Data Approved by Delegated Design Professional:
   a. Submit with delegated design professional's approval stamp those Shop Drawings and product data Submittals indicated in this Article but for which final design was performed by delegated design professional.
2. Calculations by Delegated Design Professional:
   a. Submit sealed and signed calculations for sizing and determining embedment length of anchorages to concrete not fully designed by Engineer.
   b. Post-Installed Anchors Designed by Delegated Design Professional: In addition, also submit design calculations:
      1) Indicate design load to each anchor.
      2) When design load is not indicated on the Drawings, include calculations to develop anchor forces based on performance and design criteria indicated in this Section.
3. Supplier's Instructions:
   a. Submit manufacturer's published instructions for installation.
4. Field Quality Control Submittals:
   a. Submit written results of required field quality control activities indicated in this Section.
5. Reports of Supplier's Visits to Site:
   a. Submit each written report of visit to the Site by Supplier's factory trained representative and delegated design professional. For each, indicate date and time of visit, purpose of visit, observations made, decisions made, problems encountered, and other pertinent information.
6. Qualifications Statements:
   a. Delegated design professional.
   b. Each installer.

PART 2 - PRODUCTS

2.1 MATERIALS – ALL ANCHORAGES

A. Materials – General:

1. This Article applies to all anchorages to concrete, regardless of whether fully designed by Engineer or delegated design professional. Requirements for delegated designs are in the following Article.
2. Additional requirements for anchorages fully designed by Engineer are indicated in the Article following requirements for delegated design anchorages.
3. For structural applications, do not use powder actuated fasteners and other types of bolts or fasteners not specified in this Section unless approved by Engineer or otherwise required by the Contract Documents.

B. Description:
1. Provide anchorages to concrete, of the types shown or indicated, to secure to concrete materials, equipment, and appurtenances installed as part of the Work.
2. Locations where anchorages are required are generally shown or indicated on the Drawings. Where not shown or indicated on the Drawings provide anchorages or the types required for materials, equipment, and systems where such materials, equipment, and systems are shown on the Drawings.
3. Anchorages required include those for materials, equipment, and systems shown on the structural Drawings and Drawing other than the structural Drawings.
4. Design loads for concrete anchorages are shown or indicated on the Drawings for anchorages where design responsibility is delegated to Contractor's delegated design professional. For such anchorages, embedment depths are not shown or indicated.

C. Cast-in-place Concrete Anchors:
1. Buildings, non-building structures, and equipment, unless otherwise specified:
   a. ASTM F1554, Grade 36 or Grade 55 with weldability supplement S1 for galvanized threaded rods.
   b. ASTM A307, Grade A for galvanized headed bolts.
2. All other cast-in-place concrete anchors:
   a. Stainless steel with matching nut and washer.
   b. Submerged application: ASTM F593, Type 316, minimum yield strength of 45,000 psi.
   c. Non-submerged application: ASTM F593, Type 304 or Type 316, minimum yield strength of 45,000 psi.

D. Post-Installed Mechanical and Adhesive Concrete Anchors:
1. Submerged application: ASTM F593, Type 316, minimum yield strength of 45,000 psi with matching nut and washer.
2. Non-submerged application: ASTM F593, Type 304 or Type 316, minimum yield strength of 45,000 psi with matching nut and washer.
3. Post-installed anchors and related materials shall be listed by ICC-ES or Engineer-approved equivalent.

E. Reinforcing: Comply with Section 03 21 00 - Reinforcement.

F. Headed Studs: ASTM A108 with a minimum yield strength of 50,000 psi and a minimum tensile strength of 60,000 psi.

G. Washers:
1. ASTM F436 unless indicated otherwise, finish to match bolt.
2. When stainless steel anchorage is provided for cast-in-place anchorages, provide washers of the same material and alloy as in the associated anchorage.
3. Plate washers: Minimum 1/2 inch thick fabricated ASTM A36 square plates as required.
4. Comply with manufacturer's written instructions for all post-installed anchorages.

H. Nuts:
1. ASTM A563 for cast-in-place anchorages.
2. When stainless steel anchorages are provided for cast-in-place anchorages, nuts shall comply with ASTM F594 and shall match material and alloy of the associated anchorage.
3. Follow manufacturer's requirements if using post-installed anchorage.

I. Galvanizing Repair Paint:
   1. High zinc dust content paint for regalvanizing welds and abrasions.
   2. ASTM A780.
   3. Zinc content: Minimum 92 percent in dry film.
   4. Products and Manufacturers: "ZRC Cold Galvanizing", by ZRC; or "High Performance Zinc Spray", by Clearco; or equal.

J. Dissimilar Materials Protection: Comply with Section 09 96 00 - High-Performance Industrial Coatings.

2.2 DELEGATED DESIGN ANCHORAGES TO CONCRETE

A. Manufacturers:
   1. Post-installed anchor systems for indicated manufacturers are acceptable only when a current ICC-ES evaluation report is furnished as a Submittal and the subject anchorage system is approved by delegated design professional.
      a. Hilti.
      b. Dewalt.
      c. Simpson Strong-Tie.
      d. Or equal.

B. Description: Perform delegated design for anchorages when one or more of the following applies:
   1. Design load for concrete anchorage is shown or indicated on the Drawings and anchorage embedment depth is not shown or indicated.
   2. When specifically required by the Contract Documents.
   3. When an anchorage is necessary but is not shown or indicated on the Drawings.
   4. Anchorages shown on the Drawings other than the structural Drawings.

C. Performance and Design Criteria for Delegated Design Anchorages:
   1. Determine design loads, including wind and seismic loads, in accordance with applicable building code and other Laws and Regulations.
   2. For anchorage of equipment and non-structural components, use actual dead load and operating loads obtained by Contractor or delegated design professional from manufacturer. Design loads shall include operating conditions when equipment or element of the Work is in operation, dynamic loads, and other loads as appropriate or required by the building code or other Laws or Regulations.
   3. Pipe Hangers and Pipe Support: Comply with additional requirements in Section 40 05 07 – Pipe Support Systems.
   4. Design assuming cracked concrete.

2.3 ANCHORAGES FULLY DESIGNED BY ENGINEER

A. When size, length, and details of anchorage are shown or indicated on the structural Drawings, such anchorages are considered as fully designed by Engineer and delegated design of such anchorage is not required.

B. Manufacturers:
   1. For post-installed anchor systems regardless of whether proposed manufacturer is indicated below, furnish as Submittal current evaluation agency report and anchor system is certified by ICC-ES for cracked concrete conditions.
   2. Mechanical Anchors:
      a. Hilti:
         1) Kwik Bolt TZ (ICC-ES ESR-1917).
      b. Or equal.
   3. Adhesive Anchors for Concrete:
      a. Hilti:
         1) HIT RE 500 V3 (ICC ESR-3814).
         2) HIT-HY 200 V3 (ICC-ES ESR-4868).

b. Dewalt:
   1) PURE110+ (ICC-ES ESR-3298).
c. Simpson Strong-Tie:
   1) SET-3G (ICC ES 4057)
d. Or equal.

4. Requests, if any, for Engineer's approval of "or-equals" or substitutes shall indicate proposed anchor has at least the same tension and shear strength as the associated anchorage products indicated by name in this Article.

PART 3 - EXECUTION

3.1 PREPARATION

A. For cast-in-place concrete anchorages, allow adequate time for proper installation, inspection, and observation prior to placing concrete.

B. Prior to installation, inspect and verify areas and conditions under which concrete anchorages will be installed.
   1. Notify Engineer of conditions detrimental to proper and timely completion of the Work.
   2. Do not proceed with the Work until unsatisfactory conditions are properly remedied.

3.2 INSTALLATION

A. Installation Requirements - General:
   1. Install items in accordance with the Contract Documents, manufacturer's written instructions, and Laws and Regulations. Where such requirements conflict, obtain interpretation or clarification from Engineer prior to commencing the associated Work.
   2. Perform the following unless shown or indicated otherwise:
      a. Provide stainless steel anchorages for connecting aluminum and steel members to concrete and masonry. Provide dissimilar materials protection in accordance with Section 09 96 00 – High-Performance Industrial Coatings.
      b. Provide washers for all anchorages.
      c. Where exposed, extend threaded anchorage a minimum of 0.5 inch above top of fully-engaged nut. If anchorage is cut off to required maximum height, dress the threads to allow nuts to be removed without damage to nuts.
   3. Tightening of nuts: Do the following after nuts are snug-tightened down:
      a. Upset anchorage threads to prevent nuts from backing off. Provide double nut or lock nut in lieu of upset threads for items that may require future removal.
      b. For cast-in-place anchorages (excluding post-installed anchorages), tighten nuts an additional 1/8 turn beyond snug tight to prevent nuts from backing off.
      c. When two nuts are used per concrete anchor above the base plate, tighten top nut an additional 1/8 turn to "lock" the two nuts together.
      d. For post-installed anchorages, comply with MPII.
   4. Secure architectural components to avoid aesthetic distortion and to avoid overstressing fasteners from expansion, contraction, or installation.

B. Cast-in-Place Anchorages:
   1. Provide where anchor rods or anchor bolts are indicated on the Drawings, unless another anchor type is approved by Engineer.
   2. Provide concrete anchorages as shown on the Drawings or as required to secure the Work to concrete.
   3. Tie cast-in-place anchorage in position to embedded reinforcing steel using wire.
   4. Tack welding of anchorage is prohibited.
   5. Chase threads as required and coat projected portion of carbon steel anchors and nut threads with a heavy coat of clean grease after concrete has cured.
   6. Anchorage location Tolerance: in accordance with AISC 303.

7. Provide steel or durable wood templates for all column and equipment anchorages. Place templates above top of concrete; do not impede proper concrete placement and consolidation.

C. Mechanical Anchorages:
   1. Use only where specifically indicated on the Drawings or when approved for use by the Engineer.
   2. Do not use where subjected to vibration.
   3. May be used in overhead applications.
   4. Contact Engineer for clarification when anchors will not be installed in compliance with manufacturer's printed installation requirements.

D. Post-installed Anchorages:
   1. For post-installed anchors, comply with MPII regarding hole diameter and depth required to fully develop the tensile strength of anchor or reinforcing bar.
   2. Use hammer drills to create holes.
   3. Properly clean out holes in accordance with the associated ICC-ES report using non-metallic, fiber bristle brush and compressed air, or as otherwise necessary to remove all loose material from each hole prior to installing anchor in the presence of Special Inspector.
   4. Adhesive Anchorages:
      a. Provide only where specifically indicated on the Drawings or when approved for use by Engineer.
      b. May be provided where subjected to vibration or at buried or submerged locations.
      c. Do not install for overhead applications or sustained tension loading conditions such as utility hangers.
      d. Install adhesive anchors in concrete aged not less than 21 days.

E. Finishes:
   1. Coat aluminum surfaces in contact with dissimilar materials in accordance with Section 09 96 00 – High-Performance Industrial Coatings.
   2. Repair of damaged galvanized surfaces:
      a. Prepare damaged surfaces by abrasive blasting or power sanding.
      b. Repair damaged galvanized surfaces in accordance with ASTM A780.
      c. Apply galvanizing repair paint to not less than 6 mils dry film thickness in accordance with galvanizing repair material manufacturer's instructions and ASTM A780.

F. Ensure that embedded items are protected from damage and are not filled in with concrete or related materials.

3.3 FIELD QUALITY CONTROL

A. Field Tests and Inspections:
   1. Special Inspections: Comply with Section 01 45 33 - Code-Required Special Inspections and Procedures.
   2. Comply with Section 03 05 05 - Concrete Testing and Inspection.
   3. Tests and inspections of anchorages shall comply with ACI 355.2 and/or ACI 355.4 as applicable.
   4. Owner reserves the right to inspect and test completed anchorages at a minimum of 10 to 25 percent of provided anchorages.

B. Supplier's services:
   1. Post-installed anchor manufacturer's representative shall demonstrate and observe the proper installation procedures for the post-installed anchors.

C. Defective Work:
   1. Anchorages that do not successfully pass required field tests and inspections or that are otherwise deemed defective by Engineer shall be remedied, in accordance with the Contract Documents, at no cost to Owner.

3.4 CLEANING

A. After concrete has been placed, remove protection and clean all anchorage of all concrete, dirt, and other foreign matter.

B. Provide surface acceptable to receive field applied paint coatings when specified in Specification Section 09 96 00.

END OF SECTION

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SECTION 03 21 00
REINFORCEMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Reinforcing bar requirements for concrete construction.

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 03 05 05 - Concrete Testing and Inspection.
   2. Section 03 15 19 - Anchorage to Concrete.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Concrete Institute (ACI):
      a. SP 66, ACI Detailing Manual.
      b. 117, Specification for Tolerances for Concrete Construction and Materials.
      c. 315, Manual of Standard Practice for Detailing Reinforced Concrete Structures.
      d. 318, Building Code Requirements for Structural Concrete.
      e. 350, Code Requirements for Environmental Engineering Concrete Structures.
   2. ASTM International (ASTM):
      a. A36, Standard Specification for Carbon Structural Steel.
      b. A276, Standard Specification for Stainless Steel Bars and Shapes.
      c. A615, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
      d. A970, Standard Specification for Headed Steel Bars for Concrete Reinforcement.
      e. A1064, Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
   3. Concrete Reinforcing Steel Institute (CRSI):
      a. Manual of Standard Practice.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Mill certificates for all reinforcing.
      d. ICC reports for manufactured mechanical splice and adhesive anchor.
      e. Manufacturer and type of proprietary reinforcing mechanical splices.
   2. Reinforcing number, sizes, spacing, dimensions, configurations, locations, mark numbers, lap splice lengths and locations, concrete cover and reinforcing supports.
   3. Sufficient reinforcing details to permit installation of reinforcing.
   4. Reinforcing details in accordance with ACI SP 66 and ACI 315.
   5. Locations where proprietary reinforcing mechanical splices are required or proposed for use.
   6. Shop Drawings shall be in sufficient detail to permit installation of reinforcing without reference to Contract Drawings.
      a. Shop Drawings shall not be prepared by reproducing the plans and details indicated on the Contract Drawings but shall consist of completely redrawn plans and details as necessary to indicate complete fabrication and installation of all reinforcing steel.
      b. Where multiple types of supports for reinforcing steel (such as chairs, runners, bolsters, and other types of supports) will be used in the Work, clearly indicate on the Shop Drawings the support types and materials of supports.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Support and store all reinforcing above ground.

B. Ship to jobsite with attached plastic or metal tags with permanent mark numbers which match the Shop Drawing mark numbers.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURES

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Reinforcing adhesive anchors:
      a. See Specification Section 03 15 19.
   2. Reinforcing mechanical splices:
      a. Lenton Rebar Splicing by Erico, Inc.
      b. Richmond dowel bar splicer system by Richmond Screw and Anchor Co., Inc.
      c. Bar-Grip Systems by Barsplice Products, Inc.

2.2 MATERIALS

A. Reinforcing Bars: ASTM A615, grade 60, deformed.

B. Welded Wire Reinforcement: ASTM .

C. Smooth Dowel Bars:
   1. Water containing structures: ASTM A276, Type 316.
   2. All other locations: ASTM A36, with metal end cap to allow longitudinal movement equal to joint width plus 1 inch.

D. Proprietary Reinforcing Mechanical Splices: To develop in tension and compression a minimum of 125% of the yield strength of the reinforcing bars being spliced.

E. Reinforcing Adhesive Anchors:
   1. See Specification 03 15 19.

2.3 ACCESSORIES

A. Chairs, Runners, Bolsters, Spacers, Hangers, and Other Reinforcing Supports:
   1. Metal fabrications with plastic-coated tips in contact with forms.
      a. Plastic coating meeting requirements of CRSI Manual of Standard Practice.
   2. All plastic construction meeting the requirements of CRSI Manual of Standard Practice.
      a. 100% non-metallic, non-corrosive.
      b. Required for all walls and elevated construction exposed to liquid containing structures.

B. Protective plastic caps at mechanical splices.

2.4 FABRICATION

A. Tolerances:
   1. Conforms to ACI 117, expect as modified herein.
   2. Sheared lengths: +1 inches.
   3. Overall dimensions of stirrups, ties and spirals: +1/2 inches.
   4. All other bends: +0 inches, -1/2 inches.

B. Minimum diameter of bends measured on the inside of the reinforcing bar to be as indicated in ACI 318 Paragraph 7.2.

C. Ship reinforcing to jobsite with attached plastic or metal tags.
   1. Place on each tag the mark number of the reinforcing corresponding to the mark number indicated on the Shop Drawing.
   2. Mark numbers on tags to be so placed that the numbers cannot be removed.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Tolerances:
   1. Conform to ACI 117, except as modified herein.
   2. Reinforcing placement:
      a. Clear distance to formed surfaces: +1/4 inches.
      b. Minimum spacing between bars: -1/4 inches.
      c. Top bars in slabs and beams:
         1) Members 8 inches deep or less: +1/4 inches.
         2) Members between 8 inches and 2 feet deep: -1/4 inches, +1/2 inches.
         3) Members more than 2 feet deep: -1/4 inches, +1 inches.
      d. Crosswise of members: Spaced evenly within +1 inches.
      e. Lengthwise of members: +2 inches.
   3. Minimum clear distances between reinforcing bars:
      a. Beams, walls and slabs: Distance equal to bar diameter or 1 inch, whichever is greater.
      b. Columns: Distance equal to 1-1/2 times the bar diameter or 1-1/2 inches, whichever is greater.
      c. Beam and slab reinforcing shall be threaded through the column vertical rebars without displacing the column vertical bars and still maintaining the clear distances required for the beam and slab reinforcing bars.

B. Minimum concrete protective covering for reinforcement: As shown on Drawings.

C. Unless indicated otherwise on Drawings, provide splice lengths for reinforcing as follows:
   1. For reinforcing: Class B splice meeting the requirements of ACI 350.
   2. For welded wire reinforcement:
      a. Splice lap length measured between outermost cross wires of each fabric sheet shall not be less than one spacing of cross wires plus 2 inches, nor less than 1.5 x development length nor less than 6 inches.
      b. Development length shall be as required for the yield strength of the welded wire reinforcement in accordance with ACI 350.
   3. Provide splices of reinforcing not specifically indicated or specified subject to approval of Engineer.
      a. Mechanical proprietary splice connectors may only be used when approved or indicated on the Contract Drawings.

D. Welding:
   1. Welding reinforcing is not permitted.

E. Placing Reinforcing:
   1. Assure that reinforcement at time concrete is placed is free of mud, oil or other materials that may affect or reduce bond.
   2. Reinforcement with rust, mill scale or a combination of both will be accepted as being satisfactory without cleaning or brushing provided dimensions and weights including heights of deformations on a cleaned sample is not less than required by applicable ASTM specification that governs for the reinforcing supplied.
   3. Reinforcing support:
      a. Uncoated reinforcing:
         1) Support reinforcing and fasten together to prevent displacement by construction operations.
            a) Locate and support reinforcement with bar supports to maintain minimum concrete cover.
            b) Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

c) Reinforcement shown on the Contract Documents may not be repositioned for use a support for reinforcement. Additional drop bars may be provided for support of reinforcing,

2) Reinforcing supported on ground:
   a) Slab on grade and other members with only one mat of reinforcing:
      (1) Provide metal bar supports with bottom plate.
      (2) Do not use concrete blocks to support slab-on-grade reinforcing.
   b) All other members: Provide supporting concrete blocks or metal bar supports with bottom plate.
3) Reinforcing supported on formwork:
   a) Concrete surfaces in contact with or over process liquid: All-Plastic chairs, runners and bar supports.
   b) All other formed surfaces:
      (1) Provide plastic-coated metal chairs, runners, bolsters, spacers, hangers and other reinforcing support.
      (2) Only tips in contact with the forms need to be plastic coated.

4. Support reinforcing over cardboard void forms by means of concrete supports which will not puncture or damage the void forms during construction nor impair the strength of the concrete members in any way.
5. Where parallel horizontal reinforcement in beams is indicated to be placed in two or more layers, bars in the upper layers shall be placed directly above bars in the bottom layer with clear distance between layers to be 1 inch.
   a. Place spacer bars at 3 feet maximum centers to maintain the required 1 inch clear distance between layers.
6. Extend reinforcement to within 2 inches of concrete perimeter edges.
   a. If perimeter edge is formed by earth , extend reinforcement to within 3 inches of the edge.
7. To assure proper placement, furnish templates for all column vertical bars and dowels.
8. Do not bend reinforcement after embedding in hardened concrete unless approved by Engineer.
   a. Do not bend reinforcing by means of heat.
9. Do not tack weld reinforcing.
10. Embed reinforcing into hardened concrete utilizing adhesive anchor system specifically manufactured for such installation:
    a. See Specification Section 03 15 19.

3.2 FIELD QUALITY CONTROL

A. Reinforcement Congestion and Interferences:
   1. Notify Engineer whenever the specified clearances between bars cannot be met.
   2. Do not place any concrete until the Engineer submits a solution to reinforcing congestion problem.
   3. Reinforcing may be moved as necessary to avoid interference with other reinforcing steel, conduits, or embedded items.
   4. If bars are moved more than one bar diameter, obtain Engineer's approval of resulting arrangement of reinforcing.
   5. No cutting of reinforcing shall be done without written approval of Engineer.

B. Special Inspection:
   1. See Section 01 45 33.
   2. See Section 03 05 05.

END OF SECTION

SECTION 03 31 30
CONCRETE MATERIALS AND PROPORTIONING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Requirements for concrete materials, including:
      a. Materials, including various types of grout, admixtures, cement, sand, aggregate, and other materials.
      b. Concrete strength and proportioning, including design mixes for:
         1) Normal weight concrete.
         2) Flowable fill (Controlled low strength material).
         3) Grout.

B. Scope:
   1. Unless shown or indicated otherwise in the Contract Documents, concrete Work shall comply with:
      a. ACI 301.
      b. Laws and Regulations, including applicable building code.
   2. In this Section, material is apportioned into the following grouting types:
      a. Base plates for columns and equipment.
      b. As otherwise shown or indicated in the Contract Documents.
   3. This Section addresses materials for concrete. Other Specifications sections present other requirements for complete concrete Work, including, but not necessarily limited to:
      a. Section 03 05 05 - Concrete Testing and Inspection.
      b. Section 03 11 13 - Formwork.
      c. Section 03 21 00 - Reinforcement.
      d. Section 03 31 31 - Concrete Mixing, Placing, Jointing, and Curing.
      e. Section 03 35 00 - Concrete Finishing and Repair of Surface Defects.
      f. Others as indicated in the Contract Documents.

C. Related Requirements: Include but are not necessarily limited to:
   1. Section 03 05 05 - Concrete Testing and Inspection.
   2. Section 03 11 13 - Formwork.
   3. Section 03 15 19 - Anchorage to Concrete.
   4. Section 03 21 00 - Reinforcement.
   5. Section 03 31 31 - Concrete Mixing, Placing, Jointing, and Curing.
   6. Section 03 35 00 - Concrete Finishing and Repair of Surface Defects.

1.2 REFERENCES

A. Abbreviations and Terminology:
   1. Abbreviations: The following abbreviations are used in this Section:
      a. "AAR" means deleterious "alkali-aggregate reaction", resulting from either alkali-silica reactive (ASR) or alkali-carbonate reactive (ACR) aggregates.
      b. "SCM" means "supplementary cementitious materials", with the meaning indicated below.
      c. "CLSM" means controlled low strength material in accordance with requirements of this Section.
   2. Terminology: Terminology indicated below are not defined terms and are not indicated with initial capital letters, but when used in this Section have the meanings indicated below:
      a. "Supplementary cementitious materials" (SCM) means fly ash, silica fume, and GGBFS.

b. "Water-bearing concrete" is concrete surface to be in contact (whether continuously or intermittently) with water, process liquid, or slurries during intended operation of the facility, including, but not limited to, concrete tanks, channels, wet wells, distribution chambers, and secondary containment structures.
c. Independent Laboratory:
1) Testing shall be performed by an independent laboratory complying with requirements of the generally recognized accrediting entity for the jurisdiction where the Site is located.
2) Testing laboratory shall obtain all concrete samples and waterproofing product samples from the manufacturer of the associated product or material.

B. Reference Standards:
1. American Concrete Institute (ACI):
a. CT-13, Concrete Terminology.
b. 117, Specification for Tolerances for Concrete Construction and Materials.
c. 211.1, Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
d. 212.3R, Chemical Admixtures for Concrete.
e. 232.2R, Use of Fly Ash in Concrete.
f. 301, Specifications for Structural Concrete for Buildings.
g. 318, Building Code Requirements for Structural Concrete.
h. 350, Code Requirements for Environmental Engineering Concrete Structures.
2. ASTM International (ASTM):
a. C33, Standard Specification for Concrete Aggregates.
b. C39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
c. C94/C94M, Standard Specification for Ready-Mixed Concrete.
d. C125, Terminology Relating to Concrete and Concrete Aggregates.
e. C150, Standard Specification for Portland Cement.
f. C157, Standard Test Method for Length Change of Hardened Hydraulic-Cement, Mortar, and Concrete.
g. C192, Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory.
h. C260, Standard Specification for Air-Entraining Admixtures for Concrete.
i. C494, Standard Specification for Chemical Admixtures for Concrete.
j. C595, Standard Specification for Blended Hydraulic Cements.
k. C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
l. C1107, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink).
m. C1602, Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.
n. C1778, Standard Guide for Reducing Risk of Deleterious Alkali-Aggregate Reaction in Concrete.

1.3 SUBMITTALS

A. Action Submittals: Submit the following:
1. Shop Drawings:
a. Schedule (table) of concrete materials proposed, listed by each specified grouping of concrete Work, including, but not limited to, aggregates, sand, cement (by type), SCM, admixtures, grouts, and other materials. For each separate material and product, indicate manufacturer and type of material.
b. Mix Designs:
1) Proposed mix design for each concrete grouping required. For each, indicate concrete designation (type) indicated in the Contract Documents, proposed materials and proportioning, and intended special uses, such as concrete intended

for placement in cold weather or warm weather, concrete to be placed by pumping, concrete intended for specific locations in the Work, and others.

2) Engineer's approval of mix design Shop Drawing is only for limited purposes indicated in the Contract Documents, including the General Conditions, and in no way reduces or mitigates Contractor's responsibility for construction means, methods, techniques, procedures, and sequences.

2. Product Data:
   a. Written affidavit stating materials proposed comply with requirements of reference standards indicated in this Section. Clearly indicate specific reference standards applicable to each specific material.
   b. For aggregate and sand, indicate source (quarry) and gradation of materials proposed for use. Indicate the specific concrete mix design(s) proposed for each.
   c. For cement and SCM, indicate material source and submit manufacturer's technical data (except safety data sheets).
   d. For each proposed admixture and type of grout material (including non-shrink grouts, epoxy grout, and grout cure/seal compound), submit manufacturer's published technical data (except safety data sheets).

B. Informational Submittals: Submit the following:
   1. Certifications: Submit concurrent with, but separate from, associated Shop Drawings and product data Submittals:
      a. Certification of standard deviation, in units of pounds per square inch, for ready mix plant furnishing concrete.
      b. SCM: Certification that SCM complies with quality requirements of this Section, and SCM Supplier's certified test reports of SCM delivered to concrete Supplier.
      c. ASTM C33: Certification that class of coarse aggregate complies with ASTM C33 for type and location of concrete Work.
      d. Aggregate:
         1) Certification of aggregate gradation.
         2) Certification of coarse aggregate impurities relative to alkali-aggregate reactivity in accordance with ASTM C1778.
      e. Certification of shrinkage test results.
   2. Test Reports:
      a. Cement and SCM mill certificates for all materials to be supplied.
      b. Test results for AAR impurities of coarse aggregates within proposed mixes, in accordance with ASTM standards cited in this Section.
   3. Supplier's Instructions: Submit concurrent with, but separate from, associated product data Submittals:
      a. Manufacturer's written instructions on proper storage, handling, mixing, and use of materials furnished.

1.4 DELIVERY, STORAGE AND HANDLING

A. Storage of Materials:
   1. Admixtures:
      a. Store admixtures in manner that avoids contamination, evaporation, and damage.
      b. For admixtures used in form of suspensions or non-stable solutions, perform agitating as recommended by manufacturer to ensure uniform distribution of ingredients.
      c. Protect liquid admixtures from freezing and temperature changes that adversely affect admixture characteristics and performance.
   2. Cement and SCM:
      a. Store cement and SCM in containers in weathertight space that prevent contamination with moisture and other contaminants.
   3. Aggregates:
      a. Store and access aggregates in manner avoiding excessive segregation and preventing contamination with other materials and other sizes of like aggregate.
      b. Do not use frozen or partially frozen aggregate.

4. Sand: Allow natural sand to drain until sand has relatively uniform moisture content, prior to use.
5. If stockpiled materials contact the ground, unless such materials are stored on a clean, firm, reasonably impervious surface such as concrete or asphalt paving, do not use in the concrete Work bottom six inches of stockpiled materials.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cement:
1. ASTM C150, Type I/II cement, unless otherwise required by the Contract Documents.
2. At Contractor's option, provide ASTM C595, Type IL (MS) or IL (HS).
3. Cement type provided shall match cement type used in associated approved mix design.

B. SCM:
1. Fly Ash:
   a. ASTM C618, Class F.
   b. Non-staining.
   c. Appropriate for providing hardened concrete of uniform, light-gray color.
   d. Compatible with all other concrete ingredients. Fly ash shall have no deleterious effect on hardened concrete Work.
   e. Evaluate and use in accordance with ACI 232.2R.
2. SCM type used shall match SCM type used in associated approved mix design.

C. Admixtures:
1. Admixtures – General:
   a. Provide admixtures of same type, manufacturer and quantity as used in establishing required concrete proportions in mix design approved by Engineer.
   b. Provide admixtures certified by manufacturers as compatible with other admixtures proposed.
2. Air Entraining Admixtures: Comply with ASTM C260.
3. Water Reducing Admixtures:
   a. Provide water-reducing admixtures in all concrete mixes to provide and maintain required water-to-cement ratio without additional cement.
   b. Water Reducing, Retarding and Accelerating: Comply with ASTM C494 Types A through E, and ACI 212.3R.
   c. High Range Water Reducers (Superplasticizers):
      1) Required for pumped concrete.
      2) Comply with ASTM C494 Types F and G.
4. Hydration Stabilizer:
   a. Comply with ASTM C494 Type D.
5. Admixture Chlorides – General:
   a. Provide chloride-free admixtures.
   b. Do not use calcium chloride.

D. Crystalline Cementitious Waterproofing:
1. Products and Manufacturers: Subject to compliance with the Contract Documents, the following are acceptable.
   a. Xypex Chemical Corporation, C-500 or C-500 NF.
   b. Kryton International Inc, Krystol Internal Membrane (KIM).
   c. Or equal.
2. Description: Factory blended dry powder compound consisting of Portland cement, treated aggregate, and active chemicals.
3. Dosage rate shall be not less than percentages by weight of cementitious material shown below for each product or additional as necessary to comply with the performance requirements indicated below.

a. Xypex Chemical Corporation, C-500: 2 percent
b. Xypex Chemical Corporation, C500 NF: 1 percent
c. Kryton International Inc, Krystol Internal Membrane (KIM): 2 percent

4. Required Locations: Provide crystalline cementitious waterproofing admixture in all water bearing foundation concrete and concrete in contact with soil that does not require the antimicrobial crystalline cementitious waterproofing admixture. Provide admixture in bottom wall pour concrete at aeration basin nos. 5-8 as indicated on the Drawings.
5. Performance Criteria:
   a. Mix waterproofing material in proportions recommended by manufacturer.
   b. Submit to Engineer, together with product data Submittal, results of tests (previously performed for manufacturer) by independent third-party testing entity.
   c. Crystalline cementitious waterproofing material, identical to that proposed for use in the Work, shall have been tested in accordance with the following:
      1) DIN 1048/ EN 12390, Water Impermeability of Concrete:
         a) Supplier shall retain independent testing entity to perform testing in accordance with DIN 1048/EN 12390.
         b) Prepare and test untreated samples ("control samples") and treated samples, all of the same concrete mix design using a mix design similar to that used for the Work. Test not less than three control samples and three treated samples.
         c) Sample size to be in accordance with DIN 1048/EN 12390 requirements.
         d) Subject samples to test pressure of water not less than design hydrostatic pressure to which concrete will be subject after Substantial Completion, for test duration of not less than 72 hours.
         e) Treated samples shall demonstrate not less than 90 percent reduction in depth of water penetration (average of all treated samples tested compared with average of all untreated control samples tested).
      2) Permeability: Supplier shall retain independent testing entity to perform permeability testing in accordance with USACE CRD-C 48 - Standard Test Method for Water Permeability of Concrete.
         a) Test samples of concrete, of identical mix design, using mix design similar to that used for the Work. Test untreated samples ("control samples") and samples treated with the admixture.
         b) Sample size to be in accordance with USACE CRD-C 48 requirements.
         c) Subject samples to water at test pressure of 200 psi.
         d) When compared with control samples, the treated samples shall exhibit no measurable leakage. Control samples shall exhibit full saturation and measurable leakage.

E. Antimicrobial Crystalline Cementitious Waterproofing
1. Products and Manufacturers: Subject to compliance with the Contract Documents, the following are acceptable.
   a. Xypex Chemical Corporation, Bio-San C500.
2. Description: Factory blended dry powder compound consisting of Portland cement, treated aggregate, and active chemicals.
3. Dosage rate shall be not less than 1 percent by weight of cementitious materials or additional as necessary to comply with the performance requirements indicated above for Crystalline Cementitious Waterproofing.
4. Required Locations: Provide antimicrobial crystalline cementitious waterproofing admixture in all water bearing concrete above the foundation except for the bottom wall pours of the aeration basin nos. 5-8 as indicated in the Drawings.

F. Water:
1. Potable in accordance with Laws and Regulations.
2. Clean and free from deleterious substances.
3. Free of oils, acids, and organic matter. Comply with ASTM C1602.

G. Aggregates for Normal Weight Concrete:

1. Comply with ASTM C33.
2. Fine aggregates and coarse aggregates are separate ingredients.
3. Blended aggregates are unacceptable.
4. Coarse Aggregate:
   a. Material shall be well-graded, washed aggregate, free of organic material.
   b. Gradation: In accordance with Table 03 31 30-A in this section's "Mixes" Article.

H. Maximum total water-soluble chloride ion content for concrete mix including all ingredients measured as weight percent of cement in accordance with ASTM C1218:
   1. All concrete: 0.10.

I. Sand Cement Grout (termed "Grout" on the Drawings):
   1. Performance Criteria:
      a. Minimum 28 day compressive strength: 3,000 PSI.
      b. Strength shall be not less than strength of adjacent concrete to which grout is applied.
   2. Materials:
      a. Provide sand cement grout as approximately three parts sand to one part Portland cement, 4.5 percent to 7.5 percent entrained air and water to provide slump allowing grout to completely fill required spaces and surround adjacent reinforcing.
      b. Provide sand in accordance with requirements for fine aggregate for concrete.

J. Non-shrink Grout:
   1. Manufacturers and Products: Subject to compliance with the contract Documents, the following are acceptable:
      a. Sika, SikaGrout 713.
      b. Euclid Chemical Company, NS Grout.
      c. Five Star Products, Five Star Grout.
      d. Or equal.
   2. Description:
      a. This provision requires non-shrink, non-metallic grout. Unless otherwise shown or indicated in the Contract Documents, references to "non-shrink grout" refer to non-shrink, non-metallic grout required by this provision.
   3. Performance Criteria:
      a. Non-shrink grout shall produce a positive but controlled expansion.
      b. Mass expansion shall not be created by gas liberation or by other means.
      c. Minimum 28-day Compressive Strength: 7,000 PSI.
   4. Material:
      a. Provide material that is non-shrink, non-metallic, non-corrosive, and non-staining.
      b. Comply with ASTM C1107, Grade B.
      c. Premixed with water only. Add water in accordance with manufacturer's written instructions.

K. Epoxy Grout:
   1. Manufacturers and Products: Subject to compliance with the Contract Documents, the following are acceptable:
      a. Sika, SikaFlow 648.
      b. Five Star Products, DP Five Start Epoxy Grout.
      c. Euclid Chemical Company, E3 Flowable.
      d. Sika, Sikadur 42, Grout Pak.
      e. Or equal.
      f. One manufacturer shall furnish both aggregate and adhesive.
   2. Description:
      a. Three-component epoxy resin system, comprised of two liquid epoxy components and one inert aggregate filler component.
      b. Indication of locations where epoxy grout is required are indicated in the grout schedule in Section 03 31 31 - Concrete Mixing, Placing, Jointing, and Curing.
      c. Furnish each component in separate package for mixing at the Site.

3. Performance Criteria:
   a. Minimum 28-day Compressive Strength: 13,000 psi.
4. Materials:
   a. Aggregate shall be compatible with adhesive.

2.2 MIXES

A. Mixes - General:
   1. Provide concrete capable of: (a) being placed without segregation of aggregate from other components, and (b) developing all properties necessary and required.
   2. Provide ready-mix concrete in accordance with ASTM C94/C94M.
   3. Batching and other tolerances shall be in accordance with ACI 117.
   4. All concrete shall be normal weight concrete, unless otherwise required by the Contract Documents. Normal weight concrete shall weigh approximately 145 to 150 pounds per cubic foot (without reinforcing steel), measured 28 days after placing.

B. Concrete Mixes:
   1. Mix design requirements are indicated in this Section's Table 03 31 30-A, below.

C. Air Entrainment:
   1. Provide air entrainment in concrete providing total air content, expressed as percent by volume, in accordance with this Section's Table 03 31 30-A, below.
   2. Adjust dosage rate as necessary to compensate for shrinkage reducing admixtures and concrete placing method.

D. Slump:
   1. Slump – General:
      a. Measure slump at point of discharge of wet concrete into final location.
      b. Compensate for slump loss due to placing method.
      c. Concrete with slump less than minimum required may be used provided such concrete can be properly placed and consolidated.
      d. Slump of Concrete to be Placed by Pumping:
         1) Provide water or water-reducing admixture at ready-mix plant for concrete to be placed by pumping, to allow for slump loss due to pumping.
         2) Provide additional water sufficient only so that slump of concrete at discharge end of pump hose does not exceed: (a) maximum allowable slump indicated, and (b) maximum specified water-to-cement ratio.
      e. Slump Adjustment at the Site:
         1) Slump may be adjusted at the Site by providing water reducers.
         2) Dosing shall be performed by experienced quality control technician employed by concrete Supplier. Concrete mixing thereafter shall be directed by the same technician.
      f. Slump tolerances shall comply with ACI 117.
   2. Concrete for Walls and Columns:
      a. 8 inches maximum; 4 inches minimum.
      b. Slump shall be obtained by use of mid-range or high-range water reducer complying with ASTM C494.
   3. Concrete for Drilled Piers:
      a. Comply with Specification Section 31 63 29.
   4. All Other Members:
      a. Concrete using water reducer in accordance with ASTM C494: 8 inches maximum; 4 inches minimum.
      b. Concrete without water reducer in accordance with ASTM C494: 5 inches maximum, one inch minimum.

E. Proportioning:
   1. Proportioning - General:

a. Proportion components of concrete to provide mixture that can be placed: (a) into corners and angles of forms, and around reinforcing, by placing and consolidation methods employed, (b) without component materials becoming segregated, and (c) without excessive, free water to collecting on concrete surface or other surfaces.
b. Proportion component elements of concrete to provide proper concrete Work, including concrete durability, strength, and other necessary and required properties.

2. Normal Weight Concrete:
   a. Normal weight concrete target cementitious materials contents and maximum water to-cementitious ratios shall be in accordance with this Section's Table 03 31 30-A, below.
   b. Target cementitious materials contents indicated in the Contract Documents are intended to provide crack-free, durable, finished concrete Work, rather than concrete Work of excessive strength.
3. SCM:
   a. SCM – General:
      1) Use only one type of SCM in a given mix unless expressly required or approved by Engineer.
      2) Water-to-cementitious (i.e, total of SCM plus cement) ratio shall not exceed required maximum water-to-cement ratio indicated in this Section.
   b. Fly Ash:
      1) For cast-in-place concrete only, maximum of 25 percent by weight of Portland cement content, per cubic yard, may be fly ash, at rate of one pound fly ash for one pound cement.
4. Water-Reducing, Water-Retarding, and Water-Accelerating Admixtures:
   a. Provide in accordance with admixture manufacturer's written instructions.
   b. Add to mix at ready-mix plant.
   c. Use hydration stabilizer admixture, in concrete, as necessary and required, for placing and workability.
      1) Water reducers are required to maintain required maximum water-to-cement ratios.
5. High Range Water Reducers (Superplasticizers):
   a. Superplasticizers are required in:
      1) Concrete to be pumped, except slabs-on-grade and mats.
      2) Concrete for water-bearing structures.
      3) Other concrete Work at Contractor's option.
   b. Maximum concrete slump, before addition of admixture, shall be three inches. Maximum slump after addition of superplasticizer admixture shall be eight inches.
   c. Comply with Section 03 31 31 - Concrete Mixing, Placing, Jointing, and Curing, relative to superplasticizers.
6. Normal Weight Concrete Mix Proportioning:
   a. Method 1:
      1) Use Method 1 when combination of concrete component materials and mixes will be evaluated and selected via trial-and-error.
      2) Provide mixes with suitable proportions and properties in accordance with ACI 211.1, using not less than three different water-to-cementitious ratios providing a range of concrete compressive strengths, including required average compressive strength.
      3) Trial mixes shall have slump within 0.75 inches of maximum allowed in the Contract Documents. For air-entrained concrete, air content of trial batches shall be within 0.5 percent of air entrainment required by the Contract Documents.
      4) For each water-to-cementitious ratio:
         a) Provide not less than three trial compressive strength tests for concrete test age required, and cure in accordance with ASTM C192.
         b) Cylinder Size: In accordance with ASTM C31.
         c) Test for compressive strength at 28 days, in accordance with ASTM C39.
            (1) Quantity of cylinders shall comply with one of the following trial strength test:

(a) 6-inch diameter cylinders: Two.
(b) 4-inch diameter cylinders: Three.

5) From results of such required tests, plot curve showing relationship between water-to-cementitious ratio and compressive strength.
6) Based on required curve, select water-to-cementitious ratio for the Work, that will provide concrete of required average compressive strength.
7) Provide cementitious content and mixture proportions so maximum water cement ratio is not exceeded when slump is equal to maximum allowed in the Contract Documents.
8) Required average compressive strength is indicated below in this Section.

b. Method 2:
1) In lieu of trial mixes required by Method 1, field test results from prior projects, for concrete made using identical or substantively identical concrete component materials and proportioning, may be used by concrete supplier in determining proposed mix proportions, provided the test results are within a year of project start date.
2) Use of proposed concrete mix proportions based on field test results from prior projects are subject to approval by Engineer. Engineer's decision will be based on information in such Submittals and demonstrated ability, of such concrete successfully provided on such prior projects, to provide required average compressive strength.
3) Requirements for Submittals of Concrete Test Results from Prior Projects:
a) Submittals of field test results from prior projects shall clearly indicate all materials, proportions, and conditions, and clearly indicate where such matters are similar to those required for the concrete Work on the Project.
b) Changes in the materials, proportions, and conditions within submitted test results from prior projects shall have been not more restricted than those for the subject, proposed concrete mix.
c) Field test reports from prior projects shall be in accordance with ACI 350.
4) Concrete proportions for the concrete Work may be determined from test results of prior projects via interpolation (by Contractor and concrete Supplier) between compressive strengths and proportions of two or more test results from prior projects, each in accordance with requirements of the Contract Documents for this Project.

7. Required average compressive strength shall exceed required 28-day compressive strength by the extent determined in accordance with ACI 350, Chapter 5 using the standard deviation of concrete ready-mix plant proposed for the Work as described in ACI 350, Chapter 5.

F. Flowable Fill(Controlled Low-Strength Material (CLSM)):
1. Provide mixture of cement, SCM, fine sand, water, and air, with consistency allowing flow under a very low pressure (low head).
2. Approximate quantities of each component per cubic yard of mixed material:
a. Cement (ASTM C150 Type I/II): 50 pounds.
b. SCM: 200 pounds.
c. Fine Sand: 2,700 pounds.
d. Water (approximate): 420 pounds.
e. Air Content (approximate): 10 percent.
3. Adjust actual quantities to provide yield of one cubic yard with materials used.
4. Approximate compressive strength shall be 85 to 175 psi.
5. Sand Gradation: Fine sand shall be evenly graded material with not less than 95 percent passing No. 4 sieve and not more than five percent passing No. 200 sieve.

G. Allowable Shrinkage:
1. Provide in accordance with Table 03 31 30-A of this Section, tested in accordance with ASTM C157 at 28 days.

2. Perform for concrete Work for all water bearing structures unless expressly indicated otherwise in the Contract Documents.

TABLE 03 31 30-A

Type of Concrete	28-day Compressive Strength	Max. W/C Ratio	Target Total Cement (pounds)	SCM	ASTM C33 Size No.	Air Content (%)	Allowable Shrinkage Limit
Normal weight lean concrete	3000 PSI	0.50	517	Note 1	7	0 to 3	NA
Normal weight concrete fill	3000 PSI	0.50	517	Note 1	57 or 67	3 to 6	NA
Normal weight concrete topping	4000 PSI	0.45	564	Note 1	89	3 to 6	NA
Normal weight water-bearing concrete	5000 PSI	0.40	611	Note 1 Note 2	57 or 67	4.5 to 7.5	0.04 percent
Drilled pier concrete	4500 PSI	0.45	564	Note 1	57	0 to 3	NA
Normal weight all other concrete	4000 PSI	0.45	564	Note 1	57 or 67	3 to 6	NA

Table 03 31 30-A Notes:

1. If SCM is proposed for use, the weight of SCM plus weight of Portland cement shall be used to comply with total target cement content.
2. SCM is required for all water bearing concrete.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Field Testing and Inspections:
   1. Code-Required Tests and Special Inspections:
      a. Section 01 45 33 - Code-Required Special Inspections and Procedures, indicates testing scope for code-required testing and special inspections by testing entity retained by Owner or entity for whom Owner is responsible.
      b. Section 03 05 05 - Concrete Testing and Inspection, indicates required testing for concrete Work.
   2. Contractor-Performed Field Testing and Inspections:
      a. Where concrete testing and inspection is required by the Contract Documents and is not part of the code-required tests and special inspections by Owner or other entity for whom Owner is responsible, such tests and inspections shall be by Contractor.
      b. Perform concrete testing and inspections in accordance with Section 03 05 05 - Concrete Testing and Inspection.
      c. Aggregates and Other Stockpiled Materials: To ensure stockpiles at the concrete mixing location are not contaminated and otherwise comply with Contract requirements, perform tests on such materials at the concrete ready-mix plant.
      d. Perform strength test on all concrete to which water or superplasticizer, above the amount stated in concrete mix design Submittal approved by Engineer, has been added.
         1) Perform sampling after water or superplasticizer has been added and additional mixing has been performed.

END OF SECTION

SECTION 03 31 31
CONCRETE MIXING, PLACING, JOINTING, AND CURING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Mixing, placing, jointing, and curing of concrete construction.

B. Related Requirements: Include but are not necessarily limited to:
   1. Section 01 45 33 – Special Inspections and Testing Program.
   2. Section 03 05 05 - Concrete Testing and Inspection.
   3. Section 03 11 13 - Formwork.
   4. Section 03 21 00 - Reinforcement.
   5. Section 03 31 30 - Concrete, Materials and Proportioning.
   6. Section 03 35 00 - Concrete Finishing and Repair of Surface Defects.
   7. Section 07 26 00 - Under Slab Vapor Retarder.
   8. Section 07 92 00 - Joint Sealants.

1.2 REFERENCES

A. Terminology:
   1. Terminology: Terminology indicated below are not defined terms and are not indicated with initial capital letters, but when used in this Section have the meanings indicated below:
      a. Unless obviously meant or intended otherwise, certain words and terms used in this Section have meanings indicated in ACI CT-13.
      b. "Water-bearing concrete" means concrete surface to be in contact (whether continuously or intermittently) with water, process liquid, or slurries during intended operation of the facility, including, but not limited to, concrete tanks, channels, wet wells, distribution chambers, and secondary containment structures.

B. Reference Standards: Standards referenced in this Section include, but are not necessarily limited to, the following:
   1. American Association of State Highway and Transportation Officials (AASHTO):
      a. M182, Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats.
   2. American Concrete Institute (ACI):
      a. CT-13, Concrete Terminology.
      b. 117, Specification for Tolerances for Concrete Construction and Materials.
      c. 304R, Guide for Measuring, Mixing, Transporting and Placing Concrete.
      d. 304.2R, Placing Concrete by Pumping Methods.
      e. 305R, Guide to Hot Weather Concreting.
      f. 305.1, Specification for Hot Weather Concreting.
      g. 306R, Guide to Cold Weather Concreting.
      h. 306.1, Standard Specification for Cold Weather Concreting.
      i. 308.1, Specification for Curing Concrete.
      j. 309R, Guide for Consolidation of Concrete.
      k. 318, Building Code Requirements for Structural Concrete and Commentary.
      l. 350, Code Requirements for Environmental Engineering Concrete Structures.
      m. 360R, Guide to Design of Slabs-on-Ground.
   3. ASTM International (ASTM):
      a. C94/C94M, Standard Specification for Ready-Mixed Concrete.
      b. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

c. C1315, Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
d. D994, Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
e. D1056, Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.
f. D1751, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

4. National Ready Mixed Concrete Association (NRMCA):
   a. Checklist for Certification of Ready Mixed Concrete Production Facilities.
5. United States Army Corps of Engineers (USACE):
   a. CRD-C572, Specifications for Polyvinylchloride Waterstop.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate concrete placement Work with other Work, and work of other contractors (if any), that must be installed prior to placement of concrete.
   2. Inform other contractors, if any, affected by the concrete Work of intended date(s) of placement of concrete. Provide sufficient advance notice to allow other contractors to perform their work that is to be completed prior to placing of concrete.

1.4 QUALITY ASSURANCE

A. Qualifications:
   1. Concrete Supplier:
      a. Ready-mix concrete batch plant shall be certified by NRMCA.
      b. Ready mix plant shall comply with NRMCA Checklist for Certification of Ready Mixed Concrete Production Facilities.
   2. Installer:
      a. Where the Work includes installing prefabricated waterstops, each worker of installer that will field-weld or splice prefabricated waterstops shall possess current, valid certification in field-welding and installing of the associated manufacturer's prefabricated waterstops. Submit to Engineer copies of certifications for workers.
   3. Independent Testing Laboratory for Waterstops:
      a. Testing shall be performed by an independent laboratory complying with requirements of the generally recognized accrediting entity for the jurisdiction where the Site is located.
      b. Testing laboratory shall obtain all concrete samples and waterproofing product samples from the manufacturer of the associated product or material.

1.5 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Scaled (minimum 1/8 inch per foot) drawings showing proposed locations of construction joints, control joints, expansion joints (as applicable) and joint profile dimensions for each joint type.
      b. Drawing indicating location, size and type of prefabricated waterstop joints.
   2. Product Data including:
      a. Manufacturers and types:
         1) Joint fillers.
         2) Curing agents.
         3) Construction joint bonding adhesive.
         4) Prefabricated waterstops.
      b. Acknowledgement that products submitted meet requirements of standards referenced.
   3. Samples:

a. Sample of each type of prefabricated waterstop proposed for the Work, when requested by Engineer.

B. Informational Submittals: Submit the following:
   1. Delivery Tickets:
      a. Copies of concrete delivery tickets.
   2. Supplier Instructions:
      a. Procedure for adding high-range water reducer at the Site.
      b. Instructions for handling and installing products approved by Engineer.
   3. Field Quality Control Submittals:
      a. Results of tests, inspections, and other quality control activities required by the Contract Documents, including Section 03 05 05 - Concrete Testing and Inspections, and this Section's "Field Quality Control" Article performed at the Site.
   4. Supplier Site Visit Reports:
      a. Report of each visit to the Site by Supplier, summarizing purpose of visit, activities while onsite, problems encountered, advice given to Contractor or Subcontractor, and actions taken.
   5. Special Procedure Submittals:
      a. Description of proposed curing methods.
   6. Qualifications:
      a. Ready-mix plant certification, in accordance with this Section's "Quality Assurance" Article.
      b. Waterstops: Certificate of training from waterstop manufacturer for individuals performing installation of waterstops and field welds and splices of waterstops.
      c. Independent testing laboratory for waterstops.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Concrete Delivery:
   1. Prepare a delivery ticket for each load of ready mixed concrete.
   2. Truck operator shall hand ticket to Contractor at the time of delivery.
   3. Ticket to show:
      a. Mix identification.
      b. Quantity delivered.
      c. Quantity of material in each batch.
      d. Outdoor temperature in the shade at location of concrete placement.
      e. Time at which cement was added.
      f. Time of delivery.
      g. Time of discharge.
      h. Quantity of water that may be added at the site without exceeding the specified water-cement ratio.
      i. Quantity of any water added at the Site.

1.7 PROJECT CONDITIONS

A. Adjust concrete mix design when material characteristics, job conditions, weather, strength test results or other circumstances warrant.
   1. Do not use revised concrete mixes until submitted to and approved by Engineer.

1.8 SEQUENCING AND SCHEDULING

A. Do not begin concrete production until proposed concrete mix design has been approved by Engineer.
   1. Engineer's approval of concrete mix design does not relieve Contractor of responsibility to provide concrete that meets the requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 PRODUCTS

A. Subject to compliance with the Contract Documents, the manufacturers listed in this article are acceptable.

B. Neoprene Expansion Joint Fillers:
   1. Acceptable manufacturers:
      a. Permaglaze.
      b. Rubatex.
      c. Williams Products.
      d. Or equal.
   2. Materials:
      a. Closed cell neoprene.
      b. ASTM D1056, Type 2, Class A or C.
      c. Grade: Compression deflection as required to limit deflection to 25 percent of joint thickness under pressure from concrete pour height.

C. Asphalt Expansion Joint Fillers:
   1. Acceptable manufacturers:
      a. W.R Meadows.
      b. J and P Petroleum Products.
      c. Or equal.
   2. Materials: ASTM D994.

D. Fiber Expansion Joint Fillers:
   1. Materials: ASTM D1751.

E. Waterstops, PVC Type:
   1. Acceptable manufacturers:
      a. Sika Greenstreak Plastic Products.
      b. W.R Meadows.
      c. Vinylex Corporation.
      d. Bometals, Inc.
      e. Or equal.
   2. Materials:
      a. Virgin polyvinyl chloride compound not containing scrap or reclaimed materials or pigment.
      b. Cast-in-place type: USACE CRD-572.
   3. Approved profiles as listed.
      a. Construction joints:
         1) Ribbed: 6 inches wide by 3/8 inch.
         2) Sika Greenstreak Plastic Products Style #679, or equal.
      b. Control joints:
         1) 6-inch wide by 3/8 inch thick with ribs and center bulb.
         2) Sika Greenstreak Plastic Products Style #705, or equal.
      c. Expansion joint:
         1) 6 inches wide by 1/8 inch thick tear web type waterstop.
         2) Allowing not less than 2 inches of horizontal movement without rupturing.
         3) Sika Greenstreak Plastic Products Style #698, or equal
   4. Provide factory-made waterstop fabrications at all changes in direction, intersections and transitions, leaving only straight butt splices for the field. Butt welds to be a minimum six inches clear of the intersection.
   5. Factory prepunched (less than 1.5 feet on centers, each edge, staggered) for wire supports.
      a. Provide hog rings or grommets at all punched holes along the length of the waterstop.
   6. See Drawings for application and other requirements.

F. Waterstops, Preformed Strip Type:

1. Acceptable manufacturers:
   a. Sika Greenstreak Plastics, Inc. (Hydrotite).
   b. Adeka Ultra Seal USA (MC-2010MN).
   c. DeNeef (Swellseal 2010).
   d. Or equal.
2. Hydrophilic, non-bentonite composition.
3. Manufactured solely for the purpose of preventing water from traveling through construction joints.
4. Volumetric expansion limited to three times maximum.
5. See the Drawings for locations, applications, and other requirements.

G. Water Swelling Sealant:
1. Required adhesive for use with strip-type waterstop.
2. Compatible with strip-type waterstop.
3. Single component, gun applied.
4. Moisture cured.
5. Minimum 70 percent volumetric expansion swelling capability.

H. Curing Materials shall comply with one or more of the following:
1. Absorbent Covers.
   a. AASHTO M182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 ounces per square yard when dry.
      1) Materials must be free of harmful substances, such as sugar or fertilizer, or substances that may discolor the concrete.
      2) To remove soluble substances, burlap should be thoroughly rinsed in water before placing it on the concrete.
2. Moisture Retaining Covers.
   a. Plastic Film: ASTM C171, not less than 10 mils thickness polyethylene film.
   b. White burlap-polyethylene sheet meeting ASTM C171.
   c. Moisture Retaining Fabric.
      1) Comply with ASTM C171.
         a) A naturally colored, non-woven polypropylene fabric with 4-mil non-perforated reflective (white) polyethylene coating containing stabilizers to resist degradation from ultraviolet light.
         b) Fabric shall exhibit low permeability and high moisture retention.
         c) Products:
            (1) PNA Construction Technologies, Inc.; Hydracure M15.
            (2) Reef Industries Inc; Transguard 4000.
            (3) Or equal.
3. Dissipating curing compound:
   a. Fugitive dye, waterborne, membrane-forming.
   b. ASTM C309, Type 1D, Class B, shall be composed of hydrocarbon resins, and dissipating agents that begin to break down upon exposure to UV light, and traffic, approximately four to six weeks after applications, providing a film that is removable with standard degreasing agents, and mechanized scrubbing actions to not impair the later addition and performance of applied finishes.
   c. Products and Manufacturers:
      1) Dayton Superior Corporation; Day Chem Rez Cure (J-11-WD).
      2) Euclid Chemical Company; Kurez DR VOX.
      3) L&M Construction Chemicals, Inc.; L&M Cure R.
      4) Or equal.

I. Epoxy Bonding Agent:
1. Three component, water based, epoxy modified Portland cement bonding agent and anti-corrosion protection coating providing up to 24 hours open time in which to apply repair mortar.
2. Capable of achieving bond strength of 2,700 psi in accordance with ASTM C882.

3. Products and Manufacturers:
    a. Euclid Chemical Company, Duralprep AC.
    b. Sika Corporation; Armatec 110 EpoCem.
    c. Or equal.

J. Vapor Retarder: Comply with Section 07 26 00 - Under Slab Vapor Retarder.

K. Sand cement grout, non-shrink grout and epoxy grout: Comply with Section 03 31 30 - Concrete Materials and Proportioning.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Installing the Work constitutes Contractor's approval of underlying work, substrates, and field conditions prevailing at the time of the Work.

3.2 PREPARATION

A. Preparation – General:
1. Materials and construction shall comply with the tolerances as specified in ACI 117.
2. Complete formwork.
    a. Perform formwork in accordance with Section 03 11 13 - Formwork.
3. Remove earth, snow, ice, water, foreign matter, and other extraneous materials from areas that will receive concrete.
4. Secure reinforcement in place.
    a. Provide reinforcing in accordance with Section 03 21 00 - Reinforcement.
5. Provide expansion joint material, anchors and other embedded items.
6. Prior to placing concrete, obtain Engineer's concurrence that associated formwork and reinforcing appear to be in accordance with the Contract Documents. However, in no event will Engineer's observations, comments, or concurrence that any part of the Work appears to be in accordance with the Contract Documents modify or reduce Contractor's sole responsibility for providing Work in accordance with the Contract Documents.
7. Do not place concrete during rain, sleet, snow, or other adverse ambient or environmental conditions unless adequate protection is provided by Contractor and such placement is acceptable to Engineer.
    a. Provide sufficient quantity of competent, experienced workers with due regard for effects of concrete temperature and atmospheric conditions on rate of hardening of concrete as required to obtain good surfaces and avoid unplanned cold joints.
    b. Do not allow precipitation or storm water runoff to increase mixing water nor to damage surface finish.
8. Remove hardened concrete and foreign materials from inner surfaces of conveying equipment and formwork.
9. Provide slabs and beams of minimum indicated required depth when sloping structural foundation base slabs and elevated slabs to drains.
    a. For floor slabs on grade, slope top of subgrade to provide slab of required uniform thickness.

B. Preparation of Subgrade for Slabs On Ground:
1. Subgrade shall be wetted without standing water immediately prior to placing concrete.
2. Obtain approval of subgrade compaction density prior to placing slabs on ground.

C. Edge Forms and Screeds:
1. Set accurately to produce designated elevations and contours of finished surface.
2. Sufficiently strong to support vibrating screeds or roller pipe screeds, if required.
3. Use strike off templates, or acceptable vibrating type screeds, to align concrete surfaces to contours of screed strips.

3.3 CONCRETE MIXING

A. Concrete Mixing - General:
   1. Provide concrete materials from one ready-mix batch plant qualified in accordance with this Section's "Quality Assurance" Article.
   2. Batch, mix, and transport in accordance with ASTM C94/C94M.

B. Control of Admixtures:
   1. Control at ready-mix plant:
      a. Admixtures shall be introduced at the ready-mix plant in accordance with manufacturer's recommendations.
      b. Charge admixtures into mixer as solutions.
         1) Measure by means of an appropriate mechanical dispensing device.
         2) Liquid considered a part of mixing water.
         3) Admixtures that cannot be added in solution may be weighed or measured by volume if so recommended by manufacturer.
      c. Add separately, when two or more admixtures are used in concrete, to avoid possible interaction that might interfere with efficiency of either admixture, or adversely affect concrete.
      d. Complete performing addition of retarding admixtures within one minute after addition of water to cement has been completed, or prior to beginning of last three quarters of required mixing, whichever occurs first.
   2. Control of Admixtures at the Site:
      a. Additional quantities of admixtures (with the exception of retarders) may be added at the Site provided:
         1) Addition of admixtures shall be under the supervision of the ready-mix plant's quality control representative.
         2) Addition of each admixture shall be documented on the delivery ticket.
         3) Provide additional mixing in accordance with ASTM C94.

C. Tempering and Control of Mixing Water:
   1. Mix concrete only in quantities for immediate use.
   2. Discard concrete which has set.
   3. Discharge concrete from ready-mix delivery vehicles within time limit stated in ASTM C94.
   4. Addition of water at the Site:
      a. Comply with Section 03 31 30 - Concrete Materials and Proportioning, for specified water cement ratio and slump.
      b. Do not exceed maximum specified water cement ratio or slump.
      c. Incorporate water by additional mixing equal to at least half of total mixing required.

3.4 PLACING OF CONCRETE

A. Placing of Concrete - General:
   1. Place concrete as a rate such that concrete, which is being integrated with fresh concrete, is "workable".
      a. Provide sufficient, competent, skilled workers for timely delivery of concrete into forms to avoid unintended cold joints and placement consolidation issues.
   2. Comply with ACI 304R,ACI 304.2R, and ACI 301.
   3. Do not begin placing concrete during rain, sleet, snow, or other adverse weather or environmental conditions that may be detrimental to concrete placement.
      a. Protect fresh concrete from ensuing inclement weather and other environmental conditions that may be detrimental to concrete.
   4. Time between concrete batching and final placement shall not exceed 90 minutes, unless indicated otherwise by the ready-mix plant or noted on the delivery ticket.
      a. Selection of time limit to end of discharge should consider ambient conditions, types of cementitious materials and admixtures used, placement procedures, and projected transportation time between ready-mix plant and the point of delivery.

b. If discharge is acceptable after more than 90 minutes have elapsed since batching, verify that air content of air-entrained concrete, slump, and temperature of concrete are as specified.

5. Do not deposit concrete which has partially hardened or has been contaminated by foreign materials.
6. Begin work only when work of other trades affecting concrete is complete.
7. When pumping concrete, do not use excess grout or mortar to lubricate concrete conveyance piping.
8. Do not use excess water for workability or any reason when placing concrete by freefall.
9. Deposit concrete continuously to avoid cold joints.
10. Provide construction joints at locations shown or indicated in the Contract Documents, unless otherwise approved by Engineer via Shop Drawing or Contract modification.
    a. Plan size of crews with due regard for effects of concrete temperature and ambient conditions to avoid unplanned cold joints.
11. Spreaders:
    a. Temporary: Remove as soon as concrete placing renders their function unnecessary.
    b. Embedded:
        1) Obtain approval of Engineer for their use.
        2) Materials: Concrete or metal.
        3) Ends of metal spreaders coated with plastic coating two inches from each end.
12. Deposit concrete as nearly as practicable in its final position to avoid segregation.
    a. Maximum free fall: 4 feet.
    b. Place concrete by means of hopper, "elephant trunk" or tremie pipe extending to within four feet of surface.
13. Perform the following operations before bleeding water has an opportunity to collect on surface:
    a. Spread.
    b. Consolidate.
    c. Straightedge.
    d. Darby or bull float.
14. No water shall be added to the concrete surface to ease finishing operation.
15. Do not discharge water into forms.
16. Consider use of form vibrators for certain placement situations.
17. Deposit concrete on void forms by methods which will not crush or damage void forms in any way.

B. Cold Weather Concrete Placement:
1. Comply with ACI 306.1.
2. Do not place concrete on forms or subgrades that are below 32 degrees F or contain frozen material.
3. Maintain all materials, forms, reinforcement, subgrade and any other items which concrete will come in contact with free of frost, ice or snow at time of concrete placement.
4. Temperature of concrete when discharged at site: in accordance with ACI 306.1.
5. Heat subgrade forms, embedments and reinforcement to between 45 and 70 degrees F, when temperature of surrounding air is 40 degrees F or below at time concrete is placed.
    a. Remove frost from subgrade, forms and reinforcement before concrete is placed.
6. Combine water with aggregate in mixer before cement is added, if water or aggregate is heated above 90 degrees F.
7. Do not mix cement with water or with mixtures of water and aggregate having a temperature greater than 90 degrees F.
8. Comply with ACI 306R for specific requirements dealing with elevated steel troweled slabs that will be exposed to freeze-thaw cycles.

C. Hot Weather Concrete Placement:
1. Comply with ACI 305.1.

2. Cool ingredients before mixing or add flake ice or well crushed ice of a size that will melt completely during mixing for all or part of mixing water if high temperature, low slump, flash set, cold joints, or shrinkage cracks are encountered.
3. Temperature of concrete at point of delivery (i.e. delivery vehicle discharge) when placed:
   a. Not to exceed 90 degrees F.
   b. Not so high as to cause:
      1) Shrinkage cracks.
      2) Difficulty in placement due to loss of slump.
      3) Flash set.
4. Temperature of forms and reinforcing when placing concrete:
   a. Not to exceed 95 degrees F.
   b. May be reduced by spraying with water to cool below 95 degrees F.
      1) Leave no standing water to contact concrete being placed.
5. Prevent plastic shrinkage cracking, slab curling, or both due to evaporation.

D. Consolidating:
1. Consolidate in accordance with ACI 309R except as modified herein.
2. Consolidate by vibration so that concrete is thoroughly worked around reinforcement, embedded items and into corners of forms.
   a. Ensure no displacement of reinforcing or other embeds from final position.
   b. Eliminate:
      1) Air or stone pockets.
      2) Honeycombing, pitting, or both.
      3) Planes of weakness.
3. Use suitable form vibrators located just below top surface of concrete, where internal vibrators cannot be used in areas of congested reinforcing.
   a. Size and coordinate external vibrators to specifically match forming system used.
4. Internal vibrators:
   a. Minimum frequency of 8000 vibrations per minute.
   b. Insert and withdraw at points approximately 1.5 feet apart.
      1) Allow sufficient duration at each insertion to consolidate concrete but not sufficient to cause segregation.
   c. Use in:
      1) Beams and girders of framed slabs.
      2) Columns and walls.
      3) Vibrating concrete around all waterstops.
   d. Size of vibrators shall be in accordance with ACI 309R, Table 5.1.5.
5. Obtain consolidation of slabs with internal vibrators, vibrating screeds, roller pipe screeds, or other appropriate means.
6. Do not use vibrators to transport concrete within forms.
7. When placing self-consolidating concrete, the use of form or pencil vibrators is acceptable, provided such methods do not cause aggregate segregation, or otherwise adversely affect the quality of the Work.
8. Provide sufficient spare vibrators at the Site during all concrete placing operations to ensure continuous vibration.
9. Bring a full surface of mortar against form by vibration supplemented if necessary by spading to work coarse aggregate back from formed surface, where concrete is to have an as-cast finish.
10. Prevent construction equipment and machinery, construction operations, and personnel from introducing vibrations into freshly placed concrete after the concrete has been placed and consolidated.

E. Handle concrete from mixer to place of final deposit by methods which will prevent segregation or loss of ingredients and in a manner which will assure that required quality of concrete is maintained.
1. Use truck mixers, agitators, and non-agitating units in accordance with ASTM C94.

2. Temporary horizontal belt conveyors:
    a. Mount at a slope which will not cause segregation or loss of ingredients.
    b. Protect concrete against undue drying or rise in temperature.
    c. Use an arrangement at discharge end to prevent segregation.
    d. Do not allow mortar to adhere to return length of belt.
    e. Discharge conveyor runs into equipment specially designed for spreading concrete.
3. Temporary metal or metal lined chutes:
    a. Slope not exceeding 1 vertical to 2 horizontal and not less than 1 vertical to 3 horizontal.
    b. Chutes more than 20 feet long and chutes not meeting slope requirements may be used provided they discharge into a hopper before distribution.
    c. Provide end of each chute with a device to prevent segregation.
4. Temporary pumping or pneumatic conveying equipment:
    a. Designed for concrete application and having adequate pumping capacity.
    b. Control pneumatic placement so segregation is avoided in discharged concrete.
    c. Loss of slump in pumping or pneumatic conveying equipment shall not exceed 1.5 inches.
    d. Do not convey concrete through pipe of aluminum or aluminum alloy.
    e. Provide pumping equipment without Y sections.

3.5 JOINTS AND EMBEDDED ITEMS

A. Construction Joints - General:
1. Provide joints at locations as shown or indicated on the Drawings or as shown on approved Shop Drawings approved by Engineer or in an appropriate Contract modification.
    a. Where construction joint spacing shown on the Drawings exceeds the joint spacing indicated in Paragraph B. below, submit proposed construction joint location in conformance with this Section.
2. Unplanned construction joints are unacceptable.
    a. If concrete cannot be completely placed between planned construction joints, then it must be removed.
3. In general, locate joints near middle of spans of slabs, beams and girders unless a beam intersects a girder at this point, in which case, offset joint in girder a distance equal to twice the width of the beam.
4. Locate joints in walls and columns at underside of floors, slabs, beams, or girders, and at tops of foundations or floor slabs, unless shown otherwise.
    a. At Contractor's option, beam pockets may be formed into concrete walls.
    b. Size pockets to allow beam reinforcing to be placed as detailed on the Drawings.
5. Place beams at same time as slabs.
6. Make joints perpendicular to main reinforcement with all reinforcement continuous across joints.
7. Provide the following joints unless shown or indicated otherwise on the Drawings:
    a. Roughen joints: horizontal construction joints.
    b. Keyed joints: vertical construction joints.
8. Roughen construction joints:
    a. Clean the previously hardened concrete interface and remove all laitance.
    b. Intentionally roughen the interface to a full amplitude of 0.25 inch.
    c. Provide recessed flat surface as required to install strip type waterstops.
9. Keyways:
    a. Construction joint keyways shall have the following dimensions, unless shown or indicated otherwise on the Drawings or as directed by Engineer.
    b. Wall keys:
        1) Keyway width, not less than one-third and not more than one-half the wall thickness measured perpendicular to wall faces.
        2) Keyway depth shall be not less than 1.5 inches.
        3) Continuous along length of wall.

4) Place keyway in wall center unless otherwise shown or indicated on the Drawings.

c. Keyways in footings, foundations, base slabs, and structural or elevated slabs:
   1) Keyway height not less than one-third and not more than one-half the footing or slab thickness.
   2) Keyway depth not less than 1.5 inches.
   3) Continuous along footing or slab.
   4) Keyway in footing or slab center unless shown otherwise on the Drawings.

d. Beam keyways:
   1) Full width of beam.
   2) Keyway height not less than 5.5 inches.
   3) Keyway depth not less than 1.5 inches.
   4) Keyway located in initial beam pour, directly above the bottom reinforcing, unless shown otherwise on the Drawings.

10. Minimum time before placement of adjoining concrete construction:
    a. All concrete: 72 hours, unless otherwise noted.

B. Construction Joints - Spacing Unless Otherwise Specified:
   1. Structures not intended to contain liquid:
      a. Wall vertical construction joints:
         1) 50 feet maximum on centers.
         2) At wall intersections, four feet minimum from corner.
      b. Base slab, floor, and roof slab construction joints:
         1) Placements to be approximately square and not to exceed 4,000 square feet.
         2) Maximum side dimension of a slab pour shall be 70 feet.
   2. Water bearing structures:
      a. Wall vertical construction joints:
         1) 30 feet maximum on centers.
         2) At wall intersections, 10 feet minimum from corner.
      b. Wall horizontal construction joints: 18 feet on centers.
      c. Floor slab, construction joints:
         1) Placements to be approximately square and not to exceed 3,600 square feet.
         2) Maximum side dimension of a slab pour to be less than or equal to:
            a) Twice the length of the short side.
            b) 60 feet.
      d. Elevated slab construction joints:
         1) Placements to be approximately square and not to exceed 4,000 square feet.
         2) Maximum side dimension of a slab pour to be less than:
            a) Twice the length of the short side.
            b) 70 feet.

C. Construction Joints - Bonding:
   1. Obtain bond between concrete pours at construction joints by thoroughly cleaning and removing all laitance from construction joints.
   2. Before new concrete is placed, all construction joints shall be coated with cement grout, or dampened, as indicated below:
   3. Roughen construction joints:
      a. Roughen the surface of the concrete to expose the coarse aggregate uniformly with 0.25 inch minimum amplitude.
         1) Remove laitance, loosened particles of aggregate or damaged concrete at the surface.
   4. Keyed construction joints:
      a. Thoroughly clean construction joints and remove all laitance.
      b. Dampen the hardened concrete immediately prior to placing of fresh concrete.

D. Slab On Grade Joints:
   1. Locate construction and control joints in slabs on grade as shown or indicated on the Drawings.

2. Time cutting properly with set of concrete, if saw cut joints are required or allowed.
    a. Start cutting as soon as concrete has hardened sufficiently to prevent aggregates being dislodged by saw.
    b. Complete before shrinkage stresses become sufficient to produce cracking.

E. Expansion Joints:
1. Do not allow reinforcement or other embedded metal items bonded to concrete (except smooth dowels bonded on only one side of joint) to extend continuously through an expansion joint.
2. Use neoprene expansion joint fillers, unless shown or indicated otherwise on the Drawings.
3. Seal expansion joints as shown or indicated on the Drawings.
    a. Comply with Section 07 92 00 - Joint Sealants.

F. Waterstops - General:
1. Waterstop shall be continuous with splices in accordance with manufacturer's instructions and create water tight joints.
2. Do not mix different types of waterstop materials in the same structure without approval from the Engineer unless shown or indicated on the Drawings.
3. Preformed strip type:
    a. Locate waterstop at center of wall, unless shown or indicated otherwise on the Drawings.
        1) Maintain at least three inches from edge of concrete or as recommended by manufacturer.
    b. Install in a bed of swelling sealant on smooth surface of hardened concrete by use of nails, adhesive or other means as recommended by manufacturer to prevent movement of waterstop during placement of concrete.
    c. Roughened joints shall be specially prepared during concrete placement to provide smooth surface for proper water stop installation.
    d. Use in joints against existing concrete where shown or indicated on the Drawings.
4. PVC waterstops:
    a. Pre-position waterstop accurately in joints, with adequate clearance from all reinforcing. Do not push waterstop into wet concrete.
    b. Secure waterstops in correct position using hog rings or grommets spaced no more than 1.5 feet maximum staggered along each edge full length and passed through the edge of the waterstop.
        1) Tie wire to adjacent reinforcing.
    c. Hold horizontal waterstops in place with continuous supports.
    d. Install according to manufacturer's instructions.
        1) Do not displace reinforcement from required location.
    e. Splice ends and intersections with perpendicular butt splice using electrical splicing iron in accordance with manufacturer's instructions.
        1) Use factory fabricated "T" and corner intersection fittings.
        2) Field splice straight runs of material.
    f. Unless otherwise noted, provide for construction joints in new construction for all structures indicated on the Drawings.

G. Other Embedded Items:
1. Place sleeves, inserts, anchors, and embedded items required for adjoining work or for its support, prior to initiating concreting.
2. Do not route electrical conduit, drains, or pipes in concrete slabs, walls, columns, foundations, beams or other structural members unless approved by Engineer.

H. Placing Embedded Items:
1. Support against displacement.
2. Fill voids in sleeves, inserts and anchor slots temporarily with readily removable material to prevent entry of concrete into voids.
3. Provide adequate means for anchoring waterstop in concrete.

a. Provide means to prevent waterstops in the forms from being folded over by the concrete as it is placed.

3.6 FINISHING

A. Comply with Section 03 35 00 - Concrete Finishing and Repair of Surface Defects.

B. Coordinate mixing and placing with finishing.

3.7 INSTALLATION OF GROUT

A. Grout Schedule:
   1. Sand cement grout:
      a. General use.
      b. As shown or indicated on the Drawings.
   2. Non-shrinking non-metallic grout:
      a. Filling form tie holes.
      b. Under column and beam base plates.
      c. Other uses shown or indicated on the Drawings.
   3. Epoxy grout:
      a. Patching cavities in concrete.
      b. Grouting of rotating or oscillating equipment base plates.
      c. As shown or indicated on the Drawings.

B. Grout Installation:
   1. Sand cement grout:
      a. Cure grout by one of methods specified.
   2. Non-shrink non-metallic grout:
      a. Clean concrete surface to receive grout.
      b. Saturate concrete with water for 24 hours prior to grouting.
      c. Mix in a mechanical mixer.
      d. Use no more water than necessary to produce flowable grout.
      e. Place in accordance with manufacturer's instructions.
      f. Provide under beam, column, and equipment base plates, and in other locations shown or indicated on the Drawings.
      g. Completely fill spaces and cavities below the top of base plates.
      h. Provide forms where base plates and bed plates do not confine grout.
      i. Where exposed to view, finish grout edges smooth.
      j. Except where a slope is shown or indicated on the Drawings, finish edges flush at the base plate, bed plate, member or piece of equipment.
      k. Coat exposed edges of grout with cure or seal compound recommended by the grout manufacturer.
      l. Protect against rapid moisture loss by covering with wet rags or polyethylene sheets. Wet cure grout for seven days minimum.
   3. Epoxy grout:
      a. Mix and place in accordance with manufacturer's written instructions.
      b. Apply only to clean, dry, sound surface.
      c. Completely fill cavities without voids.
      d. Grout base and bed plates as specified for non-shrinking, non-metallic grout.
      e. Obtain manufacturer's field technical assistance as necessary to ensure proper placement.

3.8 CURING AND PROTECTION

A. Protect concrete from premature drying, excessively hot or cold temperatures, and mechanical damage immediately after placement, and maintain with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement, hardening, and compressive strength gain.
   1. Comply with ACI 308.1 except as modified herein.

2. Do not impose loads by foot traffic, wheeled traffic, and other loads until concrete has sufficiently cured to carry imposed loads without adversely affecting the concrete. In no event shall concrete be subject to loading or traffic during initial 48 hours of curing, unless otherwise approved by Engineer.

B. For surfaces of non-water bearing structures, apply one of the following curing procedures immediately after completion of placement and finishing (surfaces not in contact with forms).
   1. Ponding or continuous sprinkling. Avoid eroding the surface of freshly placed concrete.
   2. Application of wet Absorbent Covers:
      a. Minimum lap: 12 inches.
      b. Provide continuous uniform supply of moisture, such as sprinklers or soaker hoses as necessary to keep concrete surface continuously wet.
      c. Monitor Absorbent Covers as required to prevent cover materials or concrete surface from drying out.
   3. Continuous application of steam (not exceeding 150 degrees F) or mist spray.
   4. Application of Moisture Retaining Cover sheet materials.
      a. Place as soon as possible after final finishing and without marring the surface.
      b. Minimum lap: 12 inches.
      c. Seal edges to make water-tight.
      d. Place Moisture Retaining Cover in intimate contact with the concrete surface, without wrinkles and weighted to hold in place.
      e. Hold cover and edges in place as necessary to prevent wind from displacing the cover.
      f. Moisture Retaining Fabric:
         1) Install in accordance with manufacturer's written recommendations.
         2) Saturate concrete surface and fabric side of cover immediately prior to placing.
      g. Monitor continuously during the curing period:
         1) Repair holes, tears or displaced cover.
         2) Rewet as necessary to keep concrete moist under cover.
   5. Application of other moisture retaining covering acceptable to Engineer.
   6. Water used for curing shall be within 20 degrees F of the concrete temperature.
   7. Application of a curing compound.
      a. Apply curing compound in accordance with manufacturer's written recommendations immediately after any water sheen, which may develop after finishing, has disappeared from concrete surface.
      b. Do not use on surface against which additional concrete or other material is to be bonded unless it is proven that curing compound will not prevent bond.
      c. Where a vertical surface is cured with a curing compound, the vertical surface shall be covered with a minimum of two coats of the curing compound.
         1) Apply the first coat of curing compound to a vertical surface immediately after form removal.
         2) The vertical concrete surface at the time of receiving the first coat shall be damp with no free water on the surface.
         3) Allow the preceding coat to completely dry prior to applying the next coat.
         4) A vertical surface: Any surface steeper than 1 vertical to 4 horizontal.
   8. Surfaces In Contact with Forms:
      a. Formed surfaces: Cure formed concrete surfaces utilizing final curing methods per ACI 308.1, including underside of beams, supported slabs, and other similar surfaces,
         1) See Section 03 11 13 - Formwork.
      b. Minimize moisture loss from and temperature gain of concrete placed in forms exposed to heating by sun by keeping forms wet and cool until they can be safely removed.
      c. Make provisions to keep concrete wall moist while stripping forms and until curing measures are in place.
      d. After form removal, cure concrete until end of time prescribed.
      e. Use one of the methods listed above.
      f. Forms left in place shall not be used as a method of curing in hot weather.
      g. The term "hot weather", where used in these Specifications, is defined in ACI 305.1.

h. In hot weather, remove forms from vertical surfaces as soon as concrete has gained sufficient strength so that the formwork is no longer required to support the concrete.

C. For Surfaces of Water Bearing Structures:
1. Protect concrete from premature drying, excessively hot or cold temperatures, and mechanical damage immediately after placement, and maintain with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement, hardening, and compressive strength gain.
a. Follow recommendations of ACI 308.1 except as modified herein.
b. Use Evaporation Retardant to reduce surface moisture evaporation of slabs during concrete placement. Comply with the manufacturer's written instructions of use as required to obtain the intended results.
2. Apply one of the following moist curing procedures immediately after completion of placement and finishing, for concrete surfaces not in contact with forms.
a. Ponding or continuous sprinkling.
b. Application of absorptive mats or fabric kept continuously wet and in intimate contact with concrete.
1) Surfaces shall be covered with a double layer of absorptive mats or fabric, wetted before placing, and overlapped at least 6 inches.
c. Application of sand kept continuously wet.
d. Continuous application of steam (not exceeding 150 degrees F) or mist spray.
e. Ponding and sprinkling in conjunction with application of waterproof sheet materials, conforming to ASTM C171 and only with a program as approved by the Engineer that will keep the surface continuously wet.
f. Ponding and sprinkling in conjunction with application of other moisture retaining covering as approved by the Engineer that will keep the surface continuously wet.
g. After seven days of moist curing, application of a curing compound conforming to ASTM C309 or ASTM C1315 may be substituted for moist curing.
1) Apply curing compound in accordance with manufacturer's written recommendations immediately after any water sheen which may develop during moist curing has disappeared from concrete surface.
2) Do not use on surface against which additional concrete or other material is to be bonded unless it is proven that curing compound will not prevent bond.
3) Where a surface is cured with a curing compound, the surface shall be covered with a minimum of two coats of the curing compound, 30 mils thick each coat.
4) Apply the first coat of curing compound immediately after form removal or discontinued moist curing and before the surface displays water loss. Apply in one direction only, covering uniformly to a minimum thickness of 30 mils.
5) The concrete surface at the time of receiving the first coat shall be damp with no free water on the surface.
6) Allow the preceding coat to completely dry prior to applying the next coat.
7) Apply second coat in direction perpendicular to the first coat application direction, covering uniformly to a minimum thickness of 30 mils.
h. Curing Concrete In Contact with Forms:
1) Minimize moisture loss of concrete placed in forms by keeping forms wet and cool until they can be safely removed.
2) Moist cure the top surface of concrete placed in forms as specified.
3) After form removal, cure concrete until end of time prescribed using one of the methods indicated above.
4) Forms left in place shall not be used as a method of curing in hot weather.
a) The term "hot weather", where used in these Specifications, is defined in ACI 305R.
b) In hot weather, remove forms from vertical surfaces as soon as concrete has gained sufficient strength so that the formwork is no longer required to support the concrete and commence moist curing as specified.

i. When acceptable to the Engineer, placement of the second pour at joints may occur prior to the end of the curing period.

D. Curing Period:
1. Continue curing for at least 14 days for all water bearing concrete.
2. Continue curing for at least seven days for all other concrete.
a. If one of curing procedures indicated above is used initially, it may be replaced by one of other procedures indicated any time after concrete is two days old, provided concrete is not permitted to become surface dry during transition.

E. Cold Weather:
1. Comply with of ACI 306.1.
2. Maintain temperature of concrete in accordance with ACI 306.1 for a minimum of 72 hours after concrete is placed, when outdoor temperature is 40 degrees F, or less.
a. Maximum temperature rate of decrease: In accordance with ACI 306.1.
3. Provide temporary heating, covering, insulating, or housing of the concrete Work to maintain required temperature without damage due to concentration of heat.
4. Do not use combustion heaters unless precautions are taken to prevent exposure of concrete to exhaust gases which contain carbon dioxide.
5. Interior slabs in areas intended to be heated shall be adequately protected so that frost does not develop in the supporting subgrade.

F. Hot Weather:
1. Comply with ACI 305.1 and ACI 308.1.
2. Provide as necessary cooling forms, reinforcement and concrete, windbreaks, shading, fog spraying, sprinkling, ponding, or wet covering with a light colored material.
3. Provide protective measures as quickly as concrete hardening and finishing operations will allow.
4. Maximum temperature rate of decrease: In accordance with ACI 305.1.

G. Rate of Temperature Change:
1. Maintain temperature of air immediately adjacent to concrete as uniform as possible, during and immediately following curing.

H. Protection from Mechanical Damage:
1. Protect concrete from damage of all types, whether or not mechanically imparted including load stresses, heavy shock, and excessive vibration.
2. Protect finished concrete surfaces from all types of damage, including damage by construction equipment and machinery, construction means and methods, precipitation, and running water.
3. Do not load self-supporting structures in such a way as to overstress concrete.

3.9 FIELD QUALITY CONTROL

A. Tests and Inspections:
1. Special Inspections in accordance with building code:
a. Comply with Section 01 45 33 - Code-Required Special Inspections and Procedures, and 03 05 05 - Concrete Testing and Inspection.

B. Supplier's Onsite Services:
1. Waterstop manufacturer's representative shall provide on-site training of waterstop installation, field splicing, welding and inspection procedures prior to construction.

END OF SECTION

SECTION 03 35 00
CONCRETE FINISHING AND REPAIR OF SURFACE DEFECTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Concrete finishing and repair of surface defects.
2. Chemical Sealers.
3. Polymer Modified Cementitious Coating.
4. Resurfacing Mortar.

B. Related Specification Sections include but are not necessarily limited to:
1. Section 03 11 13 - Formwork.
2. Section 03 31 30 - Concrete, Materials and Proportioning.
3. Section 03 31 31 - Concrete Mixing, Placing, Jointing and Curing.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
1. American Concrete Institute (ACI):
   a. CT-13, Concrete Terminology.
   b. 117, Specification for Tolerances for Concrete Construction and Materials.
   c. 308, Standard Practice for Curing Concrete.
2. ASTM International (ASTM):
   a. C109, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens).
   b. C150, Standard Specification for Portland Cement.
   c. C157, Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete.
   d. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
   e. C595, Standard Specification for Blended Hydraulic Cements.
   f. C666, Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing.
   g. C779, Standard Test Method for Abrasion Resistance of Horizontal Concrete Surfaces.
   h. C1315, Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
   i. D4258, Standard Practice for Surface Cleaning Concrete for Coating.
   j. D4259, Standard Practice for Abrading Concrete.
   k. E1155, Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers.
   l. E1486, Standard Test Method for Determining Floor Tolerances Using Waviness, Wheel Path and Levelness Criteria.
3. International Concrete Repair Institute (ICRI):
   a. 310.1R, Guide for Surface Preparation for the Repair of Deteriorated Concrete Resulting from Reinforcing Steel Corrosion.
   b. 310.2R, Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays.
4. The Society for Protective Coatings/NACE International (SSPC/NACE):
   a. SP 13/NACE No. 6, Surface Preparation of Concrete.

B. Qualifications:
1. Chemical Sealer CS-2:

a. Applicator shall be factory trained and approved, in writing, by the manufacturer to apply the product.
b. Applicator shall have a minimum of five years of experience successfully applying materials specified.

1.3 DEFINITIONS

A. Vertical Surface Defects:
1. Any void in the face of the concrete deeper than 1/8 inches, such as:
a. Tie holes.
b. Air pockets (bug holes).
c. Honeycombs.
d. Rock holes.
2. Scabbing:
a. Scabbing is defect in which parts of the form face, including release agent, adhere to concrete.
3. Foreign material embedded in face of concrete.
4. Fins 1/16 inches or more in height.

B. Installer or Applicator:
1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
2. Installer and applicator are synonymous.

C. Other words and terms used in this Specification Section are defined in ACI CT-13.

1.4 SUBMITTALS

A. Shop Drawings:
1. Product technical data including:
a. Acknowledgement that products submitted meet requirements of standards referenced.
b. Manufacturer's installation instructions.
2. Certifications:
a. Certification of aggregate gradation.
b. Certification of manufacturer experience qualifications and performance history.
c. Certification of applicator's qualifications.
1) Refer to Qualifications paragraph.
2) Provide manufacturer's written approval of applicators.
3) Provide references substantiating specialty experience.

B. Informational Submittals:

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's recommendations and requirements for materials used.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Bonding Agents:
a. Sika Corporation.
b. Euclid Chemical Co.
2. Patching Mortar:
a. Euclid Chemical Co.
b. Sika Corporation.

2.2 MATERIALS

A. Patching Mortar: Trowelable cementitious repair mortar for vertical, overhead, and horizontal repairs.
   1. Portland cement-based, rapid set repair mortar for interior or exterior use.
   2. Compressive Strength, ASTM C109:
      a. Minimum 3000 psi at 7 days.
      b. Minimum 5000 psi at 28 days.
   3. Freeze Thaw Durability, ASTM C666: 96.75% at 300 Cycles.
   4. Shrinkage, ASTM C157: 0.069%.
   5. Euclid Chemical Speed Crete Red Line.

B. Bonding Agents:
   1. Cementitious three component epoxy coating material for interior or exterior application as a bonding agent to improve adhesion and mechanical properties of concrete patching mortars.
      a. Euclid Chemical Company; Duralprep A.C.
      b. Sika Corporation; Armatec – 100 EpoCem.
      c. Or equal.

C. Cement:
   1. ASTM C150, Type V cement for water bearing concrete and concrete in contact with soil, unless otherwise required by the Contract Documents.
   2. ASTM C150, Type I/II cement for all other concrete, unless otherwise required by the Contract Documents.
   3. At Contractor's option, provide ASTM C150, Type V cement for all concrete.
   4. At Contractor's option, provide ASTM C595, Type IL (HS) cement for water bearing concrete and concrete in contact with soil.
   5. At Contractor's option, provide ASTM C595, Type IL (MS) cement for all other concrete.
   6. At Contractor's option, provide ASTM C595, Type IL (HS) cement for all concrete.

D. Aggregate:
   1. Sand: Maximum size #30 mesh sieve.

E. Water: Potable.

F. Nonshrink Grout: See Specification Section 03 31 30 and Specification Section 03 31 31.

2.3 MIXES

A. Bonding Grout: One part cement to one part aggregate.

B. Patching Mortar:
   1. One part cement to 2-1/2 parts aggregate by damp loose volume.
      a. Substitute white Portland cement for a part of gray Portland cement to produce color matching surrounding concrete.

PART 3 - EXECUTION

3.1 PREPARATION

A. For methods of curing, see Specification Section 03 31 31.

B. Surface Preparation:
   1. Clean surfaces in accordance with ASTM D4258 to remove dust, dirt, form oil, grease, or other contaminants prior to abrasive blasting, chipping, grinding or wire brushing.
   2. Prepare surfaces in accordance with ASTM D4259 and SSPC SP 13/NACE No. 6 to completely open defects down to sound concrete and remove laitance.
      a. Provide concrete surface profile (CSP) in accordance with ICRI 310.2:
         1) Areas to receive Repair Mortar:

a) Areas larger than 1 SF or deeper than 1/4 inches Abrasive blast, scarify or needle scale to CSP No. 6-8.

b. If additional chipping or wire brushing is necessary, make edges perpendicular to surface or slightly undercut.
c. No featheredges will be permitted.
d. Rinse surface with clean water to remove all dust, dirt, debris, loosened concrete, laitance, and other contaminants.
e. Prepare corroded steel in accordance with ICRI 310.1R.

C. Preparation of Bonding Grout Mixture:
1. Mix cement and aggregate.
2. Mix bonding agent and water together in separate container in accordance with manufacturer's instructions.
3. Add bonding agent/water mixture to cement/aggregate mixture.
4. Mix to consistency of thick cream.
5. Bonding agent itself may be used as bonding grout if approved by manufacturer and Engineer.

D. Preparation of Patching Mortar Mixture:
1. Pre-blended patching mortar:
a. Mix specified patching mortar per manufacturer's published recommendations.
b. For repairs exceeding 2 inches in depth, mix with clean, pre-dampened 3/8 inches pea gravel in accordance with the manufacturer's recommendations.
2. Field mixed patching mortar:
a. Mix cement and aggregate.
b. Add only enough water to cement/aggregate mixture to allow handling and placing.
c. Let stand with frequent manipulation with a trowel, until mix has reached stiffest consistency to allow placement.

3.2 INSTALLATION AND APPLICATION

A. Do not repair surface defects or apply wall or floor finishes when temperature is or is expected to be below 50 degrees F.
1. If necessary, enclose and heat area to between 50 and 70 degrees F during repair of surface defects and curing of patching material.
a. Use only clean fuel, indirect fired heating apparatus.
b. Exhaust combustion byproducts outside of work area.

B. Repairing Surface Defects:
1. This method is to be used on vertical concrete surfaces as indicated in the Concrete Finishes for Vertical Wall Surfaces paragraph of this Specification Section and similar concrete surfaces not otherwise specified to receive another finish or coating.
a. For surfaces indicated to receive finish or coating other than those specified herein; refer to the applicable Specification Section for surface preparation requirements:
1) High Performance Industrial Coatings: See Specification Section 09 96 00.
2. Fill and repair surface defects and tie-holes using patching mortar mix specified in the MATERIALS Article in PART 2.
a. Pre-blended patching mortar:
1) Prime exposed reinforcing steel, embeds or other steel surfaces with primer as recommended by patching mortar manufacturer.
2) Scrub bond coat:
a) Wet substrate to a saturated surface dry (SSD) condition.
b) Mix patching mortar to a scrub coat or slurry consistency per manufacturer's published recommendations and apply to entire area.
3) As an alternate to the scrub bond coat, concrete may be primed with manufacturer's recommended epoxy primer.
4) Patching Mortar Application:

a) Mix and apply Patching Mortar per manufacturer's recommendations within the open time of the product scrub coat or any bonding agents.
b) Finish to level of surrounding concrete surface utilizing techniques recommended by manufacturer.

b. Field mixed patching mortar:
1) Fill and repair using patching mortar mix specified in the MIXES Article in PART 2 of this Specification Section.
2) If required by bonding agent manufacturer, etch surfaces with a muriatic acid solution followed by a thorough rinse with clean water.
a) Test concrete to determine pH level and continue flushing with clean water until surface pH is within acceptable limits.
3) Dampen area to be patched to a saturated surface dry (SSD) condition prior to application of bonding grout.
4) Brush bonding grout into the surface.
5) Allow bonding grout to set for period of time required by bonding agent manufacturer before applying patching mortar.
6) Fill all defects with patching mortar.

3. Consolidate patching mortar into place and strike off so as to leave patch slightly higher than surrounding surface.
4. Leave undisturbed until mortar has stiffened before finishing level with surrounding surface.
a. Do not use steel tools in finishing a patch in a formed wall which will be exposed to view.
5. Cure patching mortar in accordance with ACI 308.

C. Concrete Finishes for Vertical Wall Surfaces:
1. General:
a. Give concrete surfaces finish as specified below after removal of formwork and repair of surface defects.
b. Finish numbers not listed are "Not Used".
2. Finish #1 - As cast rough form finish:
a. Selected forming materials are not required.
b. Prepare surface in accordance with the PREPARATION Article in PART 3 of this Specification Section.
c. Repair the following surface defects using patching mortar specified in PART 2:
1) Tie holes.
2) Honeycombs deeper than 1/4 inches.
3) Air pockets deeper than 1/4 inches.
4) Rock holes deeper than 1/4 inches.
d. Chip or rub off fins exceeding 1/4 inches in height.
e. Provide at unexposed surfaces such as:
1) Foundations.
2) Below-grade walls not to be waterproofed.
3. Finish #2 - As cast form finish:
a. Form facing material shall produce a smooth, hard, uniform texture.
1) Use forms specified for surfaces exposed to view in accordance with Specification Section 03 11 13.
b. Prepare surface in accordance with the PREPARATION Article in PART 3 of this Specification Section.
1) Chip or rub off fins exceeding 1/8 inches in height.
2) Abrasive blast surfaces in accordance with ASTM D4259 and SSPC SP 13/NACE No. 6 to completely open defects down to sound concrete and remove laitance.
a) Provide ICRI 310.2 Concrete Surface Profile (CSP) No. 3, minimum across the entire surface.
(1) For contiguous repair areas larger than 1 SF or deeper than 1/4 inches Abrasive blast, scarify or needle scale to CSP No. 6-8.

b) If additional chipping or wire brushing is necessary, make edges perpendicular to surface or slightly undercut.
c) No feather edges will be permitted.

3) Rinse surface with clean water and allow surface water to evaporate prior to repairing surface defects.
4) Repair the following surface defects using patching mortar specified in PART 2:
a) Tie holes.
b) Honeycombs deeper than 1/4 inches or larger than 1/4 inches diameter.
c) Air pockets deeper than 1/4 inches or larger than 1/4 inches diameter.
d) Rock holes deeper than 1/4 inches or larger than 1/4 inches diameter.
e) Scabbing.
5) Brush blast repaired areas to match adjacent surface texture.

c. Provide this finish for:
1) Underside of horizontal elements adjacent to the finished surface.
2) Exposed surfaces not specified to receive another finish.

D. Related Unformed Surfaces (Except Slabs):
1. Strike smooth and level tops of walls or buttresses, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces after concrete is placed.
2. Float surface to a texture consistent with that of formed surfaces.
a. If more than one finish occurs immediately adjacent to unformed surface, provide surface with most stringent formed surface requirement.
3. Continue treatment uniformly across unformed surfaces.

E. Concrete Finishes for Horizontal Slab Surfaces:
1. General:
a. Tamp concrete to force coarse aggregate down from surface.
b. Screed with straightedge, eliminate high and low places, bring surface to required finish elevations; slope uniformly to drains.
c. Dusting of surface with dry cement or sand during finishing processes not permitted.
2. Unspecified slab finish:
a. When type of finish is not indicated, use following finishes as applicable:
1) Surfaces intended to receive bonded applied cementitious applications: Scratched finish.
2) Floors: Troweled finish.
3) Exterior slabs, sidewalks, platforms, steps and landings, and ramps, not covered by other finish materials: Broom or belt finish.
4) All slabs to receive a floated finish before final finishing.
3. Scratched slab finish: After concrete has been placed, consolidated, struck off, and leveled to a Class B tolerance, roughen surface with stiff brushes or rakes before final set.
4. Floated finish:
a. After concrete has been placed, consolidated, struck off, and leveled to a Class B tolerance, do no further work until ready for floating.
b. Begin floating when water sheen has disappeared and surface has stiffened sufficiently to permit operations.
1) Use wood or cork float.
c. During or after first floating, check planeness of entire surface with a 10 feet straightedge applied at not less than two different angles.
5. Cut down all high spots and fill all low spots to produce a surface with Class B tolerance throughout.
a. Refloat slab immediately to a uniform texture.
6. Troweled finish:
a. Float finish surface to true, even plane.
b. Power trowel, and finally hand trowel.
c. First troweling after power troweling shall produce a smooth surface which is relatively free of defects, but which may still show some trowel marks.

d. Perform additional trowelings by hand after surface has hardened sufficiently.
e. Final trowel when a ringing sound is produced as trowel is moved over surface.
f. Thoroughly consolidate surface by hand troweling.
g. Finish in accordance with the FIELD QUALITY CONTROL Article in PART 3 of this Specification Section.
    1) Leave finished surface essentially free of trowel marks, uniform in texture and appearance.
h. On surfaces intended to support floor coverings, remove any defects that would show through floor covering.

7. Broom or belt finish: Immediately after concrete has received a float finish as specified, give it a transverse scored texture by drawing a broom or burlap belt across surface.
8. Underside of concrete slab finish:
    a. Match finish as specified for adjacent vertical surfaces.
    b. If more than one finish occurs immediately adjacent to underside of slab surface, provide surface with most stringent formed surface requirement.

3.3 FIELD QUALITY CONTROL

A. Tolerances:
1. Finished floor slabs:
    a. Provide Floor Flatness (F_F) and Floor Levelness (F_L) in accordance with ACI 117.
        1) Measure in accordance with ASTM E1155.
    b. Slabs not indicated to be sloped:
        1) F_F: Equal or greater than 35.
        2) F_L: Equal or greater than 25.
    c. Slabs indicated to be sloped or curved:
        1) Measure in accordance with ASTM E1486.
        2) Provide slopes or curves as indicated on the Drawings.
2. Horizontal surfaces other than finished floor slabs, including but not limited to, top of footings, top of walls, concrete fill in tankage, channels and similar applications:
    a. Gap between a 10 feet straightedge placed anywhere and the finished surface shall not exceed:
        1) Class A tolerance: 1/4 inches.
        2) Class B tolerance: 3/8 inches.
        3) Class C tolerance: 1/2 inches.
    b. Accumulated deviation from intended true plane of finished surface shall not exceed 1/2 inches.

B. Unacceptable finishes shall be replaced or, if approved in writing by Engineer, may be corrected provided strength and appearance are not adversely affected.
1. High spots to be removed by grinding and/or low spots filled with a patching compound or other remedial measures to match adjacent surfaces.

END OF SECTION

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SECTION 03 64 23
CRACK REPAIR AND INJECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Repair of cracks in existing concrete wider than specified in Article 3.1 of this Section.
2. Repair of cracks in concrete Work provided by Contractor, where approved or directed, to remedy defective concrete Work.
3. Crack repair materials.
4. Crack repair methods.
5. Equipment used in performing crack repairs.

B. Scope:
1. Contractor shall provide all labor, materials, equipment, tools, services, and incidentals to furnish and install epoxy grout injected into cracks in concrete, in accordance with the Contract Documents.
2. Surface repairs of new concrete are addressed in Section 03 35 00 – Concrete Finishing and Repair of Surface Defects.

C. Related Requirements: Include but are not necessarily limited to:
1. Section 03 01 30 - Repair and Rehabilitation of Existing Concrete.
2. Section 03 05 05 - Concrete Testing and Inspection.
3. Section 03 31 30 - Concrete, Materials and Proportioning.
4. Section 03 35 00 - Concrete Finishing and Repair of Surface Defects.
5. Price and Payment Procedures.

1.2 PRICE AND PAYMENT PROCEDURES

A. Unit Prices:
1. Bid/pay items of Unit Price Work addressed in this Section are indicated in the Bid Form, the Agreement, and in Section 01 22 00 - Measurement and Payment.
2. Description of each type of crack repair Unit Price Work is indicated in Article 3.1 of this Section.
3. Criteria for measurement for payment of such Unit Price Work are addressed in the General Conditions (as may be modified by the Supplementary Conditions) and Section 01 22 00 - Measurement and Payment, as augmented by this Section.

B. Measurement:
1. Quantity of each item of Unit Price Work covered by this Section shall be measured for payment prior to commencement of the associated Work in each work area. Limits of cracks in concrete existing prior to the Contract that are to be repaired by Contractor will be marked at the Site by Engineer or Owner. Cracks, beyond the marked limits indicated at the Site, in concrete existing prior to the Contract, will not be eligible for payment.
2. Work not marked and measured in advance for payment will not be eligible for payment.
3. Engineer will observe the associated Work performed. Crack repair Work shall be in accordance with the Contract Documents for such Work to be eligible for payment, even when such Work was marked and measured in advance for payment.
4. Repair of cracks in new concrete Work provided by Contractor is not eligible for payment under the Unit Price Work item(s) addressed by this Section. Such crack repairs are included in the Work of the associated bid/pay item under which the subject new concrete Work was provided.

1.3 REFERENCES

A. Terminology:

1. This provision indicates terminology used in this Section and in other Contract Documents that coordinate with this Section. Such terminology may or may not be indicated using initial capital letters and, when used in relation to the Work of this Section, have the meanings indicated below.
2. "Active crack" means crack in concrete with plane surfaces in a state of movement relative to each other; dynamic condition.
3. "Crack depth" means distance the crack extends from injection surface into the concrete to location where the subject crack is less than 0.002 inches wide.
4. "Effective pressure" means fluid grout pressure at point of grout entry at the injection port/nozzle. Effective pressure is gauge pressure minus hydraulic head losses in the injection system.
5. "Flushing" means removing debris and foreign matter from concrete crack to be repaired by introducing pressurized air or pressurized liquid.
6. "Gauge pressure" means reading of pressure of fluid grout, as indicated on an appropriate gauge for the service, with current, valid calibration, on discharge of the grout pump during injection of epoxy grout.
7. "Gravity feed" means filling and sealing of horizontally positioned cracks in concrete, using low-viscosity resins, by pouring and spreading onto surface or placing into purposely formed reservoirs.
8. "MPII" means manufacturer's printed installation instructions.
9. "Passive crack" means crack in concrete with plane surfaces not moving relative to each other.
10. "Pot life" means time during which polyurethane or epoxy resin is capable of being pumped.
11. "Refusal criteria" means zero flow of grout at proposed effective pressure for duration of five minutes.
12. "Resin" or "resin adhesive" means crack-filling material injected or introduced into crack in concrete for re-bonding the crack's separated edges for transfer of stress across the crack and to prevent subsequent flow of water or other liquids through the crack.
13. "Sealant" means crack-filling material, with adhesive and cohesive properties, that forms seal preventing ingress and egress of liquids and gases into and from concrete.
14. "Structural crack repair" means repair of cracks in concrete required to restore structural capacity of the cracked concrete member. Structural crack repair restores ability for tensile and compressive forces transmitted across the crack through the resin adhesive placed in the crack. Structural cracks typically display dimensional offset in the out-of-plane direction.
15. The meaning of selected, other words and terminology used in this Section are indicated in ACI CT and ACI 503.7.

B. Reference Standards:
1. American Concrete Institute (ACI):
   a. 117, Specification for Tolerances for Concrete Construction and Materials.
   b. 503.7, Specification for Crack Repair by Epoxy Injection.
   c. CT, Concrete Terminology.
2. ASTM International (ASTM):
   a. C881, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
   b. C882, Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear.
   c. D638, Standard Test Method for Tensile Properties of Plastics.
   d. D695, Standard Test Method for Compressive Properties of Rigid Plastics.
   e. D790, Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

1.4 QUALITY ASSURANCE

A. Qualifications (General):
1. Entity Performing Crack Repairs:

a. Entity performing repair of cracks in concrete, whether Contractor or Subcontractor, and including installers and applicators, shall possess not less than five years current experience repairing cracks in concrete in facilities of similar environmental exposures installing or applying materials similar to those required in this Section
b. Entity performing crack repairs shall submit to Engineer documentation of qualifications and experience, including:
    1) Documentation of successfully completing not less than three projects of similar size and complexity to the crack repair Work of this Project within the past five years.
c. Certification by Materials Manufacturers:
    1) Installer or applicator of crack repair materials shall be certified or approved, in writing, by crack repair materials manufacturers used in the Work, for installing the crack repair materials required.
d. As an alternative, installer or applicator may be certified or approved at the Site by the materials manufacturer during initial installations in accordance with Paragraph 3.6.B of this Section.

2. Additional Qualifications for Epoxy Resin Adhesive Injection:
    a. The following qualification requirements are in addition to the general qualifications required indicated above and apply to epoxy resin adhesive injection to restore structural integrity of existing concrete.
    b. Licensed or certified by manufacturer of epoxy resin adhesive.
    c. Superintendent or foreman of installer or applicator personnel shall possess not less than five years' experience in successfully injecting epoxy resin adhesive for not less than 10,000 feet of crack repair.
    d. Injection Pump Operating Technician: Shall possess not less than one year of experience consisting of not less than 3,000 feet of crack injection.
    e. Submit documentation of qualifications and experience to Engineer.
3. Manufacturer's Representative:
    a. Trained at materials manufacturers' production facilities.
    b. Experienced with and capable of properly and clearly instructing entity performing crack repairs.
    c. Knowledgeable of and experienced with current theories on the nature and causes of cracking in concrete.
    d. Methods for repairing damaged concrete.
    e. Technical aspects of correct materials selection and use.
    f. Operation, maintenance, and troubleshooting of application equipment.

B. Pre-Installation Conference for Crack Repair Work:
1. Schedule, convene, and actively participate in pre-installation conference at the Site not less than seven days prior to commencing crack repair Work at the Site.
2. Conference participants shall be knowledgeable on the types and general extent of the crack repair Work and requirements of the Contract Documents relative to crack repair Work, and times for crack repair Work as allocated in the Progress Schedule accepted by Engineer. Conference participants shall include individuals empowered to speak for and bind their respective organization regarding crack repair Work.
3. Required Participants:
    a. Contractor's project manager and Site superintendent.
    b. Project manager and foreman for each entity performing crack repair Work, including installers and applicators of crack repair materials.
    c. Manufacturer's representative of each Supplier of crack repair materials to be used in the Work.
    d. Engineer.
    e. Owner's Site Representative, if any.
    f. Owner-hired entity performing code-required tests and special inspections for crack repair Work.

g. Owner's project manager (when available) and other personnel invited by Owner (when available).

4. Conference will be chaired by Contractor, who will also advise required participants of conference date, time, and location, and prepare and distribute to participants (and others as appropriate) a record of topics discussed, and decisions made during the conference.
5. Topics to be discussed include:
   a. Procedures for marking and measuring crack repair Unit Price Work.
   b. Required environmental conditions and forecasted weather conditions at scheduled times of crack repair Work.
   c. Storage of crack repair materials.
   d. Material manufacturers' representatives' required services.
   e. Submittals required prior to commencing the crack repair Work.
   f. Surface preparation under this Section and other Specifications sections, and substrate condition and pretreatment
   g. Installation and application of repair materials.
   h. Required curing period.
   i. Special details.
   j. Field quality control requirements.
   k. Protection of adjacent surfaces and installed Work, and clean.

1.5 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Prepare crack repair work plan and submit to Engineer not less than 28 days prior to commencing Work under this Section.
      b. Crack repair work plan shall indicate the following:
         1) Basis of material selection.
         2) Specific materials proposed for use at each type of crack and work area.
         3) Proposed effective pressure for injection of repair material(s) into cracks.
         4) Surface finishing.
         5) Location and size of injection ports.
         6) Surface preparation of concrete prior to surface sealing.
         7) Method of storing and handling resins, cleaning solvents, and waste materials.
      c. Engineer's approval of crack repair work plan and any proposed crack repair methods, and Engineer's acceptance of any required certifications, does not mitigate or relieve Contractor of Contractor's responsibility to provide crack repair Work in accordance with the Contract Documents and, in no way, imparts on Engineer responsibility of any sort for construction means, methods, techniques, procedures, or sequences, or safety and protection measures incident thereto.
   2. Product Data:
      a. Material manufacturers' published technical data including:
         1) Published product data, indicating properties, appropriate uses and applications, and limitations; and manufacturer's specifications.
         2) Manufacturer's written acknowledgement that materials proposed comply with requirements of standards referenced in the Contract Documents.
      b. Material manufacturers and types:
         1) Epoxy resin adhesive.
         2) Polyurethane sealant.
         3) Surface seal.
         4) Epoxy penetrating sealant.
         5) Silane sealer.

B. Informational Submittals: Submit the following:
   1. Certifications:
      a. Certification of Materials for Intended Service:

1) Certification of material manufacturer, signed by person factory-trained by material manufacturer in the application of the materials proposed for use, indicating that materials have been reviewed and are suitable for the intended use on this Project.
2) Do not begin injection of cracks in concrete until crack repair methods proposed for the Work are certified by material manufacturer's technical representative and accepted by Engineer.

b. Manufacturer's Certification of Installer or Applicator:
1) Written certification or approval of material manufacturer of each proposed installer or applicator of crack repair materials, acknowledging that installer or applicator is knowledgeable regarding installing and applying each product proposed for use.
2) In lieu of written certification or approval required by the paragraph immediately above, submit certification that manufacturer's technical representative performed training for the installers or applicators at the Site in accordance with this Section.

c. Certification of calibration, and calibration records for the past year, for each pressure gauge to be used in the crack repair Work.

2. Technical data for metering, mixing, and injection equipment.
3. Manufacturer's Instructions:
a. Repair materials manufacturers' published installation instructions.
b. Installation instructions for repairing core holes taken at epoxy resin injection locations.
4. Qualifications Statements:
a. Entity performing concrete crack repairs, including installers and applicators.
b. Qualifications for installers and applicators performing epoxy resin adhesive injection to restore structural capacity.
c. Manufacturers' representatives performing services at the Site, when such qualifications are requested by Engineer.

C. Closeout Submittals: Submit the following:
1. Record documents that accurately depict actual locations of repaired cracks and type of crack injection materials used at each location. This may be shown and indicated on record drawings required in Section 01 78 39 - Project Record Documents.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with material manufacturer's written instructions and recommendations regarding handling, delivery, and storage.

B. Storage:
1. Store materials in tightly-sealed, original containers, off the ground and in dry location with humidity controls.
2. Do not store in direct sunlight.
3. Protect materials from temperature extremes and avoid freezing temperatures.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, manufacturers indicated below are acceptable for use in the Work of this Section.
1. Epoxy Resin Adhesive:
a. Master Builders Solutions.
b. Sika Corporation.
c. Euclid Chemical Company.
d. Or equal.
2. Surface Seal:
a. Master Builders Solutions.
b. Sika Corporation.

c. Euclid Chemical Company.
d. Or equal.

3. Polyurethane Sealant:
   a. Master Builders Solutions.
   b. Sika Corporation.
   c. Euclid Chemical Company.
   d. Green Mountain International.
   e. Or equal.
4. Epoxy Penetrating Sealant:
   a. Master Builders Solutions.
   b. Sika Corporation.
   c. Euclid Chemical Company.
   d. Or equal.
5. Silane Sealer:
   a. Sika Corporation.
   b. Or equal.

B. All materials of each type used for crack injection shall be furnished by a single manufacturer, to ensure compatibility of materials.

2.2 MATERIALS

A. Epoxy Resin Adhesive:
   1. Two-part epoxy adhesive containing 100% solids, complying with the following:
      a. Compliant with ASTM C881, Type IV, Grade 1. Viscosity that allows material to achieve and maintain penetration requirements of ACI 503.7.
      b. Bond Strength: 2,000 psi in accordance with ASTM C882.
      c. Neat Tensile Strength: 7,000 psi in accordance with ASTM D638.
      d. Neat Elongation: 1.5%, minimum, at seven days at 70 degrees F, in accordance with ASTM D638.
      e. Flexural Strength: 8,000 psi in accordance with ASTM D790.
      f. Compressive Strength: 10,000 psi in accordance with ASTM D695.
   2. For injection of structural cracks (active cracks and passive cracks).
   3. Acceptable Products:
      a. MasterInject 1380, by Master Builders Solutions.
      b. Sikadur 35, Hi-Mod LV, by Sika Corporation.
      c. Dural 452 LV, by Euclid Chemical Company.
      d. Or equal.

B. Surface Seal:
   1. Material shall seal crack faces and have sufficient strength and adhesion to contain the injection adhesive during injection and while injection adhesive cures.
   2. Capable of being removed after injection, when not leave residue or damage concrete surface concrete.
   3. Acceptable Products:
      a. MasterEmaco ADH 1420, by Master Builders Solutions.
      b. Sikadur 31, Hi-Mod Gel, by Sika Corporation.
      c. Dural Fast Set Gel, by Euclid Chemical Company.
      d. Or equal.

C. Polyurethane Sealant:
   1. Low-viscosity, expanding, hydrophilic polyurethane chemical grout forming a flexible gasket to seal non-structural cracks in concrete.
   2. Acceptable Products:
      a. MasterInject 1210 IUG, by Master Builders Solutions.
      b. SikaFix HH Hydrophilic, by Sika Corporation.
      c. Dural Aqua-Fil, by Euclid Chemical Company.
      d. Mountain Grout Gel Foam, by Green Mountain International.

e. Or equal.

D. Epoxy Penetrating Sealant:
1. Super-low-viscosity, two-component epoxy penetrating sealer containing 100% solids.
2. Capable of being used alone to seal passive horizontal cracks less than 0.030 inches wide.
3. Acceptable Products:
a. MasterInject 1000, by Master Builders Solutions.
b. Sikadur 55 SLV, by Sika Corporation.
c. Dural 335, by Euclid Chemical Company.
d. Or equal.

E. Silane Sealer:
1. Use only for cracks less than 0.010 inches wide, brushed onto surface.
2. Acceptable Products:
a. Sikagard 706, by Sika Corporation.
b. Or equal.

PART 3 - EXECUTION

3.1 CRACK REPAIR – GENERAL

A. Cracks wider than 0.012 inches in existing concrete, as shown or indicated or as directed by Engineer and designated as active crack or passive crack, and as either structural crack or non-structural crack, shall be numbered, and physically marked and measured in accordance with Article 1.2 of this Section.

B. Crack Monitoring:
1. Engineer may require monitoring of cracks to be repaired, using crack width monitor (provided by Contractor) for period (not less than 96 hours) established by Engineer, to verify whether crack is active or passive.
2. When directed by Engineer, continue monitoring crack width for time required by Engineer to determine whether crack is at its widest, as measured at concrete surface.

C. Crack repair procedures for cracks shall be verified by material manufacturer's technical representative and shall be in conformance with the following:
1. Method 1: Repair of passive cracks and cracks requiring structural repair in walls shall be as follows:
a. Crack widths less than 1/8 inches shall be pressure injected with epoxy resin adhesive.
2. Method 2: Repair of passive cracks and cracks requiring structural repair in slabs shall be as follows:
a. Cracks widths less than 1/8 inches may be pressure injected with epoxy resin adhesive or gravity fed with epoxy penetrating sealant in accordance with MPII.
3. Method 3: Repair of active, non-structural cracks, cracks that exhibit leakage, or as directed by Engineer shall be as follows:
a. Crack widths less than 1/8 inches shall be pressure injected with polyurethane sealant.
4. Method 4: Repair of active cracks requiring structural repair shall be as follows:
a. Crack widths less than 1/8 inches shall be pressure injected with epoxy resin adhesive.
b. Inject crack where crack is widest, as measured at concrete surface during one, 24 hour period.
5. Method 5: Very narrow crack (less than 0.010 inches wide) may be treated with silane sealer when directed by Engineer and approved by material manufacturer for the intended application.
6. Crack widths greater than 1/8 inches will be further investigated by Engineer and direction furnished to Contractor on repair method(s) required.

3.2 PREPARATION

A. Remove loose matter, dirt, dust, laitance, oil, grease, salt, and other contaminants from surfaces of cracks.

B. Clean cracks in accordance with the crack repair product MPII.

C. Clean surfaces adjacent to cracks, for not less than 1 inch on each side of each crack, to remove loose matter, dirt, dust, laitance, oil, grease, salt, and other contaminants that may be detrimental to bond of surface seal.

D. Do not use cleaners that will or have potential to adversely affect the repair.

3.3 EQUIPMENT USED FOR CRACK REPAIRS

A. Gauges:
   1. Use properly-calibrated gauges, with current calibration, with pump and injection hose used for introducing material into cracks. Provide additional gauges at the Site to replace gauges that malfunction.

B. Pump:
   1. Pump equipment used for pressure injection of material into cracks shall be suitable for the intended use and compatible with injection resin used.
   2. Portable, positive displacement-type pump with interlock providing inline mixing and metering for two-component injection resins.
   3. Where volume of crack repair is less than one quart for 1000 square feet of gross repair area, or where excessive grout pressure developed by pump might further damage structure, pre-mixed material and hand cartridge pumps may be used if acceptable to Engineer.
   4. Pump may be electric-powered or air-powered with interlocks providing, at the nozzle, positive ratio control of proportions for the two components.
   5. Use a primary injection pump for each material of different mix ratio. Also have available at the Site standby backup pump of similar ratio.
   6. Capable of immediately compensating for changes in resins.
   7. Do not use batch mix pumps.
   8. Provide pressure hoses and injection nozzle for proper mixing of two adhesive components of epoxy resin adhesive.

C. Discharge Pressure Control:
   1. Use automatic pressure controls capable of discharging mixed resin adhesive at pressures up to 190 to 210 psi, that maintain required pressure within range indicated in this paragraph.

D. Automatic Shutoff Control:
   1. Provide and use sensors on both components for epoxy resin adhesive reservoirs for stopping pump automatically when only one component is being pumped to mixing head.

E. Proportioning Ratio Tolerance:
   1. Maintain resin adhesive manufacturer's prescribed mix ratio within a tolerance of plus or minus 5% by volume at discharge pressure up to 160 psi.

F. Ratio/Pressure Check Device:
   1. Use two independent, valved nozzles capable of controlling flow rate and pressure by opening or closing valve as necessary to restrict material flow.
   2. Pressure gauge capable of sensing pressure behind each valve.

3.4 APPLICATION

A. Environmental Conditions:
   1. Comply with material manufacturers' written instructions for substrate temperature and moisture content, ambient temperature and humidity, ventilation, and other conditions affecting performance of concrete crack repair products.
   2. Substrate surface and ambient air temperature shall be between 40 and 90 degrees F for not less than 24 hours after application.
   3. Pre-condition components to temperature of 70 degrees F for 24 hours immediately prior to installation, unless otherwise required in MPII.
   4. Allow surfaces to attain temperature and conditions required before application.

B. Pressure Injection:
   1. Use repair methods and equipment in accordance with Articles 3.1 and 3.3 of this Section. Use of caulk guns to fill cracks is unacceptable.
   2. Drilling and Installing Injection Ports:
      a. Drill injection holes on each side of crack at a 45-degree angle to concrete surface.
      b. Provide holes at locations so that holes intersect crack at the approximate midpoint of crack depth. Holes shall extend through the crack section.
      c. Size of holes shall accommodate injection ports.
      d. Spacing of Injection Ports:
         1) Spacing between injection port holes shall not exceed the lesser of: depth of crack, 8 inches, or thickness of concrete member. Injection port holes shall be alternated from one side of crack to the other side of the crack.
         2) Space injection ports closer together to allow adjustment of injection pressure for minimum loss of resin to soil at locations where:
            a) Cracks extend entirely through wall.
            b) Backfill of walls on one side.
            c) Difficult to excavate behind wall to seal both crack surfaces.
      e. Prior to installing injection ports, clean each hole each hole of deleterious material by air-water blast to completely remove drill cuttings from hole.
      f. Install and seal around each injection port with surface seal material in accordance with material MPII.
         1) Inserted end of injection port shall not extend beyond point at which drilled hole intersects the crack.
   3. Cleaning and Flushing:
      a. After injection ports are inserted and sealed, flush crack with air-water mixture, or alternating water and air flush, to remove deleterious materials prior to injection of resin.
      b. Inject flushing media (air and water) through injection ports. Continue flushing until flushing media discharges from adjacent injection port and the crack is thoroughly cleaned.
      c. Perform final flush with air only to remove remaining water.
   4. Surface Sealing:
      a. Provide surface seal in accordance with MPII to faces of all accessible cracks prior to pressure injecting.
      b. Seal surfaces of crack to prevent escape of injection resin.
   5. Injection:
      a. Comply with material MPII and manufacturer's technical representative for mixing and injecting procedures.
      b. Commence injecting resin starting with injection port at crack's lowest elevation.
      c. Proceed upward along the crack, injecting resin through each successive injection port, without interruption, to the crack's highest elevation.
      d. Do not relocate injection nozzle to adjacent injection port until resin appears at the next-higher adjacent injection port or refusal criteria is developed.
      e. Seal each injection port immediately after completing the injection at that injection port.

C. Gravity Feed:
   1. Provide epoxy penetrating sealant in accordance with material MPII.

3.5 CLEANING

A. Removal of Crack Seals at Pressure-Injected Cracks:
   1. After completion of pressure injecting cracks in a given work area, remove surface seal material and re-finish concrete in area of pressure injection to match finish of existing, adjacent concrete.
   2. Comply with Section 03 35 00 - Concrete Finishing and Repair of Surface Defects regarding finishing requirements.

3. Do not perform surface finishing until curing period, as specified by material MPII, is complete.

B. Cleaning:
   1. Clean and properly dispose of excess materials.
   2. Avoid creation of nuisances.
   3. Comply with Section 01 74 00 - Cleaning.

3.6 FIELD QUALITY CONTROL

A. Field Tests:
   1. Monitor each pressure injection location. Observe and record the following:
      a. Volume of resin used within each 10 feet of crack length.
      b. Pump gauge pressure at intervals of no more than 10 minutes while material is being pumped.
      c. Indication of crack location and number, injection port spacing, and confirmation of resin appearing or refusal at each injection port.
   2. Epoxy Resin Adhesive Two-Component Ratio Tests:
      a. Perform ratio test for each injection unit at beginning and end of each injection work day, and when injection work is stopped for more than one hour.
      b. Document and maintain complete, accurate records of ratios and pressure checks.
      c. Disconnect mixing head and pump two adhesive components simultaneously through ratio check device.
      d. Adjust discharge pressure to 160 psi for both adhesive components.
      e. Simultaneously discharge both adhesive components into separate calibrated containers.
      f. Compare amounts simultaneously discharged into calibrated containers during same period, to determine mix ratio.
      g. Complete test at 160 psi discharge pressure and repeat procedure for 0 psi discharge pressure.
      h. Perform test in the presence of special inspector.
   3. Injection Pressure Test:
      a. Perform injection pressure test for each injection equipment unit:
         1) At start and end of each injection work day.
      b. When injection work is stopped for more than 45 minutes Disconnect mixing head of injection equipment and connect two adhesive component delivery lines to pressure check device.
      c. Pressure Check Device:
         1) Two independent, valved nozzles capable of controlling flow rate and pressure.
         2) Pressure gauge capable of sensing and displaying pressure behind each valve.
      d. Close valves on pressure check device and operate equipment until gauge pressure on each line reads 160 psi.

      Stop pumps and observe pressure; do not allow pressure gauge to drop below 150 psi within three minutes.
      e. Check tolerance to verify equipment capable of meeting specified ratio tolerance.
      f. Perform test in the presence of special inspector.
   4. Crack Injection Tests (Structural Crack Repairs Only):
      a. Perform crack injection testing on structural crack repairs, when required by Engineer.
      b. Engineer may reduce the frequency of crack injection tests at Engineer's sole discretion.

B. Suppliers' Services:
   1. Manufacturers of crack repair materials shall:
      a. Furnish required materials and services of manufacturer's representative at the Site.
      b. Review preparation and installation by Contractor and entity performing crack repair Work.

c. Certify the installation methods to be used for each repair material used in the crack repair Work of this Section.
d. Certify the installers and applicators of crack repair materials, if documentation of such prior certification was not previously furnished as a Submittal prior to starting the Work.

2. Manufacturers' representatives of crack repair materials shall be at the Site prior to and during first installation of the materials furnished under this Section to review preparation, field quality control, and proposed installation methods.
3. Project special inspector shall be present while the manufacturer's representative is on-site training the contractor and installers.

END OF SECTION

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SECTION 04 01 20
MASONRY CLEANING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Masonry cleaning.

B. Related Sections include but are not necessarily limited to:
   1. Section 04 22 00 - Concrete Masonry.

1.2 QUALITY ASSURANCE

A. Qualifications:
   1. Use experienced workmen familiar with product and its application.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Product technical data including:
      a. Manufacturer's application instructions.
      b. Manufacturer's dilution recommendations.
      c. Manufacturer's recommendations on neutralizing rinse.

B. Certifications:
   1. Certification that Contractor is experienced in this type of masonry cleaning.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Cleaning solution, detergent type:
      a. PROSOCO, Inc.
      b. Diedrich Technologies, Inc.
   2. Cleaning solution for manganese or vanadium stained masonry:
      a. PROSOCO, Inc.
      b. Diedrich Technologies, Inc.

2.2 MATERIALS

A. Detergent-Type Cleaning Solution: PROSOCO, Inc. "Sure Klean #600 inches detergent masonry cleaner.

B. Manganese or Vanadium-Stained Masonry: PROSOCO, Inc. "Vanatrol."

C. Water: Potable.

D. Neutralizing rinse as required by manufacturer.

2.3 MIXES

A. Dilute cleaning solution with potable water at rate which will provide for the weakest solution allowable for cleaning wall.

B. If project conditions require solution of greater than 5% acid, obtain permission from Engineer in writing prior to applying solution to wall surface.

PART 3 - EXECUTION

3.1 PREPARATION

A. Allow seven days after completion of masonry work before start of cleaning.

B. Remove excess mortar using wooden paddles and scrapers.

C. Protect adjacent surfaces not to be cleaned.

3.2 APPLICATION

A. Protect adjacent surfaces subject to potential damage by cleaning solution.

B. Apply masonry cleaner to exposed-to-view masonry surfaces.
   1. Do not use wire brushes.
   2. Use only tools free of rust.
   3. Apply solution using fibered wall-washing brush.

C. Thoroughly rinse and pre-soak walls.

D. Flush all loose mortar and dirt from surface.

E. Wet to prevent "run-off" streaking.

F. Scrape off mortar and reapply cleaning solution.

G. After scrubbing, clean thoroughly with pressurized water.

H. Apply neutralizing rinse as recommended by manufacturer.

END OF SECTION

SECTION 04 05 13
MASONRY MORTAR AND GROUT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Masonry mortar.
   2. Masonry grout.
   3. Integral water repellent admixture.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 04 22 00 - Concrete Masonry.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. C143/C143M, Standard Test Method for Slump of Hydraulic-Cement Concrete.
      b. C144, Standard Specification for Aggregate for Masonry Mortar.
      c. C150/C150M, Standard Specification for Portland Cement.
      d. C207, Standard Specification for Hydrated Lime for Masonry Purposes.
      e. C270, Standard Specification for Mortar for Unit Masonry.
      f. C404, Standard Specification for Aggregates for Masonry Grout.
      g. C476, Standard Specification for Grout for Masonry.
      h. C1019, Standard Test Method for Sampling and Testing Grout.
      i. C1093, Standard Practice for Accreditation of Testing Agencies for Masonry.
      j. C1384, Standard Specification for Admixtures for Masonry Mortars.
   2. The Masonry Society (TMS):
      a. Building Code Requirements and Specification for Masonry Structures (TMS 402/602-16).
   3. Building code:
      a. International Code Council (ICC):
         1) International Building Code and associated standards, 2021 Edition including all amendments, referred to herein as Building Code.

B. Qualifications:
   1. Preconstruction Testing Laboratory shall be an independent agency qualified in accordance with ASTM C1093 for performing the testing indicated.
      a. Testing Laboratory shall have a minimum of 10 years of experience in the testing of mortar and grout.
      b. Technician conducting tests shall have minimum of five years of experience in the testing of mortar and grout.

C. Mock-Ups:
   1. Provide mortar and grout for mock-up specified in Specification Section 04 22 00.

1.3 DEFINITIONS

A. Coarse grout and fine grout are defined by the aggregate size used in accordance with ASTM C476.

B. Coarse aggregate and fine aggregate are defined in ASTM C404, Table 1.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. General:
         1) Product data for cementitious materials.
         2) Source or producer of aggregates and gradation.
         3) Integral water repellent manufacturer's dosage rate.
      c. Proposed mortar mix design:
      d. Proposed masonry grout mix design.
   3. Test results:
      a. Preconstruction mortar test results.
      b. Preconstruction masonry grout test results.
   4. Samples:
      a. Colored mortar samples for color selection by Engineer.
      b. Color card and plastic simulations are not acceptable.

B. Informational Submittals:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Qualifications of testing lab and technician.
   3. Test results and inspection reports per Specification Section 01 45 33.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store cementitious materials on elevated platforms, under cover, and in a dry location.
   1. Do not use cementitious materials that have become damp.

B. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

C. Deliver preblended, dry mixes in moisture-resistant containers.
   1. Store preblended, dry mixes in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Portland Cement:
   1. ASTM C150/C150M, Type I or II.
   2. No air entrainment.
   3. Natural color.
   4. Maximum percent of alkalis: 0.60 in accordance with ASTM C150/C150M, Table 2.

B. Hydrated Lime:
   1. ASTM C207, Type S.
   2. Type SA not acceptable.
   3. Lime substitutes are not acceptable.

C. Mortar Aggregate: ASTM C144, free of gypsum.

D. Grout Aggregate: ASTM C404.

E. Water: Potable.

F. Mortar Pigments:
   1. Commercial colorants suitably compounded for use in mortar mixes.

2. Do not exceed manufacturer's recommended pigment-to-cement ratios.

G. Integral Water Repellent Admixture:
1. Liquid polymeric admixture: ASTM C1384.
2. Verify compatibility with liquid water repellent admixture being used in the fabrication of concrete masonry units.

2.2 MIXES

A. Mortar and grout shall comply with MSJC Specification and Building Code.

B. Type "S" mortar shall be used:
1. Comply with ASTM C270, Table No. 1, Cement-Lime Mortar.
a. Do not use masonry cement or mortar cement.
2. Mix materials minimum of three minutes and maximum of five minutes.
3. Adjust consistency to satisfaction of mason.
4. Do not use admixtures unless otherwise indicated.
5. Provide integral water repellent admixture in mortar used for:
a. Exterior concrete masonry work.
b. Interior concrete masonry work in wet areas.
6. Do not use integral water repellent admixture in mortar for brick.

C. Masonry Grout:
1. ASTM C476.
a. Minimum 28-day compressive strength: 2,000 PSI.
b. Maximum aggregate size: ½"
c. Slump: 8 to 11 IN.
2. Mix 5 minutes minimum.
3. No admixtures allowed.
4. At Contractor's option, premixed or preblended grout meeting the above minimum requirements may be used.

2.3 SOURCE QUALITY CONTROL

A. Perform preconstruction laboratory tests on proposed masonry mortar and grout prior to start of masonry work.
1. Perform tests far enough in advance so that any necessary retesting can be accomplished before masonry construction begins.
a. Test mortar per ASTM C270.
b. Test grout per ASTM C1019.

B. Source Limitations for Mortar Materials:
1. Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from a single manufacturer for each cementitious component and from one source or producer for each aggregate.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions and MSJC Specification.

B. Mortar:
1. If standard gray mortar begins to stiffen, it may be retempered by adding water and remixing unless prohibited by water repellent admixture manufacturer.
a. Standard gray mortar shall not be retempered more than one time.
2. All mortar must be used within 2-1/2 HRS maximum after initial mixing per MSJC Specification.
3. Engineer reserves right to alter mix design based on initial rate of absorption of masonry units.

C. Masonry Grout:
   1. Use grout within 1-1/2 HRS maximum after initial mixing.
   2. Use no grout after it has begun to set.
   3. Do not retemper grout after initial mixing.
   4. Place grout in lifts not exceeding 4 FT.
   5. Use coarse grout in spaces with least dimension over 2 IN.
   6. Consolidate all grout while installing.
      a. Consolidate grout pours 12 IN or less in height by mechanical vibration or by puddling.
      b. Consolidate grout pours exceeding 12 IN in height by mechanical vibration and reconsolidate by mechanical vibration after initial water loss and settlement has occurred.

3.2 FIELD QUALITY CONTROL

A. Masonry Mortar and Grout Testing and Inspection:
   1. Testing and inspection services will be provided by the Owner's special masonry inspector.
      a. Do not include in the bid price the cost of these services.
   2. Testing and inspection shall include, but is not limited to:
      a. Observe proportions of site-prepared mortar and grout.
      b. Observe grout space prior to grouting.
      c. Grout compressive strength sampling, testing and reporting per ASTM C1019.
         1) One strength test shall be the average of three specimens from the same sample, tested at 28 days.
      d. Grout slump test sampling, testing, and reporting per ASTM C143/C143M.
      e. Frequency of sampling: One sample (three specimens) collected each grouting operation during masonry construction.
   3. Reporting: Special inspector to submit test results and inspection reports per Specification Section 01 45 33.

END OF SECTION

SECTION 04 05 23
MASONRY ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Masonry accessories.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 04 22 00 - Concrete Masonry.
   4. Section 05 50 00 - Metal Fabrications.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. A82, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
      b. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
      c. A951, Standard Specification for Steel Wire for Masonry Joint Reinforcement.
      d. A1008, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
      e. D412, Standard Test Method for Vulcanized Rubber and Thermoplastic Elastomers - Tension.
      f. D624, Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
      g. D2000, Standard Classification System for Rubber Products in Automotive Applications.
      h. D2240, Standard Test Method for Rubber Property—Durometer Hardness.
   2. Building code:
      a. International Code Council (ICC):
         1) International Building Code and associated standards, 2021 Edition including all amendments, referred to herein as Building Code.

B. Mock-Ups:
   1. Provide specified products for inclusion into mock-up panels required by Specification Section 04 22 00.
   2. Coordinate with built-in items and veneer coursing.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Tear resistance of flashing material.
      d. Manufacturer's recommendations for flashing adhesive.
      e. Manufacturer's data sheet on each product.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Weep vents for cavity wall construction:
      a. Heckman Building Products Inc.
      b. Hohmann & Barnard, Inc.
      c. Wire Bond.
      d. Mortar Net USA, Ltd.
   2. Reglets:
      a. Hohmann & Barnard, Inc.
      b. W. P. Hickman Co.
      c. Superior Concrete Accessories, Inc.
   3. Masonry anchors, horizontal joint reinforcing and miscellaneous anchors:
      a. Heckman.
      b. Hohmann & Barnard, Inc.
      c. Wire Bond.
   4. Thru wall flashing:
      a. EPDM:
         1) Carlisle Syntech Systems, Inc.
         2) Firestone Building Products Co.
   5. Weep joint mortar protection system:
      a. Mortar Net USA, Ltd.
      b. Hohmann & Barnard, Inc.
      c. Wire Bond.
   6. Preformed control joint inserts:
      a. Hohmann & Barnard, Inc.
      b. Wire Bond.
   7. Grout screen:
      a. Wire Bond.
      b. Heckman Building Products.
      c. Hohmann & Barnard, Inc.

B. Submit request for substitution in accordance with Specification Section 01 26 00.

2.2 MANUFACTURED UNITS

A. Thru Wall Flashing:
   1. 40 MIL EPDM manufactured specifically for thru wall flashing.
      a. Tear resistance: ASTM D624, 150 LB/IN minimum.
      b. Width as necessary.
         1) Provide single piece full width, no horizontal joints will be allowed unless approved in writing by Engineer.
      c. Factory precut wherever possible.
      d. Factory fabricated inside corners, outside corners, and end dams.

B. Flashing Adhesive: As recommended by flashing manufacturer for sealing laps, sealing to vertical masonry and concrete surfaces and sealing to stainless steel surfaces.

C. Weep Vent:
   1. 90 PCT open mesh vent designed to be placed in vertical mortar joint.
   2. Mortar Net USA, Ltd. "Mortar Net Weep Vents."
   3. Color: Match masonry color.

D. Reglets:
   1. Products specified are manufactured by Hohmann & Barnard, Inc.
   2. For masonry construction: Type #MR - Masonry Reglet.

3. For concrete construction: Type #CR - Concrete Reglet.

E. Veneer Anchorage System for Concrete Masonry Back-up:
   1. Adjustable pintle and plate:
      a. Conform to ASTM A951.
      b. Cold drawn steel wire pintle, ASTM A82.
      c. 14 GA steel plate, ASTM A1008.
      d. Galvanized, ASTM A153/A153M, Class B2.
      e. 3/16 IN DIA wire x length necessary to embed pintle minimum 2 IN into veneer mortar joint.

F. Horizontal Joint Reinforcing:
   1. General:
      a. Conform to ASTM A951.
      b. Cold drawn steel wire, ASTM A82.
      c. 9 GA side rods.
      d. 9 GA cross rods.
      e. Hot-dipped galvanized, ASTM A153/A153M.
      f. Prefabricated corner and tee sections with minimum length of 30 IN from point of intersection.
   2. Single wythe wall joint reinforcing: Ladder design.
   3. Cavity wall joint reinforcing with masonry back-up:
      a. Ladder design horizontal joint reinforcing.
      b. Wire eyes welded to horizontal joint reinforcing.
         1) Length as necessary to project through rigid insulation into airspace.
      c. 3/16 IN DIA adjustable pintle veneer anchors.
         1) Length as necessary to provide minimum 2 IN embed into veneer mortar joint.
      d. Hohmann & Barnard "270 Ladder."

G. Rigid Steel Masonry Anchors:
   1. 1 IN by 1/4 IN with ends turned up 2 IN.
   2. Hot-dipped galvanized steel, ASTM A153/A153M.
   3. Length:
      a. 24 IN unless noted otherwise.
      b. Where wall conditions such as jambs or other obstructions preclude the use of 24 IN anchors, shorter anchors may be used.

H. Mesh Wall Ties:
   1. Hot-dipped galvanized steel, ASTM A153/A153M.
   2. 16 GA, 1/2 IN square mesh.
   3. Width: 2 IN less than nominal wall thickness.
   4. Length: As necessary to embed minimum 6 IN into each wall.

I. Grout Screen:
   1. Polypropylene monofilament.
   2. 1/4 x 1/4 IN mesh.
   3. Width of grout screen to be 2 IN less than nominal width of CMU.

J. Weep Joint Mortar Protection System:
   1. 100 PCT recycled polyester.
   2. 90 PCT minimum open weave mesh.
   3. Minimum 10 IN high by full width of air cavity.
   4. Trapezoidal shape.

K. Preformed Rubber Control Joint Inserts:
   1. ASTM D2000, M2AA-805.
   2. Hardness: ASTM D2240, Shore A Durometer, 80 +/-5.
   3. Ultimate elongation: 350 PCT, ASTM D412.
   4. Tensile strength: 1000 PSI, ASTM D412.

5. Hohmann & Barnard #RS Series.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Thru Wall Flashing:
   1. Install to provide positive drainage of cavity moisture.
   2. Extend flashing horizontally beyond each edge of lintel or sills to next vertical mortar joint but not less than 4 IN and turn up edge one (1) full veneer course.
      a. Seal all joints.
   3. Where thru wall flashing steps up or down in the wall, provide end dam at step.
      a. End dam shall extend up or down to tie into thru wall flashing step.
      b. Seal all joints for continuous watertight barrier.
   4. At concrete masonry unit back-up, install upper edge of flashing into block joint.
   5. Adhere vertical surface of flashing to back-up wall with adhesive recommended by flashing manufacturer.
   6. Extend flashing minimum of 6 IN above top of weep joint mortar protection system.
   7. Lap and seal flashing at all inside and outside corners to provide continuous uninterrupted barrier.

C. Weeps:
   1. Provide open weep joints at maximum 16 IN OC in head joint of first course of veneer immediately above thru wall flashing.
      a. Omit mortar bed on top of thru wall flashing at each open weep joint location to allow moisture an unobstructed path to the exterior.
      b. Weep joints shall be not more than 4 IN high.
   2. Provide weep vents maximum 16 IN OC in top of head joint of top course of veneer or as indicated on Drawings.
      a. Do not use weep vents in weep joints at the bottom of the wall.
      b. Set weep vents back away from face of veneer slightly so the front edge of the vent is contained within the mortar joint.

D. Weep Joint Mortar Protection System:
   1. Install continuous row(s) of material.
   2. Provide multiple thicknesses of material compressed as necessary to completely fill the entire air cavity.
      a. Thickness to be at least 10 PCT wider than air cavity being filled.
   3. Set material directly on top of thru wall flashing.

E. Butt joints of preformed control joint inserts tightly together and secure with adhesive or sealant acceptable to insert manufacturer.

F. Anchoring Veneer:
   1. Veneer with concrete block back-up:
      a. Anchor veneer to new construction using horizontal joint reinforcing and adjustable pintle veneer anchors.

G. Reinforcing Masonry:
   1. General:
      a. Provide continuous horizontal joint reinforcing in all concrete masonry wall construction.
         1) Embed longitudinal side rods in mortar for entire length with minimum cover of 5/8 IN on exterior side of walls and 1/2 IN at other locations.
            a) For interior partitions, the "exterior" side of the wall is considered the side having the most corrosive atmosphere or the corridor side of the wall.
         2) Lap reinforcement minimum of 14 IN at ends.

a) Remove cross wires on one (1) side of the lap splice and bend the side rods slightly so the lap is provided with 12 IN of uninterrupted wire lap occurring in the same plane.

3) Do not bridge control joints with horizontal joint reinforcing.
4) Do not bridge expansion joints with horizontal joint reinforcing.
5) At corners and wall intersections use prefabricated "L" and "T" horizontal joint reinforcing sections.
6) Cut and bend as necessary.

b. Install reinforcing at 16 IN OC vertically unless noted otherwise on Drawings.
c. Install reinforcing 8 IN OC vertically for a minimum of 24 IN at starter courses.
1) Do not install horizontal joint reinforcing in veneer mortar joint having through-wall flashing.
d. In concrete masonry back-up construction, install additional horizontal joint reinforcing and adjustable pintle veneer anchors 16 IN OC in courses on each side of vertical control joints and on each jamb of openings for full height of joint or opening.
1) Alternate with normal wall horizontal joint reinforcing.
2) Extend reinforcing minimum 32 IN beyond joint or jambs of opening.
e. In concrete masonry back-up construction, reinforce masonry openings over 12 IN wide with horizontal joint reinforcing and adjustable pintle veneer anchors placed in three (3) horizontal joints above lintel and two (2) horizontal joints below sill.
1) Extend minimum of 32 IN beyond jambs of opening.

2. Reinforcing concrete masonry:
a. Install reinforcing bars where indicated on Drawings.
1) Provide means necessary to ensure position of vertical steel reinforcing meets requirements of Building Code.
b. At intersecting load-bearing walls, provide rigid steel anchors 16 IN OC vertically, embed ends in grout filled cores.
1) Alternate rigid steel anchors with horizontal joint reinforcing.
c. At intersecting non-load bearing walls or at intersecting load bearing/non-load bearing walls provide mesh wall ties in mortar joint at 16 IN OC vertically.
1) Extend minimum 6 IN into each wall.
2) Alternate mesh wall ties with horizontal joint reinforcing.
d. Anchor intersecting concrete masonry to intersecting cast-in-place or precast concrete using dovetail slots and anchors.
3. Repair all galvanized coatings damaged as a result of welding.
a. See Specification Section 05 50 00 for galvanizing repair system.
4. Reinforcing veneer:
a. Reinforce veneer with joint reinforcement placed in veneer mortar joints:
1) In new masonry back-up construction alternate veneer horizontal joint reinforcing with horizontal joint reinforcing and adjustable pintle veneer anchors.

H. Install reglets as walls are being constructed.
1. Set reglets true with wall, plumb and at consistent depth.

I. Remove all excess mortar and grout from reglets as walls are being constructed and protect reglet openings from filling with mortar, grout and other construction debris.

END OF SECTION

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SECTION 04 05 50
COLD AND HOT WEATHER MASONRY CONSTRUCTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Cold weather protection.
   2. Hot weather protection.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Brick Industry Association (BIA):
      a. Technical Note 1, Cold and Hot Weather Construction.
   2. The Masonry Society (TMS):
      a. Building Code Requirements and Specification for Masonry Structures (TMS 402/602-16)
   3. National Concrete Masonry Association (NCMA).
      a. TEK 3-1C, All Weather Concrete Masonry Construction.

1.3 DEFINITIONS

A. As defined in MSJC Specification.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 ERECTION AND APPLICATION

A. General:
   1. Comply with NCMA TEK 3-1C recommendations and practices.
   2. Do not use frozen or ice coated materials.
   3. At end of each day or at shutdown, cover tops of all walls not enclosed or sheltered with clear polyethylene minimum 6 MIL thick.
      a. Extend down each side of wall minimum of 16 IN and secure.

B. Temporary Facilities:
   1. Construct and maintain temporary protection required to permit continuous and orderly progress of work.
   2. Provide and maintain heat sufficient to assure temperature above 32 DEGF within protected areas.
   3. Remove all temporary facilities after completion of work.

C. Cold Weather Construction and Protection Requirements:
   1. Prior to and during installation:
      a. Air temperature 32 to 40 DEGF: Heat mixing water or aggregate to produce mortar temperatures between 40 and 120 DEGF.
      b. Air temperature 25 to 32 DEGF:
         1) Heat mixing water or aggregate to produce mortar temperatures between 40 and 120 DEGF.

2) Maintain mortar temperatures above freezing until used.

c. Air temperature below 25 DEGF:
   1) Heat mixing water and aggregate to produce mortar temperatures between 40 and 120 DEGF.
   2) Maintain mortar temperatures above freezing until used.
   3) Maintain temperature of units until laid at not less than 40 DEGF.
   4) Provide heat on both sides of walls under construction to maintain air temperature above freezing.
   5) Provide windbreaks or shelters when wind is in excess of 15 MPH.
      a) Wind breaks or shelters shall be translucent.

2. After installation:
   a. Air temperature 32 to 40 DEGF: Protect from rain or snow for not less than 24 HRS by covering with weather-resistive translucent membrane.
   b. Air temperature 25 to 32 DEGF: Completely cover with translucent weather-resistive membrane for not less than 24 HRS.
   c. Air temperature 20 to 25 DEGF: Completely protect with insulating blankets for not less than 24 HRS or provide other protection approved by Engineer.
   d. Air temperature below 20 DEGF:
      1) Provide enclosed translucent shelters and heating to maintain air temperature on each side of wall above 32 DEGF for 24 HRS.
      2) Do not allow rapid drop in temperature after removal of heat.
   e. Promptly repair all tears, holes, etc., to translucent membrane and shelter using compatible patching material and tape as recommended by membrane manufacturer.

D. Hot Weather Construction and Protection Requirements:
   1. Comply with requirements of NCMA, BIA and MSJC Specification.
   2. Storage and preparation of materials.
      a. Cover or shade masonry units and mortar materials from direct sun.
      b. Maintain sand in a damp loose condition.
         1) Sand moisture shall be maintained at minimum 8 PCT.
         2) Sprinkle with cool water as required to maintain moisture content.
      c. Use cool water for mixing mortars.
      d. Avoid using tools and equipment that have been sitting in the sun.
         1) Sprinkle mortar boards, mortar pans, wheel barrows, mixers, etc., with cool water.
      e. Do not wet concrete masonry units prior to use.
   3. Installation:
      a. Place masonry units within one minute of the spreading of the mortar.
         1) Mortar beds shall not be spread more than 4 FT ahead of the masonry unit being placed.
      b. Provide wind screens and shading partitions as required to eliminate direct sunlight exposure.
      c. Wet installed units using fog spray of clean water.
      d. Cover installed work immediately after installation to slow rate of loss of moisture from units.
      e. Fog-spray new masonry work until damp.
         1) Repeat fog spraying minimum of three times per day until masonry work has cured for 72 HRS.
         2) In high humidity conditions, Engineer reserves the right to discontinue fog spraying if operation is found to be introducing excessive amounts of moisture into the Work.

END OF SECTION

SECTION 04 22 00
CONCRETE MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Concrete masonry construction (CMU), including:
      a. Standard concrete masonry.
      b. Split-face masonry.
   2. Integral water repellent admixture.
   3. Masonry special inspection.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Division 03 - Concrete
   4. Section 04 01 20 - Masonry Cleaning.
   5. Section 04 05 13 - Masonry Mortar and Grout.
   6. Section 04 05 23 - Masonry Accessories.
   7. Section 04 05 50 - Cold and Hot Weather Masonry Construction.
   8. Section 07 19 00 - Liquid Water Repellent.
   9. Section 07 21 00 - Building Insulation.
   10. Section 07 92 00 - Joint Sealants.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. C33, Standard Specification for Concrete Aggregates.
      b. C55, Standard Specification for Concrete Building Brick.
      c. C90, Standard Specification for Loadbearing Concrete Masonry Units.
      d. C140, Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
      e. C426, Standard Test Method for Linear Drying Shrinkage of Concrete Masonry Units.
      f. C1357, Standard Test Methods for Evaluating Masonry Bond Strength.
      g. E514, Standard Test Method for Water Penetration and Leakage Through Masonry.
   2. The Masonry Society
      a. Building Code Requirements and Specification for Masonry Structures (TMS 402/602-16)
   3. National Concrete Masonry Association (NCMA):
      a. TEK 2-3A, Architectural Concrete Masonry Units.
      b. TEK 3-4B, Bracing Concrete Masonry Walls During Construction.
      c. TEK 8-2A, Removal of Stains from Concrete Masonry.
      d. TEK 8-3A, Control and Removal of Efflorescence.
   4. Building code:
      a. International Code Council (ICC):
         1) International Building Code and associated standards, 2021 Edition including all amendments, referred to herein as Building Code.
   5. Concrete masonry unit manufacturer shall be licensed or qualified, in writing, by manufacturer of integral water repellent admixture to produce masonry units containing manufacturer's admixture.
      a. Concrete masonry unit manufacturer shall have a minimum of five (5) years experience producing masonry units containing manufacturer's admixture.

B. Mock-Ups:
   1. Prior to permanent wall construction, construct mock-up.
      a. Construct mock-up on a concrete slab or footing as necessary to demonstrate construction details.
         1) Minimum slab thickness: 4 IN.
      b. Mock-up shall show full color range, texture and bond pattern(s) of all masonry specified.
      c. Mock-up shall be as large as required to properly display all conditions required by the building masonry construction.
         1) Minimum 4 FT high x 4 FT long.
            a) Return corners and intersections minimum 4 FT.
         2) Mock-up shall demonstrate:
            a) Outside corner condition.
            b) Inside corner condition.
            c) Intersection of interior masonry partition.
            d) Jamb condition demonstrating lintel bearing and flashing.
            e) Masonry control joint.
      d. Include all special corners and other special CMU detailing shown on Drawings.
      e. Include all types of masonry shown on Drawings, including:
         1) Split-face masonry.
      f. Mock-up shall include, as a minimum:
         1) All types of masonry.
            a) All special shapes.
            b) All types of back-up wall system(s).
         2) Vertical wall reinforcing with grouted cell.
         3) Typical bond beam construction.
         4) Typical lintel construction.
         5) Positioning, securing and lapping of reinforcing steel.
         6) Masonry accessories:
            a) Horizontal joint reinforcing.
               (1) Positioning and lapping of joint reinforcing.
            b) Vencer anchorage system(s).
            c) Thru wall flashing.
               (1) Demonstrate inside and outside corner conditions showing thru wall flashing lapping, jointing and sealing
            d) Weep joint mortar protection system.
            e) Weep joints and weep vents,
            f) Typical control joint construction.
            g) Mesh wall ties.
            h) Rigid steel masonry anchors.
         7) Insulation.
         8) Cleaning of masonry work.
   2. Step construction of mock-up to allow observation of all components.
   3. Mock-up shall constitute minimum standard of quality for actual construction.
      a. Maintain mock-up during construction.
   4. If not acceptable, construct additional mock-ups as required.
   5. Remove when directed by Engineer.

C. All masonry units of any one (1) particular type, color or face style shall be from the same production run.
   1. Special shapes shall be factory fabricated unless noted otherwise.

1.3 DEFINITIONS

A. Definitions to be in accordance with Standard Unit Nomenclature Table 1, NCMA TEK 2-3A.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data including:
      a. Manufacturer's information on aggregate and cement type used in manufacture.
      b. Data sheet on each type of masonry unit, including:
         1) Split-face masonry.
   3. Drawings:
      a. Scaled (minimum 1/8 IN per foot) plans showing proposed locations of masonry control joints.
      b. Wall elevations and sections, indicating special shapes, shape part numbers, applicable dimensions.
      c. Reinforcing number, sizes, spacing, dimensions, configurations, locations, mark numbers, lap splice lengths and locations, masonry cover and reinforcing supports.
         1) Refer to Specification Section 03 21 00 for additional requirements.
   4. Certifications:
      a. Certification that concrete masonry units meet or exceed requirements of standards referenced.
      b. Certification that fire-resistive rated units meet the requirements of the Building Code.
      c. Certification that integral water repellent admixture will not affect the use of coloring processes or alter the actual colors of factory colored masonry units.
      d. Data sheets on integral water repellent admixture being used in masonry unit manufacturing.
      e. Technical bulletins on cleaning masonry containing integral water repellent.
      f. Certification of integral water repellent admixture dosage rates from concrete masonry unit producer.
      g. Concrete masonry producer shall certify that integral liquid water repellent admixture has been provided at dosage rate recommended by admixture manufacturer for use in exterior wall construction.
   5. Qualifications of testing lab and technician.
   6. Test results for all masonry testing.

B. Samples:
   1. Concrete Masonry Finish Samples: Manufacturer's complete offering of colors and textures for each type of masonry specified.
      a. Minimum 3 IN SQ samples for initial selection.
      b. Provide two (2) 8 IN SQ samples if each type of masonry selected for final approval.
      c. Samples of standard gray masonry will not be required.

C. Informational Submittals:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver units on pallets with tight covers or deliver in cubes and store on dunnage.

B. Protect units from damage.

C. Inspect units upon delivery for damage, to assure color match with mock-up or approved samples, dimensional quality, and trueness of unit.
   1. Remove damaged or otherwise unacceptable units from the Project Site.

D. Store units in accordance with manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Standard masonry units:
      a. Any manufacturer capable of meeting the requirements of this Specification Section.
   2. Integral water repellent admixture:
      a. GCP Applied Technologies, Inc.
      b. ACM Chemistries, Inc.

2.2 MATERIALS

A. Cement: Type I/II Portland, ASTM C150.

B. Aggregate: ASTM C33.

C. Reinforcing Bars: Refer to Specification Section 03 21 00.

D. Mortar: Refer to Specification Section 04 05 13.

E. Masonry Grout: Refer to Specification Section 04 05 13.

F. Masonry Accessories: Refer to Specification Section 04 05 23.

G. Insulation Inserts: Refer to Specification Section 07 21 00.

H. Sealants: Refer to Specification Section 07 92 00.

I. Integral Concrete Masonry Water Repellent:
   1. Liquid polymeric admixture.
   2. GCP Applied Technologies, Inc., "DRY-BLOCK".

2.3 MANUFACTURED UNITS

A. General:
   1. Fabricated in the manufacturing plant.
   2. Provide square corners unless noted otherwise.

B. Concrete Masonry Units:
   1. Modular units: ASTM C90.
      a. Normal weight units: Minimum of 125 LB/CF. (All units unless noted otherwise.)
      b. Size:
         1) Veneer units: nominal 4 IN x 8 IN x 16 IN.
            a) Texture: Integral color split face and integral color smooth face.
            b) Refer to exterior elevations.
            c) Field color basis of design: Color to be selected from manufacturer's standard and premium colors.
         2) Back-up perimeter walls with veneer: nominal 12 IN x 8 IN x 16 IN.
            a) Texture: Standard smooth face.
         3) Interior walls: nominal 8 IN x 8 IN x 16 IN.
            a) Texture: Standard smooth face.
         4) Refer to drawings for location.
   2. Concrete bricks:
      a. Structural units: ASTM C55.
         1) Same material, texture and density as modular units.
   3. Color:
      a. Interior units: Standard gray.
      b. Exterior veneer units: To be selected from manufacturer's standard and premium colors.
         1) Refer to exterior elevations.

4. Design compressive strength: f'm=2,000 PSI minimum.
   a. Determine in accordance with MSJC Specification.
      1) Unit strength method, sampled and tested in accordance with ASTM C140.
      2) Prism test method at Contractor's option in lieu of the unit strength method.
5. Provide masonry units manufactured with integral water repellent admixture for the following exposures:
   a. Exterior and interior.
6. Special shapes and faces:
   a. Corner units.
      1) Corner units used in veneer wythe shall have a finished return leg one-half the length of a standard modular stretcher unit.
      2) Corner units shall maintain regular modular masonry coursing.
   b. Finished end units.
   c. Other special shapes as indicated on Drawings or necessary to maintain coursing.

C. Insulation Inserts: Refer to Specification Section 07 21 00.

2.4 PERFORMANCE AND DESIGN REQUIREMENTS:

A. Integral Concrete Masonry Water Repellent:
   1. Water permeance of masonry: Capable of achieving a Class E Rating when evaluated using ASTM E514 with the test extended to 72 HRS, using the rating criteria specified in ASTM E514.
   2. Flexural bond strength of masonry: An increase of 10 PCT, minimum, in masonry flexural bond strength shall occur as a result of adding integral water-repellent concrete masonry and mortar admixtures when compared to a control (containing no admixtures) concrete masonry and mortar tested in accordance with ASTM C1357.
   3. Contractor's option in lieu of the unit strength method, compressive strength of masonry prisms: Maximum 5 PCT decrease in compressive strength of prisms shall occur as a result of adding integral water-repellent concrete masonry and mortar admixtures when compared to a control (containing no mortar admixtures) concrete masonry and mortar when tested in accordance with ASTM C1314.
   4. Compressive strength validation shall be per unit strength method.
   5. Drying shrinkage of masonry: Maximum 5 PCT increase in drying shrinkage of the concrete masonry units shall occur as a result of adding integral water repellent concrete masonry admixture when compared to a control (containing no admixtures) concrete masonry when tested in accordance with ASTM C426.
   6. Grout shear bond strength: Maximum 5 PCT decrease in grout shear bond strength shall occur as a result of adding integral water repellent admixture to the concrete masonry units when compared to a control (containing no admixtures).

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify that anchors and flashings are correct.

B. Lay out walls in advance for uniform and accurate spacing of bond patterns and joints.
   1. Properly locate openings, movement type joints, returns, and offsets weep joints and weep vents.

3.2 INSTALLATION

A. General:
   1. Build in flashing, reinforcing, reglets, weeps, weep vents and related accessory items.
      a. See Specification Section 04 05 23 for installation of accessory items.
   2. Perform all cutting using masonry saw blades.
   3. Drill holes using masonry drill bits or core drill.
      a. Holes made by chipping unit will not be accepted.

4. Install field units in running bond, unless noted otherwise.
    a. Provide special coursing where indicated on the Drawings.
5. Install units in running bond as shown on Drawings.
6. Cut as required to maintain bond pattern.
7. Use solid units where cutting or laying would expose holes and as noted on Drawings.
8. Avoid use of less than half size units, whenever possible.
9. Do not use chipped, cracked, spalled, stained or imperfect units exposed in finish work.
10. Provide units of uniform color, within the range demonstrated on the approved mock-up.
11. Do not wet concrete masonry units.
12. Build chases and recesses as indicated and required for work of other trades.
    a. Provide not less than 8 IN of masonry between chase or recess and jamb of openings, and between adjacent chases and recesses unless detailed otherwise on the Drawings.
13. In fire-resistive rated wall construction, install fire resistive units in accordance with the Building Code.

B. Concrete Masonry Units:
1. Grout solid all cells containing steel reinforcing and as indicated on Drawings.
    a. Refer to Specification Section 04 05 13 for grouting.

C. Laying and Tooling:
1. Lay masonry units with completely filled bed and head joints.
    a. Provide full mortar bed on all block cross webs and completely fill head joints.
        1) Do not slush head joints.
        2) Protect cells requiring grout fill from mortar droppings.
        3) Omit mortar from head joint at weep joint opening.
    b. In cavity wall construction, taper mortar on inside edge of veneer and outside edge of masonry back-up to prevent mortar from falling into cavity.
    c. Protect cavity during laying of masonry as required to prevent mortar droppings from filling cavity.
    d. Install weep joint mortar protection system in cavity per Specification Section 04 05 23.
2. Maintain nominal 3/8 IN joint widths.
    a. Cut joints flush where concealed.
    b. Tool exposed joints concave.
    c. Compress mortar in below ground joints and in joints concealed by insulation in cavity wall construction.
    d. Provide wider joints where noted on Drawings.
        1) In no case shall any mortar joint be more than 3/4 IN wide.
    e. Where masonry sits on top of steel support omit the mortar joint on top of the support and sit masonry directly on top of the thru wall flashing or the steel support member unless a mortar joint is required to maintain coursing.
3. During tooling of joints, enlarge any voids or holes except weeps, and completely fill with mortar.
4. Point-up all joints at corners, openings, and adjacent work to provide neat, uniform appearance.
5. Remove masonry disturbed after laying.
    a. Clean and relay in fresh mortar.
    b. Do not pound units to fit.
    c. If adjustments are required, remove units, clean, and reset in fresh mortar.
6. Where work is stopped and later resumed, rack back 1/2 masonry unit length in each course.
    a. Remove loose units and mortar prior to laying fresh masonry.
7. As work progresses, build in items indicated on Drawings and specified.
    a. Fill in solidly with mortar around built-in items.
    b. Where built-in items are to be embedded in cores of hollow masonry units, place grout screen in joint below and fill core solid with mortar.

D. Control Joints and Sealants:
1. Provide vertical expansion, control and isolation joints where indicated on Drawings.

2. Where not indicated on Drawings, submit proposed control joint locations in accordance with the following requirements:
    a. Provide control joints at maximum 24 FT OC.
    b. Provide at all T intersections.
    c. Locate joints so as to allow lintels and bond beams above and below openings to extend beyond the opening as indicated on the Drawings without control joints thru the lintel or bond beam.
    d. Coordinate joints as required with brick veneer control joints.
3. Rake out mortar in joint.
4. Refer to Specification Section 07 92 00 for sealant installation requirements.
    a. Seal control and expansion joints.

E. Tolerances:
1. Maximum variation from plumb in vertical lines and surfaces of columns, walls, and arises:
    a. 1/4 IN in 10 FT.
    b. 3/8 IN in a story height not to exceed 20 FT.
    c. 1/2 IN in 40 FT or more.
2. Maximum variation from plumb for external corners, expansion joints, and other conspicuous lines:
    a. 1/4 IN in any story or 20 FT maximum.
    b. 1/2 IN in 40 FT or more.
3. Maximum variation from level of grades for exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines:
    a. 1/4 IN in any bay or 20 FT.
    b. 1/2 IN in 40 FT or more.
4. Maximum variation from plan location of related portions of columns, walls, and partitions:
    a. 1/2 IN in any bay or 20 FT.
    b. 3/4 IN in 40 FT or more.
5. Maximum variation in cross-sectional dimensions of columns and thicknesses of walls from dimensions shown on Drawings:
    a. Minus 1/4 IN.
    b. Plus 1/2 IN.
6. Maximum variation in mortar joint width:
    a. Bed joints: 3/32 IN in 10 FT.
    b. Head joints:
        1) Minus 1/8 IN.
        2) Plus 1/8 IN.

F. Protect against weather when work is not in progress.
1. During inclement weather conditions, cover top of walls with translucent waterproof membrane.
2. See Specification Section 04 05 50.

G. Protect against cold/hot weather as specified in Specification Section 04 05 50.

3.3 FIELD QUALITY CONTROL

A. Bracing Concrete Masonry Walls During Construction:
1. At a minimum, provide bracing in accordance with NCMA TEK 3-4B.
2. Contractor is responsible for adequately bracing all masonry during construction.

B. Remove and replace loose, stained, damaged and other unacceptable units as directed by Engineer.
1. Provide new units to match.
2. Install in fresh mortar.
3. Point to eliminate evidence of replacement.

C. Special Masonry Inspection:
1. See Specification Section 01 45 33 for special inspection general requirements.

D. Performance Testing:
   1. Perform prism tests at contractor's option in lieu of the unit strength method, on concrete masonry units used in construction.
      a. Contractor shall provide all testing services for concrete masonry.
      b. Perform all specimen construction, testing and reporting per ASTM C1314.
      c. Perform tests on ungrouted prisms.
      d. Frequency of testing: One (1) set of three (3) prisms for each 4,000 block units or fraction thereof for each different type and/or thickness of block.
      e. Average compressive strength of three (3) prisms tested at 28 days shall meet or exceed design strength.

3.4 CLEANING

A. Clean concrete masonry as the wall is being constructed using fiber brushes, wooden paddles and scrapers.
   1. Do not use metal tools or wire brushes.
   2. No acid-based cleaning solutions shall be used unless approved in writing by Engineer.

B. Remove dirt and stains in accordance NCMA TEK 8-2A.

C. Remove primary efflorescence in accordance with NCMA TEK 8-3A.

END OF SECTION

SECTION 05 14 00
STRUCTURAL ALUMINUM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Structural aluminum including the fabrication and erection of framing and bracing members, including connection design as required.

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 03 15 19 - Anchorage to Concrete.
   2. Section 05 50 00 - Metal Fabrications.
   3. Section 05 52 46 – Mechanically Fastened Aluminum Railings.
   4. Section 09 96 00 - High Performance Industrial Coatings.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Aluminum Association (AA):
      a. ADM 1, The Aluminum Design Manual.
      b. DAF 45, Designation System for Aluminum Finishes.
   2. American Institute of Steel Construction (AISC):
      a. 325, Manual of Steel Construction.
   3. ASTM International (ASTM):
      a. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
      b. B221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
      c. B247, Standard Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings, and Rolled Ring Forgings.
      d. B308, Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
      e. B429, Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
      f. F467, Standard Specification for Nonferrous Nuts for General Use.
      g. F468, Standard Specification for Nonferrous Bolts, Hex Cap Screws, Socket Head Cap Screws, and Studs for General Use.
      h. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
      i. F594, Standard Specification for Stainless Steel Nuts
   4. American Welding Society (AWS):
      a. D1.2, Structural Welding Code - Aluminum.

B. Qualifications:
   1. Minimum of 10 years of experience in fabrication of structural aluminum.
   2. For welding aluminum:
      a. Qualify welding procedures and welding operators in accordance with AWS D1.2.
      b. Welding operators to have been qualified during the 12-month period prior to commencement of welding.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Fabrication and/or layout drawings:
      a. Erection plans and details of each piece including connection details:
         1) Show all cuts, copes and holes.
         2) Indicate all shop welds using AWS symbols.
         3) Indicate all shop and field bolts.

b. Complete shop drawings for all of the work showing clearly all pieces, details, connections, materials and shop-applied coatings.
c. Prepare complete erection drawings showing the location and marks of all pieces.

2. Product technical data including:
   a. Acknowledgement that products submitted meet requirements of standards referenced.
   b. Manufacturer's installation instructions.
3. Certifications.
   a. Certificates of compliance with standards specified for all major components and fasteners incorporated into work.
   b. Copies of current welding certificates for each welder assigned to perform welding indicating compliance with testing specified by AWS.
4. Test reports.
   a. Certified copies of material mill tests.
   b. Manufacturer's load test and temperature sensitivity data for expansion anchor bolt and adhesive anchor bolts.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Mechanical anchor bolts: See Specification Section 03 15 19.
   2. Adhesive anchor bolts: See Specification Section 03 15 19.

2.2 MATERIALS

A. Alloy 6061-T6, 32,000 psi tensile yield strength minimum.
   1. ASTM B209 for sheets and plates.
   2. ASTM B210 for tubes.
   3. ASTM B221 and ASTM B308 for shapes: Beams, channels, angles, tees and zees.
   4. ASTM B247 for forgings.

B. Alloy 6063-T5 or T6, 15,000 psi tensile yield strength minimum.
   1. ASTM B221 and ASTM B429 for bars, rods, and wires.

C. Nonferrous Bolts and Nuts: ASTM F467 and ASTM F468 of alloy 2024-T4 (60,000 psi tensile strength minimum).

D. Stainless Steel Bolts and Nuts: ASTM F593 and ASTM F594, Type 316 with a minimum yield strength of 30,000 psi and a minimum tensile strength of 75,000 psi.

E. Washers: Same material and alloy as found in bolts and nuts with which the washers are to be used.

F. Electrodes for Welding Aluminum: AWS D1.2 filler alloy 5356.

G. Mechanical and Adhesive Anchor Bolts for Fastening to Concrete:
   1. Where approved by Engineer.
   2. Stainless steel, Type 316.
   3. See Specification Section 03 15 19.

2.3 FABRICATION

A. Fabrication of bolted and welded connections of aluminum work shall be in accordance with AA ADM 1.

B. Contractor to be solely responsible for correctness of all shop and field fabrication and fit. Verify field conditions and dimensions prior to fabrication.

C. Fabricate aluminum work and assemble in shop to greatest extent possible.

1. Make splices only where indicated or approved by Engineer.

D. Provide connections as indicated.
   1. Where not indicated, design and provide connections in accordance with requirements of this Specification Section.
   2. One-sided or other types of eccentric connections are not acceptable unless indicated on Contract Drawings or approved on Shop Drawings.

E. Drill or punch holes at right angles to surface of metal.
   1. Do not make or enlarge holes by burning.
   2. Provide holes clean and free of torn or ragged edges.
   3. Use tools which will make a 1/16 inches bevel to remove outside burrs resulting from drilling or punching operations.
   4. Punch or drill for field connections and for attachment of work by other trades.

F. Cope at 45 degrees corners of stiffener plates at junction of member flanges with webs.

G. Welding:
   1. Weld connections to members in shop and bolt connections in field.
   2. Perform welding using electrodes of filler alloy 5356.
   3. Perform welding in accordance with AWS D1.2.
   4. Use only welding procedures and welding operators qualified in accordance with requirements of Paragraph 1.2B. Qualifications.

H. All full penetration welds shall be nondestructively tested by liquid penetrant or ultrasonic methods per AWS standards.

I. Form to shapes indicated with straight lines, true angles and smooth curves.
   1. Grind smooth all rough welds and sharp edges.
   2. Round all corners to approximately 1/8 inches radius.

J. Finish: Mill finish as fabricated.

2.4 SOURCE QUALITY CONTROL

A. Special Inspection and Testing:
   1. Contractor responsible for testing to qualify shop welders and as needed for Contractor's own quality control to ensure compliance with Contract Documents.
   2. Contractor to inspect and test fabrication in accordance with the fabricator's quality control procedures and in accordance with ADM-1 2015 or later.
   3. Contractor inspect shop welding in accordance with AWS D1.2, Section 5 including the following non-destructive testing:
      a. Visually inspect all welds.
      b. In addition to visual inspection, test 50% of full penetration welds and 20% of fillet welds with liquid dye penetrant.
      c. Test 20% of liquid dye penetrant tested full penetration welds with ultrasonic or radiographic testing.

PART 3 - EXECUTION

3.1 ERECTION

A. Contractor is solely responsible for safety.
   1. Construction means and methods and sequencing of work is prerogative of the Contractor.
   2. Take into consideration that full structural capacity of many structural members is not realized until structural assembly is complete.
   3. Partially complete structural members shall not be loaded without an investigation by the Contractor.
   4. Until all elements of the permanent structure and lateral bracing system are complete, provide temporary bracing designed, furnished and installed by the Contractor.

B. Bolting:
   1. Protect bolt threads from damage.
   2. Rest bolt heads and nuts squarely against surfaces.
   3. Where bolt heads or nuts rest on beveled surfaces having slope greater that 1 in 20 with plane normal to bolt axis, use beveled washers to provide full bearing to head and nut.
   4. Correct poor matching of holes by drilling to next larger size and use larger diameter bolt.
   5. Unless otherwise specified, connect aluminum members to:
      a. Aluminum members using 3/4 inches diameter nonferrous bolts of alloy 2024-T4 or stainless steel bolts (ASTM F593 and ASTM F594).
      b. Carbon and low alloy steel using 3/4 inches diameter stainless steel bolts (ASTM F593 and ASTM F594).
         1) Provide dissimilar materials protection.
      c. Concrete or masonry using stainless steel expansion anchor bolts or adhesive anchor bolts unless shown otherwise.
         1) Provide dissimilar materials protection.

C. Welding: Field welding of aluminum is not allowed unless indicated on Drawings.

D. Correct fabrication errors and damaged members in shop.
   1. Do not use cutting torch in shop or in field to cut any members, to correct fabrication errors, or to cut openings.

E. Provide templates for anchors, bolts, and other items to be installed in other work.

F. Field Assembly:
   1. Tolerances shall comply with AISC 325 and the ADM-1.
      a. Before members are assembled, thoroughly clean all bearing surfaces and surfaces that will be in permanent contact.
      b. After assembly, carefully align all members of each frame or assembly and accurately adjust until final, correct and true location is achieved.
         1) As work progresses, securely fasten in place.
   2. Provide full length members without splices.
   3. Securely tighten and leave in place all erection bolts used in welded construction, unless removal is required.

G. Set beam and column baseplates accurately, as indicated on nonshrink grout, in accordance with Division 03.
   1. If not indicated, provide minimum of 1 inch grout thickness under base plates.
   2. Set and anchor each base plate to proper line and elevation.
      a. Use aluminum wedges, shims, or setting nuts for leveling and plumbing columns and beams.
         1) Tighten anchor bolts.
      b. Fill space between bearing surface and bottom of base plate with nonshrink grout.
         1) Fill space until voids are completely filled and base plates are fully bedded on wedges, shims, and grout.
      c. Do not remove wedges or shims and where they protrude, cut off flush with edge of base plate.

H. Temporary Protection:
   1. Suitably protect aluminum surfaces against lime mortar stains, discoloration, surface abrasion and other construction abuses.

I. Contact with Dissimilar Materials: Where aluminum surfaces will be embedded in concrete, built into masonry, or in contact with steel, concrete, grout, masonry, or other dissimilar materials, coat the aluminum surfaces as described in Specification Section 09 96 00.

3.2 FIELD QUALITY CONTROL

A. Special Inspection and Testing:
   1. See Section 01 45 33.

2. Special Inspection is required to:
   a. Inspect structural aluminum delivered on site, prior to erection.
      1) Visually inspect all welds, bolts and general fabrication
   b. Verify proper identification markings for bolts, nuts and washers per applicable standards. Verify proper hole and bolt size.
      1) Frequency: All bolts, prior to being covered up or substantial completion.
   c. Inspect structural aluminum which has been erected.
      1) Inspect the following:
         a) Details such as bracing and stiffening.
         b) Member locations.
         c) Erection tolerances.
         d) Application of joint details at each connection.
2) Frequency: Prior to members being covered up or substantially complete.

END OF SECTION

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SECTION 05 21 00
STEEL JOISTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Manufactured open-web steel joists and joist accessories.

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 01 45 33 - Code-Required Special Inspections and Procedures.
   2. Section 05 50 00 – Metal Fabrications.
   3. Section 05 30 00 - Metal Decking.
   4. Section 09 96 00 - High Performance Industrial Coatings.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Institute of Steel Construction (AISC):
      a. 360, Specifications for Structural Steel Buildings (referred to herein as AISC Specification).
   2. ASTM International (ASTM):
      a. A36, Standard Specification for Carbon Structural Steel.
      b. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
      c. A563, Standard Specification for Carbon and Alloy Steel Nuts.
      d. F436, Standard Specification for Hardened Steel Washers Inch and Metric Dimensions.
      e. F3125, Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.
   3. American Welding Society (AWS):
      a. D1.1, Structural Welding Code - Steel.
   4. Corps of Engineers (COE):
      a. CRD-C621, Standard Specification for Packaged, Dry, Hydraulic-Cement Grout (Nonshrink).
   5. Steel Joist Institute (SJI):
      a. Recommended Code of Standard Practice for Steel Joists and Joist Girders.
      b. Standard Specification for Open Web Steel Joists, K-Series (ANSI SJI-K-1.1).
      c. Standard Specification for Longspan Steel Joists LH-Series and Deep Longspan Steel Joists DLH-Series (ANSI SJI-LH-DLH-1.1).
      d. Standard Specification for Joist Girders (ANSI SJI-JG-1.1).
      e. Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders:
         1) Standard Load Table Open Web Steel Joists, K-Series.
         2) Standard Load Table Longspan Steel Joists, LH-Series.
         3) Standard Load Table Deep Longspan Steel Joists, DLH-Series.

B. Qualifications:
   1. Manufacturer: Member of SJI.
      a. Structural design calculations and details of manufactured joists shall be prepared by a qualified professional engineer retained by the manufacturer and registered in the state where the project is located.
   2. Qualification of welding work:
      a. Qualify welding processes, operations, and operators in accordance with requirements of AWS D1.1.

b. Welding operators to have been qualified during the 12-month period prior to commencement of welding.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Fabrication and/or layout drawings, signed by a professional engineer:
      a. Detailed Shop Drawings showing size and layout of each joist unit, bridging, connections, and accessories. Include mark, number, type, location, and spacing of joists and bridging.
      b. Show joining splice and connection to other work details.
      c. Provide templates or location drawings for installation of anchor bolts.
      d. Provide details of bridging, method of attachment to joists, and joist end anchorage and other details required for joist installation. Indicate beveled end plates for joist roof pitch where required.
      e. Show shop-applied coatings.
      f. Shop Drawings shall not be reproductions of the Contract Drawings.
   2. Product technical data including:
      a. Joist manufacturer's load tables, Standard Specifications and installation instructions for each type of joist and its accessories. Include product data describing materials, shop coating, bridging, and accessories.
   3. Certifications:
      a. Manufacturer's certification that steel joists and accessories comply with specified requirements.
      b. Manufacturer member of SJI.
      c. Joist material, shop welding and testing, manufacturing and shop inspection and testing are in accordance with SJI requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store and handle steel joists as recommended by SJI.
   1. Exercise care to avoid damage to joists.

B. Store joists clear of soil on platforms, skids or other durable supports.
   1. Protect joists after delivery to prevent rust and deterioration.

C. Provide anchor bolts and other items to be embedded in concrete or masonry, with templates as required, in time for incorporation into the work.

PART 2 - PRODUCTS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Nucor Corporation Vulcraft Divisions.
   2. CANAM Steel Corporation.
   3. Socar Incorporated.

2.2 MATERIALS

A. Steel: Comply with SJI and AISC Specifications for joist series indicated.

B. High-Strength Bolts, Nuts and Washers:
   1. Bolts: ASTM F3125, Grade A325 as required, heavy hexagon structural bolts.
   2. Nuts: ASTM A563.
   3. Washers (hardened): ASTM F436.

C. Bolts and Nuts, Unfinished: ASTM A307, Grade A, regular hexagon type, low carbon steel, with carbon steel washers.

2.3 STEEL JOISTS

A. Design of steel joists proposed shall have been checked by the SJI and found to conform to the standard specifications and load tables.

B. Design and fabricate joists and accessories in accordance with SJI Specifications and as follows:
   1. Make shop connections and splices using either arc or resistance welding.
      a. Do not shop bolt connections.
   2. Design and fabricate for maximum deflection of 1/360 of clear span under design live load.
   3. Shop holes, field holes, and enlargement of holes will not be permitted unless approved by Engineer.
   4. Fabricate bearing ends to provide following minimum bearing unless a longer bearing length is indicated on the Contract Documents.

	K SERIES	LH AND DLH SERIES	JOIST GIRDERS
On masonry or concrete:	4 inches min	6 inches min	6 inches min
On steel:	2-1/2 inches min	4 inches min	4 inches min

   5. With steel angle tops and bottom chord members.
   6. Design connections to resist uplift loads per building code, unless otherwise specified.

C. Sloped joists shall have bearing ends that are flush to supporting element.

D. Provide extended bottom chords where indicated.
   1. Comply with SJI and AISC requirements and load tables.

E. Provide extended top chords where indicated.
   1. Comply with SJI and AISC requirements and load tables.

F. Provide ceiling extensions in areas having ceilings attached directly to joist bottom chord.
   1. Provide either an extended bottom chord or a separate unit of sufficient strength to support ceiling construction.
   2. Extend ends to within 1/2 inches of wall surface.

G. Provide nailers bolted to top chord where indicated.

H. Prepare and paint steel joists and accessories in compliance with Section 09 96 00.

I. Comply with SJI Specifications:
   1. Joist designations indicated on the Drawing are minimum requirements; increase as required to comply with design requirements specified.
   2. Wherever possible, increased joists shall have the same depth as joist indicated on Drawings.
   3. Where necessary to increase joist depths to meet design requirements, coordinate all project changes required due to the increased depth.
   4. Make all required joist revisions at no additional cost to Owner.

2.4 SOURCE QUALITY CONTROL

A. Engineer reserves right to inspect joists or manufacturer's shop during joist fabrication.

B. Identify each joist type, size and manufacturer.
   1. Provide tagging or other suitable (permanent) means.
   2. Maintain identification continuously.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examine areas and conditions under which steel joists are to be installed for conditions detrimental to proper and timely completion of work.

B. Do not proceed with work until unsatisfactory conditions have been corrected.

C. Do not start placement of steel joists until supporting work is in place and secured.

D. Joists will be subject to rejection if:
   1. Joists do not comply with requirements of SJI and AISC Specifications and requirements herein.
   2. Joists are improperly manufactured, welded, painted or installed.
   3. Joists are damaged so that strength is impaired.
   4. Joists are not installed as indicated on Drawings.
   5. Chords are not installed straight within a tolerance of plus or minus 0.0028 times the length of the joist or the distance between points of lateral support.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.
   1. Where not specifically indicated otherwise, place and secure steel joists in accordance with SJI and AISC Specifications and as herein specified.

B. Splice any joist delivered to the site in more than one piece.

C. Do not overload joists.
   1. Note: Joists may not be stable or able to carry design loads until bridging and deck is fully installed.
   2. Contractor is solely responsible for safety, construction methods and sequencing of the Work.
   3. Do not install joists damaged so that strength is impaired.

D. Place joists on supporting work, adjust and align in accurate location and spacing before permanently fastening.
   1. Provide end bearing and anchorages to secure all joists to supporting members or walls in accordance with SJI Specifications, unless otherwise indicated.
   2. When joists are misfabricated and do not bear flush on supporting member or wall, take corrective measures to ensure full bearing.
      a. Provide steel shims as required for uniform flush bearing.

E. Field weld joists to supporting steel framework in accordance with SJI, AISC and AWS Specifications for type of joists used.
   1. Coordinate welding sequence and procedure with placing of joists.
   2. Observe any special welding requirements on erection drawings.

F. Bearing on Masonry or Concrete Bearing Surfaces:
   1. Secure joists resting on masonry or concrete bearing surfaces by bedding in mortar and anchoring to masonry or concrete construction as specified in SJI Specifications for type of steel joist used.
      a. Masonry or concrete required to support joists to have reach required 28-day compressive strength prior to placing joists thereon.
      b. Area under joist bearing shall be solidly filled with grout.
   2. Furnish anchor bolts or steel bearing plates to be built into concrete and masonry construction.
      a. Furnish templates as may be necessary for accurate location of anchors. Steel bearing plates to conform to ASTM A36.
   3. Bedding mortar:
      a. Sand cement grout:

1) Approximately 3 parts sand, 1 part Portland cement, 6 plus/minus 1% entrained air and water to produce a slump which allows grout to completely fill required areas and surround adjacent reinforcing.
2) Minimum 28-day compressive strength: 3000 psi.

b. Non-shrink grout complying with COE CRD-C621.

G. Provide type, size, spacing, and attachment of bridging in accord with SJI and AISC Specifications, where not specifically indicated otherwise, except as modified herein.
1. Clearly specify bridging on erection drawings.
2. Provide diagonal type bridging unless otherwise noted.
3. Do not use sag rods as substitute for bridging.

H. Install bridging completely, immediately after erection, and before any loads are applied.
1. Anchor ends of bridging lines at top and bottom chords of each joist and where terminating at walls or beams.
2. Provide bridging connections at top and bottom chords capable of safely resisting a force specified by SJI Specifications for open web, long span, deep long span joists, and joist girders respectively.
3. Where five rows of bridging are required in spans over 40 feet, laterally brace each joist before erecting next joist or applying loads.
4. Do not release hoisting cables before installing center row of diagonal bridging and anchoring bridging line to prevent lateral movement.
5. During construction period, Contractor is responsible for any loads placed on joists.
a. Contractor's attention is directed the fact that joists may be unstable and cannot carry their design load until steel deck and bridging are completely installed.

I. Remove or repair damaged joists or other work, to satisfaction of Engineer at no additional expense to Owner.

J. After installation, touch up paint or field paint as specified in Section 09 96 00.

3.3 FIELD QUALITY CONTROL

A. Special Inspection and Testing:
1. See Section 01 45 33.
2. Special Inspection is required for:
a. Visually inspect joists, bridging, anchorages, and connections which have been erected.
b. Inspect high-strength bolting in accordance with the RCSC Specification for Structural Joints Using High-Strength Bolts, Section 9.
1) Verify direct tension indicator gaps.

END OF SECTION

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SECTION 05 30 00
METAL DECKING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Manufactured roof decking.

B. Related Requirements: Include but are not necessarily limited to:
   1. Section 01 45 33 - Code-Required Special Inspections and Procedures.
   2. Section 05 21 00 - Steel Joists.
   3. Section 07 21 00 - Building Insulation.
   4. Section 09 96 00 - High Performance Industrial Coatings.

1.2 REFERENCES

A. Reference Standards:
   1. American Iron and Steel Institute (AISI):
      a. S100, Specification for the Design of Cold-Formed Steel Structural Members.
   2. ASTM International (ASTM):
      a. A36/A36M, Standard Specification for Carbon Structural Steel.
      b. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
      c. A780/A780M, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
      d. A1008/A1008M, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
      e. C1513, Standard Specification for Steel Tapping Screws for Cold Formed Steel Framing Connections.
      f. D746, Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
      g. D1056, Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.
   3. American Welding Society (AWS):
      a. D1.1/D1.1M, Structural Welding Code - Steel.
      b. D1.3/D1.3M, Structural Welding Code - Sheet Steel.
   4. Steel Deck Institute (SDI):
      a. 31, Design Manual for Composite Decks, Form Decks and Roof Decks.
   5. Underwriters Laboratories, Inc. (UL):
      a. UL Fire Resistance Directory.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Decking Manufacturer:
      a. Manufacturer shall possess current, valid, full membership in SDI; associate membership is unacceptable. Submit to Engineer documentation of such membership.
      b. When decking is not specified on the Drawings, structural system design of manufactured decking shall be prepared by qualified professional engineer, employed by or retained by decking manufacturer. When such services are required, submit to Engineer evidence of current, valid license and registration in the same jurisdiction as the Site.
   2. Welders:

a. Qualify welding processes, operations, and personnel in accordance with AWS D1.1 and AWS D1.3, for decking manufacturing and welding at the Site.
b. Welders shall be qualified, as indicated in the paragraph immediately above, during the 12-month period preceding commencement of welding for the Work and be experienced in welding light-gage metal.
c. Promptly submit documentation of qualifications when requested by Engineer.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
1. Shop Drawings:
a. Complete framing and erection plans and details.
b. Location, length, type, cross section, thickness, and markings of metal decking units.
c. Size and location of each opening in decking and conditions requiring closure panels and supplementary framing. Show and indicate necessary accessories and reinforcing.
d. Sequence and procedure to be followed for erecting, fastening, and securing decking. Engineer's approval or commenting on Shop Drawings does not in any way reduce or mitigate Contractor's responsibility for means, methods, procedures, techniques, and sequences of construction or for safety and protection measures incident thereto.
e. Show and indicate units and surfaces to receive shop-applied finishing, as applicable.
f. Details and gages of accessories and miscellaneous items, showing ridge plates, closure and filler strips and insulation supports.
g. Fasteners and welding details for installation, including size, spacing, type, and location of fasteners necessary and required to secure decking.
h. Recommended welding rod size, type, burn-off rate, and welder setting for deck thickness to be joined. Engineer's approval or comments on Shop Drawings showing or indicating such information in no way reduces or modifies Contractor's obligations for construction means, methods, sequences, procedures, and techniques and safety and protection measures incident thereto.
i. Define welds by indicating standard AWS welding symbols.
j. Shop Drawings shall not be developed from or reproductions of the Drawings prepared by Engineer.
2. Product Data:
a. Manufacturer's specifications and published catalog data for:
1) Welds and welding procedure.
2) Galvanizing repair paint.
3) Screws.
4) Powder actuated fasteners.
5) Joint sealing compound.
b. Manufacturer's load tables for decking to be provided, including:
1) Allowable gravity load for metal roof decking.
2) Allowable diaphragm shear values for metal roof deck.
3) Allowable metal decking superimposed load.

B. Informational Submittals: Submit the following:
1. Certifications:
a. Manufacturer's certification that metal decking provided complies with specified requirements, including:
1) Deck material, manufacturing, and shop testing and inspection are in accordance with SDI requirements.
2. Supplier's Instructions:
a. Manufacturer's written instructions for storing, handling, and installing materials furnished.
3. Test and Evaluation Reports:
a. Powder driven fastener ICC-ES Evaluation Report(s).
4. Source Quality Control Submittals:
a. Manufacturer's certified test and mill reports for actual materials furnished.

5. Qualifications Statements:
   a. Evidence of manufacturer's current, valid SDI membership.
   b. Welder qualifications and certifications, when requested by Engineer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Handling:
   1. Comply with the Contract Documents, SDI requirements and recommendations, and decking manufacturer's written instructions.

B. Storage:
   1. Comply with the Contract Documents, SDI requirements and recommendations, and decking manufacturer's written instructions.
   2. Store metal decking off the ground, entirely covered by waterproof covering, with one end elevated for drainage. Properly vent waterproof covering to avoid condensation.
   3. Prevent corrosion, deterioration, and accumulation of foreign matter.
   4. Prevent formation of "white rust" on surfaces with galvanized finish.
   5. Do not overload supporting members.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. 1.5-inch deep metal roof decking:
      a. Vulcraft.
      b. Verco Decking.
      c. New Millennium Building Systems.
      d. DACS.

2.2 METAL ROOF DECKING

A. Design of the metal decking shall be checked by decking manufacturer's professional engineer and found by such professional engineer to comply with SDI's standard specifications and load tables.
   1. Allowable superimposed live uniform loading per square foot for metal roof decking provided for spans shown or indicated shall equal or exceed allowable superimposed live uniform load per square foot for same spans as indicated in SDI's tables.
   2. Maximum Deflection: Less than 1/240 of span under live load.

B. Provide decking configurations complying with SDI 31 and as shown and indicated.
   1. Painted Decking: ASTM A1008, shop-applied.
   2. Galvanized Decking: ASTM A653 G90 zinc coating.

C. Metal Roof Decking, 1-1/2 Inch Deep:
   1. Rib type B, sheet steel, 20-gage, minimum, with minimum uncoated thickness of 0.0358-inch, galvanized.

2.3 FABRICATION

A. Standard Deck Profiles:

DEPTH	TYPE (Vulcraft designations, UNO)	RIB SPACING	TOP SURFACE MAXIMUM RIB OPENING	MINIMUM BOTTOM OF RIB WIDTH
1-1/2 inches	Roof Deck - Wide Rib ('1.5BI')	6 inches	2-5/8IN	1-5/8 inches

* Indicates produced by DACS

B. Minimum Deck Thickness:

1. Where gage of metal is indicated, provide the not less than uncoated thickness required by SDI.
   a. Delivered thickness of uncoated steel: Not less than 95 percent of the stated thickness.
2. Use steel with minimum yield stress of 33 ksi.
3. Comply with deflection limits, especially when proposing steel with greater strength than required in this provision.

C. Fabrication:
1. Fabricate decking units in lengths to span three or more support spacings with flush, telescoped or nested end laps not less than 2 inches.
   a. End laps shall occur on supporting members.
   b. Provide decking units with overlapping male and female type side laps or joints to provide positive vertical and lateral alignment of adjacent decking units.

2.4 ACCESSORIES

A. Metal Closures:
1. Form to configuration required for tight-fitting closures at open ends and sides of decking.
2. Minimum thickness before galvanizing: 0.0358-inch (20-gage).

B. Ridge Plates:
1. Minimum Width: 4.5 inches.
2. Bend to provide tight-fitting closure with deck units.
3. Provide plates in 10-foot length where possible.
4. Minimum thickness before galvanizing: 0.0358-inch (20-gage).

C. Welding Washers:
1. 16-gage bent steel plate with 3/8-inch or as required by weld size center hole.
2. Provide at all deck units thinner than 22-gage.

D. Filler Sheet:
1. Flat or formed 20-gage galvanized steel.

E. Insulation Supports:
1. Provide insulation supports that do not impair quality or finish of decking.

F. Venting:
1. Provide slotted openings in bottom flutes in accordance with manufacturer's standards.

G. Metal Pour Stops:
1. Provide and form to configuration required for mortar-tight closures at open sides and ends of decking.

H. Primer Paint:
1. Unless otherwise required in the Contract Documents, provide decking manufacturer's baked-on, rust-inhibitive paint, factory-applied to chemically cleaned and phosphate treated metal surfaces.
2. Paint is not required for galvanized surfaces, unless otherwise indicated.

I. Galvanized coating for metal decking accessories: Comply with ASTM A653 (or equivalent) G90 zinc coating.

J. Galvanizing Repair Materials:
1. Galvanized repair paint shall be in accordance with Section 09 96 00 - High Performance Industrial Coatings.

K. Screws:
1. Self-drilling, self-tapping, no. 12 size minimum, hex washer head metal screws.
2. Protected carbon steel, Hilti S-MD KF, or equal.
   a. Kwik-Cote finish.
   b. ASTM C1513 or equal.

L. Powder Actuated Mechanical Fasteners:
   1. Material: AISI 1070 modified.
   2. Hardness: Minimum Rockwell Hardness C 54.5.
   3. Strength: Minimum tensile strength 285 ksi; minimum shear strength 175 ksi.
   4. Design and Manufacture: Knurled shank with forged ballistic point. Manufacturing process shall ensure steel ductility and prevent development of hydrogen embrittlement.
   5. Washers:
      a. For Steel bar Joist Framing: Minimum 12 mm (0.472-inch) steel washers.
      b. For Structural Steel Framing: Minimum 15 mm (0.591inch) steel washers.
   6. Corrosion Resistance:
      a. For steel roof decks with waterproofing membrane: Five-micron zinc electroplated in accordance with ASTM B633 SC1 Type III.
      b. For exposed steel roof decks: Minimum AISI 304 stainless steel sealing caps with bonded neoprene washer shall be provided over each fastener.
   7. Design Requirements:
      a. ICC-ES AC43 or SDI method for diaphragm shear strength and stiffness.
      b. FM wind uplift resistance.
      c. UL fire classification.
   8. Products and Manufacturers:
      a. For use with steel bar joist and light structural steel framing supports with top chord or flange thickness 1/8-inch to 3/8-inch:
         1) Hilti X-HSN24 (1/8-inch up to and including 3/8-inch).
         2) Or equal.
      b. For use with structural steel framing supports with top flange thickness 1/4-inch or thicker:
         1) Hilti X-ENP-19 L15 (1/4-inch or thicker).
         2) Or equal.

M. Miscellaneous Steel Shapes:
   1. Comply with ASTM A36.

N. Sheet Metal Accessories:
   1. Provide of same material and finish as decking panels.

2.5 SOURCE QUALITY CONTROL

A. Tests and Inspections:
   1. Before shipping materials from the shop or fabrication facility to the Site or offsite storage, perform manufacturer's or fabricator's ordinary inspections, testing, and other source quality control activities.
   2. Do not ship materials that are damaged or otherwise defective.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examination:
   1. Examine areas and conditions under which metal decking will be installed for conditions detrimental to proper and timely completion of the Work.
   2. Do not proceed with the Work until unsatisfactory conditions are remedied.

B. Do not start installing metal decking until supporting Work is in place and properly secured.

3.2 INSTALLATION

A. Installation – General:
   1. Install decking in accordance with the Contract Documents, SDI requirements and recommendations, decking manufacturer's written instructions and approved Submittals. In

event of conflict among such requirements, obtain Engineer's written interpretation or clarification before proceeding with the associated Work.

2. Loading During Handling and Installation:
   a. Do not overload supporting structural members or architectural elements.
   b. Until entire assembly is substantially complete, structural elements may be unstable or incapable of supporting loads required by code or design loads indicated in the Contract Documents.
   c. Locate deck bundles to prevent overloading of structure.
   d. Ensure decking construction loads are less than recommendation of SDI 31, except where adequate temporary supports are provided.
3. Provide decking manufacturer's standard accessories as needed to complete decking Work installation.
4. Install each decking unit on supporting structural frame, adjust to final position and accurately align with ends properly bearing on supporting members.
5. Interlock decking units at sides without stretching, contracting, or deforming.
6. Install deck units flat and square and secure to framing without warp or excessive deflection.
7. Install decking units in accurate and close alignment for entire length of run and with close alignment of flutes of one unit with those of abutting unit.
8. Refer to requirements, below in this Article, applicable to all decking, including:
   a. Cutting, fitting, and openings.
   b. Temporary supports.
   c. Welding – general.
   d. Fastening (mechanical and welding).
   e. Pour stops for concrete.
   f. Accessories.

B. Roof Decking:
   1. Install roof decking units and accessories as required, in accordance with SDI 31.
   2. Lap roof deck units at ends not less than 2 inches.
   3. Refer to requirements, below in this Article, for roof decking provisions on:
      a. Insulation supports.
      b. End closures.
      c. Ridge plates.
      d. Others.

C. Cutting, Fitting, and Openings:
   1. Cut and fit deck units and accessories around other construction projecting through or adjacent to decking.
   2. Comply with Section 01 73 29 - Cutting and Patching.
   3. Make cutting and fitting neat, square, and trim.
   4. Cut decking by mechanical means, not by burning.
   5. Neatly and accurately install reinforcing at openings, except:
      a. Circular openings less than six-inch diameter.
      b. Rectangular openings having no side dimension greater than 6 inches.
   6. Reinforcing at Openings:
      a. Reinforce openings that are not framed between 6 inches and 1 foot with 20-gage flat steel sheet, 1-foot greater in each dimension than opening.
      b. Provide sheeting around opening. Fusion-weld to top surface of deck at each corner and midway along each side.

D. Field Welding – General:
   1. Plug weld sizes indicated are effective fusion diameter of welds.
   2. Weld metal shall penetrate all layers of deck material and have good fusion to supporting members.
   3. Do not burn through deck.

E. Fastening (Mechanical and Welded):
   1. Prevent over-torqueing of screw fasteners by using a tool with depth-limiting nosepiece and clutch.
   2. Fastening of 1.5-inch Deep Metal Roof Deck:
      a. Unless otherwise shown or indicated, secure decking units to supporting frame and side laps as follows:
         1) Fasten edge ribs of panels at each support.
         2) At interior supports and at ends of deck, use:
            a) For 2.5-foot and 3-foot wide deck: Four, 5/8-inch round plug welds per deck unit.
            b) Install 20-gage and thinner deck with welding washers at all specified weld locations.
         3) At perimeter supports, provide 5/8-inch round plug welds at 1-foot on centers.
            a) At side laps, provide no. 10 hex-head screws at 1.5 feet on centers.

F. Insulation Supports:
   1. Provide insulation supports as necessary and required.
   2. Provide insulation supports where top surface of roof decking does not extend as necessary and required to completely support roof insulation.
   3. Weld insulation supports into position.

G. Closure Strips:
   1. Provide metal closure Strips at open, uncovered ends and edges of roof decking, and in voids between deck and other construction.
   2. Weld closure strips into position to provide complete decking.
   3. Flexible Closure Strips:
      a. Provide flexible closure strips lieu of metal closures, at Contractor's option and when approved by Engineer, wherever use will ensure complete closure.
      b. Provide with elastomeric type adhesive in accordance with written directions and recommendations of manufacturers of closure strips and adhesives.

H. Ridge Plates:
   1. Provide weld at ridge plates at top surface of roof decking.
   2. Lap end joints not less than three inches with laps in direction of water flow.

I. Accessors:
   1. Provide metal accessories to close all openings and gaps between decking and other construction, at objects projecting through decking, at locations where decking changes direction, and at open ends of deck units where deck units terminate.
   2. Weld into position to provide a complete installation.

J. Cleaning and Touch-Up:
   1. After installation, remove surplus materials and debris from decking surfaces. Comply with Section 01 74 00 - Cleaning.
   2. Field-repair shop-painted surface in accordance with paint or coating manufacturer's written instructions and applicable provisions of the Contract Documents.
   3. Repair damaged galvanized surfaces in accordance with Section 09 96 00 - High Performance Industrial Coatings.

3.3 FIELD QUALITY CONTROL

A. Code-Required Special Inspection:
   1. Comply with Section 01 45 33 - Code-Required Special Inspections and Procedures.
   2. Special inspection is required for:
      a. Verifying proper decking materials and layout.
         1) Frequency: Prior to attaching decking to structure.
      b. Verifying proper weld filler materials, screws, powder actuated mechanical fasteners, weld testing and fastener spacing.
         1) Frequency:

a) First four hours during the first day of decking attachment; and
b) Inspection prior to covering decking Work with concrete, insulation, or other materials.

c. Weld Testing:
1) Perform the following test in special inspector's presence on first deck panel installed:
a) Place one end of decking panel over perimeter support and attach only to that support with two welds as specified six inches apart.
b) Move opposite end of decking panel in plane parallel to span of decking panel until shear distress is observed or apparent in weld.
c) Provide welds of sufficient quality to cause local distortions in decking panel around welds and show good perimeter contact between welds and decking panel.
d) When results of test are satisfactory and approved by special inspector, install remaining decking using same weld rod size and type, welding amperage setting, and procedures used in the tested deck.
e) Weld test shall be performed for each metal deck welder.
2) Visually inspect remainder of welds.
a) When, in special inspector's opinion, one or more welds are defective or of insufficient quality, provide additional, acceptable weld adjacent to rejected weld.
b) Provide new weld on sound, unburned decking sufficient distance from rejected weld.

B. Defective Work:
1. Metal decking Work will be deemed defective Work and will be rejected by Engineer when it:
a. Do not comply with SDI requirements and recommendations.
b. Does not comply with the Contract Documents.
c. Is improperly: manufactured, finished, and installed.
d. Is damaged resulting in impaired strength, defacing, or inappropriate appearance.
2. Remedy defective Work in accordance with the Contract Documents. Replace damaged decking with new decking in accordance with the Contract Documents
3. Remove and replace decking that:
a. Is structurally weak or unsound.
b. Has burn holes due to improper welding; or
c. Is deemed defective Work by Engineer (unless Engineer expressly allows repair or other remedy).

END OF SECTION

SECTION 05 50 00
METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Custom fabricated metal items and certain manufactured units not otherwise indicated to be supplied under work of other Specification Sections.
      a. Bollards
      b. Abrasive Stair Nosings
      c. Aluminum Grating
   2. Design of all temporary bracing not indicated on Drawings.
   3. Delegated design systems and components, including but not limited to:
      a. Metal Stairs, Landings, and Platforms.

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 01 35 73 – Delegated Design Procedures.
   2. Section 03 15 19 - Anchorage to Concrete.
   3. Section 03 31 30 - Concrete, Materials and Proportioning.
   4. Section 05 14 00 - Structural Aluminum.
   5. Section 05 52 46 – Mechanically Fastened Aluminum Railings.
   6. Section 09 96 00 - High Performance Industrial Coatings.

1.2 REFERENCES

A. Definitions
   1. Fasteners: As defined in ASTM F1789.
   2. Galvanizing: Hot-dip galvanizing per ASTM A123/A123M or ASTM A153/A153M with minimum coating of 2.0 oz of zinc per square foot of metal (average of specimens) unless noted otherwise or dictated by standard.
   3. Hardware: As defined in ASTM A153/A153M.
   4. Installer or Applicator:
      a. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
      b. Installer and applicator are synonymous.
   5. PQR: Procedure Qualification Record
   6. MIC: Microbiologically induced corrosion.

B. Referenced Standards: Standards referenced in this section include, but are not necessarily limited to, the following:
   1. Aluminum Association (AA):
      a. ADM 1, Aluminum Design Manual.
   2. American Association of State Highway and Transportation Officials (AASHTO):
      a. HB, Standard Specifications for Highway Bridges.
   3. American Institute of Steel Construction (AISC):
      a. 325, Manual of Steel Construction.
      b. 360, Specifications for Structural Steel Buildings (referred to herein as AISC Specification).
   4. The American Ladder Institute (ALI):
      a. A14.3, Ladders - Fixed - Safety Requirements.
   5. American Society of Civil Engineers (ASCE):
      a. 7, Minimum Design Loads for Buildings and Other Structures.
   6. ASTM International (ASTM):

a. A6, Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
b. A36, Standard Specification for Carbon Structural Steel.
c. A47, Standard Specification for Ferritic Malleable Iron Castings.
d. A48, Standard Specification for Gray Iron Castings.
e. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
f. A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold Finished.
g. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
h. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
i. A197, Standard Specification for Cupola Malleable Iron.
j. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
k. A276, Standard Specification for Stainless Steel Bars and Shapes.
l. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
m. A312, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
n. A380/A380M, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
o. A500, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
p. A501, Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
q. A536, Standard Specification for Ductile Iron Castings.
r. A554, Standard Specification for Welded Stainless Steel Mechanical Tubing.
s. A572, Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
t. A563, Standard Specification for Carbon and Alloy Steel Nuts.
u. A666, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
v. A668, Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use.
w. A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
x. A786, Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.
y. A992, Standard Specification for Steel for Structural Shapes.
z. A1064, Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
aa. A1011, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
bb. B26, Standard Specification for Aluminum-Alloy Sand Castings.
cc. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
dd. B221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
ee. B308, Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
ff. B429, Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
gg. B632, Standard Specification for Aluminum-Alloy Rolled Tread Plate.
a.
b. F436, Standard Specification for Hardened Steel Washers Inch and Metric Dimensions.

c. F467, Standard Specification for Nonferrous Nuts for General Use.
d. F468, Standard Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use.
e. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
f. F835, Standard Specification for Alloy Steel Socket Button and Flat Countersunk Head Cap Screws.
g. F879, Standard Specification for Stainless Steel Socket Button and Flat Countersunk Head Cap Screws.
h. F1789, Standard Terminology for F16 Mechanical Fasteners.
i. F3125, Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.

7. American Welding Society (AWS):
   a. A5.1/A5.1M, Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding.
   b. D1.1, Structural Welding Code - Steel.
   c. D1.2, Structural Welding Code - Aluminum.
   d. D1.6/D1.6M, Structural Welding Code - Stainless Steel.
8. National Association of Architectural Metal Manufacturers (NAAMM):
   a. AMP 510, Metal Stairs Manual.
   b. AMP 555, Code of Standard Practice for the Architectural Metal Industry (Including Miscellaneous Iron).
   c. MBG 531, Metal Bar Grating Manual.
9. NACE International (NACE).
10. Nickel Development Institute (NiDI):
    a. Publication 11 007, Guidelines for the Welded Fabrication of Nickel-Containing Stainless Steels for Corrosion Resistant Services.
11. Occupational Safety and Health Administration (OSHA):
    a. 29 CFR 1910, Occupational Safety and Health Standards, referred to herein as OSHA Standards.

1.3 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Fabrication and/or layout drawings and details:
         1) Submit drawings for all fabrications and assemblies.
            a) Include erection drawings, plans, sections, details and connection details.
         2) Identify materials of construction, shop coatings and third party accessories.
   2. Product technical data (for fabrications not delegated design) including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Provide manufacturer's standard allowable load tables for the following:
         1) Grating and checkered plate.
         2) Castings, trench covers and accessories.
         3) Modular framing systems.
   3. Delegated Design Professional's "Instruments of Service" Submittals:
      a. Design drawings sealed and signed by delegated design professional, including:
         1) Design drawings deemed appropriate and necessary by delegated design professional.
         2) Show or indicate necessary details establishing the method of fastening throughout system and attachments to supporting primary structure including anchorage to concrete as required.
         3) Coordinate drawings and details with delegated design professional's calculations required in this Section.

4) At option of Contractor or fabricator, design drawings may be combined with the Shop Drawings required in this Section, although delegated design professional's seal and signature is required on the Shop Drawings in the event of a combined Submittal.

b. Design specifications, sealed and signed by delegated design professional.

c. Certification of compliance in accordance with Section 01 35 73 - Delegated Design Procedures, including:

1) List of design loads and load combinations used to design structural systems and components.

2) List of loads transmitted to the supporting structural elements.

3) Compliance with project performance and design criteria specified in the Contract Documents.

4) Expressly indicate where structural element reaction forces to Engineer-designed supporting elements or existing construction differ from reaction forces indicated in the Contract Documents.

B. Informational Submittals:

1. Certifications
   a. NACE certification of surface preparation.
   b. NACE certification of paint application.
2. Supplier's Instructions:
   a. Fabricator's instructions for handling, storing, and installing structural elements furnished.
   b. Galvanizing repair paint manufacturer's installation instructions.
3. Qualifications Statements:
   a. NACE inspector qualifications.
   b. Delegated design professional.
   c. Fabricator, when requested by Engineer, including:
      1) Qualifications and experience.
      2) Qualifications of welders to be employed in fabricating the structural elements for the Project.
      3) Qualifications of welders to be employed during erection of the structural elements for the Project.
   d. Installer, when requested by Engineer, including fabricator's approval of installer.
4. Delegated design Shop Drawings approved by delegated design professional:
   a. Detailed structural elements erection drawings, shop details, erection detail.
   b. Indicate member type, location, spacing, size, and gauge of members; method of attachment to supporting members; and necessary erection details.
   c. Show and indicate supplemental bracing, strapping, splices, bridging, accessories, and details necessary for proper installation.
   d. Structural element Placement Diagram: Diagram showing and indicating assumed location of each structural element and references the corresponding structural element design drawing.
5. Delegated design product data approved by delegated design professional:
   a. Fabricator's published product data for each type of structural element and accessory required.
   b. Expressly indicate compliance with applicable reference standards. If not addressed in fabricator's published information, submit as special certification addressing compliance with reference standards indicated in this Section.
   c. Published product data for galvanizing repair paint.
6. Delegated design calculations in accordance with Section 01 35 73 - Delegated Design Procedures:
   a. Complete set of design calculations, indicating:
      1) Basis of design, including a list of codes and standards used for design.
      2) List of design loads and load combinations.
      3) Design moments, shear forces, and axial compression/tension forces.

4) Design of connections, including splices, if required.
5) Bridging and bracing design, including attachments to trusses and anchorage to supporting structural elements, if required.
6) Special requirements, if any.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:
1. Applicable construction codes including building code, are indicated in Section 01 42 00 - References.

B. Qualifications:
1. Qualify welding procedures and welding operators in accordance with AWS.
a. All welders shall be qualified in all positions that will be utilized during welding. Welders shall utilize qualified PQR for testing.
2. Fabricator shall have minimum of 10 years of experience in fabrication of metal items specified.
3. Engineer for contractor-designed systems and components: Professional structural engineer licensed in the State of Texas.
4. NACE certified inspector shall have minimum of two years of experience performing inspections as indicated.
a. Have a current Level III coating inspector certification.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver and handle fabrications to avoid damage.

B. Store above ground on skids or other supports to keep items free of dirt and other foreign debris and to protect against corrosion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Abrasive stair nosings (embedded in concrete stairs):
a. American Safety Tread.
b. Balco.
2. Headed studs:
a. Nelson Stud Welding Div., TRW Inc.
b. Stud Welding Products, Inc.
3. Mechanical anchor bolts:
a. See Section 03 15 19.
4. Epoxy adhesive anchor bolts:
a. See Section 03 15 19.
5. Concrete screw anchors:
a. See Section 03 15 19.
6. Galvanizing repair paint:
a. Aervoe Industries, Inc.
b. ZRC Products.

2.2 MATERIALS

A. Steel:
1. Structural:
a. W-shapes and WT-shapes: ASTM A992, Grade 50.
b. All other plates and rolled sections: ASTM A36.
2. Pipe: ASTM A53, Types E or S, Grade B or ASTM A501.
3. Structural tubing:

a. ASTM A500, Grade B (46 ksi minimum yield).

4. Bolts, high strength:
   a. ASTM F3125, Grade A325.
   b. Galvanized, ASTM A153/A153M where noted on Drawings.
5. Nuts, high strength:
   a. ASTM A563.
6. Washers (hardened):
   a. ASTM F436.
   b. Provide two (2) washers with all bolts.
7. Bolts and nuts (unfinished):
   a. ASTM A307, Grade A.
   b. Galvanized, ASTM A153/A153M where noted on Drawings.
8. Welding electrodes: AWS D1.1, E70 Series.

B. Stainless Steel:
   1. Stainless steel in welded applications: Low carbon 'L' type.
   2. Minimum yield strength of 30,000 psi and minimum tensile strength of 75,000 psi.
      a. Bars, shapes: ASTM A276, Type 316.
      b. Tubing and pipe: ASTM A269, ASTM A312 or ASTM A554, Type 316.
      c. Strip, plate and flat bars: ASTM A666, Type 316.
      d. Bolts and nuts: ASTM F593, Type 316.
   3. Minimum yield strength of 25,000 psi and minimum tensile strength of 70,000 psi.
      a. Strip, plate and flat bar for welded connections, ASTM A666, Type 316L.
   4. Welding electrodes: In accordance with AWS for metal alloy being welded.

C. Aluminum:
   1. Alloy 6061-T6, 32,000 psi tensile yield strength minimum.
      a. ASTM B221 and ASTM B308 for shapes including beams, channels, angles, tees and zees.
      b. ASTM B209 for weir plates, baffles and deflector plates.
   2. Alloy 6063-T5 or T6, 15,000 psi tensile yield strength minimum.
      a. ASTM B221 and ASTM B429 for bars, rods, wires, pipes and tubes.
   3. ASTM F468, alloy 2024 T4 for bolts.
   4. ASTM F467, alloy 2024 T4 for nuts.
   5. Electrodes for welding aluminum: AWS D1.2, filler alloy 4043 or 5356.

D. Washers: Same material and alloy as found in accompanying bolts and nuts.

E. Embedded Anchor Bolts:
   1. See Specification Section 03 15 19.

F. Mechanical Anchor Bolts and Adhesive Anchor Bolts:
   1. See Specification Section 03 15 19.

G. Headed Studs: ASTM A108 with a minimum yield strength of 50,000 psi and a minimum tensile strength of 60,000 psi.

H. Galvanizing Repair Paint:
   1. High zinc dust content paint for regalvanizing welds and abrasions.
   2. ASTM A780.
   3. Zinc content: Minimum 92% in dry film.
   4. ZRC "ZRC Cold Galvanizing" or Aervoe " Crown Cold Galvanize Coating 93% Zinc Rich."

I. Dissimilar Materials Protection: See Specification Section 09 96 00.

2.3 MANUFACTURED UNITS

A. Bollards:
   1. 8 inches diameter extra strength steel pipe, ASTM A53.
      a. Galvanized.

b. See Specification Section 09 96 00 for painting requirements.

B. Abrasive Stair Nosings:
   1. Exterior cast-in-place concrete stairs:
      a. One piece cast aluminum with wing anchors.
      b. Diamond abrasive pattern.
      c. Babcock Davis "BSTCA-C3W".
   2. Length:
      a. Concrete stairs and landings:
         1) 4 inches less than overall stair width.
         2) Where tread mounted railing post occurs, hold nosing back 4 inches clear from railing centerline.
      b. Concrete landings at metal stairs: 4 inches less than clear width between stringers.

C. Metal Stairs:
   1. Treads: Grating as specified.
      a. Provide integral corrugated non-slip nosing.
   2. Risers:
      a. Grating treads:
         1) Solid plate welded to trailing edge of tread or landing.
         2) Minimum 3/16 inches thick by 4 inches high.
   3. Landings:
      a. Grating as specified.
      b. Provide integral corrugated non-slip nosing at edge acting as stair tread/nosing.
      c. Nosing at concrete landing:
         1) Abrasive stair nosing.
   4. Design live load for landing platform and supporting structure:
      a. 100 PSF, uniform load.
      b. 300 LBS concentrated load on 4 inches square area.
      c. All components to be adequate for the uniform load or the concentrated load, whichever requires the stronger component.
      d. Maximum deflection: 1/300 of span under a superimposed live load of 100 psf.
   5. Design, fabricate, and install in compliance with NAAMM and applicable codes.
      a. NAAMM AMP 510:
         1) Exterior at site structures and equipment: Industrial Class.
         2) Interior or exterior at buildings: Service Class.
   6. Handrails and guardrails: Refer to Specification Section 05 52 46.
   7. Material:
      a. Aluminum.

D. Aluminum Grating:
   1. NAAMM MBG 531.
   2. Bearing bars: Rectangular, 1-1/2 by 3/16 inches at 1-3/16 inches on-center spacing OR I-bar, 1-1/2 inches deep with minimum 1/16 inches thick bar and minimum 1/4 inches flange width at 1-3/16 inches on-center spacing (unless noted otherwise on Drawings).
   3. Cross bars:
      a. Welded, swaged or pressure locked to bearing bars:
      b. Maximum 4 inches/OC spacing.
   4. Top edges of bars: Grooved or serrated.
   5. Finish: Mill, standard.
   6. Clips and bolts: Stainless steel.
   7. Seat angles: Aluminum or stainless steel
   8. Edges and perimeter edges: Banded.
   9. Openings through grating: Reinforced to provide required load carrying capacity and banded with 4 inch high toe plate.
   10. Provide joints at openings between individual grating sections.

2.4 FABRICATION

A. Verify field conditions and dimensions prior to fabrication.

B. Form materials to shapes indicated with straight lines, true angles, and smooth curves.
   1. Grind smooth all rough welds and sharp edges.
      a. Round all corners to approximately 1/32 - 1/16 inches nominal radius.

C. Provide drilled or punched holes with smooth edges.
   1. Punch or drill for field connections and for attachment of work by other trades.

D. Weld Shop Connections:
   1. Stainless steel connections subject to corrosive environments or immersion service will be subject to the following enhanced visual and welding requirements:
      a. Fabricator
         1) Fabricator shall have QC program and procedures in place to avoid cross contamination with carbon steel products and material.
      b. Weld Procedures
         1) Weld procedures shall be qualified for all positions that will be welded, qualified by testing in accordance with applicable welding code AWS D1.6 requirements.
         2) Procedure Qualification Record (PQR) shall document all essential variables to perform consistent quality welds. PQR shall include maximum heat input per pass and shall be tested for CVN properties, macro hardness, and macro/micro hardness testing.
   2. Welds shall be continuous fillet type unless indicated otherwise.
   3. Full penetration butt weld at bends in stair stringers and ladder side rails.
   4. Weld structural steel in accordance with AWS D1.1 using Series E70 electrodes conforming to AWS A5.1/A5.1M.
   5. Weld aluminum in accordance with AWS D1.2.
   6. Weld stainless steel in accordance with AWS D1.6 and NiDI 11 007.
   7. All headed studs to be welded using automatically timed stud welding equipment.
   8. Grind smooth welds that will be exposed.

E. Make provisions to prevent carbon steel/free iron contamination of stainless steel surfaces (i.e., contact between carbon steel or iron and stainless steel component). Do not use cutting/grinding/drilling tools, wire brushes, or wire wheels on stainless steel that have been previously used on carbon steel or iron. Do not support or hang stainless steel weldments or fixtures with carbon steel cables or dunnage.

F. Passivate stainless steel items and stainless steel welds after they have been ground smooth, in accordance with ASTM A380/A380M.

G. Passivation Requirements:
   1. For components/assemblies to be used only in dry air service environments:
      a. No post-fabrication passivation treatments are required for external corrosion control.

H. Conceal fastenings where practicable.

I. Fabricate work in shop in as large assemblies as is practicable.

J. Tolerances:
   1. Rolling:
      a. ASTM A6.
      b. When material received from the mill does not satisfy ASTM A6 tolerances for camber, profile, flatness, or sweep, the Contractor is permitted to perform corrective work by the use of controlled heating and mechanical straightening, subject to the limitations of the AISC Specification.
   2. Fabrication tolerance:
      a. Member length:
         1) Both ends finished for contact bearing: 1/32 inches.

2) Framed members:
   a) 30 feet or less: 1/16 inches.
   b) Over 30 feet: 1/8 inches.

b. Member straightness:
   1) Compression members: 1/1000 of axial length between points laterally supported.
   2) Non-compression members: ASTM A6 tolerance for wide flange shapes.

c. Specified member camber (except compression members):
   1) 50 feet or less: -0/+1/2 inches.
   2) Over 50 feet: -0/+1/2 inches (+1/8 inches per 10 feet over 50 feet).
   3) Members received from mill with 75% of specified camber require no further cambering.
   4) Beams/trusses without specified camber shall be fabricated so after erection, camber is upward.
   5) Camber shall be measured in fabrication shop in unstressed condition.

d. At bolted splices, depth deviation shall be taken up by filler plates.
   1) At welded joints, adjust weld profile to conform to variation in depth.
   2) Slope weld surface per AWS requirements.

e. Finished members shall be free from twists, bends and open joints.
   1) Sharp kinks, bends and deviation from above tolerances are cause for rejection of material.

K. Fabricate grating, stairs, and accessories using aluminum unless shown otherwise on Drawings.
   1. Finish:
      a. Mill, unless noted otherwise.
      b. Coat surfaces in contact with dissimilar materials.
         1) See Specification Section 09 96 00.

L. Fabricate grating in accordance with NAAMM MBG 531.
   1. Maximum tolerance for difference in depth between grating depth and seat or support angle depth: 1/8 inches.
   2. Distance between edge of grating and face of embedded seat angle or face of wall or other structural member: 1/4 inches.
      a. Tolerance: NAAMM MBG 531.
   3. Removable sections: Not wider than 3 feet and not heavier than 100 pounds.
   4. Ends and perimeter edges: Banded, with alternate bearing bars welded to band.
      a. Provide full depth banding unless noted otherwise.
      b. Banding at trenches and sumps to be 1/4 inches less than grating depth to allow for drainage.
   5. Openings through grating: Reinforced to provide required load carrying capacity and banded with 4 inches high toe plate.
   6. Provide joints at openings between individual grating sections.
   7. Fabricate grating so that bearing bars and cross bars in adjacent sections are aligned.

M. See Specification Section 09 96 00 for preparation and painting of ferrous metals and other surfaces.

2.5 SOURCE QUALITY CONTROL

A. Surface Preparation:
   1. Refer to Specification Section 09 96 00 for surface preparation requirements.
   1. All miscellaneous metal fabrication item surfaces shall be observed and approved, prior to application of shop-applied coatings, by a NACE Certified Coatings Specialist (CIP-3) with at least 4 years of experience in similar inspections.
      a. Inspection shall be performed to determine depth of blast profile and cleanliness of surface.
      b. Fabricator shall reblast and or re-clean surfaces as required until acceptable.

B. Shop Applied Coating Application:

1. Refer to Specification Section 09 96 00 for coating requirements.
2. After surface has been accepted in writing by NACE certified coatings inspector, fabricator may proceed with application of coatings.
3. Application of coatings shall be observed and certified by NACE certified coatings inspector.

C. Meet structural requirements of Specification Section 01 45 33 for inspection and testing items of structural nature.

D. Shop Inspection and Testing:
1. Owner will employ and pay for the services of a qualified independent testing agency to inspect and test all structural steel and aluminum work for compliance with Contract Documents.
2. Contractor responsible for testing to qualify shop and field welders and as needed for Contractor's own quality control to ensure compliance with Contract Documents.
3. Independent testing agency shall have a minimum of five years performing similar work and shall be subject to Owner's approval.

E. Responsibilities of Testing Agency:
1. Inspect shop and field welding in accordance with AWS Code including the following non-destructive testing:
   a. Visually inspect all welds.
   b. In addition to visual inspection, test 50% of full penetration welds and 20% of fillet welds with liquid dye penetrant or mag particle.
   c. Test 20% of liquid dye penetrant tested full penetration welds with ultrasonic or radiographic testing.
   d. For all surfaces intended to be immersed or intended to be water tight:
      1) 100% of all fillet welds shall be PT tested to ensure water-tight surfaces are free of surface defects that would create areas for MIC.
      2) 100% of all completed SS welds and material shall be passivated in accordance with ASTM A380/A380M.
2. Inspect high-strength bolting in accordance with the RCSC Specification for Structural Joints Using High-Strength Bolts, Section 9.
   a. Verify direct tension indicator gaps, if applicable.
3. Inspect structural steel and aluminum which has been erected.
4. Inspect stud welding in accordance with AWS Code.
5. Prepare and submit inspection and test reports to Engineer.
   a. Assist Engineer to determine corrective measures necessary for defective work.

PART 3 - EXECUTION

3.1 PREPARATION

A. Provide items to be built into other construction in time to allow their installation.
1. If such items are not provided in time for installation, cut in and install.

B. Prior to installation, inspect and verify condition of substrate.

C. Correct surface defects or conditions which may interfere with or prevent a satisfactory installation.
1. Field welding aluminum is not permitted unless approved in writing by Engineer.

3.2 INSTALLATION

A. Set metal work level, true to line, plumb.
1. Shim and grout as necessary.

B. Meet structural requirements of Specification Section 05 14 00 for erecting items of structural nature:
1. Tolerances.

2. Inspection and testing.

C. Contractor is solely responsible for safety.
   1. Construction means and methods and sequencing of work is the prerogative of the Contractor.
   2. Take into consideration that full structural capacity of many structural members is not realized until structural assembly is complete; e.g., until slabs, decks, and diagonal bracing or rigid connections are installed.
   3. Partially complete structural members shall not be loaded without an investigation by the Contractor.
   4. Until all elements of the permanent structure and lateral bracing system are complete, temporary bracing for the partially complete structure will be required.

D. Adequate temporary bracing to provide safety, stability and to resist all loads to which the partially complete structure may be subjected, including construction activities and operation of equipment is the responsibility of the Contractor.
   1. Plumb, align, and set structural steel members to specified tolerances.
   2. Use temporary guys, braces, shoring, connections, etc., necessary to maintain the structural framing plumb and in proper alignment until permanent connections are made, the succeeding work is in place, and temporary work is no longer necessary.
   3. Use temporary guys, bracing, shoring, and other work to prevent injury or damage to adjacent work or construction from stresses due to erection procedures and operation of erection equipment, construction loads, and wind.
   4. Contractor shall be responsible for the design of the temporary bracing system and must consider the sequence and schedule of placement of such elements and effects of loads imposed on the structural steel members by partially or completely installed work, including work of all other trades.
      a. If not obvious from experience or from the Drawings, confer with the Engineer to identify those structural steel elements that must be complete before the temporary bracing system is removed.
   5. Remove and dispose of all temporary work and facilities off-site.

E. Examine work-in-place on which specified work is in any way dependent to ensure that conditions are satisfactory for the installation of the work.
   1. Report defects in work-in-place which may influence satisfactory completion of the work.
   2. Absence of such notification will be construed as acceptance of work-in-place.

F. Field Measurement:
   1. Take field measurements as necessary to verify or supplement dimensions indicated on the Drawings.
   2. Contractor responsible for the accurate fit of the work.

G. Check the elevations of all finished footings or foundations and the location and alignment of all anchor bolts before starting erection.
   1. Use surveyor's level.
   2. Notify Engineer of any errors or deviations found by such checking.

H. Framing member location tolerances after erection shall not exceed the frame tolerances listed in the FIELD QUALITY CONTROL Article in PART 3 of this Specification Section.

I. Erect plumb and level; introduce temporary bracing required to support erection loads.

J. Use light drifting necessary to draw holes together.
   1. Drifting to match unfair holes is not allowed.

K. Welding:
   1. Comply with AWS D1.1, AWS D1.2, and AWS D1.6 (as applicable for the material welded) and requirements of this Section's "Fabrications" Article in "Part 2 - Products".
   2. When joining two sections of steel of different ASTM designations, welding techniques shall be in accordance with a qualified AWS D1.1 procedure.

3. 100% of all completed stainless steel welds and material shall be passivated in accordance with ASTM A380/A380M.

L. Shore existing members when unbolting of common connections is required.
   1. Use new bolts for rebolting connections.

M. Clean stored material of all foreign matter accumulated prior to the completion of erection.

N. Bolt Field Connections: Where practicable, conceal fastenings.

O. Field Welding:
   1. Follow AWS procedures.
   2. Grind welds smooth where field welding is required.
   3. 100% of all completed stainless steel welds and material shall be passivated in accordance with ASTM A380/A380M.

P. Field cutting grating or checkered plate to correct fabrication errors is not acceptable.
   1. Replace entire section.

Q. Remove all burrs and radius all sharp edges and corners of miscellaneous plates, angles, framing system elements, etc.

R. Unless noted or specified otherwise:
   1. Connect steel members to steel members with 3/4 inches diameter ASTM F3125, Grade A325 high strength bolts.
   2. Connect aluminum to aluminum with 3/4 inches diameter stainless bolts.
   3. Connect aluminum to structural steel using 3/4 inches diameter stainless steel bolts.
      a. Provide dissimilar metals protection.
   4. Connect aluminum and steel members to concrete and masonry using stainless steel mechanical anchor bolts or adhesive anchor bolts unless shown otherwise.
      a. Provide dissimilar materials protection.
   5. Provide washers for all bolted connections.
   6. Where exposed, bolts shall extend a maximum of 3/4 inches and a minimum of 1/2 inches above the top of installed nut.
      a. If bolts are cut off to required maximum height, threads must be dressed to allow nuts to be removed without damage to the bolt or the nuts.

S. Install and tighten ASTM F3125, Grade A325 high-strength bolts in accordance with the AISC 325, Allowable Stress Design (ASD).
   1. Provide hardened washers for all Grade A325 bolts.
      a. Provide the hardened washer under the element (nut or bolt head) turned in tightening.

T. After bolts are tightened, upset threads of ASTM A307 bolts or anchor bolts to prevent nuts from backing off.

U. Secure metal to wood with lag screws of adequate size with appropriate washers.

V. Do not field splice fabricated items unless said items exceed standard shipping length or change of direction requires splicing.
   1. Provide full penetration welded splices where continuity is required.

W. Provide each fabricated item complete with attachment devices as indicated or required to install.

X. Anchor such that work will not be distorted nor fasteners overstressed from expansion and contraction.

Y. Set beam and column base plates accurately on nonshrink grout as indicated on Drawings.
   1. See Division 03 Specification Sections for non-shrink grout and anchorage.
   2. Set and anchor each base plate to proper line and elevation.
      a. Use metal wedges, shims, or setting nuts for leveling and plumbing columns and beams.

1) Wedges, shims and setting nuts to be of same metal as base plate they support.
2) Tighten nuts on anchor bolts.

b. Fill space between bearing surface and bottom of base plate with nonshrink grout.
1) Fill space until voids are completely filled and base plates are fully bedded on wedges, shims, and grout.

c. Do not remove wedges or shims.
1) Where they protrude, cut off flush with edge of base plate.

d. Fill sleeves around anchor bolts solid with non-shrink grout.

Z. Tie anchor bolts in position to embedded reinforcing steel using wire.
1. Tack welding prohibited.
a. Coat projecting bolt threads and nuts with heavy coat of clean grease.
2. Anchor bolt location tolerance:
a. Per Section 03 15 19.

AA. Install bollards as detailed on Drawings.
1. Fill pipe with concrete and round off at top.

BB. Provide abrasive stair nosings in each tread and landing of all concrete stairs and at each concrete stair landing having metal stair structure attaching to the concrete landing.
1. Center stair nosings in stair width.

CC. Accurately locate and place frames for openings before casting into floor slab so top of plate is flush with surface of finished floor.
1. Keep screw holes clean and ready to receive screws.

DD. Attach grating to end and intermediate supports with grating saddle clips and bolts.
1. Maximum spacing: 2 feet on-center with minimum of two per side.
2. Attach individual units of aluminum grating together with clips at 2 feet on-center maximum with a minimum of two clips per side.

EE. Coat aluminum surfaces in contact with dissimilar materials in accordance with Specification Section 09 96 00.

FF. Repair damaged galvanized surfaces in accordance with ASTM A780.
1. Prepare damaged surfaces by abrasive blasting or power sanding.
2. Apply galvanizing repair paint to minimum 6 mils DFT in accordance with manufacturer's instructions.

3.3 FIELD QUALITY CONTROL

A. Tolerances shall meet structural requirements of Specification Section 05 14 00 for erecting items of structural nature.

B. Tolerances (unless otherwise noted on the Drawings):
1. Frame placement, after assembly and before welding or tightening.
a. Deviation from plumb, level and alignment: 1 in 500, maximum.
b. Displacement of centerlines of columns: 1/2 inches maximum, each side of centerline location shown on Drawings.

C. Meet structural requirements of Specification Section 01 45 33 for inspection and testing items of structural nature.

3.4 CLEANING

A. After fabrication, erection, installation, or application, clean all miscellaneous metal fabrication surfaces of all dirt, weld slag and other foreign matter.

B. Provide surface acceptable to receive field applied paint coatings specified in Specification Section 09 96 00.

END OF SECTION

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SECTION 05 52 46
MECHANICALLY FASTENED ALUMINUM RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Aluminum handrail, stair rail and guardrail.
   2. Aluminum guardrail gates.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 01 35 73 – Delegated Design Procedures.
   4. Section 05 50 00 - Metal Fabrications.
   5. Section 09 96 00 - High Performance Industrial Coatings.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Aluminum Association (AA):
      a. ADM 1, Aluminum Design Manual.
      b. DAF 45, Designation System for Aluminum Finishes.
   2. ASTM International (ASTM):
      a. B108, Standard Specification for Aluminum-Alloy Permanent Mold Castings.
      b. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
      c. B221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
      d. B247, Standard Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings, and Rolled Ring Forgings.
      e. B308, Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
      f. B429, Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
   3. National Association of Architectural Metal Manufacturers (NAAMM):
      a. AMP 521, Pipe Railing Systems Manual.
   4. U.S. Department of Justice, Architectural and Transportation Barriers Compliance Board (Access Board):
      a. Americans with Disabilities Act (ADA):
         1) Accessibility Guidelines for Buildings and Facilities (ADAAG).
   5. Occupational Safety and Health Administration (OSHA):
      a. 29 CFR 1910, Occupational Safety and Health Standards, referred to herein as OSHA Standards.

1.3 DEFINITIONS

A. Guardrail: A system of building components located near the open sides of elevated walking surfaces for the purpose of minimizing the possibility of an accidental fall from the walking surface to the lower level.

B. Handrail: A horizontal or sloping rail intended for grasping by the hand for guidance or support.

C. Railing: A generic term referring to guardrail, handrail and/or stair rails.

D. Stair Rail: A guardrail, installed at the open side of stairways with either a handrail mounted to the inside face of the guardrail, or where allowed by applicable codes, with the top rail mounted at handrail height and serving the function of a handrail.

1.4 SUBMITTALS

A. Shop Drawings:
   1. Fabrication and/or layout drawings:
      a. Drawings showing profile, location, and fabrication details.
      b. Type and details of anchorage.
      c. Location and type of expansion joints.
      d. Materials of construction, shop coatings and all third-party accessories.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation details.
   3. Certification that railings have been designed and fabricated to meet the loading requirements specified.
   4. Informational Submittals:
      a. Calculations for all proposed deviations from the Specification.
         1) Calculations shall be performed, sealed, signed and dated by a registered professional structural engineer licensed in the State of Texas.
         2) Calculations shall be specific to this Project and shall include all assumptions, references and design interpretations used to achieve the results obtained by the Engineer.
         3) Reduction in load criteria is not acceptable as reason for deviation from sizes indicated in the Specification.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver and handle railings to preclude damage.

B. Store railings on skids, keep free of dirt and other foreign matter which will damage railings or finish and protect against corrosion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Mechanically fastened component railing systems.
      a. Golden Railing – Friction Railing System.
      b. Moultrie Manufacturing Company – Wesrail II.
      c. Peak-to-Peak Engineered Railings – Tang Railing System.
      d. Tuttle Railing Systems – TABCO 8000.

2.2 MATERIALS

A. Alloy 6061-T6 or Alloy 6061-T6.
   1. ASTM B209 for sheets and plates.
   2. ASTM B221 and ASTM B308 for shapes - beams, channels, angles, tees, and zees.
   3. ASTM B247 for forgings.

B. Alloy 6063-T5 or T6.
   1. ASTM B221 and ASTM B429 for bars, rods, wires, pipes and tubes.

C. Fittings:
   1. Cast aluminum: ASTM B108.
   2. Machined aluminum: 6063-T5 or T6 alloy.

D. Shims: Aluminum of same alloy as component being shimmed.

E. Fasteners: Stainless steel.

F. Expansion and Adhesive Anchors: See Specification Section 03 15 19.

2.3 FABRICATION

A. General:
   1. Verify field conditions and dimensions prior to fabrication.
   2. For fabrication of items which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trade names and roughness.
   3. Form exposed work with smooth, short radius bends, accurate angles and straight edges.
      a. Ease exposed edges to a radius of approximately 1/32 inches.
      b. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
      c. Drill or punch holes with smooth edges.
   4. Form exposed connections with flush, smooth, hairline joints, using stainless steel or aluminum splice locks to splice sections together.
      a. Ease the edges of splices and expansion joints and remove all burrs left from cutting.
   5. Provide for anchorage of type indicated on Drawings or as required by field conditions.
      a. Drill or punch holes with smooth edges.
   6. Design railings and anchorage system in accordance with NAAMM AMP 521 to resist loading as required by the building code.
      a. Maximum allowable stresses per AA ADM 1.

B. Custom fabricate railings to dimensions and profiles indicated.
   1. Guardrails:
      a. Posts: Minimum 1 1/2 inches nominal diameter Schedule 80 pipe.
         1) Space vertical posts as required by loading requirements but not more than 4 feet on center.
      b. Rails: Minimum 1 1/2 inches nominal diameter Schedule 40 pipe.
         1) Where details are not indicated, space intermediate rails to requirements of the building code or OSHA Standards, whichever requires the more restrictive design.
   2. Handrail: Minimum 1 1/4 inches nominal diameter Schedule 40 pipe.
      a. Outside diameter: 1 1/2 inches minimum, 2 inches maximum.
      b. Space handrail brackets as required by loading requirements but not more than 4 feet on center.
   3. Mounting:
      a. Provide manufacturer's standard cast or machined flanges or brackets as necessary for conditions shown on Drawings.
         1) Railing posts shall be secured using socket-head stainless steel set screws.
            a) Bolts, TEK screws, rivets, or adhesive are not acceptable.
      b. Flanges and brackets shall allow for removal of railing sections where removable railings are indicated on the Drawing.
         1) Completed assembly shall be designed to withstand the loading capacity specified.
   4. Toeboards:
      a. 1/4 inches thick by 4 inches high extruded toeboard with stiffener ribs.
         1) Moultrie "WHKP20" contour kickplate.
   5. Guardrail gates:
      a. Constructed of same material and sizes as the guardrail system.
      b. Width of gate as shown on Drawings.
      c. Hinges:
         1) Aluminum.
         2) Self-closing.
            a) Stainless steel torsion spring.
      d. Gate latch and stop:
         1) Cast aluminum.
         2) Spring-loaded pin latch.
            a) Stainless steel spring.

3) Gate latch shall positively stop gate from opening in opposite direction.

C. Railing Fabrication:
   1. All railings are to be mechanically fastened component system.
   2. Railing system shall be an engineered system designed specifically for use as guardrail system.
      a. Fittings shall be internally connected, flush-fitting aluminum or stainless steel.
      b. Fasteners shall be 302 series stainless steel Allen head set screws.
         1) Rivets, adhesive or headed screws are not acceptable.
   3. Fit exposed ends of guardrails and handrails with solid terminations.
      a. Return ends of handrail to wall, but do not attach to wall.
      b. Where guardrail terminates at a wall, provide a vertical post or end-loop 4 inches off the wall to center of vertical member.
   4. Preassemble items in shop to greatest extent possible to minimize field splicing and assembly of units at project site.
   5. Provide weeps to drain water from hollow sections of railing at exterior and high humidity conditions.
      a. Drill 1/4 inches weep hole in railings closed at bottom:
         1) 1 inches above walkway surface at bottom of posts set in concrete.
         2) 1 inches above base flange or reinforcing spud where applicable.
         3) At low point of intermediate rails.
      b. Do not drill weep holes:
         1) In bottom of base flange.
   6. Expansion joints:
      a. Joints to be designed to allow expansion and contraction of railing and still meet design loads required.
         1) Top rail splices and expansion joints shall be located within 8 inches of post or other support.
         2) Where railings span building [or tank] expansion joints; provide a railing expansion joint in the span crossing the building [or tank] expansion joint.
      b. Provide expansion joints in any continuous run exceeding 20 feet in length.
         1) Space expansion joints at not more than 40 feet on center.
      c. Provide minimum 0.10 inches of expansion joint for each 20 feet length of top rail for each 25 DEGF differential between installation temperature and maximum design temperature.
         1) Maximum expansion joint width at time of installation shall not exceed 3/8 inches.
            a) Provide additional expansion joints as required to limit expansion joint width.
      d. Provide slip-joint with internal sleeve.
         1) Extend slip joint min 2 inches beyond joint at maximum design width.
         2) Fasten internal sleeve securely to one side.
            a) Provide Allen-head set screw located in bottom of rail.
            b) Rivets or exposed screw heads are not acceptable.

D. Finish:
   1. Architectural Class 1 coating per AA DAF 45:
      a. AA-M12C22A41 clear anodized.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prior to installation, inspect and verify condition of substrate.

B. Correct surface defects or conditions which may interfere with or prevent a satisfactory installation.

3.2 INSTALLATION

A. Install handrails and guardrails to meet loading requirements of the building code and OSHA.

B. Install products in accordance with manufacturer's instructions.

C. Set work accurately in location, alignment and elevation; plumb, level and true.
   1. Measure from established lines and items which are to be built into concrete, masonry or similar construction.

D. Align railings prior to securing in place to assure proper matching at butting and expansion joints and correct alignment throughout their length.
   1. Provide shims as required.

E. Install proper sized expansion joints based on temperature at time of installation and differential coefficient of expansion of materials in all railings as recommended by manufacturer.
   1. Lubricate expansion joint splice bar for smooth movement of railing sections.

F. Provide removable railing sections where indicated on Drawings.

G. Provide toeboards on walkway side of all elevated walkways, platforms and stair landings, and where indicated on the Drawings or required by OSHA Standards.

H. Attach handrails to walls or guardrail with brackets designed for condition:
   1. Provide brackets which provide a minimum 2-1/4 inches clearance between handrail and nearest obstruction.
      a. Handrails shall not project more than 4-1/2 inches into required stairway width.
   2. Anchor handrail brackets to concrete or masonry walls with stainless steel adhesive anchors with stainless steel hex head bolts.

I. Anchor railings to concrete with stainless steel adhesive anchors with stainless steel bolts, nuts and washers unless noted otherwise in the Contract Documents.
   1. Where exposed, bolts shall extend minimum 1/2 inches and maximum 3/4 inches above the top nut.
      a. If bolts are cut off to required height, threads must be dressed to allow nuts to be removed without damage to the bolt or the nut.
      b. Bevel the top of the bolt after cutting to provide a smooth surface.

J. Anchor railings to metal structure with stainless steel bolts, nuts and washers.

K. Install toeboards to fit tight to the walking surface.
   1. Attach to railing vertical post with manufacturer's standard mounting clamp:
      a. Adjustable.
      b. Designed to engage in extruded slot on back of toeboard.
   2. Provide splice bars, corner splices and brackets:
      a. Manufacturer's standard items as required for a complete installation.
   3. Provide spacer bar and U-bracket where necessary for toeboard to clear mounting flange..
   4. Bottom of toeboard shall not exceed 1/4 inches above walking surface.

L. Coat aluminum in contact with dissimilar metal or concrete in accordance with Specification Section 09 96 00.

M. Provide railings as required for stair construction identified in Specification Section 05 50 00.

N. Install guardrail gate plumb and level in location shown on Drawings.
   1. Center gate in opening.
   2. Top of gate to match top of guardrail.
   3. Fasten hinges to gate and jamb post:
      a. Minimum three (3) 1/4 inches stainless steel countersunk machine screws per leaf.
      b. Drill and tap into railing and gate vertical posts.
   4. Provide not less than two hinges per gate.
   5. Install gate latch and stop on strike side of opening.

a. Fasten to gate with 1/4 inches stainless steel countersunk machine screws.
b. Drill and tap into gate vertical post.
c. Drill hole in railing vertical post to receive latch pin.

6. Adjust to provide smooth operation:
   a. Self-closing and self-latching.

END OF SECTION

SECTION 06 10 00
ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Rough carpentry.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 05 50 00 - Metal Fabrications.
   4. Section 07 61 13 - Metal Roofing.
   5. Section 07 62 00 - Flashing and Sheet Metal.
   6. Section 07 92 00 - Joint Sealants.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. The Engineered Wood Association (APA):
      a. PRP-108, Performance Standards and Qualification Policy for Structural Use Panels.
      b. U450E, Storage and Handling of APA Trademarked Panels.
      c. Y510T, Plywood Design Specification.
   2. ASTM International (ASTM):
      a. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
      b. D2898, Standard Practice for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing.
      c. D4442, Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials.
      d. D4444, Standard Test Method for Laboratory Standardization and Calibration of Hand-Held Moisture Meters.
      e. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
   3. American Wood Protection Association (AWPA):
      a. M2, Standard for Inspection of Wood Products Treated with Preservatives.
      b. M3, Standard Quality Control Procedures for Wood Preserving Plants.
      c. M4, Standard for the Care of Preservative-Treated Wood Products.
      d. P5, Standard for Waterborne Preservatives.
      e. U1, Use Category System: User Specification for Treated Wood.
   4. American National Standards Institute/Single Ply Roofing Industry (ANSI/SPRI):
      a. ES-1, Wind Design Standard for Edge Systems Used with Low Slope Roof Systems.
   5. Environmental Protection Agency (EPA).
   6. FM Global (FM):
      a. 1-49, Property Loss Prevention Data Sheets - Perimeter Flashing.
   7. National Institute of Standards and Technology (NIST):
      a. PS-1, Construction and Industrial Plywood.
      b. PS-20, American Softwood Lumber Standard.
   8. Underwriters Laboratories, Inc. (UL):
      a. 723, Standard for Test for Surface Burning Characteristics of Building Materials.
   9. Building code:
      a. International Code Council (ICC):
         1) International Building Code and associated standards, 2021 Edition including all amendments, referred to herein as Building Code.

B. Qualifications:
   1. Wood Treatment Plant: AWPA M3.
   2. Treated Wood Inspection: AWPA M2.

C. Miscellaneous:
   1. Factory marking:
      a. Lumber:
         1) Identify type, grade, moisture content, inspection service, producing mill, and other qualities specified.
         2) Marking may be omitted, as allowed by Building Code, if certificate of inspection is provided for each shipment.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Fabrication drawings of all fabricated items.
   3. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions for all products specified.
   4. Certifications:
      a. Chemicals used in treatment process are registered with and approved by EPA.
      b. Moisture content of material prior to treatment: 25 PCT maximum.
      c. Material has been kiln-dried after treatment (KDAT) to the moisture content specified.
   5. Documentation of treatment of treated material in accordance with standards referenced.

1.4 DELIVERY AND STORAGE

A. Delivery, storage and handling of untreated wood products:
   1. Lumber: As recommended by the grading agency indicated on the grade stamp.

B. Delivery, storage, handling and disposal of treated wood products: AWPA M4.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the manufacturers listed in the applicable Articles below are acceptable.

B. Submit request for substitution in accordance with Specification Section 01 26 00.

2.2 MATERIALS

A. General:
   1. Lumber (for framing, blocking, nailers, furring, grounds and similar members):
      a. NIST PS-20.
      b. Species:
         1) Treated material: As indicated in the appropriate AWPA standard.
      c. Grade:
         1) For nominal sizes up to and including 2 x 4: Standard and better.
         2) For nominal sizes up to 2 IN thick and wider than 4 IN: #2 and better.

B. Preservative Treated Material:
   1. Moisture content:
      a. Prior to treatment: 25 PCT.
      b. Kiln-dry after treatment (KDAT), ASTM D4442 and ASTM D4444:
         1) Lumber: 19 PCT maximum.
   2. Preservative:

a. Waterborne: AWPA P5.
b. As indicated in the appropriate AWPA standard.
3. Pressure-treat material in accordance with AWPA U1.
4. Wherever practicable, material to be treated shall be manufactured in its final form prior to treatment.

C. Fasteners and Anchors:
1. Nails and screws:
a. Dry, non-corrosive exposure: Hot dipped galvanized or Type 304 stainless steel.
b. Wet, corrosive, marine, and/or below grade: Type 316 stainless steel.
2. Adhesive anchors, expansion anchors, self-tapping concrete anchors, bolts, nuts, and washers: See Specification Section 05 50 00.

D. Exterior Wall Sheathing:
1) Acceptable manufacturer:
2) Georgia Pacific "DensGlass Gold Fireguard" exterior sheathing.
2. Gypsum board sheathing: ASTM C1177/C1177M.
3. Water and moisture-resistant treated gypsum core.
4. Glass mat facing front and back.
a. Fire rated "TYPE X".
5. Mold resistant: ASTM D3273.
6. Class 'A' fire rated per UL 790.
1) Flame spread 10, smoke developed 0 when tested in accordance with ASTM E84.
2) Non-combustible when tested in accordance with ASTM E136.
3) Thickness: 5/8 inches.
b. Fasteners: Type 304 self-tapping stainless-steel screws, size as recommended by board manufacturers for heavy gage metal stud framing.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify measurements, dimensions, and shop drawing details before proceeding.

B. Coordinate location of studs, nailers, blocking, grounds and similar supports for attached work.

C. Eliminate sharp projections which would puncture roofing, flashing or underlayment material.

3.2 ERECTION AND INSTALLATION

A. General:
1. Provide preservative treated material for all wood used:
a. Outside building.
b. Below grade.

B. Attach work securely by anchoring and fastening as indicated or required to support applied loading.
1. Anchor wood to concrete using adhesive or expansion anchors as specified in Specification Section 05 50 00.
a. Separate wood from direct contact to concrete with polyethylene foam gasket strip.
1) Size: 1/4 IN by width of wood member.
2) Owens Corning "SillSealR".
2. Anchor wood to metal using bolts and nuts as specified in Specification Section 05 50 00.
3. Provide flat washers under all bolt heads and nuts.
4. Fasten plywood in accordance with APA recommendations.
5. Use fasteners of size that will not penetrate members where opposite side will be exposed to view or receive finish materials.
6. Install fasteners without splitting of wood; predrill as required.
7. Do not drive threaded friction type fasteners.

8. Tighten bolts and lag screws at installation and retighten as required.

C. Set work to required levels and lines, plumb, true.
   1. Shim as required.
   2. Cut and fit accurately.

D. Provide wood grounds, nailers, or blocking where required for attachment of other work and surface applied items.
   1. Form to shapes indicated or required.
      a. Field treat cuts and holes in preservative treated material in accordance with AWPA M4 and manufacturer's published recommendations.
   2. Grounds:
      a. Dressed, key beveled lumber minimum 1-1/2 IN wide of thickness required to bring face of ground even with finish material.
      b. Remove temporary grounds when no longer required.
   3. Install roofing nailers as necessary for attachment of flashing, curbs, fascia, coping, and related accessories:
      a. Match height of nailers to insulation.
      b. Anchor nailers to resist force of 300 PLF unless required otherwise by FM Global or roofing manufacturer.
         1) Metal decking attachment:
            a) Attach base nailer to metal roof deck using self-tapping stainless steel sheet metal screws (STSMS) with plate washers or with minimum 3/8 IN Type 304 stainless steel hex head bolts with nuts and washers.
            b) Countersink heads of bolts flush with top of nailer.
         2) Concrete decking attachment:
            a) Attach base nailer to concrete roof deck using minimum 3/8 IN stainless steel adhesive anchors with minimum 3 IN embedment.
            b) Countersink heads of bolts flush with top of nailer.
         3) Provide size and spacing of anchorage as required to meet loading criteria specified.
            a) Fasten blocking for perimeter flashing in accordance with ANSI/SPRI ES-1 and FM Global 1-49.
      c. Provide 1/2 IN vent spaces between lengths of nailers.
      d. Install nailers over vapor retarder.

E. When wood has been exposed to moisture allow to completely dry out prior to covering with additional wood or another material.

F. Correct or replace wood which shows bowing, warping or twisting to provide a straight, plumb and level substrate for applications of other materials.

G. Exterior Wall Sheathing Installation:
   1. Install sheathing in accordance with manufacturer's installation guidelines and fastening requirements for loading requirements noted in the Contract Documents.
   2. Install sheathing with "gold side" out.
   3. Use maximum lengths possible.
   4. Do not tape joints between panels.
   5. If sheathing surface varies more than 1/8 inches from any one panel to an adjoining panel, remove the panels and reset.
      a. If the condition persists, remove the panels and correct sub framing as required so panels align properly.
   6. Drive fasteners to bear tight against and flush with surface of sheathing.
      a. Do not countersink, fracture core or puncture facers with head of fastener.

END OF SECTION

SECTION 06 85 14
FRP WEIRS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Fiberglass reinforced plastic (FRP) weir plates, mounting equipment, and appurtenances.

B. Related Sections include but are not necessarily limited to:
   1. Section 03 15 19 – Anchorage to Concrete.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society or Testing and Materials (ASTM):
      a. D256, Determining the Pendulum Impact Resistance of Notched Specimens of Plastics.
      b. D570, Water Absorption of Plastics
      c. D618, Practice for Conditioning Plastics and Electrical Insulating Materials for Testing
      d. D638, American Standard Test Methods for Tensile Properties of Plastics
      e. E831, Coefficient of Linear Thermal Expansion of Plastics Between –30 Deg C and 30 Deg C.
      f. D790, Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
      g. D2583, American Standard test Methods for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.
   2. American Water Work Association (AWWA):
      a. F101, Contact-Molded, Fiberglass-Reinforced Plastic Wash-Water Troughs and Launders, latest edition.
      b. F102, Matched-Die Molded, Fiberglass-Reinforced Plastic Weir Plates, Scum Baffles and Mounting Brackets, latest edition.

B. Qualifications:
   1. Manufacturer's Qualifications: Manufacturer shall have experience in designing and manufacturing FRP weirs, baffles, and flumes of similar size and configuration to those specified herein. For the manufacturer to be determined acceptable for providing these products on this project, they must show evidence of a minimum of twenty installations and ten years' experience in the design and manufacturer of FRP weirs and baffles of similar size and type as specified herein.

1.3 SYSTEM DESCRIPTION

A. The FRP products specified in this section shall be designed, manufactured, and supplied by a single manufacturer.

1.4 SUBMITTALS

A. Shop Drawings:
   1. Acknowledgement that products submitted meet requirements of the AWWA standards referenced.
   2. Certified drawings showing dimensions, project specific layout drawings, construction details and materials used for fabrication.
   3. Information and instructions for the storage, handling, installation and inspection of the products.
   4. Factory test results.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, and handle the products in accordance with the manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Warminster Fiberglass Company, Southampton, PA.
   2. NEFCO, Inc., Palm Beach Gardens, FL.
   3. Molded Fiber Glass (MFG) Water Treatment Products, Union City, PA.
   4. Fiberglass Fabricators.

2.2 MATERIALS, PERFORMANCE AND DESIGN REQUIREMENTS

A. Weirs and Mounting Plates:
   1. General
      a. Comply with AWWA F101 and F102 except as modified herein.
      b. Products shall comply with NSF/ANSI 61, Drinking Water System Components – Health Effects and the Safe Drinking Water Act.
      c. Application (liquid): municipal wastewater.
      d. Application (process):
         1) Aeration Basin Splitter Structure.
         2) Aeration Basins Nos. 5-8.
      e. Operating temperature range when in service: 40 degrees F to 90 degrees F.
      f. Operating temperature range when out of service: 0 degrees to 115 degrees F.
      g. Products shall be Type I fabrications, aqua in color.
      h. The weir dimensional information is shown on the Drawings.
   2. Laminates
      a. Plastic: ¼-IN thick
      b. Glass content: 30 ± 2 percent.
      c. Type "E" glass with chrome or silane finish.
      d. Powder Reinforcement: 47.5 ± 1 percent resin mix.
      e. Final Thickness: ± 10 percent of the nominal specified thickness.
      f. Incorporate ultraviolet inhibitors.
      g. Minimum physical properties per ASTM D638, ASTM D790, ASTM D256, ASTM D570, and ASTM D2583:
         1) Tensile strength: 7,500 pounds per square inch.
         2) Flexural strength: 16,000 pounds per square inch.
         3) Flexural modulus: 800,000 pounds per square inch.
         4) Impact, notches, Izod: 10 foot-pound per inch.
         5) Barcol hardness: 35.
         6) Average coefficient of thermal expansion: 0.000016 inch per inch degree F.
         7) Water adsorption, percent 24 hours: 0.2 percent.

2.3 ACCESSORIES

A. Anchor bolts, nuts, and washers shall be Type 316 stainless steel and supplied by the manufacturer.

B. Caulking shall be two-part confirming to Federal Specification TT-S227B.

2.4 SOURCE QUALITY CONTROL

A. Factory Testing:
   1. Conduct physical property tests in accordance with AWWA F101 and F102.
   2. Conduct chemical-resistance property test in accordance with AWWA F101 and F102.
   3. Materials or products that fail to comply with the testing requirements shall be rejected and replaced, and not shipped to the project site. Re-fabrication and retesting shall be at manufacturer's expense.

PART 3 - EXECUTION

3.1 PREPARATION AND DELIVERY

A. Comply with requirements of AWWA F101 and F102.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

3.3 FIELD QUALITY CONTROL

A. Weirs shall be carefully aligned and leveled to the elevations shown on the Drawings. In the completed installation, no variation greater than 1/16-IN shall exist between any two points on the weir plate. In addition, average weir elevation shall be accurate to the elevations shown on the drawings to within 1/16-IN. Weir elevation shall be verified once the tank is filled.

END OF SECTION

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SECTION 07 11 14
ASPHALTIC EMULSION DAMPPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish labor, materials, tools, equipment, and services for Asphaltic Emulsion Dampproofing, as indicated, in accordance with provisions of Contract Documents.

B. Completely coordinate with work of other trades.

1.2 REFERENCES

A. ASTM International (ASTM):
   1. ASTM D41 Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.
   2. ASTM D1227 Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing.
   3. ASTM D1668 Standard Specification for Glass Fabrics (Woven and Treated) for Roofing and Waterproofing.

1.3 QUALITY ASSURANCE

A. Applicator Qualifications:
   1. Approved in writing by manufacturer.

1.4 SUBMITTALS

A. Product Data:
   1. Manufacturers' product data sheets, details and installation instructions including components and accessories, indicating product used to be in compliance with specifications.

B. Project Information:
   1. License or certification in writing by manufacturer of installer qualifications.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Asphaltic Emulsion Dampproofing:
   1. Base:
      a. Karnak.
   2. Optional:
      a. BASF Master Builders Solutions.
      b. WR Meadows.

B. Other manufacturers desiring approval comply with Section 01 25 00.

2.2 MATERIALS

A. Primer: ASTM-D41, compatible with substrate and recommended by dampproofing manufacturer.

B. Asphaltic Emulsion Dampproofing:
   1. Refined asphalt, clay emulsifiers, and selected non-asbestos fiber reinforced emulsion for trowel application.

2. ASTM-D1227, Type II, Class 1.
3. Base Product: Karnak 920AF Fibered Emulsion Mastic (Trowel Grade).
4. Optional Product: MasterSeal 614 by BASF Master Builders Solutions.
5. Optional Product: Sealmastic Type III by WR Meadows.

C. Saturated fabric: Woven, glass fiber, ASTM-D1668 Type I.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Clean substrate of projections and substances detrimental to work.

B. Apply dampproofing to following surfaces:
1. Exterior face of exterior perimeter CMU backup walls.
2. Do not apply to walls scheduled to be waterproofed.

C. Comply with manufacturers installation instructions.

D. Prime per manufacturer's instructions.

E. Coordinate detailing at penetrations made after completion of dampproofing system.

F. Reinforce corners, cracks, and construction joints with saturated fabric.
1. Extend 9 IN on each side of each corner, crack and joint.

G. Where walls intersect footings, reinforce with saturated fabric, and extend dampproofing 1 FT onto footing.

H. Trowel apply in 2 coats to minimum finish thickness of 1/8 IN.

I. Allow 24-hour cure period between coats.

J. Allow no dampproofing exposed in finish work.

K. Repair any damage to coatings caused prior to installation of masonry veneer.

END OF SECTION

SECTION 07 19 00
LIQUID WATER REPELLENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Liquid water repellent.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 04 22 00 - Concrete Masonry.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. E514, Standard Test Method for Water Penetration and Leakage through Masonry.

B. Mock-Ups:
   1. Product shall be applied to mock-up erected under Specification Section 04 22 00.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.

B. Informational Submittals:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Letter from manufacturer stating that product is suitable for intended use and is compatible with and will not cause discoloration of treated concrete surfaces.
   3. Field conducted water spray test results.

1.4 JOB SITE CONDITIONS

A. Material shall be stored at temperatures between 40 and 90 DEGF.

B. Do not apply Penetrating Water Repellent to frost filled surfaces.
   1. Both substrate and ambient temps shall be 45 DEGF and rising at time of application.

C. Do not apply Penetrating Water Repellent at temperatures above 90 DEGF.

D. Do not apply Penetrating Water Repellent if rain is expected within 12 HRS.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Liquid water repellent:
      a. Chemprobe by Tnemec, Inc.

b. L&M by LATICRETE International, Inc.
c. Master Builders Solutions by BASF.
d. The Euclid Chemical Company.

B. Submit request for substitution in accordance with Specification Section 01 25 00.

2.2 MATERIALS

A. Liquid Water Repellent (LWR-1):
1. Water Based, clear, penetrating water repellant designed for use on porous masonry and concrete surfaces.
a. Ready to use, silane/siloxane blend.
b. Reduction in Leakage ASTM E514:
1) Brick: 100 PCT.
2) Mortar Block: >91 PCT.
c. VOC: 50 G/L.
2. Euclid "CHEMSTOP WB HEAVY DUTY".

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect adjacent surfaces not intended to receive water repellent.

B. Clean surfaces to be covered in accordance with manufacturer's recommendations.
1. Surface shall be structurally sound, clean, dry, free of dust, dirt, paint, efflorescence, laitance and other contaminants that will prevent the proper penetration of penetrating water repellent.
2. A dry substrate is required for proper penetration of the sealer.
3. Prior to application, joints or cracks must be properly sealed.
4. If acid is used for cleaning, neutralize completely before application of penetrating water repellent.

C. Make all mortar repairs at least 72 HRS prior to application.

D. Allow masonry surfaces to cure minimum of 10 days prior to application.

3.2 INSTALLATION AND APPLICATION

A. Install products in accordance with manufacturer's instructions.
1. At a minimum apply material in accordance with manufacturer's recommended application rates using procedures and equipment recommended by manufacturer.
2. Apply two coats of material.
a. Second coat shall be applied "wet on wet" before the first coat dries
b. Do not allow material to puddle on surface.
3. Using manufacturer's recommended application rates, apply as many coats of material as necessary to obtain results required by the FIELD QUALITY CONTROL Article.

B. Apply LWR-1 to exterior porous concrete masonry units surfaces.

3.3 FIELD QUALITY CONTROL

A. Manufacturer or manufacturer's designated representative shall conduct a water spray test to an area of the mock-up wall specified in Specification Section 04 22 00 for a period of 5 HRS.
1. Begin water spray test a minimum of seven days after application of water repellent sample.
2. Water from the spray shall impact the wall at a 45 DEG angle to the vertical and shall cover an area of not less than 9 SQFT.
3. Water flow shall be minimum 5 GPM at 60 PSI pressure.
4. If, within 5 HRS, moisture appears on the inside face of the wall within the test area, the wall shall be recoated.

B. Retest as required.

C. Recoat as required until wall area remains dry within limits of testing procedure.

D. Results of this test shall be used to determine material quantity in excess of manufacturer's minimum recommended amounts to be applied per square foot to the building surface.

E. Protect adjacent materials not required to be coated.

END OF SECTION

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SECTION 07 21 00
BUILDING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Building insulation.
      a. Does not include roof insulation or roof vapor retarder; see Specification Section 07 61 13.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 04 22 00 - Concrete Masonry
   4. Section 07 19 00 - Liquid Water Repellent.
   5. Section 07 61 13 - Metal Roofing.
   6. Section 07 92 00 - Joint Sealants.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. C272, Standard Test Method for Water Absorption of Core Materials for Structural Sandwich Constructions
      b. C423, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
      c. C518, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
      d. C578, Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
      e. C665, Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
      f. D1621, Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
      g. E96, Standard Test Methods for Water Vapor Transmission of Materials.
   2. International Energy Conservation Code (IECC) 2021 Edition, including all amendments.
   3. Underwriters Laboratories, Inc. (UL):
      a. Building Materials Directory.

B. Mock-Ups:
   1. Provide insulation for mock-ups required in Specification Section 04 22 00.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Manufacturer's recommendations on sealants, tapes and mastics.

B. Informational Submittals:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Certification from insulation manufacturer stating that insulation proposed is acceptable for intended use per the Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Rigid polyisocyanurate foam board insulation:
      a. Dow.
      b. Dyplast Products.
      c. Hunter Panels.
      d. Other manufacturers meeting the requirements of this Specification Section.
   2. Vapor retarder:
      a. Raven Industries.
      b. Reef Industries.
      c. Fortifiber Corp.
      d. Alumiseal.
   3. Polystyrene masonry block core inserts:
      a. Basis of Design: CBIS/Korfill.

B. Submit request for substitution in accordance with Specification Section 01 26 00.

2.2 MATERIALS

A. General:
   1. Foam plastic insulation used in buildings and structures shall comply with the requirements of the Building Code.
      a. Surface burning characteristics: ASTM E84.
      b. Flame spread index: Maximum 75.
      c. Smoke developed: Maximum 450.

B. Rigid Polyisocyanurate Foam Board Insulation:
   1. ASTM C1289, Type I Class 1.
   2. Compressive Strength: ASTM D1621, Minimum 25 PSI.
   3. CFC and HCFC free.
   4. Ozone depletion potential: 0.
   5. Foil facers or foil/kraft/foil facer on front and back side.
      a. Facers shall be treated to eliminate corrosive action of aluminum foil contacting masonry, mortar and concrete.
   6. Fire resistance: ASTM E84.
      a. Flame spread: Less than 25.
      b. Smoke developed: Less than 450.
   7. Provide insulation designed for intended use.
   8. R-Value: Minimum 5.7 R per IN.
   9. Required thickness at masonry cavity wall construction and interior furred walls: 1-1/2 IN (R8.55)
   10. Meets minimum IECC Requirements for air barrier compliance.

C. Polystyrene Masonry Block Core Inserts, ASTM C578:
   1. Individually molded inserts designed to fit against both inside faces of concrete block cores.
   2. Designed to be used with vertical reinforcing and grout filled cores without affecting the structural strength of the wall.
   3. Installed in the factory or at the project site.
   4. Density: 1.0 pcf.
   5. Thermal Conductivity (K-Factor): 0.26 (BTU/HR)/(SQFT)(DEGF)/(IN).
   6. Water vapor transmission: ASTM E96/E96M, maximum 5.0 perm IN.
   7. Absorption: Maximum 4.0%.

D. Sealant and Mastic (for setting polystyrene and/or polyisocyanurate insulation board): Manufacturer's recommended standard.

E. Refer to Specification Section 07 61 13 for roofing insulation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions and IECC.

B. General:
   1. Insulate full thickness over surfaces to be insulated.
   2. Fit tightly around obstructions, fill voids.
   3. Cover all penetrations (electrical junction boxes, switch boxes, piping, conduits, etc.) with insulation, taking care not to compromise the workings of the device.
   4. Fit butted joints of insulations tightly together.
   5. Apply single or double layer to achieve total thickness.
      a. If double layer is provided, stagger all joints minimum 12 IN.
   6. Do not use broken or torn pieces of insulation.
   7. Install so that completed installation is vapor tight.
      a. Seal all joints.
      b. Seal to abutting materials to maintain vapor retarder integrity.
      c. Provide manufacturer's recommended vapor retarder tape for use with faced batt insulation or separate vapor retarder.
         1) If vapor retarder tape fails to adhere to any surface, apply sprayed-on adhesive as recommended by tape manufacturer to promote adhesion.

C. Rigid Board Insulation in Cavity Walls and Furred Walls:
   1. Do not proceed with installation until subsequent work which conceals insulation is ready to be performed.
   2. Set each piece of insulation flush with the abutting piece to eliminate ledges in the face of the insulation.
   3. Install mastic on face of concrete or masonry back-up in accordance with mastic and insulation manufacturer's recommendation.
   4. Press courses of insulation between wall ties (horizontal reinforcing) with edges butted tightly both ways.
   5. Set units firmly into mastic.
   6. Seal all horizontal and vertical joints with sealant recommended by insulation manufacturer.
   7. Do not use damaged insulation.

D. Polystyrene Masonry Block Core Inserts:
   1. Install inserts in interior wall concrete masonry block cores (except bond beams, cores noted to be grouted solid and cores having vertical reinforcing) noted on Drawings.
   2. Inspect all inserts as units are installed.
      a. Do not install damaged inserts.
   3. Install all inserts in accordance with manufacturer's recommendations.
   4. Ensure that all inserts fit tightly to face of block core.

3.2 FIELD QUALITY CONTROL

A. Repair or replace damaged insulation and/or accessories as directed by Engineer.

END OF SECTION

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SECTION 07 26 00
UNDER SLAB VAPOR RETARDER

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Under slab vapor retarder.

B. Related Specification Sections include but are not necessarily limited to:

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Concrete Institute (ACI):
      a. 302.2R, Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.
   2. ASTM International (ASTM):
      a. E1643, Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
      b. E1745, Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Product data sheet on vapor retarder sheet and vapor retarder tape.
      c. All accessories proposed for use.
      d. Manufacturer's installation instructions.

B. Informational Submittals: Manufacturer's recommendation on vapor retarder tape.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Vapor retarder:
      a. Fortifiber Building Systems Group, Inc. by Henry Company.
      b. Layfield Group, Ltd.
      c. ISI Building Products.
      d. Raven Industries, Inc.
      e. Reef Industries, Inc.
      f. Stego Industries, LLC.
      g. W.R. Meadows, Inc.

2.2 PERFORMANCE REQUIREMENTS

A. Vapor Retarder:
   1. ASTM E1745, Class A.
   2. Thickness: Minimum 15 mil.
   3. Water vapor permeance: 0.02 maximum.

2.3 ACCESSORIES

A. Pipe Boots: Manufacturer's standard boot fabricated to maintain the integrity of the vapor retarder system.

B. Vapor Retarder Tape: As recommended by vapor retarder manufacturers.

PART 3 - EXECUTION

3.1 PREPARATION

A. Base material over which vapor retarder is to be installed shall be level, compacted and free of debris, foreign objects or other deleterious materials.

B. Surfaces at perimeter and penetrations of vapor barrier shall be clean, smooth and free of sharp objects, fins or projections.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions, ASTM E1643 and ACI 302.2R.

B. Provide vapor retarder where indicated on the Drawings.
   1. Place continuous vapor retarder above granular fill subgrade material, unless noted otherwise.

C. Lap minimum 6 inches and seal in accordance with ASTM E1643 and manufacturer's recommendations.

D. Extend to extremities of area and seal to adjacent elements.

E. Seal all penetrations: Provide pipe boot for all pipes or conduit penetrating the floor slab.

3.3 FIELD QUALITY CONTROL

A. Ensure proper precautions are implemented to prevent damage to installed vapor retarder membrane prior to and during pouring of concrete floor slab.

B. Inspect vapor retarder immediately prior to placement of concrete.
   1. Patch all punctures, tears, holes, etc.
      a. Patch small punctures with vapor retarder tape as allowed by ASTM E1643 and manufacturer's recommendations.
      b. Repair larger damage with additional layer of vapor retarder.
         1) Lap repairs minimum 6 inches beyond extent of damage in all directions.
         2) Seal perimeter of patch with vapor retarder tape or as recommended by manufacturer.

END OF SECTION

SECTION 07 61 13
METAL ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Ice and water shield.
2. Thermal barrier sheathing.
3. Roof insulation.
4. Standing seam metal roofing.
5. Prefinished gutters and downspouts.
6. Soffit panels.
7. Sheet metal work required for roofing.

B. Related Specification Sections include but are not necessarily limited to:
1. Division 00 - Procurement and Contracting Requirements.
2. Division 01 - General Requirements.
3. Section 04 05 23 - Masonry Accessories.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
1. American Architectural Manufacturers Association (AAMA):
   a. 621, Voluntary Specifications for High Performance Organic Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) and Zinc-Aluminum Coated Steel Substrates.
   b. 2605, Voluntary Specifications, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
2. ASTM International (ASTM):
   a. A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   b. A666, Standard Specification for Annealed or Cold-Worked Austenitic Stainless-Steel Sheet, Strip, Plate and Flt Bar.
   c. A792, Standard Specification for Steel Sheet, 55 PCT Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
   d. B209, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate.
   e. C209, Standard Test Methods for Cellulosic Fiber Insulating Board.
   f. C1289, Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
   g. D882, Standard Test Method for Tensile Properties of Thin Plastic Sheeting.
   h. D1970, Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
   i. D4833, Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products.
   j. E96, Standard Test Methods for Water Vapor Transmission of Materials.
   k. E1592, Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference.
   l. E1646, Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference.
   m. E1680, Standard Test Method for Rate of Air Leakage Through Exterior Metal Roof Panel Systems.
   n. E1745, Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.
   o. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.

3. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
   a. Architectural Sheet Metal Manual, Sixth Edition, 2003.
4. Underwriters Laboratories, Inc. (UL):
   a. Building Materials Directory.
   b. Fire Resistance Directory.
   c. 580, Standard for Tests for Uplift Resistance of Roof Assemblies.
   d. 790, Standard Test Methods for Fire Tests of Roof Coverings.
   e. 1256, Fire Test of Roof Deck Constructions.
5. Building code:
   a. International Code Council (ICC):
      1) International Building Code and associated Standards, 2021 Edition including all amendments, referred to herein as Building Code.
      2) International Energy Conservation Code (IECC), 2021 Edition including all amendments.

B. Qualifications:
1. Manufacturer shall have minimum of 10 years experience in the production of structural standing seam metal roofing.
   a. All structural components of the roof system shall be designed and sealed by registered professional structural engineer licensed in the State of Texas.
2. Installing contractor shall be licensed or approved in writing by manufacturer.
3. Contractor and installer shall have minimum of seven (7) years experience in the installation of structural standing seam metal roof systems similar to system specified.
4. Contractor and installer shall have successfully completed two (2) projects of similar size, scope and complexity within past two (2) years.
5. All roll forming performed on-site shall be supervised by personnel trained and employed by the roofing manufacturer.
   a. Roofing manufacturer shall have been engaged in field roll forming for a minimum of 15 years with experience in roll forming long panels similar to panels being used.

C. Mock-Ups:
1. Prior to start of permanent roof construction construct mock-ups of roofing system.
   a. Mock-ups shall be of sufficient size to properly display all components required by the roofing system.
   b. Mock-ups shall be a minimum 4 FT x 4 FT in size.
   c. Provide multiple mock-ups as required to illustrate the different roof configurations.
2. Mock-ups shall incorporate all components, specified and/or required but not specified, needed for a complete water and airtight roofing fascia, and soffit system.
   a. Components include, but are not limited to:
      1) Thermal barrier sheathing, roof insulation.
      2) Roofing panels, including mounting system and seaming.
      3) All fascia and soffit conditions.
      4) All flashing and counterflashing conditions, including:
         a) Eave, rake, hip and ridge conditions.
         b) Roof/vertical wall intersections.
         c) Roof penetrations.
         d) All reglet conditions.
      5) All miscellaneous clips, angles, plates, brackets, closures and sealants.
      6) Gutter and downspouts.
3. Panels shall be same panels as specified or approved for Project.
   a. Exact color is not necessary; however, Contractor is to label each exposed component to identify final installed color of component.
4. Step construction to allow observation of all components.
5. Construct additional mock-ups or rework existing mock-ups until acceptable to Engineer.
6. Maintain mock-ups at project site until Engineer approves removal of mock-ups.

7. Approved mock-ups to constitute minimum acceptable standard of quality for actual construction.

D. Completed roof system to be inspected by roof manufacturer's authorized factory trained representative prior to issuance of roof warranty.

1.3 DEFINITIONS

A. Installer or Applicator:
   1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
   2. Installer and applicator are synonymous.

B. Steep Slope: Having a pitch of 3:12 or greater.

C. Low Slope: Having a pitch less than 3:12 but greater than 1/4:12.

D. PVDF: Polyvinylidene fluoride.

1.4 SYSTEM DESCRIPTION

A. Prefinished, field-insulated, structural standing seam metal roof system, including but not limited to:
   1. Ice and water shield.
   2. Roof insulation.
   3. Structural standing seam metal roof panels.
      a. Roof panel support and attachment system to be determined by standing seam roof manufacturer.

B. All flashing and miscellaneous trim required for a complete water and airtight system, including but not limited to:
   1. Reglets.
   2. Flashing.
   3. Counterflashing.
   4. Sealants.

C. Flat metal fascia system.

D. Prefinished gutters and downspouts.

E. Prefinished aluminum soffit panels.

1.5 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Fabrication and/or layout drawings:
      a. Manufacturer prepared computer-generated Drawings showing anchorage, flashing, jointing and all other accessories required and all special detailing required by the system.
         1) Minimum plan scale: 1 IN = 8 FT.
         2) Minimum detail scale: 1-1/2 IN = 1 FT.
      b. Provide complete erection plan for each building structure with all details and sections referenced, all penetrations shown, expansion joints shown, detailed and referenced, and all special conditions identified, referenced and detailed.
      c. Erection plan to identify limits of each different substrate material (decking).
      d. Provide distinction between factory and field assembled work.
   3. Product technical data including:
      a. Manufacturer data sheets on each component, including masonry reglets used in the roof system.
      b. Acknowledgement that products submitted meet requirements of standards referenced.

1) Certification by manufacturer that roofing assembly being supplied has been successfully tested under UL 580 procedures and has achieved a Class 90 rating.

4. Test results:
   a. UL 580, Class 90 test data.
   b. ASTM E1592 test results.
      1) Provide results of tests conducted in accordance with ASTM E1592 for panel size and gage and clip type and spacing similar to panels and clips being used.
   c. ASTM E1646 and ASTM E1680 test results.
   d. Concentrated load test data.
      1) Load test to be conducted on panel size, gage and with clip spacing as required.
5. Qualifications:
   a. Manufacturer: Provide structural engineer qualifications.
   b. Contractor:
      1) Certification of approval or license to install product from manufacturer.
      2) Certification of experience.
      3) Listing of projects completed in the past two (2) years with similar scope.
      4) Completed projects information to include, square footage of roofing installed, dollar value of roofing installed, manufacturer and type of roofing installed and contact name and telephone number of building Owner.
   c. Installer: Provide qualifications of all personnel expected to be working on the Project.
6. Roofing manufacturer's letter of approval for insulation proposed for use.
7. Warranty: Sample language of manufacturer's warranty to be provided on this Project.
8. Structural Engineer's sealed and signed calculations certifying that system structural components meet the requirements for lateral, upward and downward loads specified.

B. Samples:
   1. General: Tag, identify and provide statement regarding use for all fasteners, anchor clips, closures and sealants.
   2. Roof panel:
      a. Two (2) samples, full width, 24 IN long.
      b. Provide color selected or specified when possible.
   3. Fasteners.
   4. Anchor clips.
   5. Closures, (both metal and non-metallic).
   6. Masonry reglet.
   7. Factory and field applied sealants.
   8. Color samples:
      a. For initial preliminary color selection, provide manufacturer's color chart showing all colors available.
      b. For final color selection, provide two (2) 2 IN x 3 IN colored metal samples, for each color selected during the initial color selection.

C. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

D. Informational Submittals:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Final warranty.

1.6 WARRANTY

A. Provide 10-year complete system warranty, including material and material substrate for air and weather tightness of entire roof assembly signed by manufacturer.
   1. Warranty limits shall meet the minimum load capacity requirements of ASTM E1592.

B. Provide manufacturer's 20-year warranty on panel finish against fading, chipping, cracking and peeling of the panel exterior finish and/or erosion of substrate metal.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Metal roofing products basis of design:
   1. Sloped roofs: Berridge C-lock with vinyl weather seals.

B. Manufacturers listed and other manufacturers not listed, but capable of meeting this Specification Section, are expected to provide a system with similar profile, standing seam height, spacing, construction and factory applied finish.

C. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Metal roofing:
      a. Berridge.
      b. Centria.
      c. Merchant and Evans - Zip Rib.
      d. Other manufacturers capable of providing structural standing seam system and profiles similar to that specified will be considered.
   2. Thermal barrier sheathing:
      a. Georgia-Pacific.
   3. Ice and water shield.
      a. Grace.
   4. Insulation: Any manufacturer meeting these specifications and approved by metal roofing manufacturer.
   5. Cover Board: Provide per manufacturer's system requirements.
   6. PVDF resin:
      a. PPG - DURANAR.
      b. Valspar - Fluropon.
      c. Arkema Inc. - KYNAR 500.
      d. Solvay Solexis - HYLAR 5000.
      e. Solvay Solexis - HYLAR 5000.
   7. Soffit panels: Provided by metal roofing panel manufacturer.
   8. Structural roof curbs:
      a. Thybar Corporation.
      b. The Pate Company.
   9. Masonry reglets: See Specification Section 04 05 23.

D. Submit request for substitution in accordance with Specification Section 01 26 00.

2.2 MATERIALS

A. Roof Panels:
   1. General:
      a. GalvaLume Steel, ASTM A792, Class SS, Grade 50B
         1) Painted Surfaces: AZ50
         2) Unpainted surfaces: AZ55.

B. Fascia Metal: 22 GA to match roof material, finish and color.

C. Soffit Panels: Aluminum, ASTM B209.

D. Insulation:
   1. Rigid polyisocyanurate.
      a. Approved by roofing manufacturer.

E. Perimeter Trim, Panel Closures, Flashing and Counterflashing: Material and factory applied finish to match roof panels.

F. Fasteners: 300 series stainless steel, ASTM F593.

G. Intermediate Support System:
   1. Stainless steel: ASTM A666m Type 304.

H. Sealant: Manufacturer's standard non-curing butyl.

I. Thermal Barrier Sheathing:
   1. Gypsum board sheathing: ASTM C1177.
      a. Water and moisture-resistant treated gypsum core.
      b. Glass mat facing front and back.
   2. Mold resistant: ASTM D3273.
   3. Class 'A' fire rated per UL 790.
   4. Flame spread 15 and smoke developed 0 when tested in accordance with ASTM E84 or UL 723.
   5. Thickness: 1/2 IN.
   6. Compatible with roofing vapor retarder, insulation and adhesives.
   7. Georgia-Pacific "DensDeck Roof Board".

J. Ice and water shield.
   1. Basis of design: Grace Ice and Water Shield or approved equal.
   2. Thickness: Minimum 40 MIL.
   3. Meets IECC requirements for air barrier compliance.

K. Masonry Reglets: See Specification Section 04 05 23.

L. Cover Board: Approved by manufacturer for roofing system.

2.3 ACCESSORIES

A. Gutters and Downspouts:
   1. General:
      a. GalvaLume Steel, ASTM A792, Class CS
         1) Painted Surfaces: AZ50
         2) Unpainted Surfaces: AZ55.
         3) Minimum thickness: 22 GA.
         4) All exposed surfaces to have finish and color to match roofing metal.
   2. Gutters:
      a. "Style D" gutter per SMACNA Figure 1-2.
         1) Seamless except for expansion joints.
      b. Gutter straps and eave closure flashing: Match gutter material, finish and color.
      c. Match roof color.
      d. Size: Min. 5" x 5".
   3. Downspouts:
      a. SMACNA Figure 1-32B.
         1) Seam on concealed side of downspout.
         2) Provide gutter to downspout connection per SMACNA Figure 1-33B, Detail 1.
      b. Hanger straps: Material and finish to match downspouts.
      c. Match roof color.
      d. Size: Min. 4" x 4".

B. Roof Insulation:
   1. Rigid polyisocyanurate foam board.
      a. ASTM C1289, Class I, Type II.
      b. Compressive strength: 20 PSI minimum.
      c. Density: 2 PCF minimum.
      d. Thermal resistance (R-Value): 5.7/IN.

e. Water vapor transmission: ASTM E96, less than 1.0 perms.
f. Water absorption: ASTM C209, less than 1.0 PCT.
g. R Value: Minimum R-25.
h. Acceptable to roof manufacturer.

C. Roof Penetration Flashing:
1. Round penetrations:
a. Premolded EPDM boot with metal collar.
b. Buildex "DEK-TITE."

D. Foam and metal closures, sealant, gaskets, fasteners, washers, clips, angles, and all miscellaneous trims shall be provided by roofing manufacturer, fabricated for the specific condition as required.

E. Soffit Panels:
1. Minimum 0.032 IN aluminum, ASTM B209.
2. Factory applied finish to match roof panels.
3. AAMA 2605.
4. Profile: Flat interlocking sheet with reinforcing ribs as required to prevent warping and oil canning.
5. Panel joints shall match standing seam spacing of roof panels when possible.
6. Hat shaped steel channel sub-framing:
a. 1 IN deep x 20 GA steel.
b. Galvanized, ASTM A653.
7. Soffit panels match roof color.

F. Structural Roof Curbs:
1. Aluminum, ASTM B209.
a. Minimum thickness: 0.040.
2. Insulated: Minimum 1-1/2 IN rigid polystyrene with sheet metal liner.
3. Factory installed fire-retardant treated wood nailer.
4. Minimum 12 IN high.
5. Fabricated to conform to roof pitch and roof panel profile indicated.
6. ThyCurb Model TC-3.
7. Exterior side of curb shall be covered in same material as roofing to match roofing.

2.4 FABRICATION

A. General:
1. Fabricate with square, true corners, mitered and welded.
2. Fabricate trim, flashings and closure pieces to match panel profile and finish.
3. Hem all edges.
4. Fabricate panels in full length with no end laps.

B. Standing Seam Metal Roof Panels:
1. Profile:
a. Sloped roofs: Basis of Design: Berridge C-lock with vinyl weather seals.
2. Minimum thickness: 24 GA.
3. Width:
a. 16 IN.
b. Longitudinal stiffening elements to minimize oil canning.
4. System shall be designed as a true structural standing seam shape.
5. Finish:
a. PVDF based with minimum 70 PCT resin.
b. Three-coat system having minimum 0.8 MIL epoxy primer coat on both sides of panel with a 0.8 MIL PVDF resin color coat and a 0.8 MIL PVDF resin clear top coat on the exterior side of the panel.
c. Meet or exceed requirements of AAMA 6621.
d. Smooth finish.

e. Roof, fascia, and trim Color:
1) To be selected from manufacturer's standard color range.

6. Concealed fasteners:
a. Provide concealed fasteners in all locations.
b. If exposed fasteners are required by the roof panel manufacturer, because of location, constructability issues or other critical design requirement, finish of fastener shall match roof panel finish.
1) Exposed fasteners are to be approved by Engineer.
c. The use of deflection limiter devices is not allowed.

C. Intermediate Support System:
1. Roof panel anchor clips:
a. Manufacturer's standard one-piece clip suitable for condition.
1) Two-piece clips are acceptable if required by roofing manufacturer.
b. Stainless steel, thickness as required for roof system.
1) ASTM A666, Type 304.
2. Roof panel manufacturer shall be responsible for designing and providing all necessary intermediate "Z" or "hat-shaped" or other miscellaneous support members as required to transfer roof panel loads into building roof framing members.
a. Design in accordance with Building Code and loads shown on the Structural Drawings.
3. Bearing plates:
a. Sized by roofing manufacturer for roof loading indicated.
b. Stainless steel.
1) ASTM A666, Type 304.

2.5 SOURCE QUALITY CONTROL

A. Roof assembly to be Class A roof covering assembly per UL 1256.

B. Structural Testing:
1. The system shall be designed to safely resist the positive and negative loads per Building Code and as shown on Drawings.
2. Structural-uniform uplift load capacity of the panel system shall be determined in accordance with ASTM E1592.
a. The factor of safety on the test results shall be 1.65 for the panel, batten or clip ultimate loads with no increase for wind.
b. The factor of safety for fasteners shall be 3.0 for one (1) single fastener per clip, 2.25 for two (2) fasteners per clip and 4.0 IN masonry.
c. Design uplift capacity for conditions of gage, span or loading other than those tested may be determined by interpolation of test results.
1) Extrapolation of conditions outside the range of the tests is not acceptable.
d. Deflection shall be L/180 for positive loading.

C. Water Penetration: No uncontrollable leakage at minimum 6.4 PSF when tested in accordance with ASTM E1646.

D. Air Infiltration: Maximum 0.00 scfm/SF when tested at 4.0 PSF differential pressure when tested in accordance with ASTM E1680.

E. Fire Resistance/Wind Uplift Rating:
1. UL 790, Class 1.
2. UL 580, Class 90.

F. The panels shall withstand a 250 LB concentrated load applied to a 4 SQIN area at the center of the panel at mid span between supports with no panel deformation, rib buckling, or panel sidelap separation which will adversely affect the weather tightness of the system.

G. Support roofing panels on top of roof insulation using bearing plates attached to the structural frame or connect to manufacturer-provided intermediate support system.

1. Bearing plate and standing seam roof panel anchor clip attachment is to be determined by the roofing manufacturer and shall take precedent over this Specification.
    a. Provide attachment to roof structural frame or deck as required for loading criteria specified.
2. Roof panel anchor clips shall be designed to allow thermal movement of the panels except where specific fixed points are indicated.
    a. Roof panel manufacturer shall be responsible for determining fixed point locations unless otherwise indicated.
3. Wood blocking shown at roof edge is strictly for attachment of miscellaneous flashings and shall not be used for any structural value.
4. Maximum spacing of roof clips shall be determined by manufacturer.

H. Roof panel manufacturer shall be responsible for designing and installing all necessary expansion joints in the roof system.
    1. Where roof expansion joints occur, provide corresponding expansion joints in fascia, soffit and gutters.

2.6 MAINTENANCE MATERIALS

A. Provide Owner with 4 OZ of touch-up paint to match each different color used in the system.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
    1. Install products in accordance with manufacturer's instructions, IECC, SMACNA (where referenced) and details shown on Drawings for a complete weathertight installation without waves, warps buckles or distortions.
        a. Provide all closures, trim, angles, plates, sealant, gaskets, fasteners, washers, etc., as necessary.
    2. Attachments shall allow for thermal expansion and contraction.
    3. Seal all joints as required for watertight installation.
    4. Touch-up paint all damaged surfaces.

B. Thermal Barrier Sheathing:
    1. Install in accordance with manufacturer's recommendations and UL listed assembly as required to provide fire-resistance rating for roof assembly.

C. Roof Insulation:
    1. Install in accordance with manufacturer's recommendations.
    2. If multiple layers are provided to achieve total thickness as shown on Drawings, stagger joints minimum 12 IN in each direction.

D. Cover Board:
    1. Install as required by manufacturer for roofing system per manufacturer's recommendations.

E. Ice and Water Shield:
    1. Install per manufacturer's recommendations in areas indicated on Drawings.
    2. Provide continuous coverage over entire roof area.
    3. Extend down fascia and below soffit back to wall insulation.
    4. Install in accordance with IECC to ensure continuous air barrier for building envelope system.

F. Standing Seam Roofing Panels:
    1. Install in one (1) continuous length from ridge to eave.
    2. Hand crimp battens at each clip.
    3. Seam panels and battens together with portable electric seaming machine supplied by the manufacturer.

G. Soffit Panels:
   1. Install in accordance with manufacturer's recommendations using concealed fasteners when possible.
   2. Exposed fasteners to be painted to match soffit finish.

H. Installation of Structural Roof Curbs:
   1. Install roof curbs on decking.
   2. Attach to metal decking using sheet metal screws.
      a. Provide fasteners at maximum 8 IN OC with minimum of one (1) fastener at each corner of curb.
   3. Install flashing curb in accordance with roofing manufacturer's standard flashing details.
      a. Provide sheet metal flashing and counterflashing as required for weather-tight installation.

I. Gutters:
   1. Install gutters using gutter straps in accordance with SMACNA Table 1-8 and Figure 1-12 and per roofing manufacturer's recommendations.
      a. Provide gutter brackets or hangers at 24 IN OC maximum.
      b. Provide expansion joints in gutters per SMACNA and at expansion joint locations shown on Drawings.
      c. Install gutters to provide positive drainage to downspout locations.
      d. Seal all joints in gutters to provide completely water tight system.

J. Downspouts:
   1. Install downspouts in locations shown on the Drawings.
   2. Provide downspout hanger straps per SMACNA Figure 1-35 as appropriate for downspout style.
   3. Provide gutter to downspout connection per SMACNA Figure 1-33B, Detail 1.
   4. Seal all joints in downspout for a complete watertight system.
      a. Angle bottom of downspout out away from building.
   5. Fasten hanger straps to building wall with stainless steel screws and anchor sleeves appropriate for wall construction.
      a. Provide minimum of two (2) fasteners per strap.
   6. Maximum spacing of hanger straps shall be 10 FT with minimum of two (2) hanger straps per vertical piece of downspout.
   7. Spacing and location of hanger straps shall be consistent from downspout to downspout.

END OF SECTION

SECTION 07 62 00
FLASHING AND SHEET METAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Architectural flashing and sheet metal work.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 04 05 23 - Masonry Accessories.
   4. Section 07 61 13 - Metal Roofing.
   5. Section 07 92 00 - Joint Sealants.
   6. Section 09 96 00 - High Performance Industrial Coatings.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Architectural Manufacturers Association (AAMA):
      a. 2605, Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
   2. American National Standards Institute/Single Ply Roofing Industry (ANSI/SPRI):
      a. ES-1, Wind Design Standard for Edge Systems Used with Low Slope Roof Systems.
   3. ASTM International (ASTM):
      a. A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
      b. A666, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
      c. B32, Standard Specification for Solder Metal.
      d. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
   4. FM Global (FM).
   5. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
      a. Architectural Sheet Metal Manual, Seventh Edition, 2012.

B. Qualifications:
   1. Sheet metal fabricator shall have minimum 10 years experience in fabrication of sheet metal items similar to items specified.
   2. Sheet metal installer shall have minimum five (5) years experience installing sheet metal items specified.

1.3 DEFINITIONS

A. Installer or Applicator:
   1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
   2. Installer and applicator are synonymous.

B. PVDF: Polyvinylidene fluoride.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

2. Product technical data including:
    a. Acknowledgement that products submitted meet requirements of standards referenced.
    b. Manufacturer's installation instructions.
3. Fabrication and/or layout drawings.
    a. Scaled drawing showing expansion joint locations, special conditions, profile, fastening and jointing details.
        1) Minimum plan scale: 1/8 IN = 1 FT.
        2) Minimum detail scale: 1-1/2 IN = 1 FT.
4. Fabricator qualifications.
5. Installer qualifications.

B. Samples:
1. Finish and color samples for each product specified for Engineer preliminary color selection.
2. For final color selection, provide two (2) 2 IN x 3 IN colored metal samples for each color selected during the preliminary color selection.

C. Informational Submittals:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Warranty: Manufacturer's sample warranty language.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Pre-finished sheet metal:
    a. Carlisle.
    b. Firestone Building Products.
    c. Petersen Aluminum Corp.
2. Butyl sealant:
    a. Pecora.
    b. Sika.
    c. Tremco.

B. Submit request for substitution in accordance with Specification Section 01 26 00.

2.2 MATERIALS

A. Sheet Metal:
1. Galvanized Steel: ASTM A653

B. Fasteners: Stainless Steel.

C. Sealants:
1. Non-curing Butyl Sealant:
    a. Pecora "BA-98 IN.
    b. Sika "SikaLastomer 511 IN.
    c. Tremco "TremPro JS-773 IN.
2. Building sealants:
    a. See Specification Section 07 92 00.

D. Fasteners: Stainless steel.

E. Retainer Clips and Continuous Cleats: Stainless steel.

F. Solder: ASTM B32.

G. Dissimilar Metal Protection: Comply with Specification Section 09 96 00.

H. Reglets: See Specification Section 04 05 23.

2.3 MANUFACTURED ITEMS

A. Finish:
   1. PVDF coating with minimum 70 PCT resin content.
      a. Meet requirements of AAMA 2605.
         1) Color:
            a) Match roof color for components installed with roofing.
            b) Match masonry color for components installed with masonry.

2.4 FABRICATED ITEMS

A. General:
   1. Shop fabricate items to maximum extent possible.
      a. Fabricate true and sharp to profiles and sizes indicated on Drawings.
         1) Shop fabricate and weld or solder all corners.
   2. Pre-Finished Steel:
      a. Galvanized, G-60 or Galvolume, AZ-55
      b. Thickness: Minimum 22 GA
      c. Texture: Smooth
      d. Coated on exposed face with PVDF coating having a minimum 70 PCT resin content and a minimum 1.0 MIL dry film thickness.
         1) Meet requirements of AAMA 2605.
      e. Color from manufacturer's available standard and premium colors.

B. Retainer Clips and Continuous Cleats:
   1. 0.050 IN stainless steel.

PART 3 - EXECUTION

3.1 PREPARATION

A. Provide items to be built into other construction to Contractor in time to allow their installation.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions, SMACNA, and as indicated on Drawings.

B. Weld aluminum to achieve weathertight joints and required details.
   1. Do not weld slip joints.
   2. Touch-up damaged prefinished items.

C. Set top edges of membrane flashing and sheet metal flashing into reglets wherever practicable.
   1. Surface applied terminations will be allowed only where specifically detailed or otherwise approved in writing by the Engineer.
   2. Provide counterflashing at all reglets.
   3. Seal reglets and counterflashings in accordance with Specification Section 07 92 00.

D. Fasten materials at intervals recommended by SMACNA.

E. Install slip joints to allow for thermal movement as recommended by SMACNA and manufacturer.
   1. Maximum spacing: 10 FT OC.
   2. Provide slip joint 24 IN from corners.
   3. Provide slip joint at each vertical expansion joint location in wall.
      a. Provide break in continuous cleat at each vertical expansion joint.
      b. The above expansion joints do not include brick veneer expansion joints.

F. Seal slip joints with two (2) beads of non-curing butyl sealant on each side of slip joint overlap.

G. Form flashings to provide spring action with exposed edges hemmed or folded to create tight junctures.

H. Provide dissimilar metals and materials protection where dissimilar metals come in contact or where sheet metal contacts mortar, concrete masonry or concrete.

I. Provide all miscellaneous sheet metal items not specifically covered elsewhere, as indicated or required to provide a weathertight installation.
   1. Provide all components necessary to create weather-tight junctures between roofing and sheet metal work.

END OF SECTION

SECTION 07 92 00
JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Sealing all joints which will permit penetration of dust, air or moisture.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 09 96 00 - High Performance Industrial Coatings.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Concrete Institute (ACI):
      a. 302.1R, Guide for Concrete Floor and Slab Construction.
   2. ASTM International (ASTM):
      a. C834, Standard Specification for Latex Sealants.
      b. C920, Standard Specification for Elastomeric Joint Sealants.
      c. C1521, Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints.
   3. NSF International (NSF):
      a. 61, Drinking Water System Components -- Health Effects.
   4. Underwriters Laboratories, Inc. (UL).
   5. International Energy Conservation Code (IECC), 2021 Edition including all amendments.

B. Qualifications: Sealant applicator shall have minimum five (5) years experience using products specified on projects with similar scope.

C. Mock-Ups:
   1. Before sealant work is started, a mock-up of each type of joint shall be sealed where directed by the Engineer.
      a. The approved mock-ups shall show the workmanship, bond, and color of sealant materials as specified or selected for the work and shall be the minimum standard of quality on the entire project.
      b. Each sample shall cure for a minimum of seven (7) days at which time the sealant manufacturer's authorized factory representative shall perform adhesion tests on each sample joint.
         1) Perform adhesion tests per ASTM C1521.
         2) If mock-up is not acceptable or if adhesion test fails, provide additional mock-up and adhesion testing as required until acceptable to Engineer.

1.3 DEFINITIONS

A. Corrosive Areas Include: Chemical Building.

B. Defect(ive): Failure of watertightness or airtightness.

C. Finish sealant: Sealant material per this specification applied over face of compressible sealant or expanding foam sealant specified, to provide a finished, colored sealant joint.

D. Installer or Applicator:
   1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.

2. Installer and applicator are synonymous.

E. "Interior wet areas": Toilets, showers, laboratories, and similar areas.

F. "Seal," "sealing" and "sealant": Joint sealant work.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Manufacturer's recommendations for joint cleaner, primer, backer rod, tooling and bond breaker.
   3. Certification from sealant manufacturer stating product being used is recommended for and is best suited for joint in which it is being applied.
   4. Certification of applicator qualification.

B. Test Results:
   1. Provide adhesion test results for each sealant sample including adhesion results compared to adhesion requirements.
   2. Manufacturer's authorized factory representative recommended remedial measures for all failing tests.

C. Samples:
   1. Cured sample of each color for Engineer's color selection.
   2. Color chart not acceptable.

D. Informational Submittals:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver material in manufacturer's original unopened containers with labels intact: Labels shall indicate contents and expiration date on material.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Compressible sealant:
      a. Polytite Manufacturing Corporation.
      b. Emseal.
      c. Norton.
      d. Sandell.
   2. Expanding foam sealant:
      a. Macklanburg Duncan.
      b. Convenience Products.
      c. FAI International, Inc.
   3. Polyether sealants:
      a. BASF.
      b. ChemLink, Inc.
      c. Tremco.
   4. Polysulfide rubber sealant:

a. Pecora.
b. BASF.
c. PolySpec.

5. Polyurea joint filler:
   a. Dayton Superior Specialty Chemical Corporation.
   b. Euclid Chemical Co.
   c. L&M Construction Chemicals, Inc.
   d. BASF.
6. Polyurethane sealants:
   a. Pecora.
   b. Sika Chemical Corp.
   c. BASF.
   d. Tremco.
7. Silicone sealants:
   a. ChemLink.
   b. GE Construction Sealants.
   c. Dow Corning.
   d. Tremco.
8. Backer rod, compressible filler, primer, joint cleaners, bond breaker: As recommended by sealant manufacturer.

B. Submit request for substitution in accordance with Specification Section 01 25 00.

2.2 MATERIALS

A. Sealants - General:
   1. Provide colors matching materials being sealed.
   2. Where compound is not exposed to view in finished work, provide manufacturer's color which has best performance.
   3. Non-sagging sealant for vertical and overhead horizontal joints.
   4. Sealants for horizontal joints: Self-leveling pedestrian/traffic grade.
   5. Joint cleaner, primer, bond breaker: As recommended by sealant manufacturer.
   6. Sealant backer rod and/or compressible filler:
      a. Closed cell polyethylene, polyethylene jacketed polyurethane foam, or other flexible, nonabsorbent, non-bituminous material recommended by sealant manufacturer to:
         1) Control joint depth.
         2) Break bond of sealant at bottom of joint.
         3) Provide proper shape of sealant bead.
         4) Serve as expansion joint filler.
   7. Exterior envelope sealants meet minimum IECC air leakage requirements.

B. Compressible Sealant:
   1. Foamed polyurethane strip saturated with polymerized polybutylene waterproofing coated on front face with nonreactive release agent that will act as bond breaker for applied sealant.
      a. Polytite Manufacturing Corp. "Polytite-B."
   2. Fire rated where required.
   3. Adhesive: As recommended by sealant manufacturer.

C. Expanding Foam Sealant:
   1. One (1) or two (2) component fire rated moisture cured expanding urethane.
   2. Shall not contain formaldehyde.
   3. Density: Minimum 1.5 PCF.
   4. Closed cell content: Minimum 70 PCT.
   5. R-value: Minimum 5.0/IN.
   6. Flame spread: Less than 25.
   7. Smoke developed: Less than 25.

D. Polyether Sealant:
   1. Silyl-terminated polyether polymer.
   2. ASTM C920, Type S, Grade NS, Class 50, Use NT, M, A, and O.
      a. BASF MasterSeal 150.
      b. ChemLink DuraLink.
      c. Tremco Dymonic FC

E. Polysulfide Rubber Sealant:
   1. One (1) or two (2) component.
   2. Meet ASTM C920.
      a. Pecora Synthacalk GC2+.
      b. PolySpec THIOKOL 2235.

F. Polyurea Joint Filler:
   1. Two (2) component, semi-rigid material for filling formed or saw-cut control joints in interior concrete slabs.
      a. Dayton Superior Specialty Chemical Corp. "Joint Fill, Joint Seal, Joint Saver II" as required for condition and recommended by manufacturer.
      b. Euclid Chemical Co. "EUCO QWIK" joint.
      c. L&M Construction Chemicals, Inc. "Joint Tite 750 IN.
      d. BASF MasterSeal "CR100 IN control joint filler.
   2. Comply with ACI 302.1R performance recommendations regarding control and construction joints.
   3. Color: Gray.

G. Polyurethane Sealant:
   1. One (1) or two (2) components.
   2. Paintable.
   3. Meet ASTM C920 Type S or Type M, Grade NS or P, Class 25, Use NT, T, M, A and O.
      a. Pecora Dynatrol-IXL, Dynatrol II, Urexpan NR-200, NR-201.
      b. Sika Chemical Corporation Sikaflex-1a, Sikaflex-2C NS/SL.
      c. BASF MasterSeal NP-1, NP-II, SL-1 SL-2.
      d. Tremco Dymonic or Dymeric, Vulkem 116,227,45,245.

H. Silicone Sealant:
   1. One (1) component.
   2. Meet ASTM C920, Type S, Grade NS, Class 25, Use NT, G, A, O.
      a. ChemLink: DuraSil.
      b. General Electric: Silpruf, Silglaze II.
      c. General Electric: Sanitary 1700 sealant for sealing around plumbing fixtures.
      d. Dow Corning: 786 for sealing around plumbing fixtures.
      e. Dow Corning: 7565, 790, 791, 795.
      f. Tremco: Spectrem 1, Spectrem 3, Tremsil 600.
   3. Mildew resistant for sealing around plumbing fixtures.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before use of any sealant, investigate its compatibility with joint surfaces, fillers and other materials in joint system.

B. Use only compatible materials.

C. Where required by manufacturer, prime joint surfaces.
   1. Limit application to surfaces to receive sealant.
   2. Mask off adjacent surfaces.

D. Provide joint depth for joints receiving polyurea joint filler in accordance with manufacturer's recommendations.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions and UL requirements and in accordance with IECC for components that comprise the air barrier system envelope.

B. Clean all joints.

C. Make all joints water and airtight.

D. At changes in direction of joints, joint intersections and where sealant joints interface with other construction, install continuous sealant as necessary to ensure a weather-tight seal.

E. Make depth of sealing compounds, except expanding foam and polyurea sealant, not more than one-half width of joint, but in no case less than 1/4 IN nor more than 1/2 IN unless recommended otherwise by the manufacturer.

F. Provide correctly sized backer rod, compressible filler or compressible sealant in all joints to depth recommended by manufacturer:
   1. Take care to not puncture backer rod and compressible filler.
   2. Provide joint backer rod as recommended by the manufacturer for polyurea joint filler.

G. Apply bond breaker where required.

H. Tool sealants using sufficient pressure to fill all voids.

I. Upon completion, leave sealant with smooth, even, neat finish.

J. Where piping, conduit, ductwork, etc., penetrate wall, seal each side of wall opening.

K. Install compressible sealant to position at indicated depth.
   1. Size so that width of material is twice joint width.
   2. Take care to avoid contamination of sides of joint.
   3. Protect side walls of joint (to depth of finish sealant).
   4. Install with adhesive faces in contact with joint sides.
   5. Install finish sealant where indicated.

L. Install expanding foam sealant to minimum 4 IN depth or thickness of wall being penetrated if less than 4 IN or as indicated on Drawings.
   1. Provide adequate fire rated backing material as required.
   2. Hold material back from exposed face of wall as necessary to allow for installation of backer rod and finish sealant.
      a. Allow expanding foam sealant to completely cure prior to installing backer rod and finish sealant.
   3. Trim off excess material flush with surface of the wall if not providing finished sealant.

3.3 SEALANT WORK

A. General:
   1. Work includes but is not limited to: Sealing all joints which will permit penetration of dust, air, or moisture.
   2. Refer to SCHEDULE for materials to be used.

B. Concrete joints:
   1. Flooring joints.
   2. Isolation joints.
   3. Joints between paving or sidewalks and building.
   4. Construction, control and expansion joints.
   5. Joints between precast roof units and between precast roof units and walls.
   6. Joints between precast wall panels.

7. Precast panel bearing joints:
    a. At panels bearing at or above grade, seal both sides of panel base joint.
    b. At panels bearing below grade:
        1) Seal exterior panel base joint prior to backfilling and/or placement of site paving.
        2) Provide compressible filler and sealant or backer rod and sealant as appropriate for interior slab condition.

C. Masonry:
1. Masonry control joints.
2. Between masonry and other materials.

D. Flashing, reglets and retainers.

E. Openings:
1. Perimeters of door and window frames, louvers, grilles, etc.
2. Door thresholds shall be set in a full bed of sealant.

F. Interior finishes:
1. Perimeter and penetrations of sound insulated walls.
2. Expansion and control joints in tile work.

G. Plumbing fixtures.

H. Penetrations of walls, floors and decks.

I. Other joints where sealant, expanding foam sealant or compressible sealant is indicated.

3.4 FIELD QUALITY CONTROL

A. Adhesion Testing:
1. Perform adhesion tests in accordance with ASTM C1521 per the following criteria:
    a. Water bearing structures: One (1) test per every 1000 LF of joint sealed.
    b. Exterior precast concrete wall panels: One (1) test per every 2000 LF of joint sealed.
    c. Chemical containment areas: One (1) test per every 1000 LF of joint sealed.
    d. Building expansion joints: One (1) test per every 500 LF of joint sealed.
    e. All other type of joints except butt glazing joints: One (1) test per every 3000 LF of joint sealed.
    f. Manufacturer's authorized factory representative shall recommend, in writing, remedial measures for all failing tests.

3.5 SCHEDULE

A. Furnish sealant as indicated for the following areas:
1. Exterior areas:
    a. Above grade: Polyether.
    b. Below grade: Polyurethane.
2. Interior areas:
    a. Noncorrosive areas:
        1) Wet exposure: Polyether.
            a) Toilet rooms, locker rooms, janitor closets or similar areas: Mildew resistant silicone.
        2) Dry exposure: Polyether, unless noted otherwise.
            a) Sound insulated construction: Acoustical sealant.
    b. Corrosive areas:
        1) Wet exposure: Polysulfide.
        2) Dry exposure: Polyurethane.
    c. Sealant exposed to or having the potential of being exposed to concentrated chlorine gas or chlorine liquid: Polysulfide.
    d. Casework, countertops and solid surface materials: Silicone.

1) Sinks, fixtures or other areas subject to potential splash, spillage or condensation: Mildew Resistant Silicone.

3. Immersion:
   a. Prolonged contact with or immersion in:
      1) Potable water:
         a) Polysulfide.
         b) NSF 61 approved.
      2) Nonpotable water, wastewater or sewage: Polysulfide.
4. Compressible sealant: Where indicated.
5. Exterior wall penetrations: Expanding urethane foam, with finish sealant.
   a. Finish sealant:
      1) Exterior side:
         a) Above grade: Polyether.
         b) Below grade: Polyurethane.
      2) Interior side:
         a) Noncorrosive area:
            (1) Wet exposure: Polyether.
            (2) Dry exposure: Polyether, unless noted otherwise.
         b) Corrosive area:
            (1) Wet exposure: Polysulfide.
            (2) Dry exposure: Polyurethane.
6. Interior concrete slab formed or saw-cut control joints: Polyurea joint filler.

END OF SECTION

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SECTION 08 11 00
HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Metal doors and frames.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 08 70 00 - Finish Hardware.
   4. Section 09 96 00 - High Performance Industrial Coatings.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   2. National Association of Architectural Metal Manufacturers (NAAMM):
      a. Hollow Metal Manufacturers Association (HMMA).
   3. National Fire Protection Association (NFPA):
      a. 80, Standard for Fire Doors and Other Opening Protectives.
   4. Steel Door Institute (SDI):
      a. 117, Manufacturing Tolerances for Standard Steel Doors and Frames.
      b. All SDI publications.
   5. Steel Door Institute/American National Standards Institute (SDI/ANSI):
      a. A250.6, Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
      b. A250.7, Nomenclature for Standard Steel Doors and Steel Frames.
      c. A250.8 (formerly SDI 100), Recommended Specifications for Standard Steel Doors and Frames.
      d. A250.10, Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
      e. A250.11, Recommended Erection Instructions for Steel Frames.
   6. Building code:
      a. International Code Council (ICC):
         1) International Building Code and associated standards, 2021 Edition including all amendments, referred to herein as Building Code.
         2) International Energy Conservation Code (IECC), 2021 Edition including all amendments.
   7. National Fenestration Rating Council (NRFC).

B. Qualifications: Manufacturer must be current member of SDI, and NAAMM (HMMA).

C. Wipe coat galvanized steel is not acceptable as substitute for galvanizing finish specified.

1.3 DEFINITIONS

A. As identified in SDI/ANSI A250.7.

1.4 SUBMITTALS

A. Shop Drawings:

1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Product technical data including:
   a. Acknowledgement that products submitted meet requirements of standards referenced.
   b. Manufacturer's installation instructions.
3. Schedule of doors and frames using same reference numbers as used on Drawings.
4. SDI certification.

B. Contract Closeout Information:
1. Operation and Maintenance Data:
   a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store doors and frames in accordance with SDI/ANSI A250.11.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Metal doors and frames:
   a. CECO Corporation.
   b. Steelcraft Manufacturing Co.
   c. Curries Company.

B. Submit request for substitution in accordance with Specification Section 01 25 00.

2.2 MATERIALS

A. Steel Sheet: Hot-dipped galvannealed steel, ASTM A653, A60 coating.

B. Frames: Hot-dipped galvannealed steel, ASTM A653, A60 coating.

C. Supports and Reinforcing: Hot-dipped galvannealed steel, ASTM A653, A60 coating.

D. Inserts, Bolts and Fasteners: Manufacturer's standard.

E. Primer: Manufacturer's standard coating meeting SDI/ANSI A250.10.

F. Galvannealed Coating Repair: See Specification Section 09 96 00.

G. Thermal Insulation: Polyurethane, CFC free.

H. Sound Insulation: Fiberglass batt insulation or impregnated Kraft honeycomb.

2.3 ACCESSORIES

A. Frame Anchors:
1. Jamb anchors:
   a. Masonry wire anchors: Minimum 0.1875 IN wire, galvanized.
   b. Existing wall anchor: Minimum 18 GA, galvanized.
   c. Stud partition and base anchors: Minimum 18 GA, galvanized.

2.4 FABRICATION

A. General:
1. SDI/ANSI A250.8.
2. Fabricate rigid, neat in appearance and free from defects.
3. Form to sizes and profiles indicated on Drawings.
   a. Beveled edge.
4. Fit and assemble in shop wherever practical.

5. Mark work that cannot be fully assembled in shop to assure proper assembly at site.
6. Continuously wire weld all joints, dress exposed joints smooth and flush.
7. Fabricate doors and frames to tolerance requirements of SDI 117.
8. Fit doors to SDI and NFPA 80 clearances if fire doors are used.
9. All doors shall be handed.
10. Hinge cut-out depth and size on doors and frames shall match hinge specified in Specification Section 08 70 00.
11. Design and fabricate doors to requirements of the Building Code.

B. Hollow Metal Doors:
   1. General:
      a. 1-3/4 IN thick.
      b. Fabricate with flush top caps.
         1) Thickness and material to match door face.
         2) Exterior doors: Seal weld top cap to door face and grind smooth and flush.
         3) Interior doors:
            a) Attach top cap to door with concealed fasteners or by welding.
            b) Factory seal if attached with fasteners.
            c) No exposed fasteners will be accepted.
      c. Continuously wire weld all joints and dress, smooth and flush.
   2. Exterior:
      a. Doors 48 IN wide, or less: SDI/ANSI A250.8, Level 3, and physical performance level A, Model 2.
         1) Face sheet minimum thickness: 16 GA.
         2) Insulated: Minimum R10.
         3) Meets minimum IECC air leakage requirements.
            a) Provide labeling on door/frame indicating conformance or letter from manufacturer certifying compliance.
            b) Products rated in accordance with NFRC.
   3. Interior:
      a. Doors 48 IN wide, or less: SDI/ANSI A250.8, Level 2, and physical performance level "B", Model 2.
         1) Face sheet minimum thickness: 18 GA.
      b. Sound insulated, minimum STC-35.

C. Hollow Metal Frames:
   1. Door frames:
      a. Provide 2 IN face at all heads, jambs and mullions for frames in stud walls.
      b. Provide 4 IN face at head where noted on Drawings or required by wall construction.
      c. 26 GA galvannealed steel boxes welded to frame at back of all hardware cutouts.
      d. Steel plate reinforcement welded to frame for hinge, strikes, closers and surface-mounted hardware reinforcing.
         1) All plate reinforcement shall meet size and thickness requirements of SDI/ANSI A250.8.
      e. Split type frames not acceptable.
         1) All horizontal and vertical mullions and transom bars shall be welded to adjacent members.
      f. Conceal all fasteners.
      g. Frames shall be set up, all face joints continuously wire welded and dressed smooth.
      h. Exterior (up to 4 FT wide): 16 GA.
      i. Exterior (over 4 FT wide): 14 GA.
      j. Interior: 16 GA.
      k. Provide removable spreaders at bottom of frame.

D. Prepare for finish hardware in accordance with hardware schedule, templates provided by hardware supplier, and SDI/ANSI A250.6.
   1. Locate finish hardware in accordance with SDI/ANSI A250.8.

2. See Specification Section 08 70 00 for hardware.
3. Prepare doors for swing direction indicated.
    a. Preparing doors for non-handed hinges is not acceptable.

E. After fabrication, clean off mill scale and foreign materials and prime with rust inhibiting primer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install doors and frames in accordance with SDI/ANSI A250.11, the Building Code, IECC requirements, and manufacturer's instructions.

B. Plumb, align, and brace frames securely until permanently anchored.
1. After completion of walls, remove temporary braces and spreaders.
2. Anchor frames with minimum of three (3) anchors per jamb.
    a. Number and location of anchors shall be in accordance with SDI and frame manufacturer's recommendations.

C. At new masonry or metal stud construction, place frames in conjunction with construction of walls or partitions.
1. Masonry construction: Anchor frames using masonry wire anchors.
2. Metal stud construction:
    a. Anchor frames using steel stud anchors.
    b. Attach wall anchors with self-tapping screws.

D. At concrete, precast concrete or existing masonry construction, place frames in rough opening using existing opening anchors.

E. Use plastic plugs to keep silencer holes clear during construction.

F. Immediately after erection, sand smooth rusted or damaged areas.
1. Touch-up with rust-inhibiting primer.
2. Finish paint door and frame in accordance with Specification Section 09 96 00.

G. Install three (3) silencers on strike jamb of single door frame and two (2) on head of double door frame for non-weather stripped doors.
1. See Specification Section 08 70 00.

H. Protect doors and frames during construction.

END OF SECTION

SECTION 08 33 23
STEEL ROLLING OVERHEAD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Steel rolling overhead doors.
   2. Motor Operators.
   3. Control Systems.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 01 61 03 - Equipment - Basic Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American National Standards Institute (ANSI).
   2. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE):
      a. 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings.
   3. ASTM International (ASTM):
      a. A36/A36M, Standard Specification for Carbon Structural Steel.
      b. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
      c. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
      d. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
      e. A307, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.
      f. A500/A500M, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
      g. A501/A501M, Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
      h. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
      i. E90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
      j. E283, Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
      k. E330, Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
      l. F3125/F3125M, Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 KSI (830 MPa) and 150 KSI (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.
   4. Door & Access Systems Manufacturers' Association, International (DASMA):
      a. ANSI/DASMA 108, Standard Method for Testing Sectional Garage Doors and Rolling Doors: Determination of Structural Performance Under Uniform Static Air Pressure Difference.
   5. International Energy Conservation Code (IECC), 2021 edition.
   6. National Electrical Manufacturers Association (NEMA):

a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
7. Underwriters Laboratories, Inc. (UL):
a. 325, Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems.

B. Qualifications:
1. Installer to be licensed or approved in writing by door manufacturer.

1.3 DEFINITIONS

A. Installer or Applicator:
1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
2. Installer and applicator are synonymous.

1.4 SUBMITTALS

A. Shop Drawings:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Product technical data including:
a. Acknowledgement that products submitted meet requirements of standards referenced.
b. Manufacturer's installation instructions.
c. Manufacturer's standard color charts.
3. Schedule of doors using same reference number for openings as indicated on Drawings.
4. Motor operator and accessories technical data including complete wiring and control diagrams.
5. Certifications:
a. Certification of installer qualifications.
6. Test Reports:
a. Test report showing compliance with ASTM E330 or ANSI/DASMA 108 for the design pressure based on the wind speed specified.

B. Samples:
1. Actual metal color samples of manufacturer's full line of colors available.

C. Contract Closeout Information:
1. Operation and Maintenance Data:
a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

D. Informational Submittals:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Steel rolling overhead doors:
a. CornellCookson.
b. Wayne Dalton.
c. Overhead Door Corporation.
d. Raynor Garage Doors.

B. Submit request for substitution in accordance with Specification Section 01 26 00.

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

A. Design Wind Load:

1. Test door assemblies in accordance with ASTM E330 or ANSI/DASMA 108.
2. Exterior doors:
   a. Determine static pressure in accordance with applicable test method.
   b. Basic Wind Load Design Criteria: See Structural Drawings.
3. Interior doors: 20 PSF minimum.

B. Air Infiltration:
1. Meet ASHRAE 90.1 and IECC 2015 C402.5.2.
2. Air leakage: <1.00 CFM/SQFT.

C. Thermal performance:
1. NFRC test report: U-factor: 0.91.

D. Sound Rating:
1. ASTM E90.
2. Minimum assembly rating: STC-21.

2.3 MATERIALS

A. Steel:
1. Hot dipped galvanized:
   a. Fasteners: ASTM A153/A153M.
   b. All other components: ASTM A123/A123M.
2. Bars, shapes, and plate: ASTM A36/A36M.
3. Pipe: ASTM A53/A53M or A501/A501M.
4. Tubing: ASTM A500/A500M.
5. Bolts and nuts: ASTM A307 or F3125/F3125M.

B. Insulation:
1. Closed cell polyurethane foam.
2. CFC free.
3. R-Value: Minimum R-4.75

C. Weatherproofing:
1. Resilient: Neoprene or vinyl.
2. Brush type: Nylon or polypropylene.

D. Fasteners: Same material as door construction.

2.4 MANUFACTURED UNITS

A. Door Curtain:
1. Insulated flat profile:
   a. Overhead Door Corp. "625 Series".
   b. 2-5/8 IN high.
   c. Interlocking face sheets:
      1) Exterior face: 0.040 IN.
      2) Interior face: 0.024 IN.
   d. Galvanized endlocks.
   e. Core: Insulated.
2. Bottom bar:
   a. Two structural angles bolted back-to-back.
      1) Minimum 1/8 IN thick.

B. Operation:
1. As scheduled on Door Schedule.
2. Motor operated with integral chain hoist backup.

C. Guides:
1. Manufacturer's standard structural angle guide system for size of door specified.
   a. Galvanized Steel.

b. Furnish curtain wind locks as necessary for design wind load.
2. Mounting:
a. Interior face of wall.
3. Cold-rolled guides are not acceptable.

D. Headplates:
1. Sized to support counterbalance assembly, curtain, motor operator and hood.
a. Field verify headroom and side clearances and coordinate motor operator mounting accordingly.

E. Counterbalance Assembly:
1. Pipe barrel:
a. Galvanized Steel.
b. Maximum deflection: 0.03 IN/FT.
2. Torsion springs:
a. Oil-tempered helical torsion springs on cast anchors.
b. 100,000 cycle.
3. Adjustable tension wheel.

F. Hood:
1. Minimum 24 GA.
2. Air baffle extending full length.

G. Weatherstripping:
1. Guide tracks: Exterior and interior weatherseal.
2. Lintel: Brush-type weatherseal.
3. Bottom seal:
a. Manually-operated doors: Resilient weather seal.
b. Motor-operated doors: Electric safety edge.

H. Finish:
1. Powder coat:
a. Factory prime and finish coats.
b. Prime coat: Minimum 0.2 MIL baked-on prime paint.
c. Finish coat: Minimum 0.6 MIL baked-on polyester powder coat.
d. Color: To be selected by Engineer from manufacturer's complete offering.
2. Trim Pieces: Material and finish to match door curtain.

2.5 ACCESSORIES

A. Motor Operator:
1. Minimum 1/2 HP with integral brake.
a. Single or 3 PH, 60 Hz, designed for the supply voltage shown on the Drawings.
b. Motor shall be sized by door manufacturer for door size indicated on Drawings.
2. Opening/Closing rate: Between 2/3 and 1 FPS.
3. See Specification Section 01 61 03 for additional motor requirements.
a. Provide manufacturer's standard reversing controller with motor thermal protection if motor is not internally protected as specified in Specification Section 01 61 03.
4. Provide enclosures with the required rating per NEMA 250 to meet classifications identified in the Contract Documents.
a. Motors and accessories for doors at the Chemical Facility shall be designed for use in a Class I, Division 2 environment.
5. Provide integral backup chain hoist and release with integrated interlock.
a. Provide chain keeper for each hoist.
6. Control System:
a. General:
1) Control system shall be hard wired to the operator power supply or a DC power transformer.
a) Battery powered control stations or receivers are not acceptable.

2) Provide complete wiring connections from control system to motor operator including all intermediate junction boxes, conduit, disconnects, and wiring.
   a) Wireless control stations or entrapment protection components are not acceptable.
3) All controls shall be intrinsically safe and rated for use in a Class I, Division 2 environment.

b. Manual control station:
   1) Interior controls.
      a) Surface mounted.
      b) Pushbutton operation: Open, Close, Stop.

c. Entrapment protection:
   1) Comply with UL 325.
      a) Instant reversing.
      b) When activated shall prevent operator from closing an open door.
   2) Electric safety edge:
      a) Contact-type sensor installed on leading edge of the door.
      b) When activated shall prevent operator from closing an open door.
      c) Safety edge on exterior doors shall act as a weatherseal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions and IECC requirements.

B. Installation shall be done by manufacturer's authorized representative.

C. Provide all required trim, weatherstripping, closures etc., for complete weather tight installation.

D. Adjust for proper counter balance.

E. Seal along bottom of vertical track (guides), seal the vertical joint between the two separate track angles (if not filled by welding) and seal all holes in vertical track (not being used for fasteners) to provide a completely weather tight track and door system.
   1. At fastener locations provide steel washers under bolt head to completely cover the slotted holes in the vertical track.
      a. Finish of steel washer shall match finish of track (guides).

F. Electrical disconnect and conduit and wiring from standard three pushbutton control to motor operator is provided in the Electrical Design.

G. Provide bracing for motor operator to eliminate vibration.

3.2 ADJUSTMENT

A. Prior to occupancy, adjust door for smooth operation.

END OF SECTION

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SECTION 08 51 13
ALUMINUM WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Aluminum windows.

B. Related Sections include but are not necessarily limited to:
   1. Section 07 92 00 - Joint Sealants.
   2. Section 09 96 00 - High Performance Industrial Coatings.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Architectural Manufacturers Association (AAMA):
      a. 904, Voluntary Specification for Multi-Bar Hinges in Window Applications
      b. 1503, Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections.
      c. 2605, Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
   2. ASTM International (ASTM):
      a. A924, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
      b. C1363, Standard Test Method for the Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus.
      c. E283, Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
      d. E330, Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights, and Curtain Walls by Uniform Static Air Pressure Difference.
      e. E331, Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.
   3. American Welding Society (AWS):
      a. D1.2, Structural Welding Code - Aluminum.

1.3 DEFINITIONS

A. Installer or Applicator:
   1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
   2. Installer and applicator are synonymous.

1.4 SUBMITTALS

A. Shop Drawings:
   1. Product technical data for framing system and major accessories including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Hardware being provided by window manufacturer.
      c. Glass being provided by window manufacturer in factory glazed units.
      d. Manufacturer's installation instructions.
   2. Elevation drawings indicating window dimensions and details.

B. Samples:
   1. After initial color selection, provide 2 x 3 inches minimum sample of each color and finish selected.

C. Informational Submittals:
   1. Qualifications of testing laboratory.
   2. Test results.
   3. Warranty.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store units in vertical position off ground with wood spacers between each unit.

1.6 WARRANTY

A. Five year warranty of weathertightness of installation.
   1. Air and water integrity and structural adequacy of units and hardware, including sealants and sealing within and around perimeter of installation.
   2. Signed jointly by fabricator, installer, and contractor.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Thermally broken windows:
      a. Wausau Metals Corp., 2250-T Series.
      b. Kawneer Company Inc., 8225-T Series.
      c. EFCO Windows, Series 510.

2.2 MATERIALS

A. Extruded Aluminum: 6063T5 alloy.

B. Sealants: As specified in Section 07 92 00.

C. Thermal Insulator: Poured in place polyurethane, self-adhering to adjacent aluminum surfaces.

2.3 ACCESSORIES

A. Flashing:
   1. Minimum 0.040 inches aluminum.
   2. Finish to match window frames.
   3. Mill finish if concealed.

2.4 FABRICATION

A. General:
   1. Fully degrease and clean members prior to assembly or application of protective coatings.
   2. Weld by methods recommended by manufacturer and AWS D1.2 to avoid discoloration at welds.
   3. Grind exposed welds smooth and restore finish.
   4. Ease corners of cut edges to a radius of approximately 1/64 inches.
   5. Conceal fasteners wherever possible.
   6. Fit and assemble work at shop to maximum extent possible.
   7. Maintain true continuity of line and accurate relation of planes and angles.
   8. Provide secure attachment and support at mechanical joint, with hairline fit of contacting members.
   9. Reinforce work as necessary to withstand wind loadings and to support system.
   10. Separate dissimilar metal with paint or preformed separators to prevent corrosion.
      a. See Section 09 96 00.
   11. Separate metal surfaces at moving joints with plastic inserts or other nonabrasive concealed inserts to permanently prevent freeze-up of joint.
   12. Reinforce frames for hardware.

13. Structural steel reinforcement hot-dip galvanized after fabrication meeting G-90, ASTM A924, requirements.

B. Construct Window Frames (Fixed):
   1. Cope and mechanically fasten together at corners or mitre at corners and heliarc weld on nonexposed surfaces, leaving only hairline joinery.
   2. Seal weathertight.
   3. Do not use joinery methods which discolor finish.

C. Thermal Insulator: Provide minimum 1/4 inches separation between exterior and interior metal surfaces after bridge is removed.

D. Glass: See drawings for types of glass to be installed under this Section.

E. Fasteners:
   1. Finish exposed fasteners to match finish of system.
   2. Provide Phillips flat head screws where exposed.

F. Finish: AA-MA10C22A31+, clear anodized.

2.5 SOURCE QUALITY CONTROL

A. General Test Requirements:
   1. Utilize independent testing laboratories specifically qualified to conduct all performance tests required.
   2. Performance tests may be conducted in manufacturer's laboratories provided they are witnessed and certified by qualified independent testing laboratory personnel.
   3. Perform all tests on "Test Unit":
      a. Full-sized window unit for project or a minimum 5 x 8 feet unit mounted in test chamber in exact accordance with job conditions including anchorage system, sealing, etc.
      b. Test unit to be completely assembled and glazed.
         1) Thermal tests may be conducted on 4 x 6 feet unit.
   4. Test air infiltration first, water resistance second.
      a. Other tests may be in any order.
   5. Test data on vertical pivot windows will be accepted for fixed windows for condensation resistance, thermal, temperature exposure and acoustical tests provided the fixed windows are the same as the vertical windows tested in the following respects:
      a. Same frame section (or same family of extrusions).
      b. Same basic metal mass inside and outside.
      c. Identical thermal break.
      d. Same type of glazing.

B. Test Requirements:
   1. Air infiltration test:
      a. With sash and ventilators closed and locked, test in accordance with ASTM E283.
      b. Air infiltration, in CFM/FT of crack length, at pressure differential of 6.24 psf as follows:
         1) Fixed windows: 0.06 maximum, all others 0.10 maximum.
   2. Water resistance test:
      a. Mount glazed unit in its vertical position, continuously supported around outside perimeter with sash and ventilators closed and locked.
      b. Test in accordance with ASTM E331.
      c. No uncontrolled leakage allowed, with pressure differential of 6.24 psf.
   3. Uniform load deflection test:
      a. Test in accordance with ASTM E330.
      b. Subject unit to load of 25 psf applied to outside of window and 25 psf applied to inside of window.
      c. Maximum allowable deflection of any unsupported span: L/175.

d. No glass breakage, permanent damage to fasteners, hardware parts, support arms or activating mechanisms, or any other damage which would cause window to be inoperable will be allowed.

4. Uniform load structural test:
   a. Test in accord with ASTM E330.
   b. Subject unit to loads indicated on structural drawings.
   c. Stabilize pressure and maintain it for minimum period of 10 seconds.
   d. No glass breakage, permanent damage to fasteners, hardware parts, support arms or activating mechanisms or any other damage which would cause window to be inoperable will be allowed.
   e. Maximum permanent deformation of any main frame, sash or ventilator member: 0.4% of its span.
   f. After performing Uniform Load Structural Test, increase loads 1-1/2 times and perform safety test.
   g. Design unit to withstand following design pressures acting normal to plane of wall, at applicable heights and locations.
5. Condensation resistance test:
   a. Perform on "test unit," except size may be 3 x 4 feet, minimum.
   b. Test in accordance with AAMA 1503.
   c. CRF (Condensation Resistance Factor): 50, minimum.
6. Thermal test:
   a. Perform on "test unit" except size may be 4 x 6 feet, minimum.
   b. Test in guarded hot box ASTM C1363, with an exterior temperature of 18 degrees F, an interior of 68 degrees F and 15 mph fan-generated wind velocity on exterior.
   c. "U" value: not to exceed 0.65 btu/HR/SQFT/DEGF.
   d. Calculated "U" values from smaller units or data or theoretical assumptions will not be acceptable.
7. Structural thermal barrier tension test:
   a. Test urethane filled sections of aluminum.
   b. Mechanically secure interior and exterior faces of 12 inches section in horizontal position.
   c. Apply heat tape to exterior face to control surface temperature at 180 degrees F 5 minutes before loading, as indicated by a thermocouple wire operated by an automatic controller.
   d. Apply direct tension (pull) using a Universal testing machine set in 12,000 pound load range.
   e. Test results: No loss of bond at 4000 pound IN/IN/MIN.
8. Structural thermal barrier shear test:
   a. Test urethane filled sections of aluminum.
   b. Mechanically secure interior face of 12 inches section in vertical position.
   c. Apply heat tape to exterior face to control surface temperature at 180 degrees F 5 minutes before loading, as indicated by a thermocouple wire operated by an automatic controller.
   d. Apply load to exterior face by a bearing plate resting on top of exterior face, using Universal Testing machine set in 12,000 pound load range at a strain rate of 0.050 inches/IN/MIN.
   e. Test results: No loss of bond at 5500 pound loading.
9. Structural thermal barrier combined torsion and shear test:
   a. Test urethane filled sections of aluminum.
   b. Secure interior face of 12 inches section in horizontal position.
   c. Apply heat tape to exterior face to control surface temperature at 180 degrees F 5 minutes before loading, as indicated by a thermocouple wire operated by an automatic controller.
   d. Apply load to bearing plate centered on portion of glazing pocket to exterior side of thermal barrier, using a Universal Testing machine set in the 12,000 pound load range.

e. Test results: No loss of bond at 3900 pound load applied at strain rate of 0.05 inches/IN/MIN.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Set units plumb, level, and true to line.

C. Anchor securely in place.

D. Separate metal surfaces from sources of corrosion or electrolytic action.
   1. See Section 09 96 00.

E. Set sill and base members in a bed of sealant.

F. Provide joint fillers or gaskets for weathertight construction.

G. Seal all joints within and at perimeter of system.

H. Provide sealant color to match finish of system at exposed locations.

I. Provide sealants compatible with aluminum system and recommended for use with this type of installation.

J. See Section 07 92 00 for sealants.

3.2 FIELD QUALITY CONTROL

A. Installation supervised or inspected by manufacturer's authorized representative.

END OF SECTION

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SECTION 08 70 00
FINISH HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Finish hardware.
   2. Inspection and testing of door operation.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 08 11 00 – Hollow Metal (HM) Doors and Frames.

1.2 QUALITY ASSURANCE

A. All door hardware shall be provided by a single hardware supplier.
   1. Hardware is to be provided under this Specification Section, unless noted otherwise.

B. Referenced Standards:
   1. American National Standards Institute/Builders Hardware Manufacturers Association (ANSI/BHMA):
      a. A156.1, Butts and Hinges.
      b. A156.3, Exit Devices.
      c. A156.4, Door Controls -Closers.
      d. A156.6, Architectural Door Trim.
      e. A156.8, Door Controls - Overhead Stops and Holders.
      f. A156.13, Mortise Locks and Latches Series 1000.
      g. A156.16, Auxiliary Hardware.
      h. A156.18, Materials and Finishes.
      i. A156.21, Thresholds.
   2. American National Standards Institute/Steel Door Institute (ANSI/SDI).
      a. A250.8, Specifications for Standard Steel Doors and Frames (SDI-100).
   3. Door and Hardware Institute (DHI).
   4. National Fire Protection Association (NFPA):
      a. 80, Standard for Fire Doors and Other Opening Protectives.
      b. 101, Life Safety Code.
   5. Underwriters Laboratories, Inc. (UL):
      a. Building Materials Directory.
   6. Building code:
      a. International Code Council (ICC):
         1) International Building Code and associated standards, 2021 Edition including all amendments, referred to herein as Building Code.
         2) International Energy Conservation Council (IECC) 2021 Edition including all amendments.

C. Qualifications:
   1. Installation shall be inspected by a certified Architectural Hardware Consultant (AHC).

1.3 DEFINITIONS

A. AHC: Architectural Hardware Consultant, certified by DHI.

B. Installer or Applicator:
   1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.

2. Installer and applicator are synonymous.

C. All weather: Capable of operation from -50 to +120 DEGF.

D. Active Leaf: Right-hand leaf when facing door from keyed side unless noted otherwise on Drawings.

1.4 SUBMITTALS

A. Shop Drawings:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Qualifications
   a. AHC qualifications.
3. Certification from AHC stating:
   a. All door hardware has been reviewed by AHC and verified to be compatible with doors and frames.
   b. No submittals will be reviewed until Engineer has received AHC certification.
4. Product technical data including:
   a. Acknowledgement that products submitted meet requirements of standards referenced.
   b. Manufacturer's installation instructions.
5. Schedule of all hardware being used on each door.
   a. Number hardware sets and door references same as those indicated on Drawings.
6. Technical data sheets on each hardware item proposed for use.
7. Warranty information for all hardware devices having extended warranties.

B. Informational Submittals:
1. Certifications:
   a. Certification from AHC stating all door hardware has been provided per approved Shop Drawings, has been installed in accordance with manufacturer's recommended installation instructions and all doors have been inspected and tested and found to be in proper working order.
      1) Door assemblies required to swing in the direction of egress have been inspected and tested in accordance with NFPA 101.
      2) Fire-rated door assemblies have been inspected and tested in accordance with NFPA 80.

1.5 WARRANTY

A. Provide all individual manufacturers' extended warranties as advertised.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Hinges:
   a. Hager Hinge Co.
   b. McKinney Manufacturing Co.
   c. Stanley Works.
2. Locksets and latchsets:
   a. Best Access Systems.
   b. Corbin/Russwin.
3. Exit devices:
   a. Corbin/Russwin.
   b. Precision.
   c. Sargent.
   d. Von Duprin, Inc.

4. Closers:
    a. Corbin/Russwin.
    b. LCN.
    c. Norton.
5. Door stops and holders:
    a. Trimco.
    b. Rockwood.
    c. Ives.
6. Overhead stops:
    a. Glynn-Johnson Corp.
    b. Rockwood.
    c. Trimco.
    d. Rixson.
7. Weatherstripping and thresholds:
    a. Pemko Manufacturing Co.
    b. Reese Enterprises, Inc.
    c. Zero Weatherstripping, Inc.
    d. National Guard Products, Inc.
8. Door bolts, coordinators and strikes:
    a. Ives.
    b. Trimco.
    c. Hager.
    d. Rockwood.
    e. Dorma.
9. Exit devices:
    a. Von Durpin, Inc.
    b. Corbin/Russwin.
    c. Precision.
    d. Sargent.
10. Other materials: As noted.

B. Submit request for substitution in accordance with Specification Section 01 25 00.

2.2 MATERIALS

A. General: As indicated in the FABRICATION Article in PART 2 of this Specification Section.

B. Fasteners: Stainless steel.

C. Closers:
1. Corrosion resistant closer:
    a. Body: Aluminum.
    b. All other components and fasteners: Stainless steel.
    c. Closer arm bushing: Bronze.

D. Kickplates:
1. Stainless steel.

E. Thresholds: Aluminum.

F. Overhead Stops and Wall Stops: Stainless steel or aluminum.

G. Keys: Bronze.

H. Weatherstripping and Smoke Seals: Polypropylene, neoprene, or EPDM.

I. Pulls and Push Plates: Stainless steel.

J. Silencers: Rubber.

2.3 COMPONENTS

A. Hinges:
   1. Butt hinges:
      a. ANSI/BHMA A156.1.
         1) A5111: Stainless steel, full-mortise, anti-friction bearing, Grade 1.
      b. Ball bearing.
      c. Flat button tips.
      d. Butt hinges:
         1) Hager BB1199.
         2) McKinney T4B3386.
      e. Hinge size:
         1) Doors up to and including 46 IN wide: 4.5 IN x 4.5 IN.
         2) Doors over 46 IN up to and including 60 IN wide: 5 IN high x 4.5 IN.

B. Mortise Locks and Latches:
   1. ANSI/BHMA A156.13, Series 1000, Operational Grade 1, Security Grade 1.
      a. Meet requirements of ADA.
   2. Antifriction two-piece mechanical stainless steel latchbolt with bronze anti-friction insert.
      a. One-piece stainless steel deadbolt, minimum 1-1/4 IN x 9/ 16 IN thick with 1 IN throw.
      b. 2-3/4 IN backset.
      c. Cylinder: bronze, 6 pin, with interchangeable core.
   3. Locking, latching and retracting mechanism and lock case:
      a. Steel, unless noted otherwise.
         1) Stainless steel plated.
   4. Trim design: Corbin/Russwin "NSP".
      a. Functions as indicated in following table in accordance with ANSI/BHMA A156.13.

MORTISE LOCK NUMBERS		
ANSI	FUNCTION	CORBIN/RUSSWIN
	Half Dummy Trim	ML2050
F01	Passage	ML2010
F19	Privacy	ML2030
F05	Classroom	ML2055
F07	Storeroom	ML2057
F13	Entrance or Office	ML2065

      b. Provide construction cores for all lockset devices.
         1) Lost ball type construction keying is also acceptable.

C. Exit Devices:
   1. ANSI/BHMA A156.3, Grade 1.
   2. Single doors: Mortise.
   3. Pairs of doors: Concealed vertical rods.
   4. Trim: Sargent "ET".
      a. Lever operation.
      b. Lever style: Sargent "L".
   5. Sargent "80 Series".
      a. Function as indicated on Hardware Schedule.

D. Bolts:
   1. ANSI/BHMAA 156.16.
   2. Surface bolts: Rockwood 580 Series with top and bottom strikes.

E. Door Closers:
   1. ANSI/BHMA A156.4, Grade 1.
   2. Size door closers to comply with ANSI recommendations for door size and location.

3. Fabricate all closers with integral back check.
4. Provide integral stop unless noted otherwise.
   a. Do not provide integral stop at closers indicated to be installed on pull side of door.
   b. Provide all weather fluid for all closers used in exterior doors.
5. Full cover.
   a. Manufacturer's standard plastic cover.
6. Arms, brackets, and plates: As required for complete installation.
7. Closers:
   a. LCN 4040 Series or Norton 7500 Series or Corbin-Russwin DC6200 Series.
   b. Corrosion resistant: Norton 7500 SS Series.
8. Provide manufacturer's standard 10 year warranty.

F. Door Stops:
1. ANSI/BHMA A156.16.
   a. Wall stops: Ives WS406-CVX or WS406-CCV.
   b. Floor stop and holder: Ives FS446.
   c. Wall stop and holder: Ives WS445.

G. Overhead Door Holders/Stop:
1. ANSI/BHMA A156.8.
2. Provide 'hold-open' function on all stops unless noted otherwise.
   a. Do not provide 'hold-open' function at fire rated doors.
3. Surface mounted stops: Rockwood N14400 Series or Glynn Johnson 90 Series.
4. Concealed stops: Rockwood N11000 Series or Glynn Johnson 100 Series.

H. Kickplates:
1. ANSI/BHMA A156.6.
2. 8 IN high x 2 IN less than door width.
3. Beveled on all edges.
1. Thickness:
   a. Stainless steel: 0.050 IN.

I. Thresholds:
1. ANSI/BHMA A156.21.
2. One-piece unit.
3. Height: 1/2 IN high maximum.
   a. Meet requirements of ADA.
4. Width: 4 IN.
5. Provide required bolt cutouts.

J. Astragal: UL listed for labeled doors.

K. Weatherstripping:
1. General: Exterior envelope locations meet minimum 2015 IECC air leakage requirements.
2. Weather seal at jambs and head:
   a. Self-adhesive strip: Reese #797.
   b. Color: Black.
3. Sweep at bottom of doors:
   a. Reese 701.
   b. Color: Clear anodized.
4. Weather seal astragal at meeting edges of pairs of doors:
   a. Reese 92 each leaf.
   b. Color: Clear anodized.

L. Automatic Door Bottom:
1. Provide end caps for semi-mortised and surface mounted units.
2. 3/4 IN drop, neoprene gasket: Reese #521.
3. 3/4 IN drop, vinyl, accordion type: Reese #371A.

M. Sound Seals:
   1. Self-adhesive strip: Reese #797.
   2. Color: Black.

N. Smoke Seals:
   1. Self-adhesive strip: Reese #797.
   2. Color: Black.
   3. UL listed.

2.4 ACCESSORIES

A. Silencers:
   1. Stainless steel frames: Trimco 1229A or Rockwood 608.
   2. Self-adhesive silencers are not acceptable.

B. Keying:
   1. Establish keying with Owner. Coordinate with Owner's existing keying.
      a. Provide and set up complete visible card indexed system with key tags and control slips.
      b. Tag and identify keys.
      c. Provide two (2) keys for each lock or cylinder.
      d. Master key and key in groups as directed.
      e. Provide construction master keys for all exterior doors.

C. Strikes:
   1. Curved lips.
      a. Extended lips when required.
   2. Furnish strike boxes.
   3. Appropriate for function and hardware listed.

2.5 FABRICATION

A. General:
   1. Generally prepare for Phillips head machine screw installation.
   2. Exposed screws to match hardware finish or, if exposed in surfaces of other work, to match finish of other work as closely as possible.
   3. Provide concealed fasteners unless thru bolted.
   4. Through bolt closers on all doors.
   5. Furnish items of hardware for proper door swing.
   6. Furnish lock devices which allow door to be opened from inside room without a key or any special knowledge.

B. Hardware:
   1. Fabricate hardware for fire rated openings in compliance with UL and NFPA 80.
      a. This requirement takes precedence over other requirements for such hardware.
      b. Provide only hardware which has been tested and listed by UL for types and sizes of doors.
   2. Provide following ANSI/BHMA A156.18 finishes:
      a. Locksets, latchsets and strikes: 630.
      b. Door pulls, push bars, push plates: 630.
      c. Kickplates:
         1) Stainless steel: 630.
      d. Exit devices: 630 where available; 626 if 630 is not available.
         1) Provide 630 finish on trim.
      e. Butt hinges: 630.
      f. Door stops, dead locks, mortise bolts, and miscellaneous hardware: 630 where available, 626 if 630 not available.
      g. Door overhead stops: 630.
      h. Closers: 600 prime coat with 689 finish coat, unless noted otherwise.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's installation instructions.
   1. Perform installation by or under the direct supervision of an AHC.
   2. Coordinate all access control hardware with appropriate installers and door manufacturers.

B. Provide all hardware in accordance with Building Code and IECC.

C. Fit hardware before final door finishing.

D. Permanently install hardware after door finishing operations are complete.

E. Locate hardware in accordance with ANSI/SDI A250.8.

F. Butt Hinges:
   1. Provide non-removable pin (NRP) at:
      a. Exterior doors.
      b. Reverse handed doors equipped with locks.
   2. Quantities:
      a. Door height 61 - 90 IN: Three (3).
      b. Door height 91 - 114 IN: Four (4).
      c. Door height 115 - 144 IN: Five (5).
      d. Doors over 48 IN wide and over 96 IN high:
         1) Provide top butt hinge within 6 IN of the top of the door to top of hinge.
         2) Provide one (1) additional butt hinge approximately 6 IN below the bottom of the top butt hinge.
   3. Provide power transfer as necessary where electrified lockset or exit device is specified or as otherwise indicated in Hardware Schedule.

G. Closers:
   1. Mount closers on push side of doors unless noted otherwise.

H. Provide coordinator when required by hardware specified.

I. Overhead Stops:
   1. Provide overhead stop when corrosion resistant closer is specified.
   2. Provide concealed overhead stop on doors scheduled to receive closer mounted on pull side of door.
   3. Provide at interior doors not scheduled to receive a closer as follows:
      a. Doors that swing more than 105 DEG without encountering a wall or obstruction.
         1) Stop shall limit swing of door from impacting wall or obstruction.
      b. Inactive leafs of pairs of doors.

J. Wall Mount Door Stops:
   1. Provide where specifically indicated on Hardware Schedule and at doors not otherwise indicated to receive:
      a. Overhead stop.
      b. Closer with integral stop.

K. Floor mounted stops are not acceptable unless noted otherwise in this Specification Section.

L. Install astragal on all pairs of UL labeled fire doors.

M. Provide silencers for door frames.
   1. Hollow metal frames: See Specification Section 08 11 00.

N. Provide weather seal, door sweep and threshold at all exterior doors and where scheduled on interior doors.
   1. Set thresholds in a full bed of sealant.
   2. Mount door sweeps on exterior face of door.

3. Mount weather seal astragal at meeting edges of pairs of doors on the exterior face of the doors.

O. Provide smoke seals on all fire rated doors.

P. Mount kickplates on push side of doors.

3.2 FIELD QUALITY CONTROL

A. Adjust and check each operating item of hardware to assure proper operation or function.
   1. Lubricate moving parts with lubricant recommended by manufacturer.

B. During week prior to startup, make a final check and adjustment of all hardware items.
   1. Clean and lubricate as necessary to assure proper function and operation.
   2. Adjust door control devices to compensate for operation of heating and ventilating equipment.

C. Inspection and Testing:
   1. AHC shall inspect and test all door assemblies and provide written certification that door assemblies are in proper working order.
      a. Door assemblies required to swing in the direction of egress shall be inspected and tested in accordance with NFPA 101.
      b. Fire-rated door assemblies shall be inspected and tested in accordance with NFPA 80.
   2. Submit documentation and certification of testing in accordance with the certifications paragraph in the SUBMITTALS Article in PART 1 of this Specification Section.

3.3 SCHEDULES

A. Hardware Schedule:

HARDWARE SCHEDULE	
Hardware Set	Description
HW-1	Mortise Entry Lockset Lever Set Hardware 1-1/2 Pair Butts Panic Hardware Threshold Weatherstripping Drip (Head) Door Bottom Sweep Closer Kick Plates

HARDWARE SCHEDULE	
Hardware Set	Description
HW-2	Mortise Entry Lockset Lever Set Hardware 1-1/2 Pair Butts (each leaf) Panic Hardware (active leaf) Threshold (each leaf) Weatherstripping Drip (Head) (each leaf) Door Bottom Sweep (each leaf) Closer (each leaf with hold open) Kick Plates (each leaf) Surface-Mounted Bolts (inactive leaf)
HW-3	Mortise Storeroom Lever Lockset 1-1/2 Pair Butts Panic Hardware Closer Kick Plates Automatic Door Bottom Weatherstripping

END OF SECTION

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SECTION 08 90 00
LOUVERS AND VENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Louvers and vents.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 07 62 00 - Flashing and Sheet Metal.
   4. Section 07 92 00 - Joint Sealants.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Architectural Manufacturers Association (AAMA):
      a. 2605, Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
   2. Air Movement and Control Association (AMCA).
   3. ASTM International (ASTM):
      a. B221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Drawing showing location of each louver or vent, indicating size and arrangement of blank-off plates if required.
   3. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Color chart showing manufacturer's full line of colors including exotic and special colors for color selection by Engineer.
   4. Factory applied high performance organic coatings utilizing PVDF resins shall be provided with manufacturer's standard 10 year warranty against color fade, chalking and film integrity.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Louvers:
      a. Ruskin Manufacturing.
      b. Airolite Co.
      c. Construction Specialties, Inc.
      d. Industrial Louvers, Inc.
      e. American Warming.
      f. Greenheck.
      g. Approved equal.

B. Submit request for substitution in accordance with Specification Section 01 26 00.

2.2 MANUFACTURED UNITS

A. Louvers and Dampers:
   1. Basis of Design: Refer to "Louver Schedule" on M drawings.
   2. AMCA certified.

B. Anchors, Fasteners, Reinforcing: Aluminum or stainless steel.

C. Finish:
   1. Meet requirements of AAMA 2605
      a. PVDF coating with minimum 70% resin content.
      b. Match wall color

D. Size: Refer to M Drawings for louver size and refer to Architectural Drawings for locations.

E. Refer to M Drawings for additional requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install anchoring and bracing accessories as required.

C. Seal around perimeter on exterior and interior.
   1. See Section 07 92 00.

D. Install 0.040 IN aluminum flashing at sill to match louver.
   1. See Section 07 62 00.

END OF SECTION

SECTION 09 96 00
HIGH PERFORMANCE INDUSTRIAL COATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. High performance industrial coatings (HPIC).
   2. Any other coating, thinner, accelerator, inhibitor, etc., specified or required as part of a complete System specified in this Specification Section.
   3. Minimum surface preparation requirements.

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 01 61 03 - Equipment - Basic Requirements.
   2. Division 23 - Heating, Ventilating, and Air-Conditioning (HVAC).
   3. Division 26 - Electrical.
   4. Division 40 - Process Interconnections.
   5. Section 40 05 00 - Pipe and Pipe Fittings - Basic Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. B499, Standard Test Method for Measurement of Coating Thicknesses by the Magnetic Method: Nonmagnetic Coatings on Magnetic Basis Metals.
      b. D3359, Standard Test Methods for Rating Adhesion by Tape Test.
      c. D4258, Standard Practice for Surface Cleaning Concrete for Coating.
      d. D4259, Standard Practice for Abrading Concrete.
      e. D4261, Standard Practice for Surface Cleaning Concrete Masonry Units for Coating.
      f. D4262, Standard Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces.
      g. D4263, Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
      h. D4414, Standard Practice for Measurement of Wet Film Thickness by Notch Gages.
      i. D4541, Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
      j. D6132, Standard Test Method for Nondestructive Measurement of Dry Film Thickness of Applied Organic Coatings Using an Ultrasonic Gage.
      k. D6677, Standard Test Method for Evaluating Adhesion by Knife.
      l. D7091, Standard Practice for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to Ferrous Metals and Nonmagnetic, Nonconductive Coatings Applied to Non-Ferrous Metals.
      m. D7234, Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers.
      n. E337, Standard Test Method for Measuring Humidity with a Psychrometer (the Measurement of Wet- and Dry-Bulb Temperatures).
      o. F1869, Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
      p. F2170, Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
   2. Environmental Protection Agency (EPA).
   3. International Concrete Repair Institute (ICRI):
      a. 310.2, Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair.
   4. NACE International (NACE).

5. National Association of Pipe Fabricators (NAPF):
    a. 500-03, Surface Preparation Standard for Ductile Iron Pipe and Fittings in Exposed Locations Receiving Special External Coatings and/or Special Internal Linings:
        1) 500-03-04, Abrasive Blast Cleaning for Ductile Iron Pipe.
        2) 500-03-05, Abrasive Blast Cleaning for Cast Ductile Iron Fittings.
6. NSF International (NSF).
    a. 61, Drinking Water System Components - Health Effects.
7. The Society for Protective Coatings (SSPC):
    a. PA 2, Procedure for Determining Conformance to Dry Coating Thickness Requirements.
    b. SP 1, Solvent Cleaning.
    c. SP 2, Hand Tool Cleaning.
    d. SP 3, Power Tool Cleaning.
    e. SP 16, Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals.
8. The Society for Protective Coatings/ NACE International (SSPC/ NACE):
    a. SP 5/ NACE No. 1, White Metal Blast Cleaning
    b. SP 6/ NACE No. 3, Commercial Blast Cleaning.
    c. SP 7/ NACE No. 4, Brush-off Blast Cleaning.
    d. SP 10/ NACE No. 2, Near-White Blast Cleaning.
    e. SP 13/ NACE No. 6, Surface Preparation of Concrete.

B. Qualifications:
1. Coating manufacturer's technical representative shall be a NACE Certified Coatings Inspector, Level 3 minimum.
2. Applicators shall have minimum of 10 years of experience in application of similar products on similar project.
    a. Provide references for minimum of three different projects completed in last five years with similar scope of work.
    b. Include name and address of project, size of project in value (coating) and contact person.
3. NACE inspector shall be NACE Certified Coatings Inspector Level 3 minimum and shall have minimum of five years of experience of conducting inspections and tests as indicated in this Specification Section.

C. Miscellaneous:
1. Furnish coating through one manufacturer unless noted otherwise.

D. Deviation from specified MIL thickness or product type is not allowed without written authorization of Engineer.

E. Material shall not be thinned unless approved, in writing, by coating manufacturer's technical representative.

1.3 DEFINITIONS

A. Applicator:
1. Applicator is the person actually installing or applying the product in the field, at the Project site, or at an approved shop facility.

B. Approved Factory Finish: Finish on a product in compliance with the finish specified in the Specification Section where the product is specified or in Specification Section 01 61 03.

C. Appurtenant Surface: Accessory or auxiliary surface attached to or adjacent to a surface indicated to be coated.

D. Corrosive Environment:
1. Immersion in or subject to:
    a. Condensation, spillage or splash of a corrosive material such as water, wastewater or chemical solution.

b. Exposure to corrosive caustic or acidic agent, chemicals, chemical fumes, chemical mixture, or solutions.
c. For purposes of this Specification Section, corrosive environments include:
   1) Outdoor areas not otherwise identified as highly corrosive.
   2) Piping galleries.
   3) Surfaces within 2 feet of high water level.
   4) Chemicals storage and feed areas.
   5) Areas indicated as corrosive in the electrical drawings.

E. Outdoor Atmosphere or Surface: Outdoor atmosphere or surface exposed to weather and/or direct sunlight.

F. Finished Area: A room or area that is listed in or has finish called for on Room Finish Schedule or is indicated on Drawings to be coated.

G. Holiday:
1. A void, crack, thin spot, foreign inclusion, or contamination in the coating that significantly lowers the dielectric strength of the coating.
2. May also be identified as a discontinuity or pinhole.

H. HPIC: High performance industrial coatings.
1. Epoxies, urethanes, vinyl ester, waterborne vinyl acrylic emulsions, acrylates, silicones, alkyds, acrylic emulsions and any other coating listed as a HPIC.

I. Indoor Atmosphere or Surface: Indoor atmosphere or surface not exposed to weather and/or direct sunlight.

J. Immersion Service:
1. Any surface immersed in water or some other liquid.
2. Surface of any pipe, valve, or any other component of the piping system subject to frequent wetting.
3. Surfaces within two feet above high water level in water bearing structures.

K. Piping System: Pipe, valves, fittings and accessories.

L. Surface Hidden from View:
1. Within pipe chases.
2. Between top side of ceilings and underside of floor or roof structures above.

M. Vapor Space: Interior space within tankage, closed structures, or similar elements that is above the low liquid line and subject to the accumulation of fumes, vapor and/or condensation.

1.4 SUBMITTALS

A. Certifications:
1. Applicator experience qualifications.
   a. No submittal information will be reviewed until Engineer has received and approved applicator qualifications.
2. NACE inspector certification.
3. NACE inspector experience qualifications.
4. Certification that High Performance Coating Systems proposed for use have been reviewed and approved by a NACE Certified Coatings Inspector employed by the coating manufacturer.
   a. Submittals not including this certification will be returned without review.

B. Shop Drawings:
1. Product technical data including:
   a. Acknowledgement that products submitted meet requirements of standards referenced.
   b. Manufacturer's surface preparation instructions.
   c. Manufacturer's application instructions.

1) Manufacturer's standard details, including but not limited to penetrations, transitions, and terminations for:
    a) High-build coatings on concrete.
    b) Other special conditions as applicable.

d. If products being used are manufactured by Company other than listed in the MATERIALS Article of this Specification Section, provide complete individual data sheet comparison of proposed products with specified products including:
    1) Application procedure.
    2) Coverage rates.
    3) Certification that product is designed for intended use and is equal or superior to specified product.

e. Contractor's written plan of action for containing airborne particles created by blasting operation and location of disposal of spent contaminated blasting media.

f. Coating manufacturer's recommendation on abrasive blasting.

g. Coating manufacturer's technical representative's written statement attesting that applicator has been instructed on proper preparation, mixing and application procedures for coatings specified.

h. Manufacturer's recommendation for universal barrier coat.

i. Manufacturer's recommendation for providing temporary or supplemental heat or dehumidification or other environmental control measures.

2. Manufacturer's statement regarding applicator instruction on product use.

C. Samples:
1. Manufacturer's full line of colors for Engineer's preliminary color selection.
2. After preliminary color selection by Engineer provide two, 3 x 5 inches samples of each final color selected.

D. Informational Submittals:
1. Approval of application equipment.
2. Applicator's daily records:
    a. Submit daily records at end of each week in which coating work is performed unless requested otherwise by Engineer's on-site representative.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver in original containers, labeled as follows:
1. Name or type number of material.
2. Manufacturer's name and item stock number.
3. Contents, by volume, of major constituents.
4. Warning labels.
5. VOC content.

B. Store materials in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 degrees F.

1.6 PROJECT CONDITIONS

A. Pre-application Conference:
1. Prior to commencement of surface preparation or coating application, the Contractor shall convene a pre-application conference with all affected parties, including but not limited to: the applicator, coating manufacturer's technical representative, Owner's representative, and Engineer's representative(s).
2. The meeting shall discuss all aspects of the Project including but not limited to:
    a. Schedule.
    b. Material storage and handling.
    c. Examination of surfaces to be coated.
    d. Protection of surfaces not to be coated.
    e. Surface preparation.
    f. Coating application:

1) Environmental conditions for application of coatings.
2) Temporary environmental controls.

g. Field quality control requirements:
1) Manufacturer's technical representative responsibilities.
2) Contractor performed testing.
a) Instrumentation requirements.
b) Frequency of testing.
c) Record keeping.
3) NACE inspector performed testing.

B. Verify that atmosphere in area where coating is to take place is within coating manufacturer's acceptable temperature, humidity and sun exposure limits.
1. Provide temporary heating, shade and/or dehumidification as required to bring area within acceptable limits.
a. Provide temporary dehumidification equipment properly sized to maintain humidity levels required by coating manufacturer.
b. Provide clean heat with heat exchanger type equipment sufficient in size to maintain temperature on a 24 hour basis.
1) Vent exhaust gases to outdoor environment.
2) No exhaust gases shall be allowed to vent into the space being coated or any adjacent space.
2. Do not apply coatings in snow, rain, fog or mist.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. High Performance Industrial Coatings:
a. Carboline Protective Coatings.
b. PPG.
c. The Sherwin-Williams Company.
d. Tnemec.
e. AkzoNobel.

B. "Or-Equal" Submittals:
1. Materials by other manufacturers are acceptable provided that they are established as being compatible with and of equal quality to the coatings of the manufacturers listed.
2. Provide satisfactory documentation from the proposed "or-equal" manufacturer that proposed materials meets or exceeds the following:
a. Is of the same generic resin.
b. Requires comparable surface preparation.
c. Has comparable application requirements.
d. Meets the same VOC levels or better.
e. Provides the same finish and color options.
f. Is suitable for the intended service.
g. Resistance to abrasion and physical damage.
h. Resistance to chemical attack.
i. Resistance to UV exposure.
j. Ability to recoat in future.
k. Dry film thickness per coat.
1) Where manufacturer's product data sheet indicates a minimum MIL thickness per coat that is greater than specified herein, MIL thickness for entire coating system shall be increased proportionately.
l. Minimum and Maximum time between coats.
m. Compatibility with other coatings.

n. Temperature limitations in service and during application.
o. Type and quality of recommended undercoats and topcoats.
p. Ease of application.
q. Ease of repairing damaged areas.
r. Stability of colors.

3. The cost of all testing and analyzing of the proposed substitute materials shall be borne by the CONTRACTOR.

2.2 MATERIALS

A. Coatings used for indoor finishes shall meet the requirements of the building code.

B. Coatings shall comply with the VOC limits of EPA.

C. For unspecified materials such as thinner, provide manufacturer's recommended products.

D. High Performance Industrial Coatings:

COATING CODE	GENERIC DESCRIPTION	MANUFACTURER	
		TNEMEC	SHERWIN WILLIAMS
AAE	Acrylic/Acrylate Emulsion	Series 180 WB Tneme-Crete	Cement Plex 875
ARE	Abrasion-Resistant Epoxy	Series 435 Perma-Glaze	Duraplate 6000
AREC	Abrasion-Resistant Epoxy Coating	Series 435 Perma-Glaze	Duraplate 5900
AAP	Aliphatic Acrylic Polyurethane	Series 1095 Endurashield	Acrolon Ultra
AP	Acrylic Polymer	Series 1029 Enduratone	Pro Industrial Acrylic Coating
CRM	Cementitious Repair Mortar	Series 217 MortarCrete	Cemtec Silatec MSM
CRU	Corrosion Resistant Urethane	Series 290 CRU	Polylon HP
DFA	Dry-fall Acrylic	Series 115 Uni-Bond DF	DFA Dry Fall Acrylic
EBF	Epoxy Block Filler	Series 1254 Epoxoblock WB	Kem Cati Coat HS
ESF	Epoxy Surfacer/Filler	Series 215 Surfacing Epoxy	Steel Seam FT 910
EMM	Epoxy Modified Cementitious Mortar	Series 218 MortarClad	Duraplate 2300
EF	Epoxy Flooring	Series 237 Power-Tread	GP3746
GFRE	Glass Flake Reinforced Epoxy	Series 142	Sher-Glass FF
HRE	H2S-Resistant Epoxy	Series 132 Protuff Mastic	Duraplate 235
HREM	H2S-Resistant Epoxy Mortar	Series 434 Perma-Shield H_2S	Duraplate 5900 Mortar
MIO	MIO Polyurethane	Series 1 Omnithane	Corothane 1 milesO

COATING CODE	GENERIC DESCRIPTION	MANUFACTURER	
		TNEMEC	SHERWIN WILLIAMS
MPE	Multi-Purpose Epoxy	Series N69 Hi-Build Epoxoline II	Macropoxy 646
MTEP	Moisture-Tolerant Epoxy Primer	Series 201 Epoxoprime	Corobond 100
PVA	PVA Drywall Primer	Series 51 PVA Sealer	ProMar 200 Zero VOC Interior Latex Primer
SCN	Secondary Containment Novolac	Series 282	Cor Cote HCR
SCE	Secondary Containment Epoxy	Series 237SC Chembloc	Cor Cote HP
SCEP	Secondary Containment Epoxy Primer	Series 206SC Chembloc	GP3552
STEP	Surface-Tolerant Epoxy Primer	Series 135 Chembuild	Macropoxy 646
UHSE	Ultra-High Solids Epoxy (NSF 61)	Series 22 Epoxoline	Duraplate UHS
VEP	Vinyl Ester Primer	Series 251SC Chembloc	Corobond Vinyl Ester Primer
VESC	Vinyl Ester Secondary Containment	Series 252SC Chembloc	Cor Cote VEN FF
PVA	PVA Drywall Primer	Series 51 PVA Sealer	ProMar 200 Zero VOC Interior Latex Primer
SCN	Secondary Containment Novolac	Series 282	Cor Cote HCR
ZRU	Zinc-Rich Urethane	Series 94-H_20 Hydro-Zinc	Corothane 1 Galvapak

E. High Temperature Coatings:

COATING CODE	GENERIC DESCRIPTION	MANUFACTURER		
		PPG	TNEMEC	SHERWIN WILLIAMS
HTZRP	High Temperature Zinc Rich Primer	Dimetcote 9 Series	Series 1505 Endura-Heat ZR	Zinc Clad II Plus

2.3 COATING SYSTEMS:

A. The following tables indicate coating systems by material and environment unless a specific application is indicated.

B. Ferrous Metals (Structural and Miscellaneous Metals):

Environment/ Application	Surface Preparation	Prime Coat	Intermediate Coats	Finish Coat
Indoor atmospheric	SSPC-SP 6/ NACE No. 3	3.0 to 4.0 mil MPE	3.0 to 4.0 mil MPE	3.0 to 4.0 mil MPE
Indoor atmospheric (corrosive environment)	SSPC-SP 10/ NACE No. 2, min. 2 mil anchor profile	2.5 to 3.5 mil ZRU	3.0 to 4.0 mil MPE	3.0 to 4.0 mil MPE

Environment/ Application	Surface Preparation	Prime Coat	Intermediate Coats	Finish Coat
Immersion - Wastewater	SSPC-SP 10/ NACE No. 2	3.0 to 4.0 mil MPE		12 to 16 mil GFRE
Immersion - Wastewater (abrasion resistant)	SSPC-SP 10/ NACE No. 2 min. 3 mil anchor profile	15 to 20 mil AREC		15 to 20 mil AREC
Immersion - non NSF	SSPC-SP 10/ NACE No. 2	3.0 to 4.0 mil MPE	3.0 to 4.0 mil MPE	3.0 to 4.0 mil MPE
Immersion - NSF	SSPC-SP / NACE No.1	4.0 to 5.0 mil NSFE	4.0 to 5.0 mil NSFE	4.0 to 5.0 mil NSFE
Outdoor atmospheric	SSPC-SP 6/ NACE No. 3	2.5 to 3.5 mil ZRU	3.0 to 5.0 mil MPE	2.5 to 3.5 mil AAP

C. Galvanized Steel:

Environment/ Application	Surface Preparation	Prime Coat	Intermediate Coats	Finish Coat
Indoor atmospheric	SSPC-SP 16	4.0 to 6.0 mil STEP		2.0 to 3.0 mil MPE
Immersion - non NSF	SSPC-SP 16	4.0 to 6.0 mil STEP	2.0 to 3.0 mil MPE	2.0 to 3.0 mil MPE
Outdoor atmospheric	SSPC-SP 16	4.0 to 6.0 mil STEP		2.5 to 3.5 mil AAP
Field cut pipe threads	SSPC-SP 3	4.0 to 6.0 mil STEP	Coat per exposure above	Coat per exposure above

D. Non Ferrous Metals, including piping:

Environment/ Application	Surface Preparation	Prime Coat	Intermediate Coats	Finish Coat
Dissimilar Materials Protection	SSPC-SP 2	4.5 to 5.5 mil MPE		
Indoor atmospheric	SSPC-SP 2	3.0 to 4.0 mil MPE		3.0 to 4.0 mil MPE
Immersion - Wastewater (abrasion resistant)	SSPC-SP 16			40 to 45 MIL AREC
Outdoor atmospheric	SSPC-SP 2	4.0 to 6.0 mil MPE		2.5 to 3.5 mil AAP

E. Ferrous Piping:

Environment/ Application	Surface Preparation	Prime Coat	Intermediate Coats	Finish Coat
Indoor atmospheric	SSPC-SP 6/ NACE No. 3	2.5 to 3.5 mil ZRU	3.0 to 4.0 mil MPE	3.0 to 4.0 mil MPE
Immersion - Wastewater	SSPC-SP 10/ NACE No. 2	3.0 to 4.0 mil HRE		12 to 16 mil GFRE
Outdoor atmospheric	SSPC-SP 10/ NACE No. 2	2.5 to 3.5 mil ZRU	3.0 to 4.0 mil MPE	2.5 to 3.5 mil AAP

F. Ductile Iron Piping:

Environment/ Application	Surface Preparation	Prime Coat	Intermediate Coats	Finish Coat
Indoor atmospheric	Pipe: NAPF 500-03-04 Fittings: NAPF 500-03-05	3.0 to 4.0 mil MPE	3.0 to 4.0 mil MPE	3.0 to 4.0 mil MPE
Immersion - Wastewater	Pipe: NAPF 500-03-04 Fittings: NAPF 500-03-05	3.0 to 4.0 mil HRE		12 to 16 mil GFRE
Outdoor atmospheric	Pipe: NAPF 500-03-04 Fittings: NAPF 500-03-05	3.0 to 4.0 mil MPE	3.0 to 4.0 mil MPE	2.5 to 3.5 mil AAP

G. Concrete:

1. For repair of deteriorated existing concrete, provide additional surface preparation as specified in PREPARATION article in this Specification Section.

Environment/ Application	Surface Preparation	Filler/Surfacer	Prime Coat	Intermediate Coat(s)	Finish Coat
Walls, ceilings, and appurtenant surfaces Indoor atmospheric	SSPC-SP 13/ NACE No. 6 ICRI CSP 5	ESF and/or EMM as necessary to fill holes and depressions	100 to 150 square feet/GAL MPE		100 to 150 square feet/GAL MPE
Indoor floors	SSPC-SP 13/ NACE No. 6 ICRI CSP 5	ESF as necessary to fill holes and depressions	175 to 225 square feet/GAL EF clear	200 to 250 square feet/GAL EF pigmented	200 to 250 square feet/GAL EF pigmented
			[broadcast slip-resistant aggregate into wet intermediate coat on walking surfaces]		

Environment/ Application	Surface Preparation	Filler/Surfacer	Prime Coat	Intermediate Coat(s)	Finish Coat
Indoor Safety Striping	SSPC-SP 13/ NACE No. 6 ICRI CSP 3	ESF and/or EMM as necessary to fill holes and depressions			6.0 to 8.0 mil EF Pigmented
Interior surfaces at Headworks Effluent Box structure	SSPC-SP 13/ NACE No. 6 ICRI CSP 5	1/16 to 1/4 inches EMM			30 to 45 mil ARE

H. Concrete Masonry:
1. Coverage rates indicated are based on smooth-face normal weight CMU.
2. Provide increased coverage rates in accordance with manufacturer's recommendations for more porous surfaces.

Environment/ Application	Surface Preparation	Filler/Surfacer	Prime Coat	Intermediate Coat(s)	Finish Coat
Indoor atmospheric	Refer to PART 3	100 to 150 square feet/Gal EBF	75 to 100 square feet/Gal MPE		75 to 100 square feet/Gal MPE

I. Gypsum Board:

Environment/ Application	Surface Preparation	Prime Coat	Intermediate Coats	Finish Coat
Paper-faced gypsum board walls, ceilings, and appurtenant surfaces	Level #5 in accordance with GA-214 (Gypsum Association)	350 to 400 SF/GAL PVA	250 to 300 SF/GAL AP	250 to 300 SF/GAL AP

PART 3 - EXECUTION

3.1 ITEMS TO BE COATED

A. Outdoor Surfaces, including but not limited to:
1. Concrete:
   a. Components of concrete tankage:
      1) Coat interior surfaces of tankage.
      2) Walls, columns, beams:
         a) Coat from 1 foot below low water level to top of component.
      3) Troughs, launders, weirs.
      4) Underside of concrete walkways within [2] feet of high water level.
   b. Secondary containment enclosures.
   c. Chemical fill stations.
      1) Paving where indicated on Drawings.
      2) Spill containment sumps.
2. Concrete masonry:
   a. Where indicated on Drawings.
3. Piping, valves, fittings, hydrants and supports:

a. As scheduled in Specification Section 40 05 00.
4. Pumps and motors.
5. Mixer motors.
6. Ferrous metal tankage.
7. Ferrous metal process equipment.
   a. Clarifier mechanisms.
   b. Equipment bridges.
   c. Gates and operators.
8. Structural steel:
   a. Columns, beams and bracing.
   b. Field welded connections of factory coated structural steel.
9. Miscellaneous ferrous metal surfaces:
   a. Items specifically noted on Drawings to be coated.
10. Miscellaneous galvanized steel surfaces:
   a. Pipe Bollards.
   b. Embed Plates.
   c. Loose lintels.
   d. Steel components of concrete lintels.
   e. Items specifically noted on Drawings to be coated.
11. Appurtenant surfaces attached to or adjacent to a surface indicated to be coated:
   a. Conduit, boxes, covers and supports.

B. Indoor Areas:
1. Refer to Room Finish Schedule on Drawings.
   a. If space is scheduled to be coated, coat all appurtenant surfaces within the space unless specifically noted otherwise. Appurtenant surfaces include but are not limited to:
      1) Columns.
      2) Equipment pads.
      3) Equipment supports.
      4) Underside of roof or floor decks above:
         a) Including semi-exposed or concealed from view unless noted otherwise.
      5) Conduit, boxes, covers and supports.
      6) Miscellaneous ferrous metal surfaces.
2. Concrete:
   a. Components of concrete tankage:
      1) Walls, columns, beams:
         a) Coat from 1 foot below low water level to top of component.
      2) Troughs, launders, weirs.
      3) Underside of concrete walkways within [2] feet of high water level.
   b. Chemical storage areas:
   c. Chemical storage areas:
      1) Flooring where scheduled or indicated on Drawings.
      2) Secondary containment enclosures.
3. Piping, valves, fittings, hydrants and supports:
   a. Do not coat piping scheduled to be insulated.
4. Pumps and motors.
5. Ferrous metal tankage.
6. Ferrous metal process equipment.
   a. Clarifier mechanisms.
   b. Equipment bridges.
   c. Gates and operators.
   d. Items specifically noted on Drawings to be coated.
7. Miscellaneous galvanized steel surfaces:
   a. Pipe Bollards.
   b. Embed Plates.
   c. Loose lintels.

d. Steel components of concrete lintels.
e. Seismic angles at masonry partitions.
f. Items specifically noted on Drawings to be coated.

8. Safety Striping:
   a. Equipment Pads: Coat vertical face and return 3 inches onto horizontal surface of pad.
   b. Pipe supports, columns, piers and similar vertical elements: [Coat embedded galvanized steel armoring angles] [3 inches each face of corners, up to 48 inches above finished floor].
   c. As shown on Drawings.

3.2 ITEMS NOT TO BE COATED

A. General: Do not coat items listed in this Article, unless noted otherwise.

B. Items with Approved Factory Finish: These items may require repair of damaged coated areas or coating of welded connections.

C. Electrical Equipment.

D. Moving parts of mechanical and electrical units where coating would interfere with the operation of the unit.

E. Code labels, equipment identification or rating plates and similar labels, tagging and identification.

F. Contact surfaces of friction-type structural connections.

G. Stainless Steel Surfaces, except:
   1. Dissimilar metals in immersion service.
   2. Piping where specifically noted to be coated.
   3. Banding as required to identify piping.

H. Aluminum Surfaces, except:
   1. Where specifically shown in the Contract Documents.
   2. Where in contact with concrete.
   3. Where in contact with dissimilar metals.
   4. Appurtenant surfaces as described in the ITEMS TO BE COATED article.

I. Fiberglass Surfaces, except:
   1. Fiberglass piping where specifically noted to be coated.
   2. Piping supports where specifically noted to be coated.
   3. Appurtenant surfaces as described in the ITEMS TO BE COATED article.

J. Mechanical piping scheduled to be insulated.

K. Interior of Pipe, Ductwork, and Conduits.
   1. See Division 23 for ductwork.
   2. See Division 40 for pipe linings.

L. Galvanized Steel Items, unless specifically noted to be coated.

M. Architectural Finishes:
   1. Outdoor concrete indicated to receive another finish.
   2. Precast concrete surfaces, unless specifically indicated to be coated.
   3. Prefinished masonry surfaces:
      a. Pre-colored masonry (outdoor face).
         1) Interior face shall be coated where scheduled.
      b. Burnished (ground face) concrete masonry.
      c. Prefaced masonry.
      d. Face brick.
      e. Glass masonry.
   4. Plastic laminate.

5. Solid surface material.
6. Standing and running trim.
7. Fiberglass fabrications.
8. Anodized aluminum.
9. PVDF coated metals.
10. Factory finished doors and frames.
11. Aluminum windows, curtainwall and storefront framing systems.
12. Finish hardware.
13. Glass and glazing.
14. Ceramic, porcelain, quarry tile or natural stone.
15. Acoustical materials.
16. Building specialties.
17. Louvers.
18. Casework and countertops.
19. Pipe insulation and jacketing.
20. Standing seam metal roof, fascia, trim, soffit and accessories.

3.3 EXAMINATION

A. Concrete:
   1. Test pH of surface to be coated in accordance with ASTM D4262.
      a. If surface pH is not within coating manufacturer's required acceptable range, use methods acceptable to coating manufacturer as required to bring pH within acceptable range.
      b. Retest pH until acceptable results are obtained.
   2. Verify that moisture content of surface to be coated is within coating manufacturer's recommended acceptable limits.
      a. Test surface to be coated in accordance with ASTM D4263 to determine the presence of moisture.
         1) If moisture is detected, test moisture content of surface to be coated in accordance with ASTM F1869 or ASTM F2170.
         2) Provide remedial measures as necessary to bring moisture content within coating manufacturer's recommended acceptable limits.
         3) Retest surface until acceptable results are obtained.

B. Concrete Unit Masonry:
   1. Test pH of surface to be coated in accordance with ASTM D4262.
      a. If surface pH is not within coating manufacturer's required acceptable range, use methods acceptable to coating manufacturer as required to bring pH within acceptable limits.
      b. Retest pH until acceptable results are obtained.
   2. Verify that moisture content of surface to be coated is within coating manufacturer's recommended acceptable limits.
      a. Test surface to be coated in accordance with ASTM D4263 to determine the presence of moisture.
         1) If moisture is detected, test moisture content of surface to be coated in accordance with ASTM F1869.
         2) Provide remedial measures as necessary to bring moisture content within coating manufacturer's recommended acceptable limits.
         3) Retest surface until acceptable results are obtained.

3.4 PREPARATION

A. General:
   1. Prepare surfaces to be coated in accordance with coating manufacturer's instructions and this Specification Section unless noted otherwise in this Specification Section.

a. Where discrepancy between coating manufacturer's instructions and this Specification Section exists, the more stringent surface preparation shall be provided unless approved otherwise, in writing, by the Engineer.

2. Remove all dust, grease, oil, compounds, dirt and other foreign matter which would prevent bonding of coating to surface.
3. Adhere to manufacturer's recoat time surface preparation requirements.
   a. Surfaces that have exceeded coating manufacturer's published recoat time and/or have exhibited surface chalking shall be prepared prior to additional coating in accordance with manufacturer's published recommendations.
      1) Minimum SSPC-SP 7/ NACE No. 4 unless otherwise approved by Engineer.

B. Protection:
   1. Protect surrounding surfaces not to be coated.
   2. Remove and protect hardware, accessories, plates, fixtures, finished work, and similar items; or provide ample in-place protection.
   3. Protect code labels, equipment identification or rating plates and similar labels, tagging and identification.

C. Prepare and coat before assembly all surfaces which are inaccessible after assembly.

D. Ferrous Metal:
   1. Prepare ductile iron pipe in accordance with pipe manufacturer's recommendations and NAPF.
      a. All piping, pumps, valves, fittings and any other component used in the water piping system that requires preparation for coating shall be prepared in accordance with requirements for immersion service.
      b. Prepare all areas requiring patch coating in accordance with recommendations of manufacturer and NAPF.
      c. Remove bituminous coating per piping manufacturer, coating manufacturer and NAPF recommendations.
         1) The most stringent recommendations shall apply.
   2. Complete fabrication, welding or burning before beginning surface preparation.
      a. Chip or grind off flux, spatter, slag or other laminations left from welding.
      b. Remove mill scale.
      c. Grind smooth rough welds and other sharp projections.
   3. Solvent clean in accordance with SSPC-SP 1.
   4. Restore surface of field welds and adjacent areas to original surface preparation.

E. Galvanized Steel and Non-ferrous Metals:
   1. Solvent clean in accordance with SSPC-SP 1 followed by brush-off blast clean in accordance with SSPC-SP 16 to remove zinc oxide and other foreign contaminants.
      a. Provide uniform 1 mil profile surface.

F. Concrete:
   1. Cure for minimum of 28 days.
   2. Concrete surfaces shall be cleaned in accordance with ASTM D4258.
   3. Abrasive blast concrete surfaces in accordance with ASTM D4259 and SSPC-SP 13/ NACE No. 6.
      a. Provide profile per ICRI 301.2 as listed in MATERIALS article of this Specification Section.
   4. Test pH and moisture content in accordance with EXAMINATION article in this Specification Section.

G. Concrete Masonry:
   1. Cure for minimum of 28 days.
   2. Remove all mortar spatters and protrusions.
   3. Clean concrete masonry in accordance with Specification ASTM D4261.

4. Test pH and moisture content in accordance with EXAMINATION article in this Specification Section.

H. Preparation by Abrasive Blasting:
1. Schedule the abrasive blasting operation so blasted surfaces will not be wet after blasting and before coating.
2. Provide compressed air for blasting that is free of water and oil.
   a. Provide accessible separators and traps.
3. Protect nameplates, valve stems, rotating equipment, motors and other items that may be damaged from blasting.
4. All abrasive-blasted ferrous metal surfaces shall be inspected immediately prior to application of coatings.
   a. Inspection shall be performed to determine cleanliness and profile depth of blasted surfaces and to certify that surface has been prepared in accordance with these Specifications.
5. Perform additional blasting and cleaning as required to achieve surface preparation required.
   a. Re-blast surfaces not meeting requirements of these Specifications.
   b. Prior to coating, re-blast surfaces allowed to set overnight and surfaces that show rust bloom.
   c. Surfaces allowed to set overnight or surfaces which show rust bloom prior to coating shall be re-inspected prior to coating application.
6. Profile depth of blasted surface: Not less than 1 mil or greater than 2 mils unless required otherwise by coating manufacturer.
7. Ensure abrasive blasting operation does not result in embedment of abrasive particles in coating.
8. Confine blast abrasives to area being blasted.
   a. Provide shields of polyethylene sheeting or other such barriers to confine blast material.
   b. Plug pipes, holes, or openings before blasting and keep plugged until blast operation is complete and residue is removed.
9. Abrasive blasting media may be recovered, cleaned and reused providing Contractor submits, for Engineer's review, a comprehensive recovery plan outlining all procedures and equipment proposed in reclamation process.
10. Properly dispose of blasting material contaminated with debris from blasting operation.

I. All Plastic Surfaces:
1. Sand using 80-100 grit sandpaper to scarify surfaces.

3.5 APPLICATION

A. General:
1. Thin, mix and apply coatings by brush, roller, or spray in accordance with manufacturer's installation instructions.
   a. Application equipment must be inspected and approved in writing by coating manufacturer.
2. Temperature and weather conditions:
   a. Do not coat surfaces when surface temperature is below 50 degrees F unless product has been formulated specifically for low temperature application and application is approved in writing by Engineer and coating manufacturer's technical representative.
   b. Avoid coating surfaces exposed to hot sun.
   c. Do not coat damp surfaces.
   d. Apply coating to concrete or masonry surfaces in descending temperatures, in accordance with coating manufacturer's application instructions.
3. Apply materials under adequate illumination.
4. Provide complete coverage to MIL thickness specified.
   a. Thickness specified is dry MIL thickness.
5. Evenly spread to provide full, smooth coverage.
   a. All coating systems are "to cover."

1) In situations of discrepancy between manufacturer's square footage coverage rates and MIL thickness, MIL thickness requirements govern.

b. When color or undercoats show through, apply additional coats until coating is of uniform finish and color.

c. Finished coating system shall be uniform and without voids, bugholes, holidays, laps, brush marks, roller marks, runs, sags or other imperfections.

6. If so directed by Engineer, do not apply consecutive coats until Engineer has had an opportunity to observe and approve previous coats.
7. Work each application of material into corners, crevices, joints, and other difficult to work areas.
8. Provide coating manufacturer's recommended details at all terminations, penetrations, embedments, cracks, joints and changes in substrate direction.
9. Avoid degradation and contamination of blasted surfaces and avoid inter-coat contamination.
   a. Clean contaminated surfaces before applying next coat.
   b. Intercoat surface cleanliness shall be inspected and approved by the Engineer prior to application of each coat.
10. Smooth out runs or sags immediately, or remove and recoat entire surface.
11. Allow preceding coats to dry before recoating.
   a. Recoat within time limits specified by coating manufacturer.
   b. If recoat time limits have expired re-prepare surface in accordance with coating manufacturer's printed recommendations.
12. Allow coated surfaces to cure prior to allowing traffic or other work to proceed.
13. Coat all aluminum in contact with dissimilar materials.
14. When coating rough surfaces which cannot be backrolled sufficiently, hand brush coating to work into all recesses provided that the maximum DFT is not exceeded.
15. Backroll surfaces if coatings are spray applied.

B. Employ services of coating manufacturer's technical representative to ensure that field-applied coatings are compatible with factory-applied or existing coatings.
   1. Certify through material data sheets.
   2. Perform test patch.
      a. Prepare existing coating surface to receive specified coating system.
      b. Apply coating to a minimum 1 square feet area and allow to cure in accordance with manufacturer's recommendations.
      c. Evaluate adhesion to existing coating:
         1) Concrete or Masonry substrates: ASTM D4541.
         2) All other substrates: ASTM D6677 and ASTM D3359 (X-cut method).
   3. If field-applied coating is found to be not compatible, require the coating manufacturer's technical representative to recommend, in writing, product to be used as barrier coat, thickness to be applied, surface preparation and method of application.
      a. Perform test patch as described above.
   4. At Contractor's option, coatings may be removed, surface re-prepared, and new coating applied using appropriate coating system listed in the MATERIALS Article, Coating Systems paragraph of this Specification Section.
      a. All damage to surface as result of coating removal shall be repaired to original condition or better by Contractor at no additional cost to Owner.

C. Prime Coat Application:
   1. Apply structural steel and miscellaneous steel prime coat in the factory.
      a. Finish coats shall be applied in the [field] [factory] [Shop].
      b. Prime coat referred to here is prime coat as indicated in this Specification.
         1) Prime coating applied in factory (shop) as part of Fabricator's standard rust inhibiting and protection coating is not acceptable as replacement for specified prime coating.

c. Application of all factory-applied coatings(s) on structural steel and miscellaneous steel [and steel joist] [and steel truss] shall be continually observed and certified by NACE coatings inspector.

2. Prime all surfaces indicated to be coated.
   a. Apply prime coat in accordance with coating manufacturer's written instructions and as written in this Specification Section.
3. Prime ferrous metals embedded in concrete to minimum of 1 inch below exposed surfaces.
4. Apply zinc-rich primers while under continuous agitation.
5. Brush or spray bolts, welds, edges and difficult access areas with primer prior to primer application over entire surface.
6. Touch up damaged primer coats prior to applying finish coats.
   a. Restore primed surface equal to surface before damage.
7. All surfaces of steel lintels and steel components of concrete lintels used in wall construction shall be completely coated with both prime and finish coats prior to placing in wall.

D. Finish Coat Application:
   1. Apply finish coats in accordance with coating manufacturer's written instructions and in accordance with this Specification Section; manufacturer instructions take precedent over these Specifications.
   2. Touch up damaged finish coats using same application method and same material specified for finish coat.
      a. Prepare damaged area in accordance with the PREPARATION Article of this Specification Section.

3.6 COLOR CODING

A. Color code piping in accordance with the SCHEDULE Article of this Specification Section.

3.7 FIELD QUALITY CONTROL

A. Application Deficiencies:
   1. Surfaces showing runs, laps, brush marks, telegraphing of surface imperfections or other defects will not be accepted.
   2. Surfaces showing evidence of fading, chalking, blistering, delamination or other defects due to improper surface preparation, environmental controls or application will not be accepted.
      a. Epoxy surfaces showing evidence of chalking or amine blush shall be prepared and recoated as follows:
         1) Solvent clean surfaces in accordance with SSPC-SP1 and abrasive blast in accordance with SSPC-SP7/ NACE No. 4.
         2) Recoat with intermediate and finish coats in accordance with coating system specified herein.

B. Provide protection for coated surfaces.
   1. Surfaces showing soiling, staining, streaking, chipping, scratches, or other defects will not be accepted.

C. Contractor Performed Testing:
   1. Provide ongoing testing and inspection, including but not limited to the following:
      a. Measurement and recording of environmental conditions as specified herein.
      b. Measurement and recording of substrate conditions as specified herein.
      c. Thickness Testing:
         1) Wet film thickness during application in accordance with ASTM D4414.
         2) Dry Film Thickness (DFT) in accordance with SSPC-PA 2.
         3) Engineer may measure coating thickness at any time during project to assure conformance with these Specifications.
      d. Bond Strength:
         1) [Additional bond] [Bond] strength testing will be required by the [Engineer] [Owner] where there is reason to suspect the integrity of the coating system.

2) Measure bond strength of the coating in accordance with:
   a) Steel substrate: ASTM D4541.
   b) Concrete substrate ASTM D7234.
3) The number of test sites and locations to be tested shall be determined by the [Engineer] [Owner] after application of coating. The Contractor will apply the dollies, perform the tests and repair the coating in the presence of the [Engineer] [Owner].
   a) For each test that fails, two additional tests shall be performed in the adjacent area.
   b) Further bond tests may be performed to determine the extent of potentially deficient bonded areas at no additional cost to the Owner.
4) Repairs shall be made by applicator in strict accordance with manufacturer's recommendations. Any coated areas that do not pass the bond strength tests shall be removed and replaced at the expense of the Contractor.

D. NACE inspection:
   1. [The Owner reserves the right to retain a NACE Level 3 coating inspector] [A NACE Level 3 coating inspector will be assigned by the Owner] to perform observation, inspection and testing as deemed necessary to document the quality of the Work.
      a. All work shall be done to the satisfaction of the Owner's inspector.
      b. Any portion of the coating that does not satisfactorily pass the inspection and testing requirements shall be repaired or replaced by the Contractor at no additional cost to the Owner.
      c. Additional testing and/or inspection may be done at the discretion of the Owner.
         1) The Contractor will provide all equipment, materials, and labor to perform the testing.
   2. Inspection, testing or observation by the Owner's inspector shall not relieve the Contractor of responsibility for surface preparation, inspection or quality control specified herein.

E. Instrumentation:
   1. Provide instrumentation as necessary to measure and record atmospheric and substrate conditions, including but not limited to:
      a. Dry Film Thickness Gauge:
         1) Ultrasonic: ASTM D6132.
         2) Magnetic: ASTM B499.
      b. Wet Film Thickness Gauge: ASTM D4414.
      c. Sling Psychrometer: ASTM E337.
      d. Surface Temperature Gauge.
      e. Anemometer.
      f. Moisture Meter.
      g. Adhesion test apparatus:
         1) Steel: ASTM D4541.
         2) Concrete: ASTM D7234.

F. Maintain Daily Records:
   1. Record the following information during application:
      a. Date, starting time, end time, and all breaks taken by applicators.
      b. Air temperature.
      c. Relative humidity.
      d. Dew point.
      e. Moisture content and pH level of concrete or masonry substrates prior to coating.
      f. Surface temperature of substrate.
      g. Provisions utilized to maintain work area within manufacturer's recommended application parameters including temporary heating, ventilation, cooling, dehumidification and provisions utilized to mitigate wind-blown dust and debris from contaminating the wet coating.
      h. For outdoor coating, also record:

1) Sky condition.
2) Wind speed and direction.

i. Record environmental conditions, substrate moisture content and surface temperature information not less than once every 4 hours during application.
1) Record hourly when temperatures are below 50 degrees F or above 100 degrees F.

2. Record the following information daily for the coating manufacturer's recommended curing period:
a. Date and start time of cure period for each item or area.
b. For outdoor coating, also record:
1) Sky conditions.
2) Wind speed and direction.
3) Air temperature.
a) Dry Bulb.
b) Wet Bulb.
4) Relative humidity.
5) Dew point.
6) Surface temperatures.
c. Record environmental conditions not less than once every 4 hours.
1) Record hourly when temperatures are below 50 degrees F or above 100 degrees F.
d. Provisions utilized to protect each item or area and to maintain areas within manufacturer's recommended curing parameters.
3. Format for daily record to be computer generated.

G. Provide wet paint signs.

3.8 CLEANING

A. Clean coating spattered surfaces.
1. Use care not to damage finished surfaces.

B. Upon completion of coating, replace hardware, accessories, plates, fixtures, and similar items.

C. Remove surplus materials, scaffolding, and debris.

3.9 COLOR SCHEDULE

A. Pipe Bollards: Safety Yellow.

B. Piping:
1. Refer to Specification Section 10 14 00 for the piping system and banding material and refer to this Specification Section and this Schedule for the banding colors.

END OF SECTION

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SECTION 10 14 00
IDENTIFICATION DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Tag, tape and stenciling systems for equipment, piping, valves, pumps, ductwork and similar items.
   2. Hazard and safety signs.

B. Related Specification Sections include but are not necessarily limited to:

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society of Mechanical Engineers (ASME):
      a. A13.1, Scheme for the Identification of Piping Systems.
   2. The International Society of Automation (ISA).
   3. National Electrical Manufacturers Association/American National Standards Institute (NEMA/ANSI):
      a. Z535.1, Safety Color Code.
      b. Z535.2, Environmental and Facility Safety Signs.
      c. Z535.3, Criteria for Safety Symbols.
      d. Z535.4, Product Safety Signs and Labels.
   4. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).
      b. 704, Standard System for the Identification of Hazards of Materials for Emergency Response.
   5. Occupational Safety and Health Administration (OSHA):
      a. 29 CFR 1910.145, Specification for Accident Prevention Signs and Tags.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Product technical data including:
      a. Catalog information for all identification systems.
      b. Acknowledgement that products submitted meet requirements of standards referenced.
   2. Identification register, listing all items in PART 3 of this Specification Section to be identified, type of identification system to be used, lettering, location and color.
   3. Schedule of Hazard and Safety Signage indicating text and graphics.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. W.H. Brady Co.
   2. Panduit.
   3. Seton.
   4. National Band and Tag Co.
   5. Carlton Industries, Inc.

2.2 MANUFACTURED UNITS

A. Type A1 - Round Metal Tags:

1. Materials:
    a. Aluminum or stainless steel.
    b. Stainless steel shall be used in corrosive environments.
2. Size:
    a. Diameter: 1-1/2 inches minimum.
    b. Thickness: 0.035 inches (20 GA) minimum.
3. Fabrication:
    a. 3/16 inches minimum mounting hole.
    b. Legend: Stamped and filled with black coloring.
4. Color: Natural.

B. Type A2 - Rectangle Metal Tags:
1. Materials: Stainless steel.
2. Size:
    a. 3-1/2 inches x 1-1/2 inches minimum.
    b. Thickness: 0.036 inches (20 GA) minimum.
3. Fabrication:
    a. 3/16 inches minimum mounting hole.
    b. Legend: Stamped and filled with black coloring.
4. Color: Natural.

C. Type A3 - Metal Tape Tags:
1. Materials: Aluminum or stainless steel.
2. Size:
    a. Width 1/2 inches minimum.
    b. Length as required by text.
3. Fabrication:
    a. 3/16 inches minimum mounting hole.
    b. Legend: Embossed.
4. Color: Natural.

D. Type B1- Square Nonmetallic Tags:
1. Materials: Fiberglass reinforced plastic.
2. Size:
    a. Surface: 2 x 2 inches minimum.
    b. Thickness: 100 mils.
3. Fabrication:
    a. 3/16 inches mounting hole with metal eyelet.
    b. Legend: Preprinted and permanently embedded and fade resistant.
4. Color:
    a. Background: Manufacturer standard or as specified.
    b. Lettering: Black.

E. Type B2 - Nonmetallic Signs:
1. Materials: Fiberglass reinforced or durable plastic.
2. Size:
    a. Surface: As required by text.
    b. Thickness: 60 mils minimum.
3. Fabrication:
    a. Rounded corners.
    b. Drilled holes in corners with grommets.
    c. Legend: Preprinted, permanently embedded and fade resistant for a 10 year minimum outdoor durability.
4. Color:
    a. Background: Manufacturer standard or as specified.
    b. Lettering: Black.

5. Standards for OSHA signs: NEMA/ANSI Z535.1, NEMA/ANSI Z535.2, NEMA/ANSI Z535.3, NEMA/ANSI Z535.4, OSHA 29 CFR 1910.145.

F. Type C - Laminated Name Plates:
   1. Materials: Phenolic or DR (high impact) acrylic.
   2. Size:
      a. Surface: As required by text.
      b. Thickness: 1/16 inches.
   3. Fabrication:
      a. Outdoor rated and UV resistant when installed outdoors.
      b. Two layers laminated.
      c. Legend: Engraved through top lamination into bottom lamination.
      d. Two drilled side holes, for screw mounting.
   4. Color: Black top surface, white core, unless otherwise indicated.

G. Type D - Self-Adhesive Tape Tags and Signs:
   1. Materials: Vinyl tape or vinyl cloth.
   2. Size:
      a. Surface: As required by text.
      b. Thickness: 5 mils minimum.
   3. Fabrication:
      a. Indoor/Outdoor grade.
      b. Weather and UV resistant inks.
      c. Permanent adhesive.
      d. Legend: Preprinted.
      e. Wire markers to be self-laminating.
   4. Color: White with black lettering or as specified.
   5. Standards for OSHA signs: NEMA/ANSI Z535.1, NEMA/ANSI Z535.2, NEMA/ANSI Z535.3, NEMA/ANSI Z535.4, OSHA 29 CFR 1910.145.

H. Type E - Heat Shrinkable Tape Tags:
   1. Materials: Polyolefin.
   2. Size: As required by text.
   3. Fabrication:
      a. Legend: Preprinted.
   4. Color: White background, black printing.

I. Type F - Underground Warning Tape:
   1. Materials: Polyethylene.
   2. Size:
      a. 3 inches wide (minimum).
      b. Thickness: 3.5 mils.
   3. Fabrication:
      a. Legend: Preprinted and permanently imbedded.
      b. Message continuous printed.
      c. Tensile strength: 1750 psi.
   4. Color: As specified.

J. Type G - Stenciling System:
   1. Materials:
      a. Exterior type stenciling enamel.
      b. Either brushing grade or pressurized spray can form and grade.
   2. Size: As required.
   3. Fabrication:
      a. Legend: As required.
   4. Color: Black or white for best contrast.

K. Underground Tracer Wire:

1. Materials:
    a. Wire:
        1) 12 GA AWG.
        2) Solid.
    b. Wire nuts: Waterproof type.
    c. Split bolts: Brass.

2.3 ACCESSORIES

A. Fasteners:
    1. Bead chain: #6 brass, aluminum or stainless steel.
    2. Plastic strap: Nylon, urethane or polypropylene.
    3. Screws: Self-tapping, stainless steel.
    4. Adhesive, solvent activated.

2.4 MAINTENANCE MATERIALS

A. Where stenciled markers are provided, clean and retain stencils after completion and include in extra stock, along with required stock of paints and applicators.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. Install identification devices at specified locations.

B. All identification devices to be printed by mechanical process, hand printing is not acceptable.

C. Attach tags to equipment with sufficient surface or body area with solvent activated adhesive applied to back of each tag.

D. Attach tags with 1/8 inches round or flat head screws to equipment without sufficient surface or body area, or porous surfaces.
    1. Where attachment with screws should not or cannot penetrate substrate, attach with plastic strap.

E. Single items of equipment enclosed in a housing or compartment to be tagged on outside of housing.
    1. Several items of equipment mounted in housing to be individually tagged inside the compartment.

F. Tracer Wire:
    1. Attach to pipe at a maximum of 10 feet intervals with tape or tie-wraps.
    2. Continuous pass from each valve box and above grade at each structure.
    3. Coil enough wire at each valve box to extend wire a foot above the ground surface.
    4. 1,000 feet maximum spacing between valve boxes.
    5. If split bolts are used for splicing, wrap with electrical tape.
    6. If wire nuts are used for splicing, knot wire at each splice point leaving 6 inches of wire for splicing.
    7. Use continuous strand of wire between valve box where possible.
        a. Continuous length shall be no shorter than 100 feet.

3.2 SCHEDULES

A. Process Systems:
    1. General:
        a. Provide arrows and markers on piping.
            1) At 20 feet maximum centers along continuous lines.
            2) At changes in direction (route) or obstructions.
            3) At valves, risers, "T" joints, machinery or equipment.

4) Where pipes pass through floors, walls, ceilings, cladding assemblies and like obstructions provide markers on both sides.

b. Position markers on both sides of pipe with arrow markers pointing in flow direction.
1) If flow is in both directions use double headed arrow markers.

c. Apply tapes and stenciling in uniform manner parallel to piping.

2. Trenches with piping:
a. Tag type: Type F - Underground Warning Tape
b. Location: Halfway between top of piping and finished grade.
c. Letter height: 1-1/4 inches minimum.
d. Natural gas or digester gas:
1) Color: Yellow with black letters.
2) Legend:
a) First line: "CAUTION CAUTION CAUTION"
b) Second line: "BURIED GAS LINE BELOW"
e. Potable water:
1) Color: Blue with black letters.
2) Legend:
a) First line: "CAUTION CAUTION CAUTION"
b) Second line: "BURIED WATER LINE BELOW"
f. Storm and sanitary sewer lines:
1) Color: Green with black letters.
2) Legend:
a) First line: "CAUTION CAUTION CAUTION"
b) Second line: "BURIED SEWER LINE BELOW"
g. (Nonpotable) water piping, except 3 inches and smaller irrigation pipe:
1) Color: Green with black letters.
2) Legend:
a) First line: "CAUTION CAUTION CAUTION"
b) Second line: "BURIED NONPOTABLE WATER LINE BELOW"
h. Chemical feed piping (e.g., chlorine solution, polymer solution, caustic solution, etc.):
1) Color: Yellow with black letters.
2) Legend:
a) First line: "CAUTION CAUTION CAUTION"
b) Second line: "BURIED CHEMICAL LINE BELOW"
i. Other piping (e.g., compressed air, irrigation, refrigerant, heating water, etc.):
1) Color: Yellow with black letters.
2) Legend:
a) First line: "CAUTION CAUTION CAUTION"
b) Second line: "BURIED PIPE LINE BELOW"

3. Yard valves, buried, with valve box and concrete pad:
a. Tag type: Type A2 - Rectangle Metal Tags.
b. Fastener: 3/16 inches x 7/8 inches plastic screw anchor with 1 inch #6 stainless steel pan head screw.
c. Legend:
1) Letter height: 1/4 inches minimum.
2) Valve designation as indicated on the Drawings (e.g., "V-xxx").

4. Valves and slide gates:
a. Tag type:
1) Outdoor locations: Type B1 - Square Nonmetallic Tags.
2) Indoor noncorrosive:
a) Type A1 - Round Metal Tags.
b) Type B1 - Square Nonmetallic Tags.
3) Indoor corrosive:
a) Stainless steel Type A1 - Round Metal Tags.
b) Type B1 - Square Nonmetallic Tags.

b. Fastener:
    1) Type A1: Chain of the same material.
    2) Type B1: Stainless steel chain.
c. Color: Per ASME A13.1 corresponding to the piping system.
d. Legend:
    1) Letter height: 1/4 inches minimum.
    2) Valve designation as indicated on the Drawings (e.g., "V-xxx").

5. Process equipment (e.g., pumps, pump motors, blowers, air compressors, bar screens, clarifier drive mechanism, etc.):
    a. Tag type:
        1) Type B2 - Nonmetallic Signs.
        2) Type D - Self-Adhesive Tape Tags and Signs.
        3) Type G - Stenciling System.
    b. Fastener:
        1) Self.
        2) Screws.
        3) Adhesive.
    c. Legend:
        1) Letter height: 1/2 inches minimum.
        2) Equipment designation as indicated on the Drawings (e.g., "Primary Sludge Pump P-xxx").
6. Piping systems:
    a. Tag type:
        1) Outdoor locations: Type G - Stenciling System.
        2) Indoor locations:
            a) Type D - Self-Adhesive Tape Tags and Signs.
            b) Type G - Stenciling System.
    b. Fastener: Self.
    c. Color: Per ASME A13.1.
    d. Legend:
        1) Letter height: Manufacturers standard for the pipe diameter.
        2) Mark piping in accordance with ASME A13.1.
        3) Use piping designation as indicated on the Drawings.
        4) Arrow: Single arrow.
7. Process tanks (over 1000 GAL) and basins, (e.g., chemical storage, clarifiers, trickling filters, digesters, etc.):
    a. Tag type:
        1) Type B2 - Nonmetallic Signs.
        2) Type G - Stenciling System.
    b. Fastener:
        1) Screw.
        2) Self.
    c. Location as directed by Owner.
    d. Legend:
        1) Letter height: 4 inches minimum.
        2) Equipment designation as indicated on the Drawings (e.g., "Clarifier CL-xxx").
8. Tanks (less than 1000 GAL) (e.g., break tanks, chemical tanks, hydro-pneumatic tanks, air receivers, etc.):
    a. Tag type:
        1) Type D - Self-Adhesive Tape Tags and Signs.
        2) Type G - Stenciling System.
    b. Fastener: Self.
    c. Legend:
        1) Letter height: 2 inches minimum.

2) Equipment designation as indicated on the Drawings (e.g., "Polymer Storage Tank Txxx")

9. Equipment that starts automatically:
   a. Tag type:
      1) Type B2 - Nonmetallic Signs.
      2) Type D - Self-Adhesive Tape Tags and Signs.
   b. Fastener:
      1) Type B2 - Screw or adhesive.
      2) Type D - Self.
   c. Size: 5 inches x 7 inches
   d. Location: [Equipment name].
   e. Legend:
      1) OSHA Warning Sign.
      2) Description of Warning: "THIS MACHINE STARTS AUTOMATICALLY".

B. Instrumentation Systems:
   1. Instrumentation Equipment (e.g., flow control valves, primary elements, etc.):
      a. Tag type:
         1) Outdoor locations: Type B1 - Square Nonmetallic Tags.
         2) Indoor noncorrosive:
            a) Type A1 - Round Metal Tags.
            b) Type B1 - Square Nonmetallic Tags.
         3) Indoor corrosive:
            a) Stainless steel Type A1 - Round Metal Tags.
            b) Type B1 - Square Nonmetallic Tags.
      b. Fastener:
         1) Type A1: Chain of the same material.
         2) Type B1: Stainless steel chain.
      c. Legend:
         1) Letter height: 1/4 inches minimum.
         2) Equipment ISA designation as indicated on the Drawings (e.g., "FIT-xxx").
   2. Enclosure for instrumentation and control equipment, (e.g., PLC control panels, etc.):
      a. Tag type: Type C - Phenolic Name Plates.
      b. Fastener: Screws.
      c. Legend:
         1) Letter height: 1/2 inches minimum.
         2) Equipment name (e.g., "PLC CONTROL PANEL PCP-xxx").
   3. Components inside equipment enclosure, (e.g., PLC's, control relays, contactors, and timers):
      a. Tag type: Type D - Self-Adhesive Tape Tags.
      b. Fastener: Self.
      c. Legend:
         1) Letter height: 3/16 inches minimum.
         2) Description or function of component (e.g., "PLC-xxx" or "CR-xxx").
   4. Through enclosure door mounted components (e.g., selector switches, controller digital displays, etc.):
      a. Tag type: Type C - Phenolic Name Plates.
      b. Fastener: Screws.
      c. Legend:
         1) Letter height: 1/4 inches minimum.
         2) Component ISA tag number as indicated on the Drawings (e.g., "HS-xxx").

C. HVAC Systems:
   1. General:
      a. Provide arrows and markers on ducts.
         1) At 20 feet maximum centers along continuous lines.

2) At changes in direction (route) or obstructions.
3) At dampers, risers, branches, machinery or equipment.
4) Where ducts pass through floors, walls, ceilings, cladding assemblies and like obstructions provide markers on both sides.

b. Position markers on both sides of duct with arrow markers pointing in flow direction.
1) If flow is in both directions use double headed arrow markers.

c. Apply tapes and stenciling in uniform manner parallel to ducts.

2. HVAC Equipment (e.g., unit heaters, exhaust fans, air handlers, etc.):
a. Tag type:
1) Type B2 - Nonmetallic Signs.
2) Type C - Phenolic Name Plates.

b. Fastener: Screws.

c. Legend:
1) Letter height: 1 inch minimum.
2) Equipment designation as indicated on the Drawings (e.g., "EF-xxx").

3. Ductwork:
a. Tag type:
1) Type D - Self-Adhesive Tape Tags and Signs.
2) Type G - Stenciling System.

b. Fastener: Self.

c. Legend:
1) Letter height: 1 inch minimum.
2) Description of ductwork, (e.g., "AIR SUPPLY").
3) Arrows: Single arrow.

4. Enclosure for instrumentation and control equipment, (e.g., fan control panels, etc.):
a. Tag type: Type C - Phenolic Name Plates.

b. Fastener: Screws.

c. Legend:
1) Letter height: 1/2 inches minimum.
2) Equipment designation as indicated on the Drawings (e.g., "FAN CONTROL PANEL FCP-xxx").

5. Wall mounted thermostats:
a. Tag type: Type D - Self-Adhesive Tape Tags and Signs.

b. Fastener: Self.

c. Legend:
1) Letter height: 3/16 inches minimum.
2) Description of equipment controlled (e.g., "UH-xxx" or AHU-xxx").

6. Components inside equipment enclosure, (e.g., controller's, control relays, contactors, and timers):
a. Tag type: Type D - Self-Adhesive Tape Tags and Signs.

b. Fastener: Self.

c. Legend:
1) Letter height: 3/16 inches minimum.
2) Description or function of component (e.g., "CR-xxx").

7. Through enclosure door mounted equipment (e.g., selector switches, controller digital displays, etc.):
a. Tag type: Type C - Phenolic Name Plates.

b. Fastener: Screws.

c. Legend:
1) Letter height: 1/4 inches minimum.
2) Component tag number as indicated on the Drawings or as defined by contractor (e.g., "HS-xxx").

D. Electrical Systems:
1. Trenches with ductbanks, direct-buried conduit, or direct-buried wire and cable.
a. Tag type: Type F - Underground Warning Tape.

b. Letter height: 1-1/4 inches minimum.
c. Location:
1) Where trench is 12 inches or more below finished grade: In trench 6 inches below finished grade.
2) Where trench is less than 12 inches below finished grade: In trench 3 inches below finished grade.
d. Electrical power (e.g., low and medium voltage):
1) Color: Red with black letters.
2) Legend:
a) First line: "CAUTION CAUTION CAUTION".
b) Second line: "BURIED ELECTRIC LINE BELOW".
e. Communications (e.g., telephone, instrumentation, LAN, SCADA):
1) Color: Orange with black letters.
2) Legend:
a) First line: "CAUTION CAUTION CAUTION".
b) Second line: "BURIED COMMUNICATION LINE BELOW".

2. Switchgear, switchboards and motor control centers:
a. Tag type: Type C - Phenolic Name Plates.
b. Fastener: Screws.
c. Main equipment legend:
1) Letter height:
a) First line: 1 inch minimum.
b) Subsequent lines: 3/8 inches minimum.
2) First line: Equipment name (e.g., "MAIN SWITCHBOARD MSBxxx").
3) Second line:
a) Source of power (e.g., "FED FROM MCCxxx LOCATED IN ROOM xxx").
b) Include the building name or number if the source is in another building.
4) Third line: System voltage and phase (e.g., "480/277 V, 3PH").
5) Fourth line: Date installed (e.g., "INSTALLED JULY 20xx").
d. Main and feeder device legend:
1) Letter height: 3/8 inches minimum.
2) Description of load (e.g., "MAIN DISCONNECT", "PUMP Pxxx" or "PANELBOARD HPxxx").

3. Panelboards and transformers:
a. Tag type: Type C - Phenolic Name Plates.
b. Fastener: Screws.
c. Legend:
1) Letter height:
a) First line: 3/8 inches minimum.
b) Subsequent lines: 3/16 inches minimum.
2) First line: Equipment name (e.g., "PANELBOARD LPxxx" or "TRANSFORMER Txxx").
3) Second line (panelboards only): System voltage and phase (e.g., "208/120V, 3PH").
4) Third line:
a) Source of power (e.g., "FED FROM MCCxxx LOCATED IN ROOM xxx").
b) Include the building name or number if the source is in another building.
5) Fourth line: Date installed (e.g., "INSTALLED JULY 20xx").

4. Transfer switches:
a. Tag type: Type C - Phenolic Name Plates.
b. Fastener: Screws.
c. Legend:
1) Letter height:
a) First line: 3/8 inches minimum.
b) Subsequent lines: 3/16 inches minimum.

2) First line: Equipment name (e.g., "AUTOMATIC TRANSFER SWITCH ATSxxx").
3) Second line: Normal source of power (e.g., "NORMAL SOURCE FED FROM MCCxxx").
4) Third line: Emergency source of power (e.g., "EMERGENCY SOURCE FED FROM SGENxxx").
5) Fourth line: Date installed (e.g., "INSTALLED JULY 20xx").

5. Safety switches, separately mounted circuit breakers and motor starters, VFD's, etc.:
   a. Tag type: Type C - Phenolic Name Plates.
   b. Fastener: Screws.
   c. Legend:
      1) Letter height: 1/4 inches minimum.
      2) First line: Description of load equipment is connected to (e.g., "PUMP Pxxx").
      3) Second line:
         a) Source of power (e.g., "FED FROM MCCxxx LOCATED IN ROOM xxx").
         b) The source of power room number is only required when there are multiple electrical rooms, if the source is in another building, the building name or number shall be used.
6. Enclosure for instrumentation and control equipment, (e.g., lighting control panels, etc.):
   a. Tag type: Type C - Phenolic Name Plates.
   b. Fastener: Screws.
   c. Legend:
      1) Letter height: 1/2 inches minimum.
      2) Equipment name (e.g., "LIGHTING CONTROL PANEL LCPxxx").
7. Components inside equipment enclosures (e.g., circuit breakers, fuses, control power transformers, control relays, contactors, timers, etc.):
   a. Tag type: Type D - Self-Adhesive Tape Tags and Signs.
   b. Fastener: Self.
   c. Legend:
      1) Letter height: 3/16 inches minimum.
      2) Description or function of component (e.g., "M-xxx", "CR-xxx" or "TR-xxx").
8. Through enclosure door mounted equipment (e.g., selector switches, controller digital displays, etc.):
   a. Tag type: Type C - Phenolic Name Plates.
   b. Fastener: Screws.
   c. Legend:
      1) Letter height: 1/4 inches minimum.
      2) Component tag number as indicated on the Drawings or as defined by contractor (e.g., "HS-xxx").
9. Conductors in control panels and in pull or junction boxes where multiple circuits exist.
   a. Tag type: [Type D - Self-Adhesive Tape Tags] [or] [Type E - Heat Shrinkable Tape Tags].
   b. Fastener: Self.
   c. Tag conductor at both ends.
   d. Legend:
      1) Letter height: 1/8 inches minimum.
      2) Circuit number or wire number as scheduled on the Drawings or as furnished with the equipment.
10. Conductors in handholes and manholes.
    a. Tag type: Type A3 - Metal Tape Tags.
    b. Fastener: Nylon strap.
    c. Tag conductor at both ends.
    d. Legend:
       1) Letter height: 1/8 inches minimum.
       2) Circuit number or wire number as scheduled on the Drawings.

11. Grounding conductors associated with grounding electrode system in accordance with the following:
    a. Tag type: Type D - Self-Adhesive Tape Tags.
    b. Fastener: Self.
    c. Legend:
        1) Letter height: 1/8 inches minimum.
        2) Function of conductor (e.g., "MAIN BONDING JUMPER", "TO GROUND RING", "TO MAIN WATER PIPE").
12. Flash protection for switchboards, panelboards, industrial control panels and motor control centers:
    a. Tag type: Type D - Self-Adhesive Tape Signs.
    b. Fastener: Self.
    c. Legend: Per NFPA 70.
13. Entrances to electrical rooms:
    a. Tag type: Type B2 - Nonmetallic Signs.
    b. Fastener: Screw or adhesive.
    c. Size: 5 inches x 7 inches.
    d. Location: Each door to room.
    e. Legend:
        1) OSHA Danger Sign.
        2) Description of Danger: "HIGH VOLTAGE, AUTHORIZED PERSONNEL ONLY".
14. Equipment where more than one voltage source is present:
    a. Tag type:
        1) Type B2 - Nonmetallic Signs.
        2) Type D - Self-Adhesive Tape Signs.
    b. Fastener:
        1) Screw or adhesive.
        2) Self.
    c. Size: 1-3/4 inches x 2-1/2 inches.
    d. Location: Exterior face of enclosure or cubical.
    e. Legend:
        1) OSHA Danger Sign.
        2) Description of Danger: "MULTIPLE VOLTAGE SOURCES".

END OF SECTION

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SECTION 10 14 23
SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Room identification signs.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 10 14 00 - Identification Devices.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. B26, Standard Specification for Aluminum-Alloy Sand Castings.
   2. Building code:
      a. International Code Council (ICC):
         1) International Building Code and associated standards, 2018 Edition including all amendments, referred to herein as Building Code.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Color charts for Engineer's color selection.
         1) Color selection shall be made from manufacturer's complete color line including all premium and special colors.
   3. Schedule of all signs indicating text and graphics.
   4. Layout drawings of all signage showing size, letter style, text, border, finish, and installation detail.
      a. Provide drawings for:
         1) Room signs.

B. Samples:
   1. Room signs.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Room signs:
      a. ASE - Architectural Signs and Engraving.
      b. ASI Signage Innovations.
      c. Best Sign Systems.
      d. Mohawk Sign Systems.
      e. Nelson-Harkins.

f. Southwell Co.
g. Stamprite Supersine Identification Specialists.

B. Submit request for substitution in accordance with Specification Section 01 25 00.

2.2 MATERIALS

A. Room Signs:
1. Interior:
a. Dry, non-corrosive areas: Melamine plastic suitable for raised lettering and Braille.
b. Wet and/or corrosive areas: Aluminum or fiberglass suitable for raised lettering and Braille.
2. Exterior: Aluminum or fiberglass suitable for raised lettering and Braille.

2.3 FABRICATION

A. Room Identification Signs:
1. General:
a. Raised text, border and graphics.
1) Minimum 1/32 IN height.
2) Provide international graphic symbology for all toilet, locker and shower rooms or combinations thereof, and for unisex toilet rooms and stairs.
3) Provide handicap symbol on all signs for rooms meeting handicap requirements.
b. Grade 2 Braille.
c. Finish: Eggshell.
1) Color: To be selected.
d. Text:
1) Typeface: Sans Serif.
2) Size: Minimum 3/4 IN high.
e. Text as indicated in the SCHEDULES Article in PART 3 of this Specification Section.
f. Exterior signs shall be rated for exterior use.

B. Hazard Communication Signage (OSHA signage): See Specification Section 10 14 00.

2.4 MAINTENANCE MATERIALS

A. Where stenciled markers are provided, clean and retain stencils after completion and include in extra stock, along with required stock of paints and applicators.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Room Identification Signs:
1. Install signs using foam tape for interior signs and stainless steel screws (minimum of two (2)) for exterior signs.
a. Stainless steel screws shall be painted to match sign color.
2. Mounting Locations:
a. Tactile characters on signs shall be located 48 IN minimum above the finished floor or ground surface, measured from the baseline of the lowest tactile character and 60 IN maximum above the finish floor or ground surface, measured from the baseline of the highest tactile character.
b. Where a tactile sign is provided at a door, the sign shall be located alongside the door at the latch side. Where a tactile sign is provided at double doors with one active leaf, the sign shall be located on the inactive leaf. Where a tactile sign is provided at double doors with two active leafs, the sign shall be located to the right side of the right-hand door. Where there is no wall space at the latch side of a single door or at the right side of double doors, signs shall be located on the nearest adjacent wall.

c. Signs containing tactile characters shall be located so that a clear floor space of 18 IN minimum by 18 IN minimum, centered on the tactile characters, is provided beyond the arc of any door swing between the closed position and 45-degree open position.

3.2 SCHEDULES

A. Room Identification Signs:

BUILDING LOCATION	MOUNTING	VERBIAGE	REMARKS
BLOWER BUILDING NO.2			
DOOR 31-100A	EXTERIOR	BLOWER ROOM	2
DOOR 31-100D	EXTERIOR	BLOWER ROOM	2
DOOR 31-100E	INTERIOR	ELECTRICAL ROOM	2
DOOR 31-101A	EXTERIOR	ELECTRICAL ROOM	2
DOOR 31-101B	EXTERIOR	ELECTRICAL ROOM	2
DOOR 102	INTERIOR	STORAGE	2
RAS/WAS PUMP STATION			
DOOR 40-101A	INTERIOR	ELECTRICAL ROOM	2
DOOR 40-103A	INTERIOR	ELECTRICAL ROOM	2
DOOR 40-103B	INTERIOR	ELECTRICAL ROOM	2

REMARKS:
1. Provide Universal Graphic Symbology.
2. Mount adjacent to pull side of door.
3. Mount adjacent to push side of door.

END OF SECTION

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SECTION 10 44 33
FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Portable fire extinguishers.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 05 50 00 - Metal Fabrications.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. National Fire Protection Association (NFPA):
      a. 10, Standard for Portable Fire Extinguishers.
   2. Underwriters Laboratories, Inc. (UL):
      a. 8, Water Based Agent Fire Extinguishers.
      b. 154, Carbon Dioxide Fire Extinguishers.
      c. 299, Dry Chemical Fire Extinguishers.
      d. 626, Water Fire Extinguishers.
      e. 711, Rating and Fire Testing of Fire Extinguishers.
      f. 2129, Halocarbon Clean Agent Fire Extinguishers.

1.3 DEFINITIONS

A. Authority Having Jurisdiction (AHJ): Building official, fire chief, fire marshal or other individual having statutory authority.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Ratings and classification of extinguishers.

B. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver and install filled and charged extinguishers just prior to building occupancy.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Fire extinguishers:

a. Amerex Corporation.
b. Ansul – Tyco Fire Protection Products.
c. Badger Fire Protection.
d. United Technologies - Kidde.
e. Buckeye Fire Equipment.

2. Fire extinguisher signs:
a. Seton.
b. Compliance Signs.
c. Safety Sign.

B. Submit request for substitution in accordance with Specification Section 01 26 00.

2.2 MANUFACTURED UNITS

A. Fire Extinguisher (FEXT):
1. Steel bodied, all metal top (head) and valves.
2. Multi-purpose dry chemical extinguisher with hose and nozzle.
3. Provide one (1) listed 10 LB. 4A-60BC extinguisher for each fire extinguisher location (FEXT) indicated on Drawings.
4. Finish: Red with epoxy finish coat.

B. Wall Brackets:
1. Bracket type to fit specified extinguisher.
2. Furnish bracket for each extinguisher not in cabinet.
3. Bracket to be finished in red or black enamel.

C. Fire Extinguisher Signage:
1. Single faced: SETON #21999.
2. Double faced: SETON #22001.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions and NFPA 10.
1. Install units with extinguisher top not over 48 IN above floor.
2. Install wall brackets to concrete or masonry substrate with self-tapping concrete anchors.
a. See Specification Section 05 50 00.

B. Fire extinguisher locations shown on Drawings are approximate locations.
1. Verify all extinguisher mounting locations with the AHJ.

C. Provide "FIRE EXTINGUISHER" sign for each extinguisher location.
1. Provide single- or double-faced sign to provide optimum visibility for extinguisher location.

END OF SECTION

SECTION 23 05 93
HVAC SYSTEMS - BALANCING AND TESTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Adjusting, balancing, and testing of all heating, ventilating and air conditioning (HVAC) systems, including the following systems:
      a. Air distribution and exhaust systems.
      b. Air moving equipment.
      c. Control systems.

B. Related Sections include but are not necessarily limited to:
   1. Section 23 09 00 - Instrumentation and Control for HVAC Systems.
   2. Section 23 31 00 - HVAC - Ductwork.
   3. Section 23 80 00 - HVAC - Equipment.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Associated Air Balance Council (AABC):
      a. National Standards for Total System Balance.
   2. American Industrial Hygiene Association (AIHA):
      a. Z9.5, Laboratory Ventilation.
   3. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE):
      a. HVAC Applications Handbook, Chapter entitled "Laboratories".
      b. HVAC Systems and Equipment Handbook, Chapter entitled "Testing, Adjusting, and Balancing".
   4. National Environmental Balancing Bureau (NEBB):
      a. Procedural Standards for Testing Adjusting Balancing of Environmental Systems.

B. Qualifications:
   1. Work of this Section to be accomplished by an independent testing and balancing firm certified by one (1) of the following:
      a. Associated Air Balance Council (AABC).
      b. National Environmental Balancing Bureau (NEBB).
      c. Other certification entity approved by Engineer.
   2. The independent firm shall not be the same firm as the firm installing the HVAC equipment, nor under contract to the firm installing the equipment.
   3. The independent testing and balancing firm to have successfully completed at least five (5) projects of similar size and scope in accordance with [AABC or NEBB] requirements and recommendations.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Certifications:
      a. Letter stating the name and qualifications of the firm proposed.
      b. Evidence that relevant subcontractors have been notified of the requirement to coordinate balance and test elements in the work with the testing and balancing firm.
   2. Report forms:
      a. Procedures and forms to be used in calibrating of test instruments, balancing systems, and recording and reporting test data.

B. Informational Submittals:

1. Completed test reports and data forms upon completion of installation, balance and testing of HVAC systems.
    a. Insert recorded information on report forms required by specifications and approved for use on project.
    b. Additional written verification and other related information clearly identifying project, date and specifics of verification.
    c. Utilize report forms similar to those shown in Section V of AABC Standard.
    d. Provide forms typed and signed by the testing and balancing firm.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 PREPARATION

A. Secure approved Shop Drawings of all HVAC equipment.

B. Procedures and Forms:
    1. Submit procedures and forms to be used in calibration of test instruments, balancing systems, and recording and reporting test data.
    2. Obtain approval before beginning balancing and testing.

C. Do not begin balancing and testing until HVAC systems are complete and in full working order.
    1. Place HVAC systems into full operation and continue their operation during each working day of balancing and testing.

D. Provide qualified heating and ventilating Engineer(s) to supervise and perform balancing and testing.

E. Review design Drawings, specifications, approved Shop Drawings and other related items to become thoroughly acquainted with the design of HVAC systems.

F. Check all installed systems against Contract Drawings, Specifications and Shop Drawings to see that system is installed as required.
    1. Report deficiencies to the Engineer.
    2. Report deficiencies to Contractor for remedial action including providing corrective measures required in the function of any part of system to complete balancing.

G. Make necessary adjustments as required to balance the systems.

3.2 FIELD QUALITY CONTROL

A. Balance and Test Air Systems:
    1. Adjust equipment RPM to design requirements.
    2. Report motor full load amperes.
    3. Obtain design CFM at fans.
        a. Make pitot tube traverse of main supply and exhaust ducts within 5%.
    4. Test and record system static pressures, suction and discharge.
    5. Obtain design CFM for recirculated air.
    6. Obtain design CFM outside air.
    7. Test and record entering air temperatures, (DB, heating and cooling).
    8. Test and record leaving air temperatures, (DB, heating and cooling).
    9. Test and record leaving air temperatures, (WB, cooling).
    10. Adjust dampers in supply, exhaust and return air ducts to design CFM.
    11. Test grilles, and registers as follows:
        a. Adjust to comply with design requirements within 10%.
        b. Identify location and area of each.
        c. Adjust face velocity to establish required CFM.
            1) Retest after initial adjustments.

d. Adjust to minimize drafts and to ensure uniform air distribution in all areas.

12. Identify and list size, type and manufacturer of grilles, registers, and HVAC equipment.
    a. Use manufacturer's ratings on equipment to make required calculations.
13. Adjust and assure that the operation of automatically operated dampers are as specified.
    a. Check and calibrate controls.
14. Prepare and submit reports.

END OF SECTION

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SECTION 23 09 00
INSTRUMENTATION AND CONTROL FOR HVAC SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Instrumentation and control for HVAC systems.
2. Control wiring.
3. Panels and accessories.
4. Miscellaneous.

B. Related Specification Sections include but are not necessarily limited to:
1. Section 10 14 00 -Identification Devices.
2. Section 01 61 03 - Equipment – Basic Requirements.
3. Section 23 31 00 - HVAC - Ductwork.
4. Section 23 80 00 - HVAC - Equipment.
5. Section 26 05 19 - Wire and Cable – 600 Volts and Below.
6. Section 26 05 33 - Raceways and Boxes.
7. Section 40 61 13 - Process Control Systems General Requirements.

1.2 QUALITY ASSURANCE

A. See Specification Section 01 61 03.

B. Referenced Standards:
1. ASTM International (ASTM):
   a. D1693, Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics.
2. The International Society of Automation (ISA):
   a. S5.1, Instrumentation Symbols and Identification.
   b. S5.4, Standard Instrument Loop Diagrams.
3. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
4. National Fire Protection Association (NFPA):
   a. 70, National Electrical Code (NEC).
5. Underwriters Laboratories, Inc. (UL).

C. Miscellaneous:
1. Controls to be in compliance with Section 26 05 00 for NEMA and NFPA 70 enclosure class requirements unless noted or specified otherwise.
2. Unless specifically noted otherwise, components of systems shall be industrial duty suitable for moist, corrosive environments.

1.3 SYSTEM DESCRIPTION

A. Work shall be provided as an integrated operating system.

B. Provide a complete system of automatic temperature control, thermostats, relays, valves, damper operators and other associated controls and appurtenances required to maintain minimum conditions described in detail herein and on Drawings, together with thermometers, gages and other accessory equipment.
1. Assemble control system with complete system of wiring and air piping to fulfill requirements of the Contract Documents.

C. Install system using competent mechanics under direct supervision of control manufacturer.

D. Controls, as set out in "Sequence of Operation," are designed to illustrate operating functions only.

1. Control sequence shall be considered supplementary to "Sequence of Operation".
2. These minimum specified items, and any additional controls, not indicated but required to meet performance as outlined in the Contract Documents, shall be furnished and installed at no additional cost to Owner to make a complete system.

E. Sequence of Operation - General:
1. Sequence of operation indicated illustrates basic operating functions only.
2. Review Drawings and submit complete installation data, including minor details, to provide proper operation in his proposal.
3. Where an item differs from specifications, control manufacturer shall submit manufacturer's recommendations subject to Engineer's approval.

1.4 SUBMITTALS

A. Shop Drawings:
1. Wiring diagrams showing point to point termination with auxiliary interlocks for each item in each control loop.
2. Information on equipment proposed for use including corrosion protection.
3. Instrument loop diagrams and word description of loop function for each individual unit controlled including auxiliary interlocks in full compliance with ISA S5.4.
a. Show components in system and ensure diagrams are in full compliance with ISA S5.1 (Instrumentation Symbols and Identification) and other related ISA standards.

B. Quality Control Submittals:
1. Secure from equipment manufacturers, detailed and complete control and power wiring diagrams, word descriptions of controls provided as part of the HVAC equipment or equipment interfaced or interlocked thereto, and submit with equipment manufacturer's submittals.
a. Provide the above information to control manufacturer.

C. Contract Closeout Information:
1. Operation and Maintenance Data:
a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

1.5 SITE CONDITIONS

A. Unless stated otherwise, the environment and air streams will include varying concentrations of the following chemical components:
1. H_2SO_4 - Sulfuric acid.
2. NH_3 - Ammonia.
3. Cl_2 - Chlorine.
4. H_2S - Hydrogen sulfide.
5. HCl - Hydrochloric acid.
6. Condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Manufacturer's catalog numbers hereinafter are for reference to type, style, dimension, related items and to establish a standard of quality.
a. Reference to a manufacturer's number hereinafter does not imply full compliance to these Specifications.
2. Instrumentation and control systems:
a. Honeywell.

b. Johnson Control Co.
c. Approved equal.

2.2 EQUIPMENT

A. Dampers:
1. Refer to Specification Section 23 31 00.

B. Damper Operators:
1. Provide operators of proper size and number to secure true throttling or two-position action as required.
2. Furnish damper operators for installation inside ductwork and attached to frame of damper, or installed outside ductwork and connected to extended shaft as required.
3. Provide operators for outside air, spring-loaded with sufficient power to assure tight closing of dampers on fan shutdown or in the fail-safe position indicated by "Sequence of Controls."
4. Electric operators:
   a. Provide operators:
      1) Fully immersed in oil gear train.
      2) Enclosed in closed cast aluminum housing.
   b. As an alternate to 5.a.: Provide operators in NEMA 4X enclosure, Belimo ZS-300.
   c. Provide damper operators with integral spring return motor springs to make controls fail safe in position specified under "Sequence of Controls."
   d. Provide fully modulating operators from proportional electric controllers.
   e. Provide end switches or proportioning controllers permitting simultaneous operation or interlocking with other equipment.
   f. Provide separate electrical circuits for damper operators with no more than four operators on a circuit.
5. Coordinate with dampers provided:
   a. Provide damper operators that are rated for the required torque.
   b. If single damper operator cannot meet torque requirement, provide sectional dampers to match operator torque.
6. Ensure coordination to provide for the installation of tight closing dampers low leakage type (6 cfm per square foot at 4 inches WC pressure across damper) with compatible dampers, damper operators and related controls.

C. Electric Control Instruments:
1. Provide stainless steel sensing elements type thermostats with liquid filled, compensated thermal systems so that equally spaced dial graduations are possible over entire range.
   a. Make thermal systems field detachable with averaging or plain bulbs as installation conditions dictate.
   b. Provide sensing elements minimum of 60 inches in length and suitable for operation from -30 to 300 degrees F.
   c. Provide reverse acting on-off type thermostats for controlling ventilating fans.
   d. Provide multiple stage thermostats where designated in Paragraph "Sequence of Operation".
2. Provide transformers for supplying current to control equipment operating at less than 120 V and where required by manufacturer's automatic control system design capable of supplying 125% of energy requirements of equipment connected for not less than 1 hour.
   a. Enclose transformers in UL listed cabinets with conduit connections.
   b. Provide fused disconnect switches on both primary and secondary sides.
3. Provide low limit electric thermostats of two-position type with 20 feet bulb and manual reset.
   a. Shall be capable of opening thermostat circuit if any 1 foot section of bulb is subjected to a temperature below thermostat setting.
   b. Each thermostat shall have two circuits, one to shut down fan, another for alarm.
   c. Install all freeze-stats to override starter circuits regardless of position.
   d. For corrosive environments provide thermostats with stainless steel sensing elements.

1) Ensure element is installed to sense coldest point should stratification occur.

4. Provide each thermostat with an accurate red-reading thermometer sensing temperature outside of enclosure.
5. Label thermostat with identification tag of equipment controlled using phenolic nameplate in accordance with Specification Section 10 14 00.

D. Industrial Controllers:
   1. Provide control instruments, devices, and incidentals of industrial process control quality capable of producing the outlined performances.
   2. Controller shall be capable of receiving both pneumatic and analog electric systems.
   3. The pneumatic controller shall have three control mode capabilities of proportional, automatic reset, and rate (derivative) within following minimum performance and application criteria:
      a. Proportional band: 1 to 40%.
      b. Reset rate: 1 to 20 repeats per minute.
      c. Rate (derivative): 0.1 to 15 minutes.
      d. Hysteresis: Less than 0.25% of span.
      e. Tracking accuracy: Within 0.5% of span.
      f. Repeatability: Within 0.1% of span.
      g. Response level: Less than 0.01% of span.
   4. Electronic (and electric) controller shall have three control mode capabilities of proportional rate (time), and dead band within following minimum performance and application criteria:
      a. Setpoint adjustment: 0 to 110% of span.
      b. Repeatability: Setpoint repeats within +0.1% of span.
      c. Dead band: 1% of span, standard.
      d. Rate: 5 to 30 seconds adjustable.
      e. Response level: 50 milliseconds for a step change of 1% of span beyond setpoints.
      f. Output: SPDT relay contacts, 5 amps at 117 VAC noninductive.
   5. Controller shall be capable of remote setpoint adjustment, permanently mounted in air flow control panel unless otherwise indicated.
   6. Provide each controller with instruments (pressure gages, milliampmeters, voltmeters, etc.) to indicate magnitude of output signal in both medium of signal (psig, mA, volt DC, etc.) and percentage of full output signal.
   7. Recording controllers:
      a. Where recording controllers are required by "Sequence of Controls," they shall be 10 IN chart, 24 hour or 30-day charts (field selection), with one, two, or three pens as listed in control sequence.
      b. Pens shall have capillary ink supply and cartridge type ink supply.
      c. Recorders shall operate on 110 V power supply.
      d. Optional 4 inches strip chart recorders may be used with the strip traveling vertically.

E. Static Pressure Gages:
   1. Install gages on control panel for each system.
      a. One gage shall serve each filter while others shall serve as a check on system.
      b. Gages shall be Magnahelic by Dwyer 2000 ASF, flush mounted with signal flag for filter gage.
      c. Install static pressure tips as scheduled under control panel indication points.
      d. Static pressure ranges:
         1) Filter (cartridge): 0 to 2.0 inches WC.
         2) Air-handling systems: 0 to 10.0 inches WC (one per air-handling unit).

F. Local Temperature Control Panel:
   1. Panel shall be floor or wall-mounted and be sized to accommodate electrical switches, protective devices (except electrical switches and devices furnished as an integral part of air handling unit).

2. Mount indicating controllers or receiver-controllers, three-way air valves, relay, EP and PE switches, switching relays, ammeters and other accessory items on local sub-panels set in vicinity of equipment to be served.
    a. Where two similar items of equipment, such as pumps, are installed adjacent to each other a single panel may be used to contain all instruments.
3. Fully compensated capillaries connected to instruments shall be of sufficient length to allow them to be run between equipment and placed in such a position so that they will not obstruct service of equipment or become damaged.
4. Air pressure gages for pneumatic controls of at least 2 inches diameter shall be provided for indication of transmitter signals and output signal of all controllers, relays, EP switches, outdoor air dampers, PE switches, control valves larger than 4 inches and other points throughout system.
    a. Provide visual indication for operating purposes.
    b. Temperature and pressure indicating gages where scheduled for panel door mounting shall be not less than 2-1/2 inches diameter, flush mounted with accuracy of +1 degrees F.
    c. Where a temperature indication gage is used, a pressure gage is not required for same signal.
    d. Transmitter signal and controller output gages shall be in-line mounted or mounted on controllers if provided with tapped connections.
    e. One or more permanently mounted gages with flexible hose terminating in a hypodermic needle may be used for checking other parts of control signals; however, signal connections may not be used as a substitute for in-line mounted gages.
    f. All gages and instruments shall be suitably tagged with their function.
5. Miniature milliamp meters for electronic temperature transmission may be used.
6. Manufacture panels in one of the following manners:
    a. NEMA electrical panel boxes with windows.
    b. Install gages flush mounted in swing out panel behind window with instruments and other control items located inside enclosures behind panel.
        1) Refer to Paragraph "Corrosion Protection."
7. Mount all relays, , switches, etc., on rear inside of enclosure.
    a. Tag each instrument corresponding to symbols used on control diagrams.
8. Temperatures, pressures, equipment operation, and related items shall be continuously indicated on panels.
9. Points to be monitored are scheduled under another paragraph of this Specification Section.

2.3 FABRICATION

A. Corrosion Protection:
1. Protect metal parts of controls, instrumentation and related items from corrosive atmosphere by either protective coatings or select materials.
    a. Aluminum and stainless steel require no further protection.
2. Provide NEMA 4X fiberglass control enclosures with tempered glass windows and vapor tight gaskets, illustrated in Hoffman Bulletin A-50, for protection of controls from corrosive environment.
    a. Install control instruments inside enclosure and extend remote stainless steel sensing elements through enclosure wall.
    b. Provide vaportight seals for penetrations of enclosure.
3. Provide in each enclosure industrial corrosion inhibitors, Hoffman Corrosion Inhibitors, as illustrated in Hoffman's technical Bulletin HCI.
4. Protect metal accessory items such as mounting brackets and fasteners not stainless steel, fiberglass or aluminum by epoxy or phenolic coatings.
5. Protect electric motor operator with corrosion inhibitors inside enclosure.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with requirements of Section 26 05 19.

B. Identification: See Section 10 14 00.

C. Connect control devices to perform functions indicated and perform in required sequence.

D. Use remote element temperature transmitters for points of temperature transmitters for points of temperature measurement occurring in air ducts or shafts, or in mechanical piping system.

E. Use remote element pressure transmitters of panel-mounted pressure gages.

F. Where continuous indication of space temperature is on local control panels, install a thermostat and a temperature transmitter side by side.
   1. Pipe continuous indication signal to a receiver on panel.
   2. A resistance element or thermocouple signal may be used with continuous indicating meter, calibrated in degrees Fahrenheit.

G. In general, locate thermostats for room control immediately inside door, above light switch, unless shown otherwise.
   1. Where light switch is in an entryway to room, locate thermostat on wall within room so it is capable of sensing true space conditions.
   2. Prior to installation, coordinate thermostat location with Engineer.

H. Mount local control panels adjacent to equipment served.

I. Where a temperature indicating gage is used at the panel, a pressure gage indicating transmitter signal is not required.

J. Provide appropriate type continuous reading indicator for each controller, transmitter and transducer.
   1. Mount in-line or tapped on controller.
   2. Mount at local control panel.

K. Gages with flexible hose terminating with hypodermic needle may be used for checking control system.
   1. Do not substitute for in-line gages.

L. Locate panels so visual observation and adjustment can be accomplished from floor level.

END OF SECTION

SECTION 23 31 00
HVAC - DUCTWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. HVAC ductwork and accessories.

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 08 90 00 - Louvers and Vents.
   2. Section 01 61 03 - Equipment – Basic Requirements.
   3. Section 23 09 00 - Instrumentation and Control for HVAC Systems.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE):
      a. 52, Method of Testing Air Conditioning Devices Used in General Ventilation for Removing Particulate Matter.
   2. National Fire Protection Association (NFPA).
   3. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
      a. Ducted Electric Heat Guide for Air Handling Systems.
      b. HVAC Duct Construction Standards - Metal and Flexible.
   4. Underwriters Laboratory, Inc. (UL):
      a. 555, Standard for Safety Fire Damper and Ceiling Fire Damper.
      b. 555S, Standard for Safety Leakage Rated Dampers for Use in Smoke Control Systems.
      c. Building Materials Directory.

B. Qualifications:
   1. Fabricator: Firms regularly engaged in the manufacture of the specific product, of type, size required, whose products have been in use in similar service for not less than three years.
   2. Installers: Firm with at least five years installation experience on products similar to that required for this Project.

1.3 DEFINITIONS

A. Installer or Applicator:
   1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
   2. Installer and applicator are synonymous.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 61 03.
   2. Scaled ductwork drawings (1/4 inches equals 1 foot) showing duct and accessory layout and support.

B. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

C. Miscellaneous Submittal:
   1. Documentation of qualifications for fabricators and installers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Transverse Joints (Factory Fabricated Aluminum):
      a. Ductmate Industries, Inc.
      b. Approved equal.
   2. Turning vanes:
      a. Ductmate Industries, Inc.
      b. Duro Dyne.
      c. SEMCO Incorporated.
      d. Ward Industries, Inc.
      e. Approved equal.
   3. Flexible Duct Connections:
      a. Duro Dyne.
      b. Vent Fabrics.
      c. Approved equal.
   4. Access Doors in Ductwork:
      a. Vent Fabrics.
      b. American Warming.
      c. Approved equal.
   5. Automatic Gravity Backdraft dampers:
      a. Ruskin.
      b. Air Balance.
      c. American Warming.
      d. Approved equal.
   6. Grilles andRregisters:
      a. Titus.
      b. Price.
      c. Krueger.
      d. Approved equal.
   7. Manual (Volume) Dampers:
      a. Ruskin.
      b. Air Balance.
      c. American Warming.
      d. Approved equal.
   8. Duct Sealers:
      a. Durkee-Atwood.
      b. Unitec McGill.
      c. Benjamin Foster.
      d. Design Polymerics.
      e. Approved equal.
   9. Temperature Control and Automatic Dampers:
      a. Tamco.
      b. Ruskin.
      c. Arrow.
      d. Approved equal.

2.2 COMPONENTS

A. Duct and Fittings (Metallic):
   1. Materials:
      a. 3003 H-14 aluminum alloy:
         1) Comply with ASTM B209.
   2. Fabrication (aluminum):

a. Minimum sheet material thickness:
   1) Ducts with largest side or diameter to 30 inches: 0.05 inches thick.
   2) Ducts with largest side or diameter greater than 30 inches: 0.08 inches thick.
b. Utilize SMACNA HVAC Duct Construction Standards for minimum of 2 inches water gage static pressure for the minimum sheet material thickness specified herein.
   1) Heavier gage sheet material may be used with associated reinforcement as an alternate to minimum thickness specified.
   2) Lighter gage sheet material with associated reinforcement shall not be used as an alternate to minimum thickness specified.
c. Longitudinal seams:
   1) 0.050 material:
      a) Pittsburgh seam.
      b) Continuously welded.
   2) 0.080 material: Continuously welded.
d. Continuously weld seams on factory assembled units.
e. Transverse joints (Alternate A):
   1) SMACNA T-22 companion flange.
   2) Gasketed.
   3) Rigidity class:
      a) Ducts with largest side or diameter to 30 inches: SMACNA Class D (1-1/2 x 1-1/2 x 1/8 inches angles).
      b) Ducts with largest side or diameter greater than 30 to 54 inches: SMACNA Class H (2-1/2 x 2-1/2 x 3/16 inches angles).
f. Transverse joints (Alternate B):
   1) Materials and fabrication:
      a) Angles: Aluminum.
         (1) Ductmate 35.
      b) Corners: Aluminum.
         (1) Ductmate DC 35.
      c) Snap cleats: Aluminized or stainless steel.
      d) Gaskets: Closed cell neoprene.
      e) Bolts: Stainless steel.
      f) Sheet metal screws: Self-drilling stainless steel with unthreaded section under head.
   2) Fabrication:
      a) Rigidity class: SMACNA Class H.
      b) 3/8 inches diameter x 1 inch bolts.

B. Supports and Hangers:
   1. Materials (for aluminum duct):
      a. Support angles: Aluminum or stainless steel, minimum 1-1/2 by 1-1/2 by 1/4 angle.
      b. Hanger rods: Stainless steel.
      c. Anchors: Stainless steel wedge type.
   2. Fabrication: Trapeze type units.
   3. Strap hangers are not allowed.

C. Turning Vanes:
   1. Materials: Same as duct.
   2. Fabrication:
      a. Fabricate double vane units.
      b. Pressure drop through elbows: Maximum 20% of velocity pressure.

D. Flexible Connections:
   1. Materials: Durolon, double coated closely woven glass fabric.
   2. Fabrication: Withstand 10 inches water column, positive and negative pressure.

E. Access Doors:

1. Materials:
    a. Inner panel, out panel and frame: Same as duct.
    b. Gaskets: Closed cell neoprene.
    c. Insulation: 1 pound density fiberglass.
    d. Hinges: Stainless steel.
    e. Latches:
        1) Aluminum-zinc alloy.
        2) Outside lever handle.
        3) Adjustable spacer.
        4) Beveled inside flange.
        5) Studs:
            a) Minimum 3/8 inches diameter stud for doors up to 24 inches wide x 48 inches high.
            b) Minimum 1/2 inches diameter stud for doors larger than 24 x 48 inches.
2. Fabrication:
    a. Provide four-side continuous gaskets.
    b. Utilize continuous piano hinges.
    c. Latches required:
        1) 12 inches in any direction: One.
        2) Up to 18 x 18 inches: Two.
        3) Up to 24 x 48 inches: Two with inside handles.
        4) Up to 24 x 72 inches: Three with inside handles.
        5) Minimum door size: 12 x 12 inches.

F. Automatic Gravity Backdraft Dampers:
1. Material:
    a. 6063 T5 aluminum.
    b. Blade edge seals: Extruded vinyl.
2. Fabrication:
    a. Frame thickness: 16 gage minimum.
    b. Blade thickness: 18 gage minimum.
    c. Linkage: 1/2 inches tie bars.
    d. Bearings: Synthetic.

G. Air Grille and Register Assembly:
1. Materials:
    a. Assembly: Extruded aluminum.
    b. Gaskets: Sponge rubber.
2. Fabrication:
    a. Supply registers: Two sets individually adjustable louvers.
    b. Exhaust and return registers: 45 degrees deflection front blades.
    c. Dampers: Key-operated opposed blade.
    d. Screws, duct collars, and transitions as required.
    e. Finish:
        1) Manufacturer's standard factory applied finish.
        2) Color: White.

H. Temperature Control, Automatic and Manually (Volume) Operated Dampers:
1. Material:
    a. Body: 6063 T5 aluminum.
    b. Seal blade edge: Extruded vinyl.
2. Fabrication:
    a. Frame thickness: 0.125 inches minimum.
    b. Provide flanged connections.
    c. Blades:
        1) Two-position damper: Parallel blade.
        2) Mixing and volume damper: Opposed blade.

3) Airfoil shape.
4) Maximum 6 inches width.

d. Linkage: Concealed in frame.
e. Axles: 1/2 inches plated steel hex.
f. Bearings: Molded synthetic.
g. Seals:
1) Jamb: Flexible compression type.
h. Control shaft: Removable, 1/2 inches diameter.
i. Air leakage (4 feet SQ damper) at 4 inches WG pressure: 99 cfm maximum.
j. Motors for motor operated damper: See Specification Section 23 09 00.
k. Provide outboard support for operator linkage where damper motor is to be installed outside of duct.
l. Provide stainless steel locking quadrants for manual (volume) dampers.
m. Provide fold out operator mounting bracket where damper motor is to be installed on face of damper or inside duct.
n. Finish: Corrosion resistant coating similar to the fans and air handling units. Refer to 23 34 00 and 23 80 00 for additional information.

I. Duct sealer:
1. NFPA rating of "Non-Combustible".
2. Flame spread rating: 25 or lower, in dry condition.
3. Smoke developed rating: 50 or lower, in dry condition.
4. Resistant to water and water vapors.
5. Comply with UL 181.
6. Pressure rupture rating: 16 inches WG, minimum.

J. Louvers: See Specification Section 08 90 00.

2.3 MAINTENANCE MATERIALS

A. Extra Materials:
1. Furnish Owner with the following extra materials:
a. 2 complete filter media change(s) for each filter unit.
b. Filter media used during construction is in addition to this requirement.

PART 3 - EXECUTION

3.1 INSTALLATION

A. See Specification Section 01 61 03.

B. Metal Ductwork:
1. Install with longitudinal seams sealed for zero leakage.
a. For welded seams, submit sample for approval by Engineer.
2. Install gaskets at each transverse joint and fasten sections together with bolts.
a. Tighten for zero leakage.
3. Install supports and hangers with anchors in accordance with SMACNA HVAC Duct Construction Standards.
4. Install turning vanes in square elbows:
a. Unsupported vane length not to exceed 48 inches.
b. Position vanes at proper angle to meet specified pressure drop.
5. Install flexible connections at fans, air handling units, and where shown on plans:
a. Locate as close as possible to fan or air handling unit connection.
b. Allow 1 inch of slack to prevent vibration transmission.
6. Install access doors where indicated on Drawings.

C. Dampers:
1. Install where indicated on Drawings of sizes shown.
2. Provide manual volume dampers in ductwork branches to each grille or register.

D. Air Grille and Register Assemblies:
   1. Install where shown on Drawings of size and capacities scheduled on Drawings.

END OF SECTION

SECTION 23 34 00
HVAC - FANS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Heating, ventilating, and cooling equipment.

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 01 61 03 - Equipment – Basic Requirements.
   2. Section 23 05 93 - HVAC Systems - Balancing and Testing.
   3. Section 23 09 00 - Instrumentation and Control for HVAC Systems.
   4. Section 23 31 00 - HVAC - Ductwork.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Air Movement and Control Association (AMCA).
      a. AMCA Publication 203 "Field Performance Measurement of Fan Systems".
      b. ANSI/AMCA 210 "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating".
   2. Air Conditioning and Refrigeration Institute (ARI).
   3. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE):
      a. HVAC Applications Handbook, Chapter entitled "Sound and Vibration Control."
      b. 20, Methods of Testing for Rating Remote Mechanical-Draft Air-Cooled Refrigerant Condensers.
      c. 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
   4. Canadian Standards Association (CSA).
   5. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
   6. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).
   7. National Roofing Contractors Association (NRCA).
   8. Underwriters Laboratories, Inc. (UL):
      a. 507, Standard for Electric Fans.

B. Miscellaneous:
   1. Gage thickness specified herein shall be manufacturer's standard gage for steel and Brown and Sharpe gage for non-ferrous metals.
   2. Corrosion protection of equipment to be as specified herein.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Wiring diagrams.
      d. Control diagrams.
      e. Manufacturer's catalog cuts and technical data.
      f. Corrosion-protection information.
      g. Fan curves.
      h. Sound data.
      i. Vibration isolation.

j. Performance data on all equipment.

2. Certifications:
   a. Provide certification of thickness of corrosion-protection coating.
   b. Fan systems have been tested in accordance with AMCA Standard 210 or 260, and are licensed to bear the AMCA Certified Ratings Seal.

B. Factory Performance test for any fan having a flow rate greater than 1,000 cfm and/or a total static pressure rating equal to or greater than 1.5 inches WC.
   1. Pursuant to AMCA Publication 203 or 210 with no plus tolerances on Power and no minus tolerances on flow or pressure.

C. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

D. Informational Submittals:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Corrosion-protective coatings:
      a. Heresite and Chemical Co.; "Heresite."
      b. Aero-Marine Engineering, Inc.
      c. Approved equal.
   2. In-line Centrifugal Fans:
      a. Loren Cook.
      b. Greenheck.
      c. Twin City Fan & Blowers.
      d. Acme Fan.
      e. Approved equal.
   3. Wall-mounted Propeller-type Exhaust Fans:
      a. Loren Cook.
      b. Greenheck.
      c. Twin City Fan & Blowers.
      d. Acme Fan.
      e. Approved equal.
   4. Roof-mounted Propeller-type Supply Air Fans:
      a. Loren Cook.
      b. Greenheck.
      c. Twin City Fan & Blowers.
      d. Acme Fan.
      e. Approved equal.

2.2 GENERAL

A. All Manufactured Units:
   1. Comply with Specification Section 01 61 03.
   2. Factory wired and assembled.
   3. Use fasteners made of same material as unit.
   4. Fabricate motor assemblies and unit housings with vibration isolation assemblies:
      a. Type: As per ASHRAE HVAC Applications Handbook.

B. Allmanufactured units shall be constructed with corrosion-resistant materials or have corrosion-resistant coating.
   1. Type:
      a. Corrosion-resistant materials:
         1) Aluminum.
         2) Stainless steel.
         3) FRP.
      b. Corrosion-resistant coating:
         1) Phenolic-based coating.
         2) 3 mil minimum dry thickness, air-dried coating, for surfaces exposed to temperatures less than 150 degrees F.
         3) 5 mil baked-on coating for heat transfer surfaces and surfaces exposed to temperatures greater than 150 degrees F.
         4) Factory applied.
         5) Provide factory certification of application.

2.3 MANUFACTURED UNITS

A. In-Line Centrifugal Fans:
   1. AMCA certified.
   2. Non-overloading horsepower capability.
   3. Materials:
      a. Wheel, impeller hub and blades: Aluminum or stainless steel.
      b. Housing, innertube and belt well: Aluminum or stainless steel.
      c. Inlet cone: Aluminum or stainless steel.
      d. Driver shaft: Solid stainless steel.
   4. Airfoil design blades.
      a. All welded construction.
   5. All welded housing, innertube and belt well.
   6. Innertube construction:
      a. Isolates bearings and drive from airstream.
      b. Removable end covers.
   7. Motor:
      a. See Specification Section 01 61 03.
      b. Electronically commutated (EC) motor with internally mounted potentiometer speed controller.
      c. Rated for continuous duty.
      d. Coordinate exact location of motor with field conditions to ensure required access clearances are maintained.
      e. Direct Drive :
         1) Keyed hub type.
      f. Adjustable motor base.
   8. Flanged inlet and outlet.
   9. Accessories:
      a. Vibration isolators recommended by manufacturer.
      b. Disconnect.
      c. Type B spark-resistant construction.
         1) .
   10. Size and capacity as scheduled on Drawings.

B. Wall-Mounted Propeller-Type Exhaust Fans:
   1. AMCA certified.
   2. Industrial quality.
   3. Materials:
      a. Propeller: Cast aluminum or aluminum.
      b. Venturi: Spun aluminum.
      c. Panel and supports: Aluminum or stainless steel.

d. Drive shaft: Solid stainless steel.
e. Sheaves: Cast iron.

4. Propellers:
   a. Statically and dynamically balanced.
   b. Airfoil design.
   c. Minimum four blades.
5. Welded reinforced motor base plate.
6. Adjustable motor base.
7. Motor:
   a. See Specification Section 01 61 03.
   b. EC motor with internally mounted potentiometer speed controller.
   c. Rated for continuous duty.
   d. Direct Drive Units:
      1) Keyed hub type.
8. Accessories:
   a. Fan and motor wire guard.
   b. Heavy-duty automatic gravity backdraft damper.
   c. Weather hood and wall collar.
   d. Insect screen.
   e. Vibration isolators recommended by manufacturer.
   f. Disconnect.
   g. Type B spark-resistant construction.
9. Size and capacity as scheduled on Drawings.

C. Roof-Mounted Propeller-Type Supply Air Fans:
1. AMCA certified.
2. Materials:
   a. Propeller: Cast aluminum or aluminum.
   b. Hood and fan housing: Aluminum.
   c. Curb cap: Aluminum.
   d. Orifice: Aluminum.
3. Propeller:
   a. Statically and dynamically balanced.
   b. Airfoil design blades.
4. Continuously welded construction.
5. Hood:
   a. Hinged access.
   b. Equipped with internal insect screen.
6. Motor: See Specification Section 01 61 03.
   a. Electronically commutated (EC) motor with internally mounted potentiometer speed controller.
   b. Rated for continuous duty.
   c. Direct Drive Units:
      1) Keyed hub type.
   d. Adjustable motor base.
7. Accessories:
   a. 24" insulated roof curb.
   b.
   c. Heavy-duty automatic gravity backdraft damper.
   d. Vibration isolators recommended by manufacturer.
   e. Disconnect.
8. Size and capacity as scheduled on Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with Specification Section 01 61 03.

B. Do not operate fans for any purpose until ductwork is clean, associated filters are in place, and fan has been test run under observation.

3.2 FIELD QUALITY CONTROL

A. Comply with Specification Section 23 05 93.

END OF SECTION

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SECTION 23 80 00
HVAC - EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Heating, ventilating, and cooling equipment.

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 01 61 03 – Equipment – Basic Requirements.
   2. Section 23 05 93 - HVAC Systems - Balancing and Testing.
   3. Section 23 09 00 - Instrumentation and Control for HVAC Systems.
   4. Section 23 31 00 - HVAC - Ductwork.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Air Movement and Control Association (AMCA).
   2. Air Conditioning and Refrigeration Institute (ARI).
   3. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE):
      a. HVAC Applications Handbook, Chapter entitled "Sound and Vibration Control."
      b. 20, Methods of Testing for Rating Remote Mechanical-Draft Air-Cooled Refrigerant Condensers.
      c. 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
   4. Canadian Standards Association (CSA).
   5. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
   6. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).
   7. National Roofing Contractors Association (NRCA).
   8. Underwriters Laboratories, Inc. (UL):
      a. 507, Standard for Electric Fans.

B. Miscellaneous:
   1. Gage thickness specified herein shall be manufacturer's standard gage for steel and Brown and Sharpe gage for non-ferrous metals.
   2. Corrosion protection of equipment to be as specified herein and on the plans.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Fabrication and/or layout drawings.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Wiring diagrams.
      d. Control diagrams.
      e. Manufacturer's catalog cuts and technical data.
      f. Corrosion-protection information.
      g. Fan curves.
      h. Sound data.
      i. Vibration isolation.
      j. Control description.
      k. Performance data on all equipment.

3. Certifications:
   a. Provide certification of thickness of corrosion-protection coating.

B. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

C. Informational Submittals:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Corrosion Protective Coatings:
      a. Heresite and Chemical Co.; "Heresite."
      b. Aero-Marine Engineering, Inc.
      c. Approved equal.
   2. Unit Heaters – Electric (Washdown Type):
      a. Reznor
      b. Brasch.
      c. Chromalox.
      d. Approved equal.
   3. Packaged Makeup Air Handling Units:
      a. Daikin Applied.
      b. Carrier.
      c. Johnson Controls.
      d. Trane.
      e. Approved equal.
   4. Packaged Air Handling Units:
      a. Daikin Applied.
      b. Carrier.
      c. Johnson Controls.
      d. Trane.
      e. Approved equal.
   5. Positive Pressurization Units:
      a. Purafil.
      b. American Air Filter.
      c. Approved equal.

2.2 GENERAL

A. All Manufactured Units:
   1. Comply with Specification Section 01 61 03.
   2. Factory wired and assembled.
   3. Use fasteners made of same material as unit.
   4. Fabricate motor assemblies and unit housings with vibration isolation assemblies:
      a. Type: As per ASHRAE HVAC Applications Handbook.

B. Allmanufactured units shall be constructed with corrosion-resistant materials or have corrosion-resistant coating.

1. Type:
    a. Corrosion-resistant materials:
        1) Aluminum.
        2) Stainless steel.
        3) FRP.
    b. Corrosion-resistant coating:
        1) Phenolic-based coating:
            a) 3 mil minimum dry thickness, air-dried coating, for surfaces exposed to temperatures less than 150 degrees F.
            b) 5 mil baked-on coating for heat transfer surfaces and surfaces exposed to temperatures greater than 150 degrees F.
            c) Factory applied.
            d) Provide factory certification of application.

2.3 MANUFACTURED UNITS

A. Equipment Coils:
    1. Cooling coils - direct expansion:
        a. ARI certified.
        b. Material:
            1) Aluminum.
        c. Fin spacing: Minimum 80 fins per foot.
        d. Minimum standard operating limit: 250 psi.
        e. Size and capacity as scheduled.
    2. Heating coil - electric:
        a. ARI certified.
        b. Built-in thermal protection.
        c. Airflow switch.
        d. Built-in circuit fusing.
        e. Control voltage transformer.
        f. Terminal block.
        g. Magnetic contactor.
        h. Fused disconnect switch.
        i. Silicon controlled rectifier (SCR) controller.
        j. Single point electrical connection.
        k. Size and capacity as scheduled on Drawings.

B. Unit Heater – Electric (Washdown Type):
    1. UL listed, corrosion-resistant washable.
    2. Material:
        a. Fan: Non-sparking aluminum.
        b. Heater case: Stainless steel.
        c. Heating Monel fintube.
        d. Junction box: NEMA 4X.
    3. Fan motor:
        a. See Specification Section 01 61 03.
        b. Built-in overload protection.
    4. Adjustable louvered outlet grille.
    5. Rear grille.
    6. Built-in over temperature protection.
    7. Accessories:
        a. Mounting bracket: Stainless steel.
        b. 24V control circuit with transformer and contactor.
        c. Integral disconnect switch.
        d. NEMA 4X electrical enclosure.
        e. High temperature limit control with automatic reset.

f. Watertight power on indicator.
g. Unit mounted watertight thermostat:
1) NEMA 4X.

C. Packaged Makeup Air Handling Units (Applies to MAU-3101, 3102, 4001, and 4002):
1. UL listed.
2. Designed for outdoor application.
3. Unit construction:
a. Fabricate unit with channel posts and panels secured with mechanical fasteners.
1) Seal all panels, access doors, and ship sections with permanently applied bulb-type gasket.
2) Loose shipped gasketing is not allowed.
b. Construct panels and access doors as a 1 inches nominal thick; thermal broke double wall assembly, injected with foam insulation for an R-value of not less than R-7.
1) Construct the outer panel and inner liner of galvanized steel.
c. Module to module assembly:
1) Provide an overlapping, full perimeter, insulated, internal splice joint sealed with bulb type gasketing on both mating modules to minimize on-site labor and meet indoor air quality standards.
d. Entire unit:
1) Provide with full perimeter base rail for structural rigidity and condensate trapping.
2) Overhang the roof curb for positive water runoff and seat on the roof curb gasket to provide positive weather tight seal (Applies to MAU-4001 and 4002 only).
3) Provide lifting lugs on unit base and with forklift slots in unit base.
e. Access doors:
1) Flush mounted to cabinetry, with stainless steel piano-type hinges, latch and full size handle assembly (provide inspection window for fan section).
2) Swing door outward for unit sections under negative pressure (inward for unit sections under positive pressure).
3) Provide a secondary latch to relieve pressure and prevent injury upon access doors limited from swinging inward (such as side access filter sections) on positive pressure sections, shall have.
4) Provide for fan, filter, control panel, and heating coil sections.
f. Construct drain pans from microbial resistant coated galvanized steel or stainless steel with cross break and double sloping pitch to drain connection.
1) Provide drain pans in outside air section.
2) Drain connections that protrude from the base rail are not acceptable.
4. Heating section:
a. Electric heat:
1) Coil: See paragraph(s) in the EQUIPMENT COILS Article.
2) Automatic reset high limit control.
5. Supply fan section:
a. Supply fan:
1) Single-width, single-inlet airfoil centrifugal type.
2) Direct drive.
3) Aluminum construction.
b. Fan motors:
1) See Specification Section 01 61 03.
2) Total enclosed electronically commutated (EC) motor.
3) Thermal overload protection.
4) Phase failure protection to prevent motor from operation in the event of a phase loss.
c. Isolated fan assembly.
6. Return fan section (Applies to MAU-3101 and 3102 only):
a. Return fan:
1) Single-width, single-inlet airfoil centrifugal type.

2) Direct drive.
3) Aluminum construction.

b. Fan motors:
1) See Specification Section 01 61 03.
2) Total enclosed electronically commutated motor.
3) Thermal overload protection.
4) Phase failure protection to prevent motor from operation in the event of a phase loss.

c. Isolated fan assembly.

7. Filter section:
a. 2" MERV 8.

8. Outside air section (Applies to MAU-4001 thru 4004 only):
a. Outside air hoods with moisture eliminator filters to drain water away from entering air stream.
b. Dampers:
1) Outside air dampers.
2) Outside and return air dampers sized to handle 100% of supply airflow.
3) Arranged vertically to encourage mixing of return and outside airstreams.
4) Airfoil type.
5) Fully gasketed and side sealed.
c. Floor sloped for water drainage to drain pan.
a) Construct drain pans from microbial resistant coated galvanized steel or stainless steel with cross break and double sloping pitch to drain connection.
b) Drain connections that protrude from the base rail are not acceptable.
d. Dampers:
1) Sized to handle 100% supply air volume.
2) Arranged vertically to encourage mixing of return and outside airstreams.
3) Airfoil type.
4) Fully gasketed and side seals.
5) Max. leakage rate of 1.5 CFM/SF at 1" differential pressure per AMCA 500.
6) Actuator shall be modulating, spring return type.
e. Floor sloped for water drainage to drain pan.
a) Construct drain pans from microbial resistant coated galvanized steel or stainless steel with cross break and double sloping pitch to drain connection.
b) Drain connections that protrude from the base rail are not acceptable.

9. Economizer section (Applies to MAU-3101 and 3102 only):
a. Outside air and relief air hoods with moisture eliminator filters to drain water away from entering air stream. Hoods located on either side of unit to eliminate mixing.
b. Dampers:
1) Outside, return, and relief air dampers.
2) Outside and return air dampers sized to handle 100% of supply airflow.
3) Arranged vertically to encourage mixing of return and outside airstreams.
4) Airfoil type.
5) Fully gasketed and side sealed.
6) Max. leakage rate of 1.5 CFM/SF at 1" differential pressure per AMCA 500.
7) Actuator shall be modulating, spring return type.
c. Floor sloped for water drainage to drain pan.
a) Construct drain pans from microbial resistant coated galvanized steel or stainless steel with cross break and double sloping pitch to drain connection.
b) Drain connections that protrude from the base rail are not acceptable.
d. Adjustable comparative enthalpy control outside of airstream.

10. Electrical:
a. Factory wired in accordance with NFPA 70 requirements.
b. 115 V control circuit transformer.
c. 115 V receptacle.

d. System service switch.
e. Control circuit fuse.
f. Individually fused fan motors, compressor and condenser fan motor branch circuits.
g. Weatherproof control panel with dead-front cover over main power controls.
h. Disconnect switch.

11. Provide side duct connections as shown on the plans.
12. Provide controls as shown on the plans.
13. Roof curb (Applies to MAU-4001 and 4002 only):
    a. Prefabricated and insulated.
    b. Wood nailer strip.
    c. Gasket for installation between curb and unit.
    d. Nominal 24 inches high.
    e. Coordinate slope with existing conditions prior to ordering.
14. Size and capacity as scheduled on Drawings.

D. Packaged Air Handling Units (Applies to AHU-3101 thru 3104 and AHU-4001 thru 4004):
1. UL listed.
2. Designed for outdoor application.
3. Unit construction:
    a. Fabricate unit with channel posts and panels secured with mechanical fasteners.
        1) Seal all panels, access doors, and ship sections with permanently applied bulb-type gasket.
        2) Loose shipped gasketing is not allowed.
    b. Construct panels and access doors as a 1 inches nominal thick; thermal broke double wall assembly, injected with foam insulation for an R-value of not less than R-7.
        1) Construct the outer panel and inner liner of galvanized steel.
    c. Module to module assembly:
        1) Provide an overlapping, full perimeter, insulated, internal splice joint sealed with bulb type gasketing on both mating modules to minimize on-site labor and meet indoor air quality standards.
    d. Entire unit:
        1) Provide with full perimeter base rail for structural rigidity and condensate trapping.
        2) Overhang the roof curb for positive water runoff and seat on the roof curb gasket to provide positive weather tight seal (Applies to MAU-4001 and 4002 only).
        3) Provide lifting lugs on unit base and with forklift slots in unit base.
    e. Access doors:
        1) Flush mounted to cabinetry, with stainless steel piano-type hinges, latch and full size handle assembly (provide inspection window for fan section).
        2) Swing door outward for unit sections under negative pressure (inward for unit sections under positive pressure).
        3) Provide a secondary latch to relieve pressure and prevent injury upon access doors limited from swinging inward (such as side access filter sections) on positive pressure sections, shall have.
        4) Provide for fan, filter, control panel, and heating coil sections.
    f. Construct drain pans from microbial resistant coated galvanized steel or stainless steel with cross break and double sloping pitch to drain connection.
        1) Provide drain pans in outside air section.
        2) Drain connections that protrude from the base rail are not acceptable.
4. Refrigerant condensing section (heat pump) (Applies to AHU-3101 and 3102)
    a. Compressors:
        1) Inverter or digital scroll type, with five year non-prorated warranty. Instead of inverter or digital scroll, lead circuit shall be provided with APR valve manufactured by Rawal Devices Inc. to provide cooling coil modulation.
        2) Suction and discharge service valves.
        3) Crankcase heater.
        4) Thermal overload protection.

b. Refrigeration circuit:
    1) Sight glass.
    2) Filter dryer.
    3) Manual shut-off valve.
    4) High pressure relief valve.
c. Compressor isolators.
d. Condenser coils:
    1) Nominal 3/8 inches OD seamless copper mechanically bonded to corrugated aluminum fins.
    2) Factory leak tested at 315 psiG under water.
e. Condenser fans:
    1) Direct drive: See Specification Section 01 61 03.
    2) Propeller type.
f. Condenser fan motors:
    1) Heavy duty, inherently protected, non-reversing.
    2) Permanently lubricated bearings.
    3) Integral rain shield.
g. Defrost control: Defrost cycles at a preselected time interval when the outdoor coil is below a preset initiation temperature.
h. Expansion valve: Designed and sized specifically for heat pump service.
i. Reversing valve: Four-way interchange reversing valve, operates on pressure differential between the outdoor unit and indoor unit.

5. Refrigerant condensing section (Applies to AHU-3103 and 3104 and AHU-4001 thru 4004 only):
    a. Compressors:
        1) Inverter or digital scroll type, with five year non-prorated warranty. Instead of inverter or digital scroll, lead circuit shall be provided with APR valve manufactured by Rawal Devices Inc. to provide cooling coil modulation.
        2) Suction and discharge service valves.
        3) Crankcase heater.
        4) Thermal overload protection.
        5) Vibration isolation.
    b. Refrigeration circuit:
        1) Sight glass.
        2) Filter dryer.
        3) Manual shut-off valve.
        4) High pressure relief valve.
        5) Refrigerant bypass valve between suction and discharge lines for low head pressure starting.
    c. Compressor isolators.
    d. Condenser coils:
        1) Nominal 3/8 inches OD seamless copper mechanically bonded to corrugated aluminum fins.
        2) Factory leak tested at 315 psiG under water.
    e. Condenser fans:
        1) Direct drive: See Specification Section 01 61 03.
        2) Propeller-type.
    f. Condenser fan motors:
        1) Heavy duty, inherently protected, non-reversing.
        2) Permanently lubricated bearings.
        3) Integral rain shield.
    g. Provide low ambient run control.
        1) Unit to operate down to 0 degrees F outside ambient.
6. Heat pump coil section (Applies to AHU-3101 and 3102 only):
    a. Direct Expansion heating and cooling:

1) Coil: See paragraph(s) in the EQUIPMENT COILS Article.

7. Cooling coil section (Applies to AHU-3103 and 3104 and AHU-4001 thru 4004 only):
   a. Direct Expansion cooling:
      1) Coil: See paragraph(s) in the EQUIPMENT COILS Article.
8. Heating coil section (Applies to AHU-3101 and 3102 only):
   a. Electric heat:
      1) Coil: See paragraph(s) in the EQUIPMENT COILS Article.
      2) Automatic reset high limit control.
9. Supply fan section:
   a. Supply fan:
      1) Single-width, single-inlet airfoil centrifugal type.
      2) Direct drive.
      3) Aluminum construction.
   b. Fan motors:
      1) See Specification Section 01 61 03.
      2) Total enclosed electronically commutated motor.
      3) Thermal overload protection.
      4) Phase failure protection to prevent motor from operation in the event of a phase loss.
   c. Isolated fan assembly.
10. Exhaust fan section (Applies to AHU-3101 and 3102 only):
   a. Exhaust fan:
      1) Single-width, single-inlet airfoil centrifugal type.
      2) Direct drive.
      3) Aluminum construction.
   b. Fan motors:
      1) See Specification Section 01 61 03.
      2) Total enclosed electronically commutated motor.
      3) Thermal overload protection.
      4) Phase failure protection to prevent motor from operation in the event of a phase loss.
   c. Isolated fan assembly.
11. Filter section:
   a. 2" MERV 8.
12. Economizer section:
   a. Outside air and relief air hoods with moisture eliminator filters to drain water away from entering air stream. Hoods located on either side of unit to eliminate mixing.
   b. Dampers:
      1) Outside, return, and relief air dampers.
      2) Outside and return air dampers sized to handle 100% of supply airflow.
      3) Arranged vertically to encourage mixing of return and outside airstreams.
      4) Airfoil type.
      5) Fully gasketed and side sealed.
      6) Max. leakage rate of 1.5 CFM/SF at 1" differential pressure per AMCA 500.
      7) Actuator shall be modulating, spring return type.
   c. Floor sloped for water drainage to drain pan.
      a) Construct drain pans from microbial resistant coated galvanized steel or stainless steel with cross break and double sloping pitch to drain connection.
      b) Drain connections that protrude from the base rail are not acceptable.
   d. Adjustable comparative enthalpy control outside of airstream.
13. Electrical:
   a. Factory wired in accordance with NFPA 70 requirements.
   b. 115 V control circuit transformer.
   c. 115 V receptacle.
   d. System service switch.

e. Control circuit fuse.
f. Individually fused fan motors, compressor and condenser fan motor branch circuits.
g. Weatherproof control panel with dead-front cover over main power controls.
h. Disconnect switch.

14. Provide side duct connections as shown on the plans.
15. Provide controls as shown on the plans.
16. Roof curb (Applies to MAU-4001 and 4002 only):
    a. Prefabricated and insulated.
    b. Wood nailer strip.
    c. Gasket for installation between curb and unit.
    d. Nominal 24 inches high.
    e. Coordinate slope with existing conditions prior to ordering.
17. Size and capacity as scheduled on Drawings.

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E. Positive Pressurization Unit:
1. Self contained.
2. Pressurization air as scheduled.
3. Total delivered air with recirculation as scheduled.
4. Vertical configuration.
5. Four (4) stages of air purification.
    a. First stage: ASHRAE 20, 20-25% removal filter.
    b. Second stage: Media modules filled with 50 pounds of media.
    c. Third stage: Same as second.
    d. Fourth stage: JFL-90, 90% removal.
6. Materials:
    a. Unit: 14 GA cold rolled steel.
    b. Modules: Perforated aluminum sheets.
    c. Stage supports: Aluminum track with sealing material.
7. Blower:
    a. Location: Between second and third stage.
    b. Wheel: Backward curved, aluminum.
    c. VFD drive or EC motor.
    d. Motor: See Specification Section 01 61 03.
8. Module media:
    a. Pelletized.
    b. Activated alumina impregnated with a minimum of 12% sodium permanganate.
    c. 100 pound of media shall remove 14 pound hydrogen sulfide; 14% minimum by weight.
    d. Inorganic.
    e. Non-toxic.
    f. Non-flammable.
    g. Shall not support bacterial or fungal growth.
9. Media performance certification (manufacturer's responsibility):
    a. Test procedure: Pass moist (85% RH) air containing 10 (±1) ppm hydrogen sulfide gas at a rate of 2900 ml per minute through a 1.0 inches diameter by 6.0 inches deep uniformly packed bed.
    b. Test shall run continuous for 48 hours.
    c. During test down stream concentration of hydrogen sulfide shall never exceed 0.05 PPM.
10. Gages:
    a. Outside air flow.
    b. Room pressure.
    c. Pressure differential across first stage.
    d. Pressure differential across final stage.
11. Size and capacity as scheduled on Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with Specification Section 01 61 03.

B. Do not operate fans for any purpose until ductwork is clean, associated filters are in place, and fan has been test run under observation.

3.2 FIELD QUALITY CONTROL

A. Comply with Specification Section 23 05 93.

3.3 ADJUSTING

A. Install new filters on units which have been running prior to acceptance of Project.

END OF SECTION

SECTION 26 05 00
ELECTRICAL - BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Basic requirements for electrical systems.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 03 - Concrete.
   2. Section 01 61 03 - Equipment - Basic Requirements.
   3. Section 03 15 19 - Anchorage to Concrete.
   4. Section 10 14 00 - Identification Devices.
   5. Section 26 05 19 - Wire and Cable - 600 Volt and Below.
   6. Section 26 05 33 - Raceways and Boxes.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Aluminum Association (AA):
      a. ADM, Aluminum Design Manual.
   2. American Institute of Steel Construction (AISC):
      a. Steel Construction Manual.
   3. American National Standards Institute (ANSI).
   4. ASTM International (ASTM):
      a. A36/A36M, Standard Specification for Carbon Structural Steel.
      b. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
      c. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   5. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
      a. C2, National Electrical Safety Code (NESC).
   6. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).
   7. National Electrical Manufacturers Association (NEMA):
   8. Underwriters Laboratories, Inc. (UL).

B. Products to be listed by a Nationally Recognized Testing Laboratory (NRTL) in accordance with applicable product standards.
   1. Applicable product standards including, but not limited to, ANSI, FM, IEEE, NEMA and UL.
   2. NRTL includes, but is not limited to, CSA Group Testing and Certification (CS), FM Approvals LLC (FM), Intertek Testing Services NA, Inc. (ETL), and Underwriters Laboratories, Inc. (UL).

1.3 DEFINITIONS

A. For the purposes of providing materials and installing electrical work the following definitions shall be used.
   1. Outdoor area: Exterior locations where the equipment is normally exposed to the weather and including below grade structures, such as vaults, manholes, handholes and in-ground pump stations.
   2. Architecturally finished interior area: Offices, laboratories, conference rooms, restrooms, corridors and other similar occupied spaces.

3. Non-architecturally finished interior area: Pump, chemical, mechanical, electrical rooms and other similar process type rooms.
4. Highly corrosive and corrosive area: Areas identified on the Drawings where there is a varying degree of spillage or splashing of corrosive materials such as water, wastewater or chemical solutions; or chronic exposure to corrosive, caustic or acidic agents, chemicals, chemical fumes or chemical mixtures.
5. Hazardous areas: Class I, II or III areas as defined in NFPA 70.
6. Shop fabricated: Manufactured or assembled equipment for which a UL test procedure has not been established.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 61 03 and individual specification sections for submittal requirements for products defined as equipment.
   2. General requirements:
      a. Provide manufacturer's technical information on products to be used, including product descriptive bulletin.
      b. Include data sheets that include manufacturer's name and product model number.
         1) Clearly identify all optional accessories.
      c. Acknowledgement that products are NRTL listed or are constructed utilizing NRTL recognized components.
      d. Manufacturer's delivery, storage, handling and installation instructions.
      e. Product installation details.
      f. Short Circuit Current Rating (SCCR) nameplate marking per NFPA 70, include any required calculations.
      g. See individual specification sections for any additional requirements.
   3. Fabrication and/or layout drawings:
      a. Concrete and reinforcing steel, per Division 03 requirements.

B. Operation and Maintenance Manuals:
   1. See Specification Section 01 78 23 for requirements for:
      a. The mechanics and administration of the submittal process.
      b. The content process of Operation and Maintenance Manuals.

C. When a Specification Section includes products specified in another Specification Section, each Specification Section shall have the required Shop Drawing transmittal form per Specification Section 01 33 00 and all Specification Sections shall be submitted simultaneously.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect nameplates on electrical equipment to prevent defacing.

1.6 AREA DESIGNATIONS

A. Designation of an area will determine the NEMA rating of the electrical equipment enclosures, types of conduits and installation methods to be used in that area.
   1. Outdoor areas:
      a. Wet.
      b. Also, corrosive and/or hazardous when specifically designated on the Drawings or in the Specifications.
   2. Indoor areas:
      a. Dry.
      b. Also, wet, corrosive and/or hazardous when specifically designated on the Drawings or in the Specifications.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, refer to specific Electrical Specification Sections and specific material paragraphs below for acceptable manufacturers.

B. Provide all components of a similar type by one (1) manufacturer.

2.2 MATERIALS

A. Electrical Equipment Support Pedestals and/or Racks:
   1. Manufacturers:
      a. Modular strut:
         1) Unistrut Building Systems.
         2) B-Line by Eaton.
         3) Globe Strut.
         4) Superstrut by Thomas & Betts.
   2. Material requirements:
      a. Modular strut:
         1) Stainless steel: AISI Type 316.
         2) Aluminum: AA Type 6063-T6.
      b. Structural members (e.g., I beams, L and C channels):
         1) Aluminum: AA Type 6061-T6 or 6063-T6.
      c. Mounting plates:
         1) Aluminum: AA Type 6063-T6.
      d. Mounting hardware:
         1) Stainless steel.
      e. Anchorage per Specification Section 03 15 19.
      f. Concrete and reinforcing steel: See Division 03 specifications.

B. Equipment pads (interior and exterior):
   1. Concrete and reinforcing steel: See Division 03 specifications.

C. Field touch-up of galvanized surfaces.
   1. Zinc-rich primer.
      a. One coat, 3.0 mils, ZRC by ZRC Products.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install and wire all equipment, including prepurchased equipment, and perform all tests necessary to assure conformance to the Drawings and Specification Sections and ensure that equipment is ready and safe for energization.

B. Install equipment in accordance with the requirements of:
   1. NFPA 70.
   2. IEEE C2.
   3. The manufacturer's instructions.

C. In general, conduit routing is not shown on the Drawings.
   1. The Contractor is responsible for routing all conduits including those shown on one-line and control block diagrams and home runs shown on floor plans.
   2. Conduit routings and stub-up locations that are shown are approximate; exact routing to be as required for equipment furnished and field conditions.

D. When complete branch circuiting is not shown on the Drawings:

1. A homerun indicating panelboard name and circuit number will be shown and the circuit number will be shown adjacent to the additional devices (e.g., light fixture and receptacles) on the same circuit.
2. The Contractor is to furnish and install all conduit and conductors required for proper operation of the circuit.
3. The indicated home run conduit and conductor size shall be used for the entire branch circuit.
4. See Specification Section 26 05 19 for combining multiple branch circuits in a common conduit.

E. Do not use equipment that exceed dimensions or reduce clearances indicated on the Drawings or as required by the NFPA 70.

F. Install equipment plumb, square and true with construction features and securely fastened.

G. Install electrical equipment, including pull and junction boxes, minimum of 6 inches from process, gas, air and water piping and equipment.

H. Install equipment so it is readily accessible for operation and maintenance, is not blocked or concealed and does not interfere with normal operation and maintenance requirements of other equipment.

I. Device Mounting Schedule:
1. Unless indicated otherwise on the Drawings, mounting heights are as indicated below:
   a. Light switch (to center): 46 inches.
   b. Receptacle in architecturally finished areas (to center): 18 inches.
   c. Receptacle on exterior wall of building (to center): 18 inches.
   d. Receptacle in non-architecturally finished areas (to center): 46 inches.
   e. Safety switch (to center of operating handle): 54 inches.
   f. Separately mounted motor starter (to center of operating handle): 54 inches.
   g. Pushbutton or selector switch control station (to center): 46 inches.
   h. Panelboard (to top): 72 inches.

J. Avoid interference of electrical equipment operation and maintenance with structural members, building features and equipment of other trades.
1. When it is necessary to adjust the intended location of electrical equipment, unless specifically dimensioned or detailed, the Contractor may make adjustments of up to 6 inches in equipment location with the Engineer's approval.

K. Provide electrical equipment support system per the following area designations:
1. Dry areas:
   a. Galvanized system consisting of galvanized steel channels and fittings, nuts and hardware.
   b. Field touch-up cut ends and scratches of galvanized components with the specified primer during the installation, before rust appears.
2. Wet areas:
   a. Aluminum system consisting of aluminum channels and fittings with stainless steel nuts and hardware.
   b. Field touch-up cut ends and scratches of galvanized components with the specified primer during the installation, before rust appears.
3. Corrosive areas:
   a. Aluminum system consisting of aluminum channels and fittings with stainless steel nuts and hardware.
   b. Stainless steel system consisting of stainless steel channels and fittings, nuts and hardware.

L. Provide all necessary anchoring devices and supports rated for the equipment load based on dimensions and weights verified from approved submittals, or as recommended by the manufacturer.

1. See Specification Section 03 15 19.
2. Do not cut, or weld to, building structural members.
3. Do not mount safety switches or other equipment to equipment enclosures, unless enclosure mounting surface is properly braced to accept mounting of external equipment.

M. Provide non-metallic corrosion resistant spacers to maintain 1/4 inches separation between metallic equipment and/or metallic equipment supports and mounting surface in wet areas, on below grade walls and on walls of liquid containment or processing areas such as Basins, Clarifiers, Digesters, Reservoirs, etc.

N. Do not place equipment fabricated from aluminum in direct contact with earth or concrete.

O. Screen or seal all openings into equipment mounted outdoors to prevent the entrance of rodents and insects.

P. Do not use materials that may cause the walls or roof of a building to discolor or rust.

Q. Identify electrical equipment and components in accordance with Specification Section 10 14 00.

R. Provide field markings and/or documentation of available short-circuit current (available fault current) and related information for equipment as required by the NFPA 70 and other applicable codes.

S. Provide equipment or control panels with Short Circuit Current Rating (SCCR) labeling as required by NFPA 70 and other applicable codes.
   1. Determine the SCCR rating by one of the following methods:
      a. Method 1: SCCR rating meets or exceeds the available fault current of the source equipment when indicated on the Drawings.
      b. Method 2: SCCR rating meets or exceeds the source equipment's Amp Interrupting Current (AIC) rating as indicated on the Drawings.
      c. Method 3: SCCR rating meets or exceeds the calculated available short circuit current at the control panel.
   2. The source equipment is the switchboard, panelboard, motor control center or similar equipment where the equipment or control panel circuit originates.
   3. For Method 3, provide calculations justifying the SCCR rating. Utilize source equipment available fault current or AIC rating as indicated on the Drawings.

3.2 FIELD QUALITY CONTROL

A. Verify exact rough-in location and dimensions for connection to electrified equipment, provided by others.
   1. Secure Shop Drawings for equipment furnished by Owner and installed by Contractor.
   2. See Specification Section 01 73 20 for openings and penetrations in structures.

B. Replace equipment and systems found inoperative or defective and re-test.

C. Cleaning:
   1. See Specification Section 01 74 00.

D. The protective coating integrity of support structures and equipment enclosures shall be maintained.
   1. Repair galvanized components utilizing a zinc rich paint.
   2. Repair painted components utilizing touch up paint provided by or approved by the manufacturer.
   3. Repair PVC coated components utilizing a patching compound, of the same material as the coating, provided by the manufacturer of the component.
   4. Repair surfaces which will be inaccessible after installation prior to installation.
   5. See Specification Section 26 05 33 for requirements for conduits and associated accessories.

E. Replace nameplates damaged during installation.

3.3 DEMONSTRATION

A. Demonstrate equipment in accordance with Specification Section 01 75 00.

END OF SECTION

SECTION 26 05 13
MEDIUM VOLTAGE CABLE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Material and installation requirements for:
      a. Medium voltage cable (601 V and above).
      b. Cable terminations and splices.

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 26 05 00 - Electrical - Basic Requirements.
   2. Section 26 05 19 - Wire and Cable - 600 Volt and Below.
   3. Section 26 08 13 - Acceptance Testing.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Association of Edison Illuminating Companies (AEIC).
      a. CS8, Specification for Extruded Dielectric Shielded Power Cables Rated 5 Through 46 kV.
   2. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
      a. 48, Standard for Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV through 500 kV.
      b. 386, Standard for Separable Insulated Connector Systems for Power Distribution Systems Rated 2.5 kV through 35 kV.
      c. 404, Standard for Extruded and Laminated Dielectric Shielded Cable Joints Rated 2.5 kV to 500 kV.
   3. National Electrical Manufacturers Association/Insulated Cable Engineers Association (NEMA/ICEA):
      a. WC 74/S-93-639, 5 - 46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy.
   4. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).
   5. Underwriters Laboratories, Inc. (UL):
      a. 1072, Standard for Medium-Voltage Power Cables.

B. Qualifications:
   1. Cable technician:
      a. Three years of experience in handling, terminating and splicing medium voltage cables.
      b. Specifically trained by a factory representative on the terminations and splices to be used on the project.
         1) If not trained on the products to be used, on-site training by the factory representative shall be performed before any terminations or splices are made.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Product data:
      a. Provide submittal data for all products specified in PART 2 of this Specification Section.
      b. See Specification Section 26 05 00 for additional requirements.
   2. Fabrication and/or layout drawings:
      a. Cable pulling plan.

B. Informational Submittals:
   1. Cable pulling tension measurements or photograph of breakaway swivel attached to cable.
   2. Submit the following before terminating cables:
      a. Cable Technician qualifications.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Ship cable with removable watertight end seals, and store in dry place.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Wire and cable:
      a. General Cable.
      b. The Kerite Company.
      c. The Okonite Company.
      d. Prysmian Group.
      e. Southwire Company.
   2. Lugs, connectors and terminations:
      a. 3M.
      b. Elastimold by Thomas & Betts.
      c. Joslyn.
      d. TE Connectivity Raychem.
      e. Eaton Cooper Power Systems.

2.2 MEDIUM VOLTAGE CABLES

A. Ratings:
   1. Voltage class as indicated on the Drawings.

B. Standards:
   1. NEMA/ICEA WC 74/S-93-639.
   2. AEIC CS8.
   3. UL 1072.

C. Conductor Material:
   1. Compact stranded copper.

D. Insulation:
   1. Temperature rating: Type MV-105 per NFPA 70.
   2. Cross-linked thermosetting polyethylene (XLP).
   3. 133% insulation level.

E. Shielding:
   1. Shielding on cables rated above 2 kV consists of:
      a. Semiconductor conductor screen.
      b. Semiconductor insulation screen.
      c. Copper concentric neutral.

F. Neutrals:
   1. Cables with a concentric neutral shall have 1/3 concentric neutral Neutral conductors of grounded neutral systems indicated on the drawings, shall be of the same insulation materials as the phase conductors, except with a 600 V insulation rating.

G. Grounds:
   1. Insulated copper per Specification Section 26 05 19.

H. Jackets:

1. Direct buried cables shall be rated for direct bury.
2. Jacket: PVC.

2.3 CABLE ACCESSORIES

A. Lugs and Connectors:
   1. Lugs:
      a. Compression type.
      b. Standard: UL 486A for copper cables.
      c. Voltage rating: Up to 35 kV.
      d. Current rating: Continuous operation at the rating of the cable.
      e. Material: Tin-plated copper.
      f. Number of holes: Two, except one on motor leads.
   2. Splice connectors:
      a. Standard: UL 486A for copper cables.
      b. Voltage rating: Up to 35 kV.
      c. Current rating: Continuous operation at the rating of the cable.
      d. Material: Tin-plated copper.

B. Terminations:
   1. Elbow connectors:
      a. Standard: IEEE 386.
      b. Voltage rating: Same as the cable rating.
      c. Current rating: 200A.
      d. One-piece design, comprised of an insulation shield, insulation layer and an outer shield constructed of EPDM rubber.
      e. Deadfront, loadbreak type with:
         1) Hot stick pulling eye.
         2) Grounding tab.
         3) Test point.
      f. Accessories to be constructed in a similar manner as the elbow connector:
         1) Bushing inserts.
         2) Bushing well plugs.
         3) Feed thru inserts.
         4) Protective caps.

C. Splices:
   1. Cold shrink kits:
      a. Standard: IEEE 404.
      b. Voltage rating: Same as the cable rating.
      c. Current rating: Continuous operation at the rating of the cable.
      d. One-piece design, comprised of an insulation shield, insulation layer and a silicone rubber body.
      e. Suitable for indoor, direct burial or submersible applications.
   2. Molded rubber kit:
      a. Standard: IEEE 386 or IEEE 404.
      b. Voltage rating: Same as the cable rating.
      c. Current rating: Continuous operation at the rating of the cable.
      d. One- or multi-piece design, comprised of an insulation shield, insulation layer and an outer shield constructed of EPDM rubber.
      e. Suitable for indoor, direct burial or submersible applications.
   3. Modular separable molded rubber:
      a. Standard: IEEE 386.
      b. Voltage rating: Same as the cable rating.
      c. Current rating: 600A.
      d. One-piece design, comprised of an insulation shield, insulation layer and an outer shield constructed of EPDM rubber.

e. Deadfront, deadbreak type.
f. Components: T-body, insulating plug with cap, insulating plug with cap and stud, and connecting plug.
g. Suitable for submersible applications.

D. Cable Shield Grounding Adapters:
1. Type: Molded rubber with constant force spring and solder-blocked tinned copper braid pigtail.
2. Waterproof, providing a positive seal for the cable jacket.
3. May be integral with termination of splice device with Engineer's approval.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Do not install cable during wet conditions.
1. Prior to pulling cables, drain or pump out manholes and other low points if standing water is present.
2. Blow out conduits with dried compressed air if moisture is present in conduits.
3. Install end caps immediately on all cut ends of cable prior to pulling, and maintain end caps while pulling in cable.
a. If end caps are damaged, remove and install new end caps.
b. Do not remove end caps until ready to terminate or splice cable.

B. Cable Installation in Manholes:
1. Arc-proof all cables in manholes.
a. Apply in spiral, half-overlap fashion to full exposed length of each cable in manhole.
b. Secure in place with glass cloth electrical tape.
1) Apply in reverse spiral to arc-proofing tape, at maximum interval of 9 inches and double wrapped at each end.

C. Do not install conductors when ambient temperature is near minimum as recommended by manufacturer for installation of the type of conductor insulation.

D. Provide components in kit form, complete with instructions, supplied by a single approved manufacturer and suitable for each shielded cable termination.
1. Select correct termination to match cable diameter and construction.
2. Form and install terminations in strict accordance with instructions of cable manufacturer and termination manufacturer.

E. Splices:
1. Provide components in kit form, complete with instructions, supplied by a single approved manufacturer and suitable for the type of cable being used.
2. Prepare cable ends, provide materials and follow all application steps in accordance with manufacturer's instructions.
a. As a minimum requirement:
1) The cable ends shall be cut squarely.
2) The insulation shall be free from nicks or burrs after removal of jacket.
3) The conductors shall be cleaned and an oxide inhibitor applied.
4) For splices, connector indents shall be filled with insulating putty to eliminate voids or prepared per manufacturer's instructions.
5) Attach grounding lead to system ground.
3. Splices shall be avoided whenever possible.
a. No more than one splice is permitted between termination points without Engineer's approval.
b. No splices are permitted in runs less than 100 feet long.
c. Splices will be made only at manholes or other accessible locations.
d. Do not pull splices into ductbanks or conduits or leave them under tension.

F. The ground shield grounding adaptors shall be grounded:
   1. Shirted and elbow terminators: Grounded to ground bar or cable loop in equipment.
   2. Splices: Grounded to ground bar or rod in manhole.
   3. Connect with insulated, stranded #6 AWG wire.

3.2 FIELD QUALITY CONTROL

A. Cable pulling plan.
   1. Underground ductbanks: Include proposed splice points, cable pulling direction for each pull, and estimated pulling tensions (tension calculation).
      a. Include unreeling tensions, sheave radius, lubrication coefficient of friction, etc. in the calculation.
      b. Identify any cable pulling aids necessary to not over tension the cable during the pull. For example: motorized cable reel roller, lubrication quantity.
      c. Identify all devices to be used to attach cables to puller. For example, wire grips, swivels, slings.
      d. Include all cables
   2. Above grade raceways: Include proposed splice points, cable pulling direction for each pull, and estimated pulling tensions (tension calculation).
      a. Include pull box sizing calculations.
      b. Identify any cable pulling aids necessary to not over tension the cable during the pull. For example, cable reel roller, lubrication quantity.
      c. Identify all devices to be used to attach cables to puller. For example, wire grips, swivels, slings.
      d. Include all cables

B. When estimated pulling tension is greater than 75% of cables maximum allowed tension, provide measurement of tensions during the pull or use breakaway swivel of a strength less than the cable's maximum allowed tension.

C. See Specification Section 26 08 13 for acceptance testing requirements.

END OF SECTION

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SECTION 26 05 19
WIRE AND CABLE - 600 VOLT AND BELOW

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Material and installation requirements for:
      a. Building wire.
      b. Power cable.
      c. Control cable.
      d. Shielded VFD cable.
      e. Instrumentation cable.
      f. Wire connectors.
      g. Insulating tape.
      h. Pulling lubricant.

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 26 05 00 - Electrical - Basic Requirements.
   2. Section 26 08 13 - Acceptance Testing.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Insulated Cable Engineers Association (ICEA):
      a. S-58-679, Standard for Control Cable Conductor Identification.
   2. National Electrical Manufacturers Association (NEMA):
      a. ICS 4, Industrial Control and Systems: Terminal Blocks.
   3. National Electrical Manufacturers Association/Insulated Cable Engineers Association (NEMA/ICEA):
      a. WC 57/S-73-532, Standard for Control Cables.
      b. WC 70/S-95-658, Non-Shielded Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy.
   4. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).
      b. 262, Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.
   5. Telecommunications Industry Association/Electronic Industries Alliance/American National Standards Institute (TIA/EIA/ANSI):
      a. 568, Commercial Building Telecommunications Cabling Standard.
   6. Underwriters Laboratories, Inc. (UL):
      a. 44, Standard for Safety Thermoset-Insulated Wires and Cables.
      b. 83, Standard for Safety Thermoplastic-Insulated Wires and Cables.
      c. 467, Standard for Safety Grounding and Bonding Equipment.
      d. 486A, Standard for Safety Wire Connectors and Soldering Lugs for use with Copper Conductors.
      e. 486C, Standard for Safety Splicing Wire Connections.
      f. 510, Standard for Safety Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape.
      g. 1277, Standard for Safety Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.
      h. 1581, Standard for Safety Reference Standard for Electrical Wires, Cables, and Flexible Cords.
      i. 2250, Standard for Safety Instrumentation Tray Cable.

1.3 DEFINITIONS

A. Cable: Multi-conductor, insulated, with outer sheath containing either building wire or instrumentation wire.

B. Instrumentation Cable:
   1. Multiple conductor, insulated, twisted or untwisted, with outer sheath.
   2. The following are specific types of instrumentation cables:
      a. Analog signal cable:
         1) Used for the transmission of low current (e.g., 4-20mA DC) or low voltage (e.g., 0-10 VDC) signals, using No. 16 AWG and smaller conductors.
         2) Commonly used types are defined in the following:
            a) TSP: Twisted shielded pair.
            b) TST: Twisted shielded triad.
      b. Digital signal cable: Used for the transmission of digital signals between computers, PLC's, RTU's, etc.

C. Power Cable: Multi-conductor, insulated, with outer sheath containing building wire, No. 8 AWG and larger.

D. Shielded VFD Cable: Multi-conductor, insulated, with shield, drain wire and building wires, No. 12 and larger.

E. Control Cable: Multi-conductor, insulated, with outer sheath containing building wires, No. 14, No. 12 or No. 10 AWG.

F. Building Wire: Single conductor, insulated, with or without outer jacket depending upon type.

1.4 SUBMITTALS

A. Shop Drawings:
   1. Product technical data:
      a. Provide submittal data for all products specified in PART 2 of this Specification Section except:
         1) Wire connectors.
         2) Insulating tape.
         3) Cable lubricant.
      b. See Specification Section 26 05 00 for additional requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

A. See Specification Section 26 05 00.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Building wire, power and control cable:
      a. Aetna Insulated Wire.
      b. Alphawire.
      c. Cerrowire.
      d. Encore Wire Corporation.
      e. General Cable.
      f. Okonite Company.
      g. Southwire Company.
   2. Shielded VFD cable:
      a. Belden Inc.
      b. General Cable.

c. Okonite Company.
d. Olflex Wire and Cable, Inc.
e. Priority Wire and Cable (Prysmian).
f. Rockbestos-Surprenant Cable Corp.
g. Southwire Company.

3. Instrumentation cable:
   a. Analog cable:
      1) Alphawire.
      2) Belden Inc.
      3) General Cable.
4. Wire connectors:
   a. Burndy Corporation.
   b. Buchanan.
   c. Ideal.
   d. Ilsco.
   e. 3M Co.
   f. Teledyne Penn Union.
   g. Thomas and Betts.
   h. Phoenix Contact.
5. Insulating and color coding tape:
   a. 3M Co.
   b. Plymouth Bishop Tapes.
   c. Red Seal Electric Co.

2.2 MANUFACTURED UNITS

A. Building Wire:
   1. Conductor shall be copper with 600 V rated insulation.
   2. Conductors shall be stranded, except for conductors used in lighting and receptacle circuits which may be stranded or solid.
   3. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL label.
   4. Conform to NEMA/ICEA WC 70/S-95-658 and UL 83 for type THHN/THWN and THHN/THWN-2 insulation.
   5. Conform to NEMA/ICEA WC 70/S-95-658 and UL 44 for type XHHW-2 insulation.

B. Power Cable:
   1. Conductor shall be copper with 600 V rated insulation.
   2. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL label.
   3. Conform to NEMA/ICEA WC 70/S-95-658 and UL 83 and UL 1277 for type THHN/THWN insulation with an overall PVC jacket.
   4. Conform to NEMA/ICEA WC 70/S-95-658 and UL 44 and UL 1277 for type XHHW-2 insulation with an overall PVC jacket.
   5. Number of conductors as required, including a bare ground conductor.
   6. Individual conductor color coding:
      a. ICEA S-58-679, Method 4.
      b. See PART 3 of this Specification Section for additional requirements.
   7. Conform to NFPA 70 Type TC.

C. Control Cable:
   1. Conductor shall be copper with 600 V rated insulation.
   2. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL label.
   3. Conform to NEMA/ICEA WC 57/S-73-532 and UL 83 and UL 1277 for type THHN/THWN insulation with an overall PVC jacket.

4. Conform to NEMA/ICEA WC 57/S-73-532 and UL 44 and UL 1277 for type XHHW-2 insulation with an overall PVC jacket.
5. Number of conductors as required, provided with or without bare ground conductor of the same AWG size.
    a. When a bare ground conductor is not provided, an additional insulated conductor shall be provided and used as the ground conductor (e.g., 6/c No. 14 w/g and 7/c No. 14 are equal).
6. Individual conductor color coding:
    a. ICEA S-58-679, Method 1, Table E-2.
    b. See PART 3 of this Specification Section for additional requirements.
7. Conform to NFPA 70 Type TC.

D. Electrical Equipment Control Wire:
1. Conductor shall be copper with 600 V rated insulation.
2. Conductors shall be stranded.
3. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL label.
4. Conform to UL 44 for Type SIS insulation.
5. Conform to UL 83 for Type MTW insulation.

E. Shielded VFD Cable:
1. Conductor shall be copper, stranded with 600 V rated insulation.
2. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL label.
3. Cables No. 1 AWG and less:
    a. Conform to NEMA/ICEA WC 70/S-95-658 and UL 44 and UL 1277 for type RHW-2 or XHHW-2 insulation with an overall PVC jacket.
    b. Shielding: 85% tinned copper braid, full size tinned copper drain wire and 100% foil shield.
    c. Number of conductors: 3 PH and 1 full size ground.
4. Cables No. 12 through 750 kcmil:
    a. Conform to NEMA/ICEA WC 70/S-95-658 and UL 44 type XHHW-2 insulation.
    b. Shielding: 5 mil copper tape, longitudinally applied with a minimum overlap of 15%.
    c. Number of conductors: 3 PH and 3 equally spaced ground conductors.
5. Individual conductor color coding:
    a. ICEA S-58-679, Method 4.
    b. See PART 3 of this Specification Section for additional requirements.
6. When installed exposed outdoors, UL listed and marked as sunlight resistant.
7. For continuously corrugated cable, use manufacturer approved fittings.
8. Conform to NFPA 70, Type TC.

F. Instrumentation Cable:
1. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL label.
2. Analog cable:
    a. Tinned copper conductors.
    b. 300 V or 600 V PVC insulation with PVC jacket.
    c. Twisted with 100% foil shield coverage with drain wire.
    d. Six (6) twists per foot minimum.
    e. Individual conductor color coding: ICEA S-58-679, Method 1, Table E-2.
    f. Conform to UL 2250, UL 1581 and NFPA 70 Type ITC.
3. Digital cable:
    a. As recommended by equipment (e.g., PLC, RTU) manufacturer.
    b. Horizontal voice and data cable:
        1) Category 6 per TIA/EIA/ANSI 568.
        2) Cable shall be label-verified.

3) Cable jacket shall be factory marked at regular intervals indicating verifying organization and performance level.
4) Conductors: No. 24 AWG solid untinned copper.
5) Rated CMP per NFPA 70.

c. Conform to NFPA 262 and NFPA 70 Type ITC.

G. Fiber Optic Cable:
1. Design and fabrication - Single-mode:
a. Type:
1) Outdoor: Loose tube with a wet or dry gel water blocking system.
b. Number of fibers: As indicated on the Drawings.
c. Fiber size: Non-dispersion shifted, 9/125 micrometer (core diameter/cladding diameter).
d. Glass fiber core.
e. Step index.
f. Maximum attenuation:
1) At 850 nm: 0.5 dB/km.
2) At 1300 nm: 0.4 dB/km.
g. Minimum bandwidth:
1) At 850 nm: 160 MHz/km.
2) At 1300 nm: 500 MHz/km.
h. Maximum tensile load:
1) Installation: 600 pounds.
2) Long term: 200 pounds.
i. Cable jacket material:
1) In conduit: PVC, or polyethylene.
j. Cables shall be listed and marked in accordance with the requirements of NFPA 70.
k. Optical fiber cable type utilized shall be in accordance with NFPA 70.
l. Fiber shall conform to TIA/EIA 492AAAA Class IVa.
m. Fiber color code shall conform to TIA/EIA 598-C.
n. Utilize FC type connectors:
1) Tip material: Ceramic or ceramic/glass composite.
2) Utilize connectors which do not require adhesive, epoxy, or polish.

H. Wire Connectors:
1. Twist/screw on type:
a. Insulated pressure or spring type solderless connector.
b. 600 V rated.
c. Ground conductors: Conform to UL 486C and/or UL 467 when required by local codes.
d. Phase and neutral conductors: Conform to UL 486C.
2. Compression and mechanical screw type:
a. 600 V rated.
b. Ground conductors: Conform to UL 467.
c. Phase and neutral conductors: Conform to UL 486A.
3. Terminal block type:
a. High density, screw-post barrier-type with white center marker strip.
b. 600 V and ampere rating as required, for power circuits.
c. 600 V, 20 ampere rated for control circuits.
d. 300 V, 15 ampere rated for instrumentation circuits.
e. Conform to NEMA ICS 4 and UL 486A.

I. Insulating and Color Coding Tape:
1. Pressure sensitive vinyl.
2. Premium grade.
3. Heat, cold, moisture, and sunlight resistant.
4. Thickness, depending on use conditions: 7, 8.5, or 10 mil.

5. For cold weather or outdoor location, tape must also be all-weather.
6. Color:
   a. Insulating tape: Black.
   b. Color coding tape: Fade-resistant color as specified herein.
7. Comply with UL 510.

J. Pulling Lubricant: Cable manufacturer's standard containing no petroleum or other products which will deteriorate insulation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Permitted Usage of Insulation Types:
   1. Type XHHW-2:
      a. Building wire and power and control cable in architectural and non-architectural finished areas.
      b. Building wire and power and control cable in conduit in outdoor areas and below grade.
      c. Building wire and power and control cable in cable tray in outdoor areas.
   2. Type THHN/THWN and THHN/THWN-2:
      a. Building wire and power and control cable No. 8 AWG and smaller in architectural and non-architectural finished areas.
   3. Type SIS and MTW:
      a. For the wiring of control equipment within control panels and field wiring of control equipment within switchgear, switchboards, motor control centers.

B. Shielded VFD Cable:
   1. For wiring between a VFD and motor when routing in cable trays or conduit other than RGS or RAC.

C. Conductor Size Limitations:
   1. Feeder and branch power conductors shall not be smaller than No. 12 AWG unless otherwise indicated on the Drawings.
   2. Control conductors shall not be smaller than No. 14 AWG unless otherwise indicated on the Drawings.
   3. Instrumentation conductors shall not be smaller than No. 18 AWG unless otherwise indicated on the Drawings.

D. Color Code All Wiring as Follows:
   1. Building wire: Verify and match existing color code.

      a. Conductors No. 6 AWG and smaller: Insulated phase, neutral and ground conductors shall be identified by a continuous colored outer finish along its entire length.
      b. Conductors larger than No. 6 AWG:
         1) Insulated phase and neutral conductors shall be identified by one of the following methods:
            a) Continuous colored outer finish along its entire length.
            b) 3 inches of colored tape applied at the termination.
         2) Insulated grounding conductor shall be identified by one of the following methods:
            a) Continuous green outer finish along its entire length.
            b) Stripping the insulation from the entire exposed length.
            c) Using green tape to cover the entire exposed length.
         3) The color coding shall be applied at all accessible locations, including but not limited to: Junction and pull boxes, wireways, manholes and handholes.
   2. Power cables ICEA S-58-679, Method 4 with:
      a. Phase and neutral conductors identified with 3 inches of colored tape, per the Table herein, applied at the terminations.

b. Ground conductor: Bare.

3. Control cables ICEA S-58-679, Method 1, Table E-2:
   a. When a bare ground is not provided, one of the colored insulated conductors shall be re-identified by stripping the insulation from the entire exposed length or using green tape to cover the entire exposed length.
   b. When used in power applications the colored insulated conductors used as phase and neutral conductors may have to be re-identified with 3 inches of colored tape, per the Table herein, applied at the terminations.

E. Install all wiring in raceway unless otherwise indicated on the Drawings.

F. Feeder, branch, control and instrumentation circuits shall not be combined in a raceway, cable tray, junction or pull box, except as permitted in the following:
   1. Where specifically indicated on the Drawings.
   2. Where field conditions dictate and written permission is obtained from the Engineer.
   3. Control circuits shall be isolated from feeder and branch power and instrumentation circuits but combining of control circuits is permitted.
      a. The combinations shall comply with the following:
         1) 12 VDC, 24 VDC and 48 VDC may be combined.
         2) 125 VDC shall be isolated from all other AC and DC circuits.
         3) AC control circuits shall be isolated from all DC circuits.
   4. Instrumentation circuits shall be isolated from feeder and branch power and control circuits but combining of instrumentation circuits is permitted.
      a. The combinations shall comply with the following:
         1) Analog signal circuits may be combined.
         2) Digital signal circuits may be combined but isolated from analog signal circuits.
   5. Multiple branch circuits for similar loads may be combined in a common raceway, such as multiple lighting circuits or multiple receptacle circuits or other 120Vac circuits. Do not combine lighting and receptacle circuits.
      a. Do not combine control device circuits with lighting or receptacle circuits.
      b. Contractor is responsible for making the required adjustments in conductor and raceway size, in accordance with all requirements of the NFPA 70, including but not limited to:
         1) Up sizing conductor size for required ampacity de-ratings for the number of current carrying conductors in the raceway.
         2) The neutral conductors may not be shared.
         3) Up sizing raceway size for the size and quantity of conductors.

G. Ground the drain wire of shielded instrumentation cables at one end only.
   1. The preferred grounding location is at the load (e.g., control panel), not at the source (e.g., field mounted instrument).

H. Splices and terminations for the following circuit types shall be made in the indicated enclosure type using the indicated method.
   1. Feeder and branch power circuits:
      a. Device outlet boxes:
         1) Twist/screw on type connectors.
      b. Junction and pull boxes and wireways:
         1) Twist/screw on type connectors for use on No. 8 and smaller wire.
         2) Compression, mechanical screw or terminal block or terminal strip type connectors for use on No. 6 AWG and larger wire.
      c. Motor terminal boxes:
         1) Twist/screw on type connectors for use on No. 10 AWG and smaller wire.
         2) Insulated mechanical screw type connectors for use on No. 8 AWG and larger wire.
      d. Manholes or handholes:

1) Twist/screw on type connectors pre-filled with epoxy for use on No. 8 AWG and smaller wire.
2) Watertight compression or mechanical screw type connectors for use on No. 6 AWG and larger wire.

2. Control circuits:
   a. Junction and pull boxes: Terminal block type connector.
   b. Manholes or handholes: Twist/screw on type connectors pre-filled with epoxy.
   c. Control panels and motor control centers: Terminal block or strips provided within the equipment or field installed within the equipment by the Contractor.
3. Instrumentation circuits can be spliced where field conditions dictate and written permission is obtained from the Engineer.
   a. Maintain electrical continuity of the shield when splicing twisted shielded conductors.
   b. Junction and pull boxes: Terminal block type connector.
   c. Control panels and motor control centers: Terminal block or strip provided within the equipment or field installed within the equipment by the Contractor.
4. Non-insulated compression and mechanical screw type connectors shall be insulated with tape or hot or cold shrink type insulation to the insulation level of the conductors.

I. Insulating Tape Usage:
   1. For insulating connections of No. 8 AWG wire and smaller: 7 mil vinyl tape.
   2. For insulating splices and taps of No. 6 AWG wire or larger: 10 mil vinyl tape.
   3. For insulating connections made in cold weather or in outdoor locations: 8.5 mil, all weather vinyl tape.

J. Color Coding Tape Usage: For color coding of conductors.

3.2 FIELD QUALITY CONTROL

A. Acceptance Testing:
   1. See Specification Section 26 08 13.

END OF SECTION

SECTION 26 05 26
GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Material and installation requirements for grounding and bonding system(s).

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 10 14 00 - Identification Devices.
   2. Section 26 05 00 - Electrical - Basic Requirements.
   3. Section 26 05 19 - Wire and Cable - 600 Volt and Below.
   4. Section 26 05 33 - Raceways and Boxes.
   5. Section 26 08 13 - Acceptance Testing.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
   2. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
      a. 837, Standard for Qualifying Permanent Connections Used in Substation Grounding.
   3. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).
   4. Underwriters Laboratories, Inc. (UL):
      a. 467, Grounding and Bonding Equipment.

B. Assure ground continuity is continuous throughout the entire Project.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Product technical data.
      a. Provide submittal data for all products specified in PART 2 of this Specification Section except:
         1) Grounding clamps, terminals and connectors.
         2) Exothermic welding system.
      b. See Specification Section 26 05 00 for additional requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Ground rods and bars and grounding clamps, connectors and terminals:
      a. ERICO by Pentair.
      b. Harger Lightning & Grounding.
      c. Heary Bros. Lightning Protection Co. Inc..
      d. Burndy by Hubbell.
      e. Robbins Lightning, Inc.
      f. Blackburn by Thomas & Betts.
      g. Thompson Lightning Protection, Inc.
   2. Exothermic weld connections:

a. ERICO by Pentair - Cadweld.
b. Harger Lightning & Grounding - Ultraweld.
c. Burndy by Hubbell - Thermoweld.
d. FurseWELD by Thomas & Betts.

3. Prefabricated composite test stations:
a. Armorcast Products Company.
b. MacLean Highline.
c. Quazite by Hubbell

2.2 COMPONENTS

A. Wire and Cable:
1. Bare conductors: Soft drawn stranded copper meeting ASTM B8.
2. Insulated conductors: Color coded green, per Specification Section 26 05 19.

B. Conduit: As specified in Specification Section 26 05 33.

C. Ground Bars:
1. Solid copper:
a. 1/4 inches thick.
b. 2 or 4 inches wide.
c. 24 inches long minimum in main service entrance electrical rooms, 12 inches long elsewhere.
2. Predrilled grounding lug mounting holes.
3. Stainless steel or galvanized steel mounting brackets.
4. Insulated standoffs.

D. Ground Rods:
1. 3/4 inches x 10 feet.
2. Copper-clad:
a. 10 mil minimum uniform coating of electrolytic copper molecularly bonded to a rigid steel core.
b. Corrosion resistant bond between the copper and steel.
c. Hard drawn for a scar-resistant surface.

E. Grounding Clamps, Connectors and Terminals:
1. Mechanical type:
a. Standards: UL 467.
b. High copper alloy content.
2. Compression type for interior locations:
a. Standards: UL 467.
b. High copper alloy content.
c. Non-reversible.
d. Terminals for connection to bus bars shall have two bolt holes.
3. Compression type suitable for direct burial in earth or concrete:
a. Standards: UL 467, IEEE 837.
b. High copper alloy content.
c. Non-reversible.
d. Factory filled with oxide inhibiting compound.

F. Exothermic Weld Connections:
1. Copper oxide reduction by aluminum process.
2. Molds properly sized for each application.

G. Prefabricated Composite Material Test Stations:
1. Body and cover: Fiberglass reinforced polymer concrete conforming to all test provisions of SCTE 77.
2. Minimum load ratings: SCTE 77 Tier 15.
3. Open bottom.

4. Stackable design as required for 3 feet depth.
5. Cover:
   a. Engraved legend of "GROUND".
   b. Lay-in non-bolt down.
6. Size: 12 inches round or 12 inches square.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
   1. Install products in accordance with manufacturer's instructions.
   2. Size grounding conductors and bonding jumpers in accordance with NFPA 70, Article 250, except where larger sizes are indicated on the Drawings.
   3. Remove paint, rust, or other non-conducting material from contact surfaces before making ground connections. After connection, apply manufacturers approved touch-up paint to protect metallic surface from corrosion.
   4. Where ground conductors pass through floor slabs or building walls provide nonmetallic sleeves and install sleeve per Specification Section 01 73 20.
      a. Seal the sleeve interior to stop water penetration.
   5. Do not splice grounding electrode conductors except at ground rods.
   6. Install ground rods and grounding electrode conductors in undisturbed, firm soil.
      a. Provide excavation required for installation of ground rods and conductors.
      b. Use driving studs or other suitable means to prevent damage to threaded ends of sectional rods.
      c. Unless otherwise specified, connect conductors to ground rods with compression type connectors or exothermic weld.
      d. Provide sufficient slack in conductor to prevent conductor breakage during backfill or due to ground movement.
      e. Backfill excavation completely, thoroughly tamping to provide good contact between backfill materials and ground rods and conductors.
   7. Do not use exothermic welding if it will damage the structure the grounding conductor is being welded to.

B. Grounding Electrode System:
   1. Provide a grounding electrode system in accordance with NFPA 70, Article 250 and as indicated on the Drawings.
      a. All grounding electrode conductors terminate on a main ground bar located adjacent to the service entrance equipment.
   2. Grounding electrode conductor terminations:
      a. Ground bars mounted on wall: Use a two-hole compression type conductor terminal and bolt it to the ground bar with two bolts.
      b. Ground bars in electrical equipment: Use compression type conductor terminal and bolt it to the ground bar or manufacture's provided mechanical type termination device.
      c. Piping systems: Use mechanical type connections.
      d. Building steel, below grade and encased in concrete: Use compression type connector or exothermic weld.
      e. Building steel, above grade: Use a two-hole compression type conductor terminal and bolt to the steel with two bolts or exothermic weld.
      f. Ground rod: Compression type or exothermic weld, unless otherwise specified.
      g. At all above grade terminations, the conductors shall be labeled per Specification Section 10 14 00.
   3. Ground ring grounding system:
      a. Ground ring consists of ground rods and a conductor looped around the structure.
      b. Placed at a minimum of 10 feet from the structure foundation and 2 feet-6 inches below grade.

c. Provide a minimum of four ground rods placed at the corners of the structure and additional rods so that the maximum distance between ground rods does not exceed 50 FT.
d. Building/Structure grounding:
1) Bond building/structure metal support columns to the ground ring at all corners of the structure.
e. Grounding conductor: Bare conductor, size as indicated on the Drawings.

4. Ufer grounding system:
a. Ground rod test stations:
1) Provide where indicated on the Drawings.
2) Grounding conductors connected to ground rod with removable ground clamps.

C. Supplemental Grounding Electrode:
1. Provide the following grounding in addition to the equipment ground conductor supplied with the feeder conductors whether or not shown on the Drawings.
a. See Grounding Electrode System paragraph for conductor termination requirements.
2. Metal light poles:
a. Connect metal pole and pole base reinforcing steel to a ground rod.
b. Grounding conductor: Bare #6 AWG minimum.
3. Equipment support rack and pedestals mounted outdoors:
a. Connect metallic structure to a ground rod.
b. Grounding conductor: #6 AWG minimum.

D. Transformer Separately Derived Grounding System:
1. Install the System Bonding Jumper at the transformer. At the first disconnect, ensure the neutral is isolated from ground.
2. Structures with a single electrical room/area:
a. Connect grounding electrode conductor to the Grounding Electrode System main ground bar.
3. Structures with multiple electrical rooms/areas:
a. Provide a ground bar mounted in each electrical room/area.
b. Interconnect all ground bars in a daisy chain or radial fashion to the main ground bar as indicated on the Drawings.
c. Connect grounding electrode conductor to the electrical room/area ground bar.
4. See Grounding Electrode System paragraph for conductor termination requirements.

E. Raceway Bonding/Grounding:
1. Install all metallic raceway so that it is electrically continuous.
2. Provide an equipment grounding conductor in all raceways with insulation identical to the phase conductors, unless otherwise indicated on the Drawings.
3. NFPA 70 required grounding bushings shall be of the insulating type.
4. Provide double locknuts at all panels.
5. Bond all conduits, at entrance and exit of equipment, to the equipment ground bus or lug.
6. Provide bonding jumpers if conduits are installed in concentric knockouts.
7. Make all metallic raceway fittings and grounding clamps tight to ensure equipment grounding system will operate continuously at ground potential to provide low impedance current path for proper operation of overcurrent devices during possible ground fault conditions.

F. Equipment Grounding:
1. Ground all utilization equipment with an equipment grounding conductor.

G. Manhole and Handhole Grounding:
1. Provide a ground rod and ground bar, when indicated or as needed, in each manhole and handhole with exposed metal parts.
a. Expose a minimum of 4 inches of the rod above the floor for field connections to the rod.
2. Connect all exposed metal parts (e.g., conduits and cable racks) to the ground rod.

H. Pad Mounted Transformer Grounding:
   1. Per detail on the Drawings.
   2. Provide a ground ring around transformer with:
      a. A minimum of four ground rods located at the corners.
      b. A ground rod connected to the ring and located in the conduit stub up area.
      c. Or as indicated on the Drawings.
   3. Connect medium voltage cable shields to the ground rod.
   4. Connect surge arrestor to the ground rod.
   5. Connect the XO and ground pad to the ground rod.
   6. Connect exposed metallic conduits to the ground rod.

I. Prefabricated Composite Material Test Station:
   1. Place test station on a foundation of compacted 1/4 to 1/2 inches crushed rock or gravel a minimum of 8 inches thick and 6 inches larger than handholes footprint on all sides.
   2. Provide concrete encasement ring around test station per manufacturers installation instructions (minimum of 10 inches wide x 12 inches deep).

3.2 FIELD QUALITY CONTROL

A. Leave grounding system uncovered until observed by Owner.

B. Acceptance testing:
   1. See Specification Section 26 08 13.

END OF SECTION

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SECTION 26 05 33
RACEWAYS AND BOXES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Material and installation requirements for:
      a. Conduits.
      b. Conduit fittings.
      c. Conduit supports.
      d. Wireways.
      e. Outlet boxes.
      f. Pull and junction boxes.

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 26 05 00 - Electrical - Basic Requirements.
   2. Section 26 05 43 - Electrical - Exterior Underground.
   3. Section 26 27 26 - Wiring Devices.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Aluminum Association (AA).
   2. American Iron and Steel Institute (AISI).
   3. ASTM International (ASTM):
      a. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
      b. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
      c. D2564, Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
   4. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
      b. RN 1, Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
      c. TC 2, Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
      d. TC 3, Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.
      e. TC 14.AG, Aboveground Reinforced Thermosetting Resin Conduit and Fittings.
      f. TC 14.BG, Belowground Reinforced Thermosetting Resin Conduit and Fittings.
   5. National Electrical Manufacturers Association/American National Standards Institute (NEMA/ANSI):
      a. C80.1, Electric Rigid Steel Conduit (ERSC).
      b. C80.3, Steel Electrical Metallic Tubing (EMT).
      c. C80.5, Electrical Aluminum Rigid Conduit (ERAC).
      d. OS 1, Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
   6. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).
   7. Underwriters Laboratories, Inc. (UL):
      a. 1, Standard for Flexible Metal Conduit.
      b. 6, Electrical Rigid Metal Conduit - Steel.
      c. 50, Enclosures for Electrical Equipment, Non-Environmental Considerations.
      d. 360, Standard for Liquid-Tight Flexible Metal Conduit.
      e. 467, Grounding and Bonding Equipment.
      f. 514A, Metallic Outlet Boxes.

g. 514B, Conduit, Tubing, and Cable Fittings.
h. 651, Standard for Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings.
i. 797, Electrical Metallic Tubing - Steel.
j. 870, Standard for Wireways, Auxiliary Gutters, and Associated Fittings.
k. 1203, Standard for Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations.
l. 2420, Belowground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.
m. 2515, Aboveground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.

1.3 SUBMITTALS

A. Shop Drawings:
1. Product technical data:
a. Provide submittal data for all products specified in PART 2 of this Specification Section except:
1) Conduit fittings.
2) Support systems.
b. See Specification Section 26 05 00 for additional requirements.
2. Fabrication and/or layout drawings:
a. Identify dimensional size of pull and junction boxes to be used.

1.4 DELIVERY, STORAGE, AND HANDLING

A. See Specification Section 26 05 00.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Rigid metal conduits and electrical metallic tubing:
a. Allied Tube and Conduit.
b. Western Tube and Conduit Corporation.
c. Wheatland Tube.
d. Patriot Aluminum Products, LLC.
2. PVC coated rigid metal conduits:
a. Robroy Industries.
b. Atkore - Calbond
3. Rigid nonmetallic conduit:
a. Prime Conduit.
b. Cantex, Inc.
c. Osburn Associates, Inc.
4. Flexible conduit:
a. AFC Cable Systems.
b. Anamet, Inc.
c. Electri-Flex Company.
d. International Metal Hose Company.
e. Southwire Company, LLC.
5. Wireway:
a. Hoffman Engineering.
b. Wiegmann by Hubbell.
c. Square D by Schneider Electric.
6. Conduit fittings and accessories:
a. Appleton by Emerson Electric Co.
b. Carlon by Thomas & Betts.
c. Cantex, Inc.
d. Crouse-Hinds by Eaton.

e. Killark by Hubbell.
f. Osburn Associates, Inc.
g. O-Z/Gedney by Emerson Electric Co.
h. Raco by Hubbell.
i. Steel City by Thomas & Betts.
j. Thomas & Betts.

7. Support systems:
   a. Unistrut by Atkore International, Inc.
   b. B-Line by Eaton.
   c. Kindorf by Thomas & Betts.
   d. Minerallac Company.
   e. CADDY by Pentair.
   f. Superstrut by Thomas & Betts.
8. Outlet, pull and junction boxes:
   a. Appleton by Emerson Electric Co.
   b. Crouse-Hinds by Eaton
   c. Killark by Hubbell.
   d. O-Z/Gedney by Emerson Electric Co.
   e. Steel City by Thomas & Betts.
   f. Raco by Hubbell
   g. Bell by Hubbell.
   h. Hoffman Engineering.
   i. Wiegmann by Hubbell.
   j. B-Line by Eaton.
   k. Adalet.
   l. RITTAL North America LLC.
   m. Stahlin by Robroy Enclosures.

2.2 RIGID METAL CONDUITS

A. Rigid Galvanized Steel Conduit (RGS):
   1. Mild steel with continuous welded seam.
   2. Metallic zinc applied by hot-dip galvanizing or electro-galvanizing.
   3. Threads galvanized after cutting.
   4. Internal coating: Baked lacquer, varnish or enamel for a smooth surface.
   5. Standards: NFPA 70 Type RMC, NEMA/ANSI C80.1, UL 6.

B. PVC-Coated Rigid Steel Conduit (PVC-RGS):
   1. Nominal 40 mil Polyvinyl Chloride Exterior Coating:
      a. Coating: Bonded to hot-dipped galvanized rigid steel conduit conforming to NEMA/ANSI C80.1.
      b. The bond between the PVC coating and the conduit surface: Greater than the tensile strength of the coating.
   2. Nominal 2 mil, minimum, urethane interior coating.
   3. Urethane coating on threads.
   4. Conduit: Epoxy prime coated prior to application of PVC and urethane coatings.
   5. Female Ends:
      a. Have a plastic sleeve extending a minimum of one pipe diameter or 2 inches, whichever is less beyond the opening.
      b. The inside diameter of the sleeve shall be the same as the outside diameter of the conduit to be used with it.
   6. Pass high temperature water PVC coating adhesion test and be ETL Verified PVC-001.
   7. Standards: NFPA 70 Type RMC, NEMA/ANSI C80.1, UL 6, NEMA RN 1.

C. Rigid Aluminum Conduit (RAC):
   1. AA Type 6063 aluminum alloy, T-1 temper.
   2. Maximum copper content of 0.10%.

3. Extruded, seamless.
4. Standards: NFPA 70 Type RMC, NEMA/ANSI C80.5, UL 6.

2.3 RIGID NONMETALLIC CONDUIT

A. Schedules 40 (PVC-40) and 80 (PVC-80):
   1. Polyvinyl-chloride (PVC) plastic compound which includes inert modifiers to improve weatherability and heat distribution.
   2. Rated for direct sunlight exposure.
   3. Fire retardant and low smoke emission.
   4. Shall be suitable for use with 90 degrees C wire and shall be marked "maximum 90 degrees C".
   5. Standards: NFPA 70 Type PVC, NEMA TC 2, UL 651.

2.4 FLEXIBLE CONDUIT

A. Flexible Galvanized Steel Conduit (FLEX):
   1. Formed of continuous, spiral wound, hot-dip galvanized steel strip with successive convolutions securely interlocked.
   2. Standard: NFPA 70 Type FMC, UL 1.

B. PVC-Coated Flexible Galvanized Steel (liquid-tight) Conduit (FLEX-LT):
   1. Core formed of continuous, spiral wound, hot-dip galvanized steel strip with successive convolutions securely interlocked.
   2. Extruded PVC outer jacket positively locked to the steel core.
   3. Liquid and vaportight.
   4. Standard: NFPA 70 Type LFMC, UL 360.

2.5 WIREWAY

A. General:
   1. Suitable for lay-in conductors.
   2. Designed for continuous grounding.
   3. Covers:
      a. Hinged or removable in accessible areas.
      b. Non-removable when passing through partitions.
   4. Finish: Rust inhibiting primer and manufacturer's standard paint inside and out except for stainless steel type.
   5. Standards: UL 870, NEMA 250.

B. General Purpose (NEMA 1 rated) Wireway:
   1. 14 or 16 gage steel without knockouts.
   2. Cover: Solid, non-gasketed and held in place by captive screws.

C. Raintight (NEMA 3R) Wiring Trough:
   1. 14 or 16 GA galvanized steel without knockouts.
   2. Cover: Non-gasketed and held in place by captive screws.

D. Watertight (NEMA 4X rated) Wireway:
   1. 14 GA Type 304 or 316 stainless steel bodies and covers without knockouts and 10 GA stainless steel flanges.
   2. Cover: Fully gasketed and held in place with captive clamp type latches.
   3. Flanges: Fully gasketed and bolted.

E. Dusttight (NEMA 12 rated) Wireway:
   1. 14 GA steel bodies and covers without knockouts and 10 GA steel flanges.
   2. Cover: Fully gasketed and held in place with captive clamp type latches.
   3. Flanges: Fully gasketed and bolted.

2.6 CONDUIT FITTINGS AND ACCESSORIES

A. Fittings for Use with RGS and RAC:

1. General:
   a. In hazardous locations listed for use in Class I, Groups C and D locations.
2. Locknuts:
   a. Threaded steel or malleable iron.
   b. Gasketed or non-gasketed.
   c. Grounding or non-grounding type.
3. Bushings:
   a. Threaded, insulated metallic.
   b. Grounding or non-grounding type.
4. Hubs: Threaded, insulated and gasketed metallic for raintight connection.
5. Couplings:
   a. Threaded straight type: Same material and finish as the conduit with which they are used on.
   b. Threadless type: Gland compression or self-threading type, concrete tight.
6. Unions: Threaded galvanized steel or zinc plated malleable iron.
7. Conduit bodies (ells and tees):
   a. Body: Zinc plated cast iron or cast copper free aluminum with threaded hubs.
   b. Standard and mogul size.
   c. Cover:
      1) Clip-on type with stainless steel screws.
      2) Gasketed or non-gasketed galvanized steel, zinc plated cast iron or cast copper free aluminum.
8. Conduit bodies (round):
   a. Body: Zinc plated cast iron or cast copper free aluminum with threaded hubs.
   b. Cover: Threaded screw on type, gasketed, galvanized steel, zinc plated cast iron or cast copper free aluminum.
9. Sealing fittings:
   a. Body: Zinc plated cast iron or cast copper free aluminum with threaded hubs.
   b. Standard and mogul size.
   c. With or without drain and breather.
   d. Fiber and sealing compound: UL listed for use with the sealing fitting.
10. Hazardous location flexible coupling (HAZ-FLEX):
    a. Liquid tight and arc resistant.
    b. Electrically conductive so no bonding jumper is required.
    c. Dry and wet areas:
       1) Bronze braided covering over flexible brass core.
       2) Bronze end fittings.
       3) Zinc-plated steel or malleable iron unions and nipples.
    d. Corrosive areas:
       1) Stainless steel braided covering over flexible stainless steel core.
       2) Stainless steel end fittings.
       3) Aluminum unions and nipples.
11. Service entrance head:
    a. Malleable iron, galvanized steel or copper free aluminum.
    b. Insulated knockout cover for use with a variety of sizes and number of conductors.
12. Expansion couplings:
    a. 2 inches nominal straight-line conduit movement in either direction.
    b. Galvanized steel with insulated bushing.
    c. Gasketed for wet locations.
    d. Internally or externally grounded.
13. Expansion/deflection couplings:
    a. 3/4 inches nominal straight-line conduit movement in either direction.
    b. 30 degrees nominal deflection from the normal in all directions.
    c. Metallic hubs, neoprene outer jacket and stainless steel jacket clamps.
    d. Internally or externally grounded.

e. Watertight, raintight and concrete tight.

14. Standards: UL 467, UL 514B, UL 1203.

B. Fittings for Use with PVC-RGS:
1. The same material and construction as those fittings listed under paragraph "Fittings for Use with RGS and RAC" and coated as defined under paragraph "PVC Coated Rigid Steel Conduit (PVC-RGS)."

C. Fittings for Use with FLEX:
1. Connector:
a. Zinc plated malleable iron.
b. Squeeze or clamp-type.
2. Standard: UL 514B.

D. Fittings for Use with FLEX-LT:
1. Connector:
a. Straight or angle type.
b. Metal construction, insulated and gasketed.
c. Composed of locknut, grounding ferrule and gland compression nut.
d. Liquid tight.
2. Standards: UL 467, UL 514B.

E. Fittings for Use with Rigid Nonmetallic PVC Conduit:
1. Coupling, adapters and conduit bodies:
a. Same material, thickness, and construction as the conduits with which they are used.
b. Homogeneous plastic free from visible cracks, holes or foreign inclusions.
c. Bore smooth and free of blisters, nicks or other imperfections which could damage the conductor.
2. Solvent cement for welding fittings shall be supplied by the same manufacturer as the conduit and fittings.
3. Standards: ASTM D2564, NEMA TC 3, UL 651, UL 514B.

F. Weather and Corrosion Protection Tape:
1. PVC based tape, 10 mils thick.
2. Protection against moisture, acids, alkalis, salts and sewage and suitable for direct bury.
3. Used with appropriate pipe primer.

2.7 ALL RACEWAY AND FITTINGS

A. Mark Products:
1. Identify the nominal trade size on the product.
2. Stamp with the name or trademark of the manufacturer.

2.8 OUTLET BOXES

A. Metallic Outlet Boxes:
1. Hot-dip galvanized steel.
2. Conduit knockouts and grounding pigtail.
3. Styles:
a. 2 inches x 3 inches rectangle.
b. 4 inches square.
c. 4 inches octagon.
d. Masonry/tile.
4. Accessories:
a. Flat blank cover plates.
b. Barriers.
c. Extension, plaster or tile rings.
d. Box supporting brackets in stud walls.
e. Adjustable bar hangers.
5. Standards: NEMA/ANSI OS 1, UL 514A.

B. Cast Outlet Boxes:
   1. Zinc plated cast iron or die-cast copper free aluminum with manufacturer's standard finish.
   2. Threaded hubs and grounding screw.
   3. Styles:
      a. "FS" or "FD".
      b. "Bell".
      c. Single or multiple gang and tandem.
      d. "EDS" or "EFS" for hazardous locations.
   4. Accessories: 40 mil PVC exterior coating and 2 mil urethane interior coating.
   5. Standards: UL 514A, UL 1203.

C. See Specification Section 26 27 26 for wiring devices, wallplates and coverplates.

2.9 PULL AND JUNCTION BOXES

A. NEMA 1 Rated:
   1. Body and cover: 14 GA minimum, galvanized steel or 14 GA minimum, steel finished with rust inhibiting primer and manufacturers standard paint inside and out.
   2. With or without concentric knockouts on four sides.
   3. Flat cover fastened with screws.

B. NEMA 4 Rated:
   1. Body and cover: 14 GA steel finished with rust inhibiting primer and manufacturers standard paint inside and out.
   2. Seams continuously welded and ground smooth.
   3. No knockouts.
   4. External mounting flanges.
   5. Hinged or non-hinged cover held closed with stainless steel screws and clamps.
   6. Cover with oil resistant gasket.

C. NEMA 4X Rated (metallic):
   1. Body and cover: 14 GA Type 304 or 316 stainless steel.
   2. Seams continuously welded and ground smooth.
   3. No knockouts.
   4. External mounting flanges.
   5. Hinged door and stainless steel screws and clamps.
   6. Door with oil-resistant gasket.

D. NEMA 4X Rated (Nonmetallic):
   1. Body and cover: Ultraviolet light protected fiberglass-reinforced polyester boxes.
   2. No knockouts.
   3. External mounting flanges.
   4. Hinged door with quick release latches and padlocking hasp.
   5. Door with oil resistant gasket.

E. NEMA 7 and NEMA 9 Rated:
   1. Cast gray iron alloy or copper-free aluminum with manufacturer's standard finish.
   2. Drilled and tapped openings or tapered threaded hub.
   3. Cover bolted-down with stainless steel bolts or threaded cover with neoprene gasket.
   4. External mounting flanges.
   5. Grounding lug.
   6. Accessories: 40 mil PVC exterior coating and 2 mil urethane interior coating.

F. NEMA 12 Rated:
   1. Body and cover:
      a. 14 GA steel finished with rust inhibiting primer and manufacturers standard paint inside and out.
      b. Type 5052 H-32 aluminum, unpainted.
   2. Seams continuously welded and ground smooth.

3. No knockouts.
4. External mounting flanges.
5. Non-hinged cover held closed with captivated cover screws threaded into sealed wells or hinged cover held closed with stainless steel screws and clamps.
6. Flat door with oil resistant gasket.

G. Miscellaneous Accessories:
1. Rigid handles for covers larger than 9 square feet or heavier than 25 pounds.
2. Split covers when heavier than 25 pounds.
3. Weldnuts for mounting optional panels and terminal kits.
4. Terminal blocks: Screw-post barrier-type, rated 600 volt and 20 ampere minimum.

H. Standards: NEMA 250, UL 50.

2.10 SUPPORT SYSTEMS

A. Multi-conduit Surface or Trapeze Type Support and Pull or Junction Box Supports:
1. Material requirements.
a. Galvanized steel: ASTM A123/A123M or ASTM A153/A153M.
b. Stainless steel: AISI Type 316.
c. PVC coat galvanized steel: ASTM A123/A123M or ASTM A153/A153M and 20 mil PVC coating.

B. Single Conduit and Outlet Box Support Fasteners:
1. Material requirements:
a. Zinc plated steel.
b. Stainless steel.
c. Malleable iron.
d. PVC coat malleable iron or steel: 20 mil PVC coating.
e. Steel protected with zinc phosphate and oil finish.

2.11 OPENINGS AND PENETRATIONS IN WALLS AND FLOORS

A. Sleeves, smoke and fire stop fitting through walls and floors:
1. See Specification Section 01 73 20.

PART 3 - EXECUTION

3.1 RACEWAY INSTALLATION - GENERAL

A. Shall be in accordance with the requirements of:
1. NFPA 70.
2. Manufacturer instructions.

B. Size of Raceways:
1. Raceway sizes are shown on the Drawings, if not shown on the Drawings, then size in accordance with NFPA 70.
2. Unless specifically indicated otherwise, the minimum raceway size shall be:
a. Conduit: 3/4 inches.
b. Wireway: 2-1/2 inches x 2-1/2 inches.

C. Field Bending and Cutting of Conduits:
1. Utilize tools and equipment recommended by the manufacturer of the conduit, designed for the purpose and the conduit material to make all field bends and cuts.
2. Do not reduce the internal diameter of the conduit when making conduit bends.
3. Prepare tools and equipment to prevent damage to the PVC coating.
4. Degrease threads after threading and apply a zinc rich paint.
5. Debur interior and exterior after cutting.

D. Male threads of conduit systems shall be coated with an electrically conductive anti-seize compound.

E. The protective coating integrity of conduits, fittings, outlet, pull and junction boxes and accessories shall be maintained.
   1. Repair galvanized components utilizing a zinc rich paint.
   2. Repair painted components utilizing touch up paint provided by or approved by the manufacturer.
   3. Repair PVC coated components utilizing a patching compound, of the same material as the coating, provided by the manufacturer of the conduit; or a self-adhesive, highly conformable, cross-linked silicone composition strip, followed by a protective coating of vinyl tape.
      a. Total nominal thickness: 40 mil.
   4. Repair surfaces which will be inaccessible after installation prior to installation.

F. Remove moisture and debris from conduit before wire is pulled into place.
   1. Pull mandrel with diameter nominally 1/4 inches smaller than the interior of the conduit, to remove obstructions.
   2. Swab conduit by pulling a clean, tight-fitting rag through the conduit.
   3. Tightly plug ends of conduit with tapered wood plugs or plastic inserts until wire is pulled.

G. Only nylon or polyethylene rope shall be used to pull wire and cable in conduit systems.

H. Contractor shall provide pull string in all spare conduits.

I. Where portions of a raceway are subject to different temperatures and where condensation is known to be a problem, as in cold storage areas of buildings or where passing from the interior to the exterior of a building, the raceway shall be sealed to prevent circulation of warm air to colder section of the raceway.

J. Fill openings in walls, floors, and ceilings and finish flush with surface.
   1. See Specification Section 01 73 20.

3.2 RACEWAY ROUTING

A. Raceways shall be routed in the field unless otherwise indicated.
   1. Conduit and fittings shall be installed, as required, for a complete system that has a neat appearance and is in compliance with all applicable codes.
   2. Run in straight lines parallel to or at right angles to building lines.
   3. Do not route conduits:
      a. Through areas of high ambient temperature or radiant heat.
      b. In suspended concrete slabs.
      c. In concrete members including slabs, slabs on grade, beams, walls, and columns unless specifically located and detailed on structural Drawings..
   4. Locate sleeves or conduits penetrating floors, walls, and beams so as not to significantly impair the strength of the construction. Do not place conduit penetrations in columns.
   5. Conduit shall not interfere with, or prevent access to, piping, valves, ductwork, or other equipment for operation, maintenance and repair.
   6. Provide pull boxes or conduit bodies as needed so that there is a maximum of 360 degrees of bends in the conduit run or in long straight runs to limit pulling tensions.

B. All conduits within a structure shall be installed exposed except as follows:
   1. As indicated on the Drawings.
   2. Concealed above gypsum wall board or acoustical tile suspended ceilings.
   3. Conduits in architecturally finished areas shall be concealed.

C. Maintain minimum spacing between parallel conduit and piping runs in accordance with the following when the runs are greater than 30 feet:
   1. Between instrumentation and telecommunication: 1 inch.
   2. Between instrumentation and 125 V, 48 V and 24 VDC, 2 inches.

3. Between instrumentation and 600 V and less AC power or control: 6 inches.
4. Between instrumentation and greater than 600 VAC power: 12 inches.
5. Between telecommunication and 125 V, 48 V and 24 VDC, 2 inches.
6. Between telecommunication and 600 V and less AC power or control: 6 inches.
7. Between telecommunication and greater than 600 VAC power: 12 inches.
8. Between 125 V, 48 V and 24 VDC and 600 V and less AC power or control: 2 inches.
9. Between 125 V, 48 V and 24 VDC and greater than 600 VAC power: 2 inches.
10. Between 600 V and less AC and greater than 600 VAC: 2 inches.
11. Between process, gas, air and water pipes: 6 inches.

D. Conduits shall be installed to eliminate moisture pockets.
   1. Where water cannot drain to openings, provide drain fittings in the low spots of the conduit run.

E. Conduit shall not be routed on the exterior of structures except as specifically indicated on the Drawings.

F. Where sufficient room exists within the housing of roof-mounted equipment, the conduit shall be stubbed up inside the housing.

G. Provide all required openings in walls, floors, and ceilings for conduit penetration.
   1. See Specification Section 01 73 20.

3.3 RACEWAY APPLICATIONS

A. Permitted Raceway Types Per Wire or Cable Types:
   1. Power wire or cables: All raceway types.
   2. Control wire or cables: All raceway types.
   3. Instrumentation cables: Metallic raceway except nonmetallic may be used underground.
   4. Motor leads from a VFD: RGS, RAC or shielded VFD cables in all other raceways.
   5. Telecommunication cables: All raceway types.

B. Permitted Raceway Types Per Area Designations:
   1. Dry areas:
      a. RGS.
      b. RAC.
   2. Wet areas:
      a. RAC.
   3. Corrosive areas:
      a. RAC.
   4. NFPA 70 hazardous areas:
      a. RAC when required by other area designations.

C. Permitted Raceway Types Per Routing Locations:
   1. In concrete block or brick walls:
      a. PVC-40.
   2. Above acoustical tile ceilings:
      a. RAC.
      b. NEMA 1 rated wireway.
   3. Embedded in poured concrete walls and floors:
      a. PVC-40.
      b. PVC-RGS when emerging from concrete into areas designated as wet, corrosive or highly corrosive.
   4. Beneath floor slab-on-grade:
      a. PVC-40.
   5. Through floor penetrations, see Specification Section 01 73 20:
      a. PVC-RGS in areas designated as wet, corrosive or highly corrosive.
   6. Direct buried conduits and ductbanks:
      a. PVC-80.

b. 90 degrees elbows for transitions to above grade:
   1) PVC-RGS.
c. Long sweeping bends greater than 15 degrees:
   1) PVC-RGS.

7. Concrete encased ductbanks:
   a. PVC-40.
   b. 90 degree elbows for transitions to above grade:
      1) PVC-RGS.
   c. Long sweeping bends greater than 15 degrees:
      1) RGS for sizes 2 inches and larger.

D. FLEX conduits shall be installed for connections to light fixtures, HVAC equipment and other similar devices above the ceilings.
   1. The maximum length shall not exceed:
      a. 6 feet to light fixtures.
      b. 3 feet to all other equipment.

E. FLEX-LT conduits shall be installed as the final conduit connection to light fixtures, dry type transformers, motors, electrically operated valves, instrumentation primary elements, and other electrical equipment that is liable to vibrate.
   1. The maximum length shall not exceed:
      a. 6 feet to light fixtures.
      b. 3 feet to motors.
      c. 2 feet to all other equipment.

F. HAZ-FLEX coupling shall be installed as the final conduit to motors, electrically operated valves, instrumentation primary elements and electrical equipment that is liable to vibrate.
   1. The maximum length shall not exceed:
      a. 3 feet to motors.
      b. 2 feet to all other equipment.

G. NEMA 1 Rated Wireway:
   1. Surface mounted in electrical rooms.
   2. Surface mounted above removable ceilings tiles of an architecturally finished area.

H. NEMA 3R Wiring Trough:
   1. Surface mounted in exterior locations.

I. NEMA 4X Rated Wireway:
   1. Surface mounted in areas designated as wet and or corrosive.

J. NEMA 12 Rated Wireway:
   1. Surface mounted in areas designated as dry in architecturally and non-architecturally finished areas.

K. Underground Conduit: See Specification Section 26 05 43.

3.4 CONDUIT FITTINGS AND ACCESSORIES

A. Conduit Seals:
   1. Installed in conduit systems located in hazardous areas as required by the NFPA 70.
   2. Fill plug and drain shall be accessible.
   3. Pour the conduit seals in a two-step process.
      a. Pour the seal and leave cover off.
      b. After seal is dry, inspect for proper sealing, install cover and mark (for example, paint or permanent marker) as complete.

B. Rigid nonmetallic conduit and fittings shall be joined utilizing solvent cement.
   1. Immediately after installation of conduit and fitting, the fitting or conduit shall be rotated 1/4 turn to provide uniform contact.

C. Install Expansion Fittings:
   1. Where conduits are exposed to the sun and conduit run is greater than 200 feet.
   2. Elsewhere as identified on the Drawings.

D. Install Expansion/Deflection Fittings:
   1. Where conduits enter a structure.
      a. Except electrical manholes and handholes.
      b. Except where the ductbank is tied to the structure with rebar.
   2. Where conduits span structural expansions joints.
   3. Elsewhere as identified on the Drawings.

E. Threaded connections shall be made wrench-tight.

F. Conduit joints shall be watertight:
   1. Where subjected to possible submersion.
   2. In areas classified as wet.
   3. Underground.

G. Terminate Conduits:
   1. In metallic outlet boxes:
      a. RGS and RAC:
         1) Conduit hub and locknut.
         2) Insulated bushing and two locknuts.
         3) Use grounding type locknut or bushing when required by NFPA 70.
      b. EMT: Compression type connector and locknut.
   2. In NEMA 1 rated enclosures:
      a. RGS and RAC:
         1) Conduit hub and locknut.
         2) Insulated bushing and two locknuts.
         3) Use grounding type locknut or bushing when required by NFPA 70.
      b. EMT: Compression type connector and locknut.
   3. In NEMA 12 rated enclosures:
      a. Watertight, insulated and gasketed hub and locknut.
      b. Use grounding type locknut or bushing when required by NFPA 70.
   4. In NEMA 4 and NEMA 4X rated enclosures:
      a. Watertight, insulated and gasketed hub and locknut.
   5. In NEMA 7 and NEMA 9 rated enclosures:
      a. Into an integral threaded hub.
   6. When stubbed up through the floor into floor mount equipment:
      a. With an insulated grounding bushing on metallic conduits.
      b. With end bells on nonmetallic conduits.

H. Threadless couplings shall only be used to join new conduit to existing conduit when the existing conduit end is not threaded and it is not practical or possible to cut threads on the existing conduit with a pipe threader.

3.5 CONDUIT SUPPORT

A. Permitted multi-conduit surface or trapeze type support system per area designations and conduit types:
   1. Dry or wet and/or hazardous areas:
      a. Aluminum system consisting of: Aluminum channels, fittings and conduit clamps with stainless steel nuts and hardware.
   2. Corrosive areas:
      a. Aluminum system consisting of: Aluminum channels, fittings and conduit clamps with stainless steel nuts and hardware.
   3. Conduit type shall be compatible with the support system material.
      a. Aluminum system may be used with RAC and PVC-RGS.

B. Permitted single conduit support fasteners per area designations and conduit types:
   1. Dry or wet and/or hazardous areas:
      a. Material: Zinc plated steel, stainless steel and malleable iron.
      b. Types of fasteners: Straps, hangers with bolts, clamps with bolts and bolt on beam clamps.
   2. Corrosive areas:
      a. Material: Stainless steel and PVC coat malleable iron or steel.
      b. Types of fasteners: Straps, hangers with bolts, clamps with bolts and bolt on beam clamps.
   3. Conduit type shall be compatible with the support fastener material.
      a. Stainless steel system may be used with RGS and RAC.

C. Conduit Support General Requirements:
   1. Maximum spacing between conduit supports per NFPA 70.
   2. Support conduit from the building structure.
   3. Do not support conduit from process, gas, air or water piping; or from other conduits.
   4. Provide hangers and brackets to limit the maximum uniform load on a single support to 25 LBS or to the maximum uniform load recommended by the manufacturer if the support is rated less than 25 pounds.
      a. Do not exceed maximum concentrated load recommended by the manufacturer on any support.
      b. Conduit hangers:
         1) Continuous threaded rods combined with struts or conduit clamps: Do not use perforated strap hangers and iron bailing wire.
      c. Do not use suspended ceiling support systems to support raceways.
      d. Hangers in metal roof decks:
         1) Utilize fender washers.
         2) Not extend above top of ribs.
         3) Not interfere with vapor barrier, insulation, or roofing.
   5. Conduit support system fasteners:
      a. Use sleeve-type expansion anchors as fasteners in masonry wall construction.
      b. Do not use concrete nails and powder-driven fasteners.

3.6 OUTLET, PULL AND JUNCTION BOX INSTALLATION

A. General:
   1. Install products in accordance with manufacturer's instructions.
   2. See Specification Section 26 05 00 and the Drawings for area classifications.
   3. Fill unused punched-out, tapped, or threaded hub openings with insert plugs.
   4. Size boxes to accommodate quantity of conductors enclosed and quantity of conduits connected to the box.

B. Outlet Boxes:
   1. Permitted uses of metallic outlet boxes:
      a. Housing of wiring devices:
         1) Recessed in all stud framed walls and ceilings.
         2) Recessed in poured concrete, concrete block and brick walls of architecturally finished areas and exterior building walls.
      b. Pull or junction box:
         1) Above gypsum wall board or acoustical tile ceilings.
         2) Above 10 feet in an architecturally finished area where there is no ceiling.
   2. Permitted uses of cast outlet boxes:
      a. Housing of wiring devices surface mounted in non-architecturally finished dry, wet, corrosive, highly corrosive and hazardous areas.
      b. Pull and junction box surface mounted in non-architecturally finished dry, wet, corrosive and highly corrosive areas.

3. Mount device outlet boxes where indicated on the Drawings and at heights as scheduled in Specification Section 26 05 00.
4. Set device outlet boxes plumb and vertical to the floor.
5. Outlet boxes recessed in walls:
   a. Install with appropriate stud wall support brackets or adjustable bar hangers so that they are flush with the face of the wall.
   b. Locate in ungrouted cell of concrete block with bottom edge of box flush with bottom edge of block and flush with the face of the block.
6. Place barriers between switches in boxes with 277 V switches on opposite phases.
7. Back-to-back are not permitted.
8. When an outlet box is connected to a PVC coated conduit, the box shall also be PVC coated.

C. Pull and Junction Boxes:
1. Install pull or junction boxes in conduit runs where indicated or required to facilitate pulling of wires or making connections.
   a. Make covers of boxes accessible.
2. Permitted uses of NEMA 1 enclosure:
   a. Pull or junction box surface mounted above removable ceiling tiles of an architecturally finished area.
3. Permitted uses of NEMA 4 enclosure:
   a. Pull or junction box surface mounted in areas designated as wet.
4. Permitted uses of NEMA 4X metallic enclosure:
   a. Pull or junction box surface mounted in areas designated as wet and/or corrosive.
5. Permitted uses of NEMA 7 enclosure:
   a. Pull or junction box surface mounted in areas designated as Class I hazardous.
      1) Provide PVC coating in corrosive and highly corrosive areas when PVC coated conduit is used.
6. Permitted uses of NEMA 12 enclosure:
   a. Pull or junction box surface mounted in areas designated as dry.

END OF SECTION

SECTION 26 05 43
ELECTRICAL - EXTERIOR UNDERGROUND

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Material and installation requirements for:
      a. Manholes.
      b. Handhole.
      c. Underground conduits and ductbanks.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 03 - Concrete.
   2. Section 03 11 13 - Formwork.
   3. Section 03 21 00 - Reinforcement.
   4. Section 03 31 30 - Concrete, Materials and Proportioning.
   5. Section 03 35 00 - Concrete Finishing and Repair of Surface Defects.
   6. Section 10 14 00 - Identification Devices.
   7. Section 26 05 26 - Grounding.
   8. Section 26 05 33 - Raceways and Boxes.
   9. Section 31 23 05 – Excavation and fill.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Association of State Highway and Transportation Officials (AASHTO):
      a. HB-17, Standard Specifications for Highway Bridges.
   2. ASTM International (ASTM):
      a. A536, Standard Specification for Ductile Iron Castings.
   3. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).
   4. Society of Cable Telecommunications Engineers (SCTE):
      a. 77, Specifications for Underground Enclosure Integrity.

1.3 DEFINITIONS

A. Direct-Buried Conduit(s):
   1. Individual (single) underground conduit.
   2. Multiple underground conduits, arranged in one or more planes, in a common trench.

B. Concrete Encased Ductbank: An individual (single) or multiple conduit(s), arranged in one or more planes, encased in a common concrete envelope.

1.4 SUBMITTALS

A. Shop Drawings:
   1. Product technical data:
      a. Provide submittal data for all products specified in PART 2 of this Specification Section.
      b. Provide signed and sealed design computations for manholes and handholes indicating compliance with design load rating.
   2. Fabrication and/or layout drawings:
      a. Provide dimensional drawings of each manhole and handhole indicating all specified accessories and conduit entry locations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Prefabricated composite handholes:
      a. Armorcast Products Company.
      b. Quazite by Hubbell.
      c. Synertech by Oldcastle Enclosure Solutions.
   2. Precast manholes and handholes:
      a. Lister Industries Ltd.
      b. Oldcastle Enclosure Solutions.
      c. Jensen Precast and Utility Concrete Products.
   3. Manhole and handhole and ductbank accessories:
      a. Cantex, Inc.
      b. Condux International, Inc.
      c. Neenah Enterprises, Inc.
      d. Prime Conduit.
      e. Thomas and Betts.
      f. Underground Devices, Inc.
      g. Unistrut by Atkore International, Inc.

2.2 MANHOLES AND HANDHOLES

A. Prefabricated Composite Material Handholes:
   1. Handhole body and cover: Fiberglass reinforced polymer concrete conforming to all test provisions of SCTE 77.
   2. Minimum load ratings: SCTE 77 Tier 15.
   3. Open bottom.
   4. Stackable design as required for specified depth.
   5. Cover:
      a. Engraved legend of "ELECTRIC" or "COMMUNICATIONS".
      b. Non-gasketed bolt down with stainless steel penta head bolts.
      c. Lay-in non-bolt down, when cover is over 100 pounds.
      d. One or multiple sections so the maximum weight of a section is 125 pounds.
   6. Cover lifting hook: 24 inches minimum in length.

B. Precast Manholes and Handholes:
   1. Fiberglass reinforced polymer concrete or steel reinforced cement concrete structures:
   2. AASHTO live load rating: H-20 for full deliberate vehicle traffic.
   3. Mating edges: Tongue and groove type.
   4. Solid bottom with a 12 inches x 12 inches or 12 inches diameter french drain in the bottom of each manhole.
   5. Cable pulling eyes opposite all conduit entrances.
      a. Coordinate exact location with installation contractor.

2.3 CONCRETE MANHOLE AND HANDHOLE ACCESSORIES

A. Cover and Frame:
   1. Cast ductile iron: ASTM A536.
   2. AASHTO live load rating: H-20.
   3. Diameter: 30 inches.
   4. Cast the legend "ELECTRICAL" or "COMMUNICATIONS" into manhole and handhole covers.

B. Cable Racks and Hooks:
   1. Material: Heavy-duty nonmetallic (glass reinforced nylon).
   2. Hook loading capacity: 400 pounds minimum.

3. Rack loading capacity: Four hooks maximum.
4. Hook deflection: 0.25 inches maximum.
5. Hooks: Length, as required, with positive locking device to prevent upward movement.
6. Mounding hardware: Stainless steel.

C. Cable Pulling Irons:
1. 7/8 inches diameter hot-dipped galvanized steel.
2. 6000 pound minimum pulling load.

D. Ground Rods and Grounding Equipment: See Specification Section 26 05 26.

2.4 UNDERGROUND CONDUIT AND ACCESSORIES

A. Concrete and reinforcing steel: See Division 03 Specifications.

B. Conduit: See Specification Section 26 05 33.

C. Duct Spacers/Supports:
1. High density polyethylene or high impact polystyrene.
2. Interlocking web or mesh design.
3. Provide 3 inches minimum spacing between conduits.
4. Accessories, as required:
a. Hold down bars.
b. Ductbank strapping.

PART 3 - EXECUTION

3.1 GENERAL

A. Drawings indicate the intended location of manholes and handholes and routing of ductbanks and direct buried conduit.
1. Field conditions may affect actual routing.

B. Manhole and Handhole Locations:
1. Approximately where shown on the Drawings.
2. As required for pulling distances.
3. As required to keep pulling tensions under allowable cable tensions.
4. As required for number of bends in ductbank routing.
5. Shall not be installed in a swale or ditch.
6. Determine the exact locations after careful consideration has been given to the location of other utilities, grading, and paving.
7. Locations are to be approved by the Engineer prior to excavation and placement or construction of manholes and handholes.

C. Install products in accordance with manufacturer's instructions.

D. Install manholes and handholes in conduit runs where indicated or as required to facilitate pulling of wires or making connections.

E. Comply with Specification Section 31 23 05 for trenching, backfilling and compacting.

3.2 MANHOLES AND HANDHOLES

A. Prefabricated Composite Material Handholes:
1. For use in areas subjected to occasional non-deliberate vehicular traffic.
2. Place handhole on a foundation of compacted 1/4 to 1/2 inches crushed rock or gravel a minimum of 8 inches thick and 6 inches larger than handholes footprint on all sides.
3. Provide concrete encasement ring around handhole per manufacturers installation instructions (minimum of 10 inches wide x 12 inches deep).
4. Install so that the surrounding grade is 1 inch lower than the top of the handhole.
5. Size: As indicated on the Drawings or as required for the number and size of conduits.

6. Provide cable rails and pulling eyes as needed.

B. Precast Manholes and Handholes:
   1. For use in vehicular and non-vehicular traffic areas.
   2. Construction:
      a. Grout or seal all joints, per manufacturer's instructions.
      b. Support cables on walls by cable racks:
         1) Provide a minimum of two racks, install symmetrically on each wall of manholes and handholes.
            a) Provide additional cable racks, as required, so that both ends of cable splices will be supported horizontally.
         2) Equip cable racks with adjustable hooks: Quantity of cable hooks as required by the number of conductors to be supported.
      c. In each manhole and handhole, drive 3/4 inches x 10 feet long copper clad ground rod into the earth with approximately 6 inches exposed above finished floor.
         1) Drill opening in floor for ground rod.
         2) Connect all metallic components to ground rod by means of #8 AWG minimum copper wire and approved grounding clamps.
         3) Utilize a ground bar in the manhole or handhole if the quantity of ground wires exceeds three.
            a) Connect ground bar to ground rod with a #2/0 AWG minimum copper wire.
   3. Place manhole or handhole on a foundation of compacted 1/4 to 1/2 inches crushed rock or gravel a minimum of 8 inches thick and 6 inches larger than manholes or handholes footprint on all sides.
   4. Install so that the top of cover is 1 inch above finished grade.
      a. Where existing grades are higher than finished grades, install sufficient number of courses of curved segmented concrete block between top of handhole and manhole frame to temporarily elevate manhole cover to existing grade level.
   5. After installation is complete, backfill and compact soil around manholes and handholes.
   6. Handhole size:
      a. As indicated on the Drawings or as required for the number and size of conduits entering or as indicated on the Drawings.
      b. Minimum floor dimension of 4 feet x 4 feet and minimum depth of 4 feet.
   7. Manhole size:
      a. As indicated on the Drawings or as required for the number and size of conduits entering or as indicated on the Drawings.
      b. Minimum floor dimension of 6 feet x 6 feet and a minimum depth of 6 feet.

3.3 UNDERGROUND CONDUITS

A. General Installation Requirements:
   1. Ductbank types per location:
      a. Reinforced concrete ductbank:
         1) Under roads.
      b. Concrete encased ductbank:
         1) Conduits containing medium voltage cables.
         2) Pad mounted transformer secondaries.
         3) Plant process equipment feeders and controls.
         4) As indicated in the Ductbank Schedule.
   2. Do not place concrete or soil until conduits have been observed by the Engineer.
   3. Ductbanks shall be sloped a minimum of 4 inches per 100 feet or as detailed on the Drawings.
      a. Low points shall be at manholes or handholes.
   4. During construction and after conduit installation is complete, plug the ends of all conduits.
   5. Provide conduit supports and spacers.
      a. Place supports and spacers for rigid nonmetallic conduit on maximum centers as indicated for the following trade sizes:

1) 1 inches and less: 3 feet.
2) 1-1/4 to 3 inches: 5 feet.
3) 3-1/2 to 6 inches: 7 feet.

b. Place supports and spacers for rigid steel conduit on maximum centers as indicated for the following trade sizes:
1) 1 inches and less: 10 feet.
2) 1-1/4 to 2-1/2 inches: 14 feet.
3) 3 inches and larger: 20 feet.

c. Securely anchor conduits to supports and spacers to prevent movement during placement of concrete or soil.

6. Stagger conduit joints at intervals of 6 inches vertically.
7. Make conduit joints watertight and in accordance with manufacturer's recommendations.
8. Accomplish underground changes in direction of runs exceeding a total of 15 degrees by long sweep bends having a minimum radius of 10 feet.
a. Sweep bends may be made up of one or more curved or straight sections or combinations thereof.
9. Furnish manufactured elbows at end of runs as the conduit transitions to above grade.
a. Minimum radius of 18 inches for conduits less than 3 inches trade size and 36 inches for conduits 3 inches trade size and larger.
10. Field cuts requiring tapers shall be made with the proper tools and shall match factory tapers.
11. After the conduit run has been completed:
a. Prove joint integrity and test for out-of-round duct by pulling a test mandrel through each conduit.
1) Test mandrel:
a) Length: Not less than 12 inches.
b) Diameter: Approximately 1/4 inches less than the inside diameter of the conduit.

b. Clean the conduit by pulling a heavy duty wire brush mandrel followed by a rubber duct swab through each conduit.

12. Pneumatic rodding may be used to draw in lead wire.
a. Install a heavy nylon cord free of kinks and splices in all unused new ducts.
b. Extend cord 3 feet beyond ends of conduit.
13. Transition from rigid nonmetallic conduit to rigid metallic conduit, per Specification Section 26 05 33, prior to entering a structure or going above ground.
a. Except rigid nonmetallic conduit may be extended directly to manholes, handholes, pad mounted transformer boxes and other exterior pad mounted electrical equipment where the conduit is concealed within the enclosure.
b. Terminate rigid PVC conduits with end bells.
c. Terminate steel conduits with insulated bushings.
14. Place warning tape in trench directly over ductbanks, direct-buried conduit, and direct-buried wire and cable in accordance with Specification Section 10 14 00.
15. Placement of conduits stubbing into handholes and manholes shall be located to allow for proper bending radiuses of the cables.

B. Concrete Encased Ductbank:
1. Ductbank system consists of conduits completely encased in minimum 3 inches of concrete and with separations between different cabling types as required in Specification Section 26 05 33 or as detailed on the Drawings.
2. Install so that top of concrete encased duct, at any point:
a. Is not less than 24 inches below grade.
b. Is below pavement sub-grading.
3. Where identified and for a distance 10 feet either side of the area, the concrete shall be reinforced.
a. The reinforcement shall consist of #4 bars and #4 ties placed 12 inches on center, in accordance with Division 03 Specification Sections or as detailed on the Drawings.

b. Conduit supports to be staggered to minimize weak vertical shear point.

4. Conduit supports shall provide a uniform minimum clearance of 3 inches between the bottom of the trench and the bottom row of conduit.
5. Conduit separators shall provide a uniform minimum clearance of 3 inches between conduits or as required in Specification Section 26 05 33 for different cabling types.

C. Direct-Buried Conduit(s):
   1. Install so that the top of the uppermost conduit, at any point:
      a. Is not less than 30 inches below grade.
      b. Is below pavement sub-grading.
   2. Provide a uniform minimum clearance of 3 inches between conduits or as required in Specification Section 26 05 33 for different cabling types.
      a. Maintain the separation of multiple planes of conduits by one of the following methods:
         1) Install multilevel conduits with the use of conduit supports and separators to maintain the required separations, and backfill with flowable fill (100 psi) per Specification Section 31 23 05 or concrete per Division 03 specifications.
         2) Install the multilevel conduits one level at a time.
            a) Each level is backfilled with the appropriate amount of soil and compaction, per Specification Section 31 23 05, to maintain the required separations.

END OF SECTION

SECTION 26 08 13
ACCEPTANCE TESTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Basic requirements for acceptance testing.

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 01 61 03 - Equipment - Basic Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. InterNational Electrical Testing Association (NETA):
      a. ATS, Standard for Acceptance Testing Specifications for Electric Power Equipment and Systems.
   2. Nationally Recognized Testing Laboratory (NRTL).
   3. Telecommunications Industry Association/Electronic Industries Alliance/American National Standards Institute (TIA/EIA/ANSI):
      a. 455-78-B, Optical Fibres - PART 1-40: Measurement Methods and Test Procedures - Attenuation.

B. Qualifications:
   1. Testing firm:
      a. An independent firm performing, as the sole or principal part of its business for a minimum of 10 years, the inspection, testing, calibration , and adjusting of systems.
      b. Must have an established monitoring and testing equipment calibration program with accuracy traceable in an unbroken chain, according to NIST.
   2. Field personnel:
      a. Minimum of one year field experience covering all phases of electrical equipment inspection, testing, and calibration.
      b. Relay test technician having previous experience with testing and calibration of relays of the same manufacturer and type used on project and proficient in setting and testing the types of protection elements used.
      c. Supervisor certified by NETA or NICET.
         1) As an alternative, supervising technician may be certified by the equipment manufacturer
   3. Analysis personnel:
      a. Minimum three years combined field testing and data analysis experience.
      b. Supervisor certified by NETA or NICET.
         1) As an alternative, supervising technician may be certified by the equipment manufacturer.

C. Phasing Diagram:
   1. Coordinate with Utility Company for phase rotations and Phase A, B and C markings.
      a. Create a phasing diagram showing the coordinated phase rotations with generators and motors through the transformers.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Equipment Monitoring and Testing Plan.

B. Informational Submittals:
   1. Prior to energizing equipment:

a. Coordinated phasing diagram.

2. Within two weeks after successful completion of Demonstration Period (Commissioning Period):
   a. Single report containing information including:
      1) Summary of Project.
      2) Information from pre-energization testing.
      3) Testing and monitoring reports.

PART 2 - PRODUCTS

2.1 FACTORY QUALITY CONTROL

A. Provide Electrical equipment with all factory tests required by the applicable industry standards or NRTL.

B. Factory testing will not be accepted in lieu of specified field acceptance testing requirements.

PART 3 - EXECUTION (INSTALLING CONTRACTOR'S SCOPE)

3.1 FIELD QUALITY CONTROL

A. General:
   1. Complete electrical testing in three phases:
      a. Pre-energization testing phase.
      b. Equipment energized with no load.
      c. Equipment energized under load.
   2. Perform testing in accordance with this Specification Section and NETA ATS.
   3. Provide field setting and programming of all adjustable protective devices and meters to settings as determined by the approved coordination study.
   4. Equip testing and analysis personnel with all appropriate project related reference material required to perform tests, analyze results, and provide documentation including, but not limited to:
      a. Contract Drawings and Specifications.
      b. Related construction change documentation.
      c. Approved Shop Drawings.
      d. Approved Operation and Maintenance Manuals.
      e. Other pertinent information as required.

B. Equipment Monitoring and Testing Plan:
   1. Approved in accordance with Shop Drawing submittal schedule.
   2. Included as a minimum:
      a. Qualifications of firm, field personnel, and analysis personnel doing the Work.
      b. List and description of testing and analysis equipment to be utilized.
      c. List of all equipment to be testing, including:
         1) Name and tag numbers identified in the Contract Documents.
         2) Manufacturer's serial numbers.
         3) Other pertinent manufacturer identification,

C. Instruments Used in Equipment and Connections Quality Control Testing:
   1. Minimum calibration frequency:
      a. Field analog instruments: Not more than 6 months.
      b. Field digital instruments: Not more than 12 months.
      c. Laboratory instruments: Not more than 12 months.
      d. If instrument manufacturer's calibration requirements are more stringent, those requirements shall govern.
   2. Carry current calibration status and labels on all testing instruments.
   3. See individual testing programs for additional instrumentation compliance requirements.

D. Testing and Monitoring Program Documentation:
   1. Provide reports with tabbed sections for each piece of equipment tested.
   2. Include all testing results associated with each piece of equipment under that equipment's tabbed section.
      a. Include legible copies of all forms used to record field test information.
   3. Prior to start of testing, submit one copy of preliminary report format for Engineer review and comment
      a. Include data gathering and sample test report forms that will be utilized.
   4. In the final report, include as a minimum, the following information for all equipment tested:
      a. Equipment identification, including:
         1) Name and tag numbers identified in the Contract Documents.
         2) Manufacturer's serial numbers.
         3) Other pertinent manufacturer identification,
      b. Date and time of each test.
      c. Ambient conditions including temperature, humidity, and precipitation.
      d. Visual inspection report.
      e. Description of test and referenced standards, if any, followed while conducting tests.
      f. Results of initial and all retesting.
      g. Acceptance criteria.
      h. "As found" and "as left" conditions.
      i. Corrective action, if required, taken to meet acceptance.
      j. Verification of corrective action signed by the Contractor, equipment supplier, and Owner's representative.
      k. Instrument calibration dates of all instruments used in testing.
   5. Provide three (3) bound final reports prior to Project final completion.

E. Electrical Equipment and Connections Testing Program:
   1. See individual Division 26 Specification Sections for equipment specific testing requirements.
   2. Test all electrical equipment.
      a. Perform all required NETA testing.
      b. Perform all required NETA testing plus the optional testing identified with each specific type of equipment in Article 3.2 of this Specification Section.

3.2 SPECIFIC EQUIPMENT TESTING REQUIREMENTS

A. Switchgear and Switchboards:
   1. Perform inspections and tests per NETA ATS 7.1.
   2. Components: Test all components per applicable paragraphs of this Specification Section and NETA ATS.

B. Transformers - Small Dry Type:
   1. Perform inspections and tests per NETA ATS 7.2.1.1.
   2. Perform the following additional tests:
      a. Record phase-to-phase, phase-to-neutral, and neutral-to-ground voltages at no load after energizing, and at operating load after startup.
   3. Adjust tap connections as required to provide secondary voltage within 2-1/2% of nominal under normal load after approval of Engineer.
   4. Record as-left tap connections.

C. Transformers - Liquid Filled:
   1. Perform inspections and tests per NETA ATS 7.2.2. except the following:
      a. Bushing power factor.
      b. Core insulation resistance.
      c. Dissolved gas analysis.
   2. Components: Test all components per applicable paragraphs of this Specification Section and NETA ATS.

3. Perform the following additional tests:
    a. Record phase-to-phase, phase-to-neutral, and neutral-to-ground voltages at no load after energizing, and at operating load after start-up.
4. Adjust tap changer setting as required to provide secondary voltage within 2-1/2% of nominal under normal load after approval of Engineer.
5. Record as-left tap changer setting.

D. Cable - Low Voltage:
1. Perform inspections and tests per NETA ATS 7.3.2.

E. Cable - Medium Voltage:
1. Perform inspections and tests per NETA ATS 7.3.3.
2. Perform Dielectric Withstand Test.
3. Perform tan delta or partial discharge Baseline Diagnostic Tests.

F. Cable - Optical Fiber:
1. Perform inspections on tests per TIA/EIA/ANSI 455-78-B, including:
    a. Optical time domain reflectometer test.
    b. Power attenuation test.
    c. Gain margin test.

G. Low Voltage Power Circuit Breakers:
1. Perform inspections and tests per NETA ATS 7.6.1.2.
    a. Tests shall include primary current injection testing of all breakers at final settings.
    b. Where short-time or instantaneous settings on large frame breakers are beyond the current capability of field testing, primary injection tests at reduced currents shall be permitted if combined with secondary injection calibration test of trip unit at final settings.
2. Components: Test all components per applicable paragraphs of this Specification Section and NETA ATS.
3. Perform the following additional tests:
    a. Shunt trip devices minimum tripping voltage.
4. Record as-left settings.

H. Low Voltage Molded Case Circuit Breakers:
1. Perform inspections and tests per NETA ATS 7.6.1.1.
2. Components:
    a. Test all components per applicable paragraphs of this Specification Section and NETA ATS.
    b. Thermal magnetic breakers: Visual and mechanical inspection per NETA ATS only.
    c. Solid state trip type: Visual and mechanical inspection and electrical tests per NETA ATS.
3. Record as-left settings.

I. Metering:
1. Perform inspections and tests per NETA ATS 7.11.
2. Components: Test all components per applicable paragraphs of this Specification Section and NETA ATS.

J. Grounding:
1. Perform inspections and tests per NETA ATS 7.13.
2. Components: Test all components per applicable paragraphs of this Specification Section and NETA ATS.

K. Ground Fault Protection:
1. Perform inspections and tests per NETA ATS 7.14.
2. Components: Test all components per applicable paragraphs of this Specification Section and NETA ATS.
3. Perform the following optional tests per NETA ATS:

a. Control wiring insulation resistance.

4. Perform the following additional tests for four-wire systems:
   a. Primary current injection into switchgear bus with test set configured to simulate transformer source and high current jumper used to simulate unbalanced load and ground fault conditions.
   b. Verify no tripping for unbalanced load on each feeder and each main breaker.
   c. Verify no tripping for unbalanced load across tie breaker for dual-source schemes.
   d. Verify tripping for ground fault on load side of feeder each feeder and on each main bus.
   e. Verify tripping for ground fault on a single feeder and on each main bus through tie breaker(s) for multiple-source schemes.

L. Motors:
   1. Perform inspections and tests per NETA ATS 7.15.
   2. Testing of motors:
      a. After installation and prior to energizing the motor, perform inspections and tests per NETA ATS 7.15 for all motors 50HP or above.
      b. Ensure motor has been lubricated.
      c. Bump motor to check for correct rotation.

M. Motor Controllers:
   1. Perform inspections and tests per NETA ATS 7.16.
   2. Components: Test all components per applicable paragraphs of this Specification Section and NETA ATS.

N. Control System Functional Test:
   1. Perform test upon completion of equipment acceptance tests.
   2. The test is to prove the correct interaction of all sensing, processing and action devices.
   3. Develop a test plan and parameters for the purpose of evaluating the performance of the system.
   4. Perform the following tests:
      a. Verify the correct operation of all interlock safety devices for fail-safe functions in addition to design function.
      b. Verify the correct operation of all sensing devices, alarms and indicating devices.
   5. Systems to be tested:
      a. Digital Metering System.
      b. Central Emergency Lighting Inverter.

END OF SECTION

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SECTION 26 09 13
ELECTRICAL METERING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Digital metering equipment.

B. Related Sections include but are not necessarily limited to:
   1. Section 26 05 00 - Electrical - Basic Requirements.
   2. Section 26 08 13 - Acceptance Testing.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
   2. National Electrical Manufacturers Association/American National Standards Institute (NEMA/ANSI):
      a. C12.20, For Electricity Meter - 0.2 and 0.5 Accuracy Classes.
   3. Underwriters Laboratories, Inc. (UL):
      a. 508, Standard for Safety Industrial Control Equipment.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Product technical data including:
      a. Provide submittal data for all products specified in PART 2 of this Specification:
      b. See Section 26 05 00 for additional requirements.
   2. Fabrication and/or layout drawings.
      a. Electrical wiring/connection diagrams.

B. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
      b. Content of Operation and Maintenance Manual:
         1) Data sheet of the meters electrical parameters, configuration and characteristics including a complete model number and associated equipment connected too.
         2) Operating instructions of the meter(s) supplied.
         3) Operating instructions of the Power Management software.
         4) Maintenance instructions.
         5) As-constructed electrical wiring/connection diagrams.
         6) Acceptance testing data.

C. Refer to Section 01 81 33 – Cyber Security Requirements for required cyber security related submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Allen-Bradley.
   2. Eaton.

3. Electro Industries.
4. GE by ABB.
5. Power Measurement.
6. Square D Company.
7. Siemens.

2.2 DIGITAL METERING DEVICES

A. Refer to Section 01 81 33 - Cyber Security Requirements for cyber security related product requirements.

B. General:
1. Direct reading metered or calculated values.
2. Microprocessor based.
3. Integral LED or LCD display.
4. Current and potential transformers as required.
5. Integral fusing.
6. Operating temperature: 0 degrees F to 150 degrees F.
7. Standards:
   a. NEMA/ANSI C12.20.
   b. UL 508.

C. Type 'B' Midrange Meter:
1. Display the following minimum electrical parameters (accuracy):
   a. RMS current per phase (+0.3% full scale).
   b. RMS voltage line-to-line and line-to-neutral (+0.3% full scale).
   c. Real power (W): 3 PH total (+0.6% full scale).
   d. Apparent power (VA): 3 PH total (+0.6% full scale).
   e. Reactive power (VAR): 3 PH total (+0.6% full scale).
   f. Power factor (+1.0%).
   g. Frequency (+0.17%).
   h. Percent current total harmonic distortion (31st).
   i. Percent voltage total harmonic distortion (31st).
2. Data logging:
   a. 128 KB.
   b. Selectable for parameters listed above for display.
   c. Software for configuration, retrieval, and trending.
3. Communication ports and protocols: Ethernet TCP/IP.
4. Supply voltage: 120 VAC.

2.3 ACCESSORIES

A. Power Management and Control Software:
1. Manufacturer's standard, see Part 3 for minimum functionality.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install as indicated and in accordance with manufacturer's recommendations and instructions.
1. Provide all equipment as necessary to provide a complete and functioning system.
2. Coordinate with the Owner on final computer screen layouts, trending requirements and printouts.

B. Meter Type Application:
1. Type B meters: Integral to equipment as indicated on the Drawings.

C. Communication Configuration:
1. As indicated on the Drawings.

D. Computer Screen Configuration:
   1. Each Type B meter shall have a data screen with the following minimum data as applicable for the capabilities of that type of meter:
      a. Voltage line-to-line for each phase and an average.
      b. Voltage line-to-neutral for each phase and an average.
      c. Current for each phase, neutral and average and peak demands.
      d. Kilowatts (kW) for each phase, total, demand and peak demand.
      e. Kilovolt-amperes (kVA) for each phase, total, demand and peak demand.
      f. Kilovolt-amperes reactive (kVAR) for each phase, total, demand and peak demand.
      g. Power factor for each phase and total.
      h. Frequency.
      i. Voltage total harmonic distortion for each phase.
      j. Current total harmonic distortion for each phase.
      k. Energy (kWhr) for each phase and total.
      l. A seven day kW, kVA and kVAR trend average.
      m. Peak demands shall be resettable by the operator.

3.2 FIELD QUALITY CONTROL

A. Acceptance Testing: See Section 26 08 13.

3.3 TRAINING

A. A qualified factory-trained manufacturer's representative shall provide the Owner with 8 hours of on-site training in the operation and maintenance of the metering system and its components.

3.4 CLOSEOUT ACTIVITIES

A. Refer to Section 01 81 33 – Cyber-Security Requirements for cyber security related closeout requirements.

END OF SECTION

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SECTION 26 09 16
CONTROL EQUIPMENT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Operator control devices (selector switches, pushbuttons, indicator lights, etc.).
   2. Control devices (timers, relays, contactors, etc.).
   3. Industrial Control Panels.
   4. Operator Control Stations.

B. Related Sections include but are not necessarily limited to:
   1. Section 01 81 33 – Cyber Security Requirements.
   2. Section 26 05 00 - Electrical - Basic Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
      b. ICS 2, Industrial Control and System Controllers, Contactors and Overload Relays Rated 600 Volts.
      c. ICS 5, Control Circuit and Pilot Devices.
   2. Underwriters Laboratories, Inc. (UL):
      a. 508, Standard for Safety Industrial Control Equipment.
      b. 508A, Standard for Industrial Control Panels.
      c. 698A, Standard for Industrial Control Panels Relating to Hazardous (Classified) Locations.

1.3 SYSTEM DESCRIPTION

A. This Specification specifies components used within other equipment as referenced in other technical specifications.

B. This Specification is used to specify the components and construction of Operator Control Stations.

C. This Specification is used to specify the components and construction of Industrial Control Panels.

1.4 SUBMITTALS

A. Shop Drawings:
   1. Product technical data:
      a. Provide submittal data for all products specified in PART 2 of this Specification:
         1) When components are used within equipment specified in another Section, submittal data for components specified herein shall be included with the submittal for the equipment the components are used in.
      b. Industrial Control Panel bill of material.
      c. Control Station bill of material.
      d. See Section 26 05 00 for additional requirements.
   2. Fabrication and/or layout drawings.
      a. Industrial Control Panel:
         1) Interior and exterior layout.
         2) Wiring/connection diagrams.
         3) Copy of the UL 508A label.

4) Short Circuit Current Rating (SCCR) nameplate marking per NFPA 70. Include any required calculations.

b. Operator Control Station:
   1) Interior (if applicable) and exterior layout.
   2) Wiring/connection diagrams.

c. Associate Industrial Control Panel and Operator Control Stations with associated equipment name and tagging.

B. Informational Submittals:
   1. Functional Test Plan.

C. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
      b. Content of Operation and Maintenance Manual:
         1) Product technical data of components used within Industrial Control Panels and Operator Control Stations.
         2) As-constructed wiring/connection diagrams for Industrial Control Panels and Operator Control Stations.
         3) Operating instructions for time clocks.
         4) Functional Test Report.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Pilot devices, relays, contactors, and termination equipment:
      a. Allen-Bradley by Rockwell Automation, Inc.
      b. ATC Diversified Electronics by Bellofram Group of Companies.
      c. ASCO by Emerson Electric Co.
      d. c3controls.
      e. Eaton.
      f. GE/ABB.
      g. IDEC Corporation.
      h. Phoenix Contact.
      i. Potter and Brumsfield (P&B) by TE Connectivity.
      j. Schneider Electric.
      k. Siemens Corporation.
      l. Time Mark Corporation.
   2. Photocells and time clocks:
      a. Grasslin by Intermatic.
      b. Tork by NSi Industries.
      c. Intermatic.
      d. Paragon Auto Control.
   3. Alarm devices:
      a. Edwards Signaling by United Technologies Corp.
      b. Federal Signal Corporation.
   4. Enclosures:
      a. Hoffman Engineering.
      b. Wiegmann by Hubbell.
      c. B-Line by Eaton.
      d. Adalet.
      e. Stahlin by Robroy Enclosures.

2.2 PILOT DEVICES

A. General Requirements:
   1. Standards: NEMA ICS 5, UL 508.
   2. Heavy-duty NEMA 4/13 watertight/oiltight.
   3. Heavy-duty NEMA 4/4X corrosion resistant.
   4. Heavy-duty factory sealed, explosion-proof and dust ignition-proof (Class I and II).
   5. Mounting hole: 30.5 mm.
   6. Contact blocks: 10 amp, NEMA A600 rated, number as required to fulfill functions shown or specified.
   7. Legend plate marked as indicated on Drawings or specified.

B. Selector Switches:
   1. Two, three- or four-position rotary switch as required to fulfill functions shown or specified.
   2. Maintained contact type.
   3. Knob or lever type operators.

C. Pushbuttons:
   1. Non-illuminated type:
      a. Protective boot.
      b. Momentary contact.
      c. Standard flush and mushroom operators.
      d. Green colored buttons for START or ON and red color for STOP or OFF.
      e. Emergency stop pushbuttons: Mushroom head operator and maintained contact.
   2. Illuminating type:
      a. Protective boot.
      b. Momentary contact.
      c. Standard flush operator.
      d. Serves as both pushbutton control and indicating light.
      e. Red colored lenses: START or ON.
      f. Green colored lenses: STOP or OFF.
      g. Resistor-type full voltage light unit with lens and panel gasket.

D. Indicating Lights:
   1. Allowing replacement of bulb without removal from control panel.
   2. Lamp: LED, 120 V or 24 V as required.
   3. Full voltage type.
   4. Push-to-test indicating lights.
   5. Plastic lens.
   6. Color code lights as follows:
      a. Green: OFF or stopped; valve closed.
      b. Amber: Standby; auto mode; ready.
      c. Red: ON or running; valve open.

2.3 RELAYS

A. General Requirements:
   1. Standards: NEMA ICS 5, UL 508.

B. Control Relays:
   1. General purpose (ice cube) type:
      a. Plug-in housing.
      b. Clear polycarbonate dust cover with clip fastener.
      c. Coil voltage: 120 VAC or as required.
      d. Contacts:
         1) 10 amp continuous.
         2) Silver cadmium oxide.
         3) Minimum of 3 SPDT contacts.
      e. Sockets: DIN rail mounted.

f. Internal neon or LED indicator is lit when coil is energized.
g. Manual operator switch.

2. Industrial type:
   a. Coil voltage: 120 VAC or as required.
   b. Contacts:
      1) 10 amp, NEMA A600 rated.
      2) Double break, silver alloy.
      3) Convertible from normally open to normally closed or vice versa, without removing any wiring.
      4) Expandable from 2 poles to 12 poles.
   c. Provide contacts for all required control plus two spares.

C. Time Delay Relays:
1. General purpose type:
   a. Timing modes: On and Off delay, interval, one shot and repeat cycle.
   b. Plug-in housing.
   c. Polycarbonate dust cover with clip fastener.
   d. Coil voltage: 120 VAC or as required.
   e. Contacts:
      1) 10 amp continuous.
      2) Silver cadmium oxide.
      3) Two normally open and two normally closed DPDT contacts.
   f. Sockets: DIN rail mounted.
   g. External timing adjustment knob.
   h. Timing ranges: 0.05 seconds to 16.65 hours.
   i. Repeat accuracy: +1%.
2. Solid State industrial type:
   a. Timing modes: On and Off delay and repeat cycle.
   b. Industrial housing.
   c. Coil voltage: 120 VAC or as required.
   d. Contacts:
      1) 5 amp, NEMA B150 rated.
      2) Silver alloy.
      3) Convertible On Delay and Off Delay contacts.
      4) One normally open and one normally closed timed contacts.
      5) One normally open and one normally closed instantaneous contacts.
   e. Furnish with "on" and "timing out" indicators.
   f. External timing adjustment knob.
   g. Timing ranges: 0.05 seconds to 10 hours.
   h. Repeat accuracy: +1%.
3. Mechanical industrial type:
   a. Timing modes: On and Off delay.
   b. Coil voltage: 120 VAC or as required.
   c. Contacts:
      1) 10 amp, NEMA A600 rated.
      2) Double break, silver alloy.
      3) Convertible On Delay and Off Delay contacts.
      4) Convertible normally open and normally closed timed contacts.
      5) Convertible normally open instantaneous contacts.
   d. External timing adjustment knob.
   e. Timing ranges: 0.2 - 60 seconds or 5 - 180 seconds.
   f. Repeat accuracy: Greater than +10%.

2.4 CONTACTORS

A. General Requirements:
1. Standards: NEMA ICS 2, UL 508.

B. Lighting and Remote Control Switches:
   1. Electrically operated, electrically held.
   2. Coil voltage: 120 VAC or as required.
   3. Contacts: Totally enclosed, double-break silver-cadmium-oxide.
   4. Rated for ballasted lighting, tungsten and general use loads.
   5. Number of poles, continuous ampere rating and voltage, as indicated on Drawings or as specified.
   6. Auxiliary control relays, as indicated on Drawings or as specified.
   7. Auxiliary contacts, as indicated on Drawings or as specified.

C. Definite Purpose:
   1. Coil voltage: 120 VAC or as required.
   2. Contacts: Totally enclosed, double-break silver-cadmium-oxide.
   3. Resistive load and horsepower rated.
   4. Number of poles, continuous ampere rating and voltage, as indicated on Drawings or as specified.
   5. Auxiliary contacts, as indicated on Drawings or as specified.

2.5 PHOTOCELLS

A. Photocells:
   1. Weatherproof enclosure.
   2. Adjustable turn-on range, initially set at 1.0 foot-candles.
      a. Turn-off level approximately three times turn-on.
   3. Provide time delay device to eliminate nuisance switching.
   4. Voltage, amperage and/or wattage ratings as required for the application.

2.6 ALARM DEVICES

A. Alarm Horns:
   1. Vibrating horn type.
   2. PLC compatible as required.
   3. Heavy-duty die cast housing with corrosion resistant finish.
   4. Adjustable volume: 78 to 103 dB at 10 feet.
   5. Voltage: 120 VAC or as required.
   6. Enclosures/mountings:
      a. Flush wall or panel mounting in dry areas.
      b. NEMA 4X panel mounting in wet areas.
      c. Surface mounting in dry areas.
      d. NEMA 4X surface mounting in wet areas.
      e. NEMA 4X, hazardous location surface mounting in wet and hazardous areas.
         1) Fixed volume: 97 dB at 10 feet.

B. Alarm Lights:
   1. Panel mounted:
      a. Strobe type.
      b. Shatter resistant polycarbonate lens and base.
      c. Lens color as indicated on Drawings.
      d. NEMA 4X enclosure.
      e. PLC compatible.
      f. Voltage: 120 VAC.
   2. Wall mounted:
      a. Heavy-duty strobe type.
      b. Weatherproof shatter resistant polycarbonate lens and cast base.
      c. Optically designed fresnel lens with color as indicated on Drawings.
      d. Immune to shock and vibration, no moving parts.
      e. Xenon flash tube providing a minimum of 65 single flashes per minute.
      f. Mounting: Wall or corner wall brackets.

3. Hazardous and corrosive locations:
    a. Heavy-duty strobe type.
    b. Weatherproof and rated for the indicated hazardous location.
    c. Body: Zinc plated cast iron or cast copper free aluminum and/or coated with 20 mils of PVC.
    d. High impact glass dome with guard.
    e. Shatter resistant polycarbonate lens with color as indicated on Drawings.
    f. Immune to shock and vibration, no moving parts.
    g. Xenon flash tube providing a minimum of 65 single flashes per minute.
    h. Mounting: Wall bracket or pendant.

2.7 MISCELLANEOUS DEVICES

A. Run Time Meters:
    1. Six-digit wheels including a 1/10 digit.
    2. Non-reset type.
    3. Time range in hours.
    4. Automatic recycle at zero.
    5. Accuracy: 1%.
    6. Sealed against dirt and moisture.
    7. Tamperproof.

2.8 TERMINATION EQUIPMENT

A. General Requirements:
    1. Modular type with screw compression clamp.
    2. Screws: Stainless steel.
    3. Current bar: Nickel-plated copper alloy.
    4. Thermoplastic insulation rated for -40 to +90 degrees C.
    5. Wire insertion area: Funnel-shaped to guide all conductor strands into terminal.
    6. End sections and end stops at each end of terminal strip.
    7. Machine-printed terminal markers on both sides of block.
    8. Spacing: 6 mm.
    9. Wire size: 22-12 AWG.
    10. Rated voltage: 600 V.
    11. DIN rail mounting.

B. Standard-Type Block:
    1. Rated current: 30 A.
    2. Color: Gray body.

C. Bladed-Type Disconnect Block:
    1. Terminal block with knife blade disconnect which connects or isolated the two sides of the block.
    2. Rated current: 10 A.
    3. Color:
        a. Panel control voltage leaves enclosure - normal: Gray body, orange switch.
        b. Foreign voltage entering enclosure: Orange body, orange switch.

D. Grounded-Type Block:
    1. Electrically grounded to mounting rail.
    2. Terminal ground wires and analog cable shields.
    3. Color: Green and yellow body.

E. Fuse Holders:
    1. Blocks can be ganged for multi-pole operation.
    2. Spacing: 9.1 mm.
    3. Wire size: 30-12 AWG.
    4. Rated voltage: 300 V.

5. Rated current: 12 A.
6. Fuse size: 1/4 x 1-1/4.
7. Blown fuse indication.
8. DIN rail mounting.

2.9 ENCLOSURES

A. Industrial Control Panels:
   1. NEMA 4X rated:
      a. Body and cover: 14 GA Type 304 or 316 stainless steel.
      b. Seams continuously welded and ground smooth.
      c. No knockouts.
      d. External mounting flanges.
      e. Hinged door and stainless steel screws and clamps.
      f. Door with oil-resistant gasket.
   2. NEMA 7 and 9 rated:
      a. Cast gray iron alloy or copper-free aluminum.
      b. Drilled and tapped openings or tapered threaded hub.
      c. Cover bolted-down with stainless steel bolts or threaded cover with neoprene gasket.
      d. External mounting flanges.
      e. Grounding lug.
      f. Accessories: 40 mil PVC exterior coating and 2 mil urethane interior coating.
   3. NEMA 12 enclosure:
      a. Body and cover: 14 GA steel finished with rust inhibiting primer and manufacturers standard paint inside and out.
      b. No knockouts.
      c. External mounting flanges.
      d. Non-hinged stainless steel cover held closed with captivated cover screws threaded into sealed wells or hinged cover held closed with stainless steel screws and clamps.
      e. Flat door with oil resistant gasket.
   4. Control panel miscellaneous accessories:
      a. Back plane mounting panels: Steel with white enamel finish or Type 304 stainless steel.
      b. Interiors shall be white or light gray in color.
      c. Wire management duct:
         1) Bodies: PVC with side holes.
         2) Cover: PVC snap-on.
         3) Size as required.
      d. Rigid handles for covers larger than 9 square feet or heavier than 25 pounds.
      e. Split covers when heavier than 25 pounds.
      f. Floor stand kits made of same material as the enclosure.
      g. Weldnuts for mounting optional panels and terminal kits.
      h. Ground bonding jumper from door, across hinge, to enclosure body.
   5. Standards: NEMA 250, UL 508.

B. Operator Control Stations:
   1. NEMA 4/13 rated:
      a. Die cast aluminum body with manufacturer's standard finish.
      b. Gasketed die cast aluminum cover with manufacturer's standard finish.
      c. Number of device mounting holes as required.
   2. NEMA 4X rated:
      a. Type 304 or 316 stainless steel body.
      b. Gasketed Type 304 or 316 stainless steel cover.
      c. Number of device mounting holes as required.
   3. NEMA 7 and 9 rated:
      a. Zinc plated cast iron or die-cast copper free aluminum, with threaded hubs, grounding screw and with manufacturer's standard finish.

b. "EDS" or "EFS" style.
c. Single or multiple gang or tandem.
d. Accessories: 40 mil PVC exterior coating and 2 mil urethane interior coating.

2.10 FABRICATION

A. Supplier of Industrial Control Panels shall build control panel under the provisions of UL 508A or UL 698A.
1. Entire assembly shall be affixed with a UL 508A or UL 698A label "Listed Enclosed Industrial Control Panel" prior to shipment to the jobsite.
2. Provide equipment or control panels with Short Circuit Current Rating (SCCR) labeling as required by NFPA 70 and other applicable codes.
a. Determine the SCCR rating by one of the following methods:
1) Method 1: SCCR rating meets or exceeds the available fault current of the source equipment when indicated on the Drawings.
2) Method 2: SCCR rating meets or exceeds the source equipment's Amp Interrupting Current (AIC) rating as indicated on the Drawings.
3) Method 3: SCCR rating meets or exceeds the calculated available short circuit current at the control panel.
b. The source equipment is the switchboard, panelboard, motor control center or similar equipment where the control panel circuit originates.
3. For Method 3, provide calculations justifying the SCCR rating. Utilize source equipment available fault current or AIC rating as indicated on the Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install as indicated and in accordance with manufacturer's recommendations and instructions.

B. Control Panels:
1. Control Panels installed outdoors shall be provided with a sunshield to mitigate exposure to direct sunlight.
2. Size as required to mount the equipment.
3. Permitted uses of NEMA 4X enclosure:
a. Surface mounted in areas designated as wet and/or corrosive or highly corrosive.
4. Permitted uses of NEMA 7 enclosure:
a. Surface mounted in areas designated as Class I hazardous.
5. Permitted uses of NEMA 12 enclosure:
a. Surface mounted in areas designated as dry and/or dusty architecturally or non-architecturally finished areas.

C. Operator Control Stations:
1. Operator Control Stations installed outdoors shall be provided with a sunshield to mitigate exposure to direct sunlight.
2. Permitted uses of NEMA 4/13 enclosure:
a. Surface mounted in areas designated as dry and/or dusty architecturally or non-architecturally finished areas and wet.
3. Permitted uses of NEMA 4X enclosure:
a. Surface mounted in areas designated as wet and/or corrosive or highly corrosive.
4. Permitted uses of NEMA 7 enclosure:
a. Surface mounted in areas designated as Class I hazardous with PVC coating in corrosive and highly corrosive areas when PVC coated conduit is used.

3.2 FIELD QUALITY CONTROL

A. See Section 26 05 00.

B. Industrial Control Panel(s) and Operator Control Station Functional Test:

1. The test is to prove the correct interaction of all sensing, processing and action devices.
2. Develop a test plan and parameters for the purpose of evaluating the performance of the system.
    a. Plan shall have witness signature lines for the contractor and owner and submitted when system pass the test.
3. Perform the following tests:
    a. Verify functionality of all control states.
    b. Verify the correct operation of all interlock safety devices for fail-safe functions
    c. Verify the correct operation of all sensing devices, alarms and indicating devices.

3.3 TRAINING

A. A qualified supplier representative shall provide the Owner with on-site training in the operation and maintenance of the Industrial Control Panel(s) and its components.

3.4 CLOSEOUT ACTIVITIES

A. Refer to Section 01 81 33 – Cyber-Security Requirements for cyber security related closeout requirements.

END OF SECTION

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SECTION 26 12 19
DISTRIBUTION TRANSFORMERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Distribution pad-mounted transformers.

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 26 05 00 - Electrical - Basic Requirements.
   2. Section 26 08 13 - Acceptance Testing.
   3. Section 01 11 00 – Summary of Work.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American National Standards Institute (ANSI).
   2. Institute of Electronic and Electronics Engineers, Inc. (IEEE):
      a. 386, Standard for Separable Insulated Connector Systems for Power Distribution Systems Rated 2.5 kV through 35 kV.
      b. C57.12.00, Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.
      c. C57.12.28, Standard for Pad-Mounted Equipment - Enclosure Integrity.
      d. C57.12.34, Standard Requirements for Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers (2500 kVa and Smaller) - High-Voltage: 34 500 GrdY/19 920 Volts and Below; Low-Voltage: 480 Volts and Below.
      e. C57.12.70, Standard for Standard Terminal Markings and Connections for Distribution and Power Transformers.
      f. C57.12.80, Standard Terminology for Power and Distribution Transformers.
      g. C57.12.90, Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers.
      h. C62.11, Standard for Metal-Oxide Surge Arresters for Alternating Current Power Circuits (>1 kV).
   3. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).

1.3 SUBMITTALS

A. Shop Drawings:
   1. Product technical data:
      a. Provide submittal data for all products including subcomponents specified in PART 2 of this Specification Section.
      b. See Specification Section 26 05 00 for additional requirements.
   2. Fabrication and/or layout Drawings.
      a. Outline Drawing including dimensions, weight and identification of all components and features.
      b. Nameplate Drawing.
   3. Certifications:
      a. Letter stating compliance with current Department of Energy efficiency requirements.

B. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
      b. Content of Operation and Maintenance Manual:

1) Instruction and maintenance manual.
2) Product technical data provided in the submittal.
3) Outline drawing updated for as-built conditions.
4) Nameplate Drawing updated for as-built conditions.
5) Actual impedance data.
6) Factory test report.
7) Acceptance testing report.

C. Informational Submittals:
1. Factory test report.

1.4 DELIVERY, STORAGE, AND HANDLING

A. See Specification Section 26 05 00.

1.5 WARRANTY

A. Minimum of a three year Warranty from date of shipment against failure when installed in compliance with applicable national/local electrical codes and the manufacturer's installation, operation and maintenance instructions. Manufacturer shall warranty all parts, devices and components provided as part of distsribution transformer assembly.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Vantran
2. ABB.
3. Eaton.
4. Square D by Schneider Electric.
5. Cooper Power Systems by Eaton.

2.2 THREE-PHASE TRANSFORMER

A. General:
1. Transformer to be designed and constructed in accordance with:
a. IEEE C57.12.00, IEEE C57.12.28, IEEE C57.12.34, IEEE C57.12.70, IEEE C57.12.80.

B. Ratings and Configurations:
1. Type: Outdoor, pad-mounted, liquid-immersed, self-cooled, compartmental type.
2. Operation and application: Step-down operation.
3. Configuration:
a. Dead-front, loop-feed primary.
4. Voltage and kVA Ratings: As specified on the Drawings.
5. Number of phases: Three.
6. Frequency: 60 Hz.
7. Polarity: ANSI standard.
8. Percent impedance: ANSI standard.
9. Basic impulse level (BIL):
a. Primary: 95 kV.
b. Secondary: 30kV.
10. Temperature rise: 65 degrees C.
11. Efficiency: Meet all current Department of Energy rules.
12. Connections:
a. Primary: Delta.
b. Secondary: Wye with grounded neutral.

c. Primary: 600 ampere one-piece bushing/well for deadbreak elbows with a 600A deadbreak to 200A loadbreak adapter.
d. Secondary (480/277V):
1) Less than 500 kVA: Four-hole, tin plated, spade-type minimum or as required.
2) 750 - 1500 kVA: Six-hole, tin plated, spade-type minimum or as required.
3) 2000 kVA and greater: Twelve -hole, tin-plated, spade-type minimum or as required.
4) Removable ground strap on neutral terminal.

13. Tap-changer: De-energized type on H-winding, five total with:
a. Two 2.5% above and two 2.5% below nominal tap.
14. Sectionalizing oil immersed load break primary switch:
a. Rating: 600A.
b. Four (4) position, 'V' blade, with the switch positions labeled:
1) "SOURCE A" (Loop is open and the coil is energized by Source A).
2) "SOURCE B" (Loop is open and the coil is energized by Source B).
3) "SOURCE A & B" (Loop is closed and the coil is energized by both sources).
4) "LOOP & XFMR OPEN" (Loop is open and the coil is de-energized).

C. Components:
1. Core and Coil:
a. Coil material: Aluminum.
b. Windings designed to reduce losses.
c. Insulating materials rated for 120 degrees C class.
d. Core material: High-grade, grain-oriented, non-aging silicon core steel with high magnetic permeability, low hysteresis and eddy current losses.
1) Magnetic flux densities are to be kept well below saturation to allow for a minimum 10% overvoltage excitation.
2) Properly annealed to reduce stresses induced during the manufacturing processes and reduce core losses.
e. Core frame:
1) Designed to provide maximum support for the core and coil assembly.
2) Welded or bolted to ensure maximum short-circuit strength.
f. Designed and manufactured to meet the short circuit requirements of ANSI C57.12.90.
g. Vacuum processed and energized or baked in an oven prior to tanking to set the epoxy coating on the insulating paper and remove moisture from the insulation prior to vacuum filing.
2. Tank and Terminal Cabinet Enclosure:
a. Carbon steel reinforced with external, internal or sidewall braces, with all seams and joints continuously welded.
b. Design the tank and attached components to withstand pressures greater than the required operating design value without permanent deformation.
c. Sealed-tank construction:
1) 1000kVA and below: Bolted main tank cover.
2) 1500kVA and above: Welded main cover and bolted tamper-resistant handhole.
d. Lifting lugs welded to tank.
e. Steel divider between high-voltage (left side) and low-voltage (right side) compartments.
f. No exposed screws, bolts, or other fastening devices that are externally removable.
g. Tamper resistant per IEEE C57.12.28.
h. Cabinet depth: IEEE standard or 20 inches minimum.
i. 1 inches upper fill plug.
j. 1 inches drain valve with sampling device mounted in an enclosure outside of the main terminal cabinet.
k. Automatic pressure relief device.
l. Nitrogen blanket with bleeder and purge valve.
m. Ground pad(s):

1) 500kVA and below: Two steel pads with one hole.
2) Above 500kVA: Two stainless steel pads with two holes.

n. Door:
1) Each compartment will have removable, three-point latching hinged doors equipped for latching in the open position.
2) The high-voltage compartment door will have a fastening device that is accessible only through the low-voltage compartment.
3) The hinge assemblies made of corrosion-resistant material.
a) Provide stainless-steel hinge pins of 3/8 inches minimum diameter.
4) Both compartment doors capable of securing with a single padlock having a maximum 1/2 inches diameter shackle.
5) Penta-head cabinet door bolts..

3. Overcurrent protection:
a. Vacuum fault interrupter (VFI) is to be used for transformer primary feeder protection & local on/off switch transformer protection.
b. The interrupter shall be manually resettable with no consumable parts (i.e. fuses).
c. The interrupter shall incorporate a trip-free mechanism to prevent the possibility of holding the interrupter mechanism closed under a faulted circuit condition.
d. The vacuum fault-interrupter shall act as a three-phase group operated interrupter. The operating handle(s) shall be mounted on the front plate of the tank in close relation to the VFI being controlled and shall have three distinct operating positions corresponding to the vacuum fault interrupter positions of closed, open, or tripped. A pointer attached to the handle shall be provided for ready identification of the handle's position. The operating handle assembly shall include provision to padlock the handle in the open position.
e. Internal partial-range current limiting backup fuse.
f. Provide full range protection two fuse system.
g. Partial-range current limiting backup fuse.
1) Interrupting rating: 50,000A.
2) Under oil, non-field replaceable.
h. Current sensing, expulsion-type, bay-O-Net fuse.

4. Finish:
a. Manufacturer's standard corrosion protection system in accordance with IEEE C57.12.28.
b. Dark "padmount" green.

5. Dielectric Fluid:
a. Tested for compatibility with the transformer.
b. Less-flammable, natural or synthetic ester, biodegradable per US EPA OPPTS 835.3100 and certified to comply with US EPA Environmental Technology Verification requirements.
1) Envirotemp FR3 or approved equal.
c. Permanently affix nameplate stamped "Non PCB".

6. Accessories:
a. Liquid level gage with auxiliary contacts.
b. Dial-type thermometer gage with auxiliary contacts.
c. Pressure vacuum gage with auxiliary contacts.
d. Gages to be mounted in a separate enclosure and not in the main terminal cabinet.
e. Stainless steel or laser-scribed anodized aluminum nameplate, with date of manufacturer and mounted on exterior of transformer.
f. Cable parking stands, one per bushing.
g. Provide Aclara kV2c Electric Smart Meter or equal.
h. Provide and size current transformers for metering device.
i. VFI interrupter controls and metering device shall not be mounted in the main terminal cabinet.

2.3 SURGE ARRESTORS

A. Standards: IEEE 386 and IEEE C62.11.

B. MOV gapless elbow type.

C. Elbow Connector:
   1. One-piece design, comprised of an insulation layer and outer shield constructed of EPDM rubber.
   2. 200A, dead front, load break type with hot stick pulling eye and grounding tab.

D. Voltage Class: As indicated on the Drawings.

E. Arrestor MCOV Rating: 8.40 MCOV.

2.4 ELECTRONIC TRIP CONTROL

A. The protective relays for the transformer protection shall be a single multifunction, microprocessor-based relay that incorporates feeder overcurrent protection for the primary or secondary of a two-winding transformer. Relay will have fixed or variable percentage, using one or two settable slopes with adjustable intersection points and minimum pickup.

2.5 SOURCE QUALITY CONTROL

A. Factory Tests: At a minimum, provide all routine tests as specified in IEEE C57.12.00 inches accordance with IEEE C57.12.90.

2.6 MAINTENANCE MATERIALS

A. Touch-up paint, two separate one quart containers.

PART 3 - EXECUTION (INSTALLING CONTRACTOR'S SCOPE)

3.1 INSTALLATION

A. Install on pad as detailed on the Drawings and in accordance with NFPA 70 and manufacturer's instructions.

B. Transformer locations as shown on the Drawings are intended to be used as a guide.
   1. Field conditions may affect actual transformer location.
   2. Coordinate final location with Owner.

C. Install three-phase transformers on concrete pad per detail on the Drawings.

3.2 FIELD QUALITY CONTROL

A. Acceptance Testing: See Specification Section 26 08 13.

END OF SECTION

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SECTION 26 22 13
LOW-VOLTAGE DISTRIBUTION TRANSFORMERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Dry-type distribution transformers, 1000 kVA and less.

B. Related Requirements: Include, but are not necessarily limited to:
   1. Section 26 05 00 - Electrical - Basic Requirements.
   2. Section 26 05 26 - Grounding.
   3. Section 26 08 13 - Acceptance Testing.

1.2 REFERENCES

A. Reference Standards: Standards referenced in this section include, but are not necessarily limited to, the following:
   1. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
      a. C57.96 - Guide for Loading Dry-Type Distribution and Power Transformers.
   2. National Electrical Manufacturers Association (NEMA):
      a. 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
      b. ST 20 - Dry Type Transformers for General Applications.
   3. Underwriters Laboratories, Inc. (UL):
      a. 506 - Specialty Transformers.
      b. 1561 - Dry-Type General Purpose and Power Transformers.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Applicable electrical code is indicated 01 42 00 - References.
   2. The Work of this Section shall comply with 10 CFR 431, Energy Efficiency Program For Certain Commercial and Industrial Equipment, administered by the United States Department of Energy.

1.4 SUBMITTALS

A. Action Submittals. Submit the following:
   1. Shop Drawings:
      a. Schedule (in tabular format), indicating low-voltage transformers proposed. Indicate for each proposed location, whether the item will be installed within a panel such as a motor control center or other panel, voltage, manufacturer and model, and other pertinent data.
      b. Fabrication drawings for each size and type of equipment to be furnished. Show and indicate dimensions, arrangement, points of connection, parts and elements, and materials.
   2. Product data:
      a. Acknowledgement or indication that items submitted comply with requirements of standards referenced in this Section.
      b. Low-voltage transformer manufacturer's published product data for each type of transformer and accessory required, including catalogs and similar published literature, marked to indicate items to be furnished for the Work and employing cross outs to indicate items not proposed and that will not be furnished.
      c. Sound level certifications.
      d. Comply with Section 26 05 00 - Electrical - Basic Requirements, for additional requirements concerning Submittals.

B. Informational Submittals. Submit the following:
   1. Supplier Instructions:
      a. Serial numbers of items furnished, equipment nameplate information, and similar information for all items furnished.
      b. Instructions for handling, storing, installing, and startup.
   2. Source Quality Control Submittals:
      a. Upon Engineer's request, submit results of tests, inspections, and other quality control activities required by the Contract Documents and performed at the place of production or fabrication.

C. Closeout Submittals. Submit the following:
   1. Operation and Maintenance Data:
      a. Submit in accordance with Section 01 78 23 - Operation and Maintenance Data.

PART 2 - PRODUCTS

2.1 GENERAL PURPOSE DRY-TYPE TRANSFORMERS

A. Manufacturers: Subject to compliance with the Contract Documents, furnished required quantity of items from one of the following:
   1. Eaton.
   2. ABB Group - GE Industrial Solutions.
   3. Schneider Electric Square D.
   4. Siemens.
   5. Emerson Electric, Appleton Group SolaHD.
   6. Or equal.

B. Description:
   1. Furnish low-voltage distribution transformers in accordance with this Section, other provisions of the Contract Documents, and Laws and Regulations.
   2. Transformers shall be ventilated or non-ventilated, air-cooled, two-winding type.
   3. Transformers shall comply with the following: IEEE C57.96, NEMA ST 20, UL 506, UL 1561.

C. Performance Criteria:
   1. Ratings: 60 Hertz, voltage, kVA and phase shall be as indicated on the Drawings.
   2. During operation, sound levels shall not exceed the following, measured three feet from the associated transformer:
      a. Average sound levels for ventilated units:
         1) Up to 9 kVA: 40 dB.
         2) 10 to 50 kVA: 45 dB.
   3. Efficiency shall be not less than the following:
      a. Ventilated:
         1) Three-phase, 15 to 1000 kVA: In accordance with 10 CFR 431.

D. Materials and Fabrication:
   1. Cores:
      a. High-grade, non-aging silicon steel with high magnetic permeability, and low hysteresis and eddy current losses.
      b. During operation, magnetic flux densities shall be well below saturation point.
   2. Coils:
      a. Continuous wound with electrical grade aluminum.
   3. Ventilated Transformer Units:
      a. Core and coils assembly shall be impregnated with non-hygroscopic, thermosetting varnish and cured to reduce hot spots and seal out moisture, completely isolated from enclosure using vibration dampening pads.
      b. Enclosure: Drip-proof, NEMA 1 in accordance with NEMA 250, finished steel enclosure for indoor locations.

c. Weather-resistant, finished steel enclosure that restricts entry of rain, sleet, or snow using baffles, grills, or barriers on ventilation openings.

4. Non-ventilated Transformer Units:
   a. Core and coil assembly shall be encapsulated in proportioned mixture of resin and aggregate providing moisture-proof, shock resistant seal.
   b. Enclosure:
      1) Totally enclosed, NEMA 3R in accordance with NEMA 250, finished steel enclosure.
5. Taps: Provide Taps for Transformers as follows:
   a. Three-phase, 3 to 15 kVA: Two, 5 percent FCBN.
   b. Three-phase, 15 kVA and above: Two, 2.5 percent FCAN and four, 2.5 percent FCBN.
6. Insulating Material (600 V and below):
   a. 3 to 10 kVA units: 180 degrees C insulation system with 135 degrees C rise.
   b. 15 kVA and above units: 220 degrees C insulation system with 150 degrees C rise.
7. Nameplates: Provide for each transformer furnished corrosion-resistant nameplate and connection diagram in accordance with NEMA ST 20 including date of manufacture.

E. Finishes:
   1. Provide for each transformer furnished finish protecting against corrosion.
   2. Appropriately clean and prepare surfaces to be finished in accordance with written instructions of finish system manufacturer.
   3. Provide protective coating of paint or enameling, inside and out.

2.2 SOURCE QUALITY CONTROL

A. Tests and Inspections:
   1. Perform manufacturer's routine tests and inspections, in accordance with NEMA ST 20.
   2. Comply with Section 26 08 13 – Acceptance Testing.
   3. Remedy defects prior to shipping items from assembly and testing location.
   4. Upon Engineer's request, submit to Engineer written results of successful completion of required tests and inspections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Installing the Work constitutes Contractor's approval of underlying work, related, connected systems, and field conditions prevailing at the time of the Work.

3.2 INSTALLATION

A. Installation Requirements:
   1. Install items in accordance with the Contract Documents, manufacturer's written instructions, and Laws and Regulations. Where such requirements conflict, obtain interpretation or clarification from Engineer prior to commencing the associated Work.
   2. Indoor Locations:
      a. Provide ventilated transformers for 15 kVA units and above.
      b. Provide non-ventilated transformers for 9 kVA units and below and at other locations shown or indicated on the Drawings.
      c. Mount 9 kVA units and below on wall.
      d. Mount 15 kVA units and above on either (1) chamfered, four-inch-high concrete housekeeping pad, or (2) supported from wall or ceiling, seven feet above finished floor, by providing equipment support brackets in accordance with Section 26 05 00 - Electrical – Basic Requirements.

3.3 FIELD QUALITY CONTROL

A. Field Tests and Inspections:
   1. Comply with Section 26 08 13 - Acceptance Testing.

2. Field-verify proper operation and functionality of each transformer installed.

END OF SECTION

SECTION 26 24 13
SWITCHBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Low voltage switchboards.

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 26 05 00 - Electrical - Basic Requirements.
   2. Section 26 09 13 - Electrical Metering Devices.
   3. Section 26 09 16 - Control Equipment Accessories.
   4. Section 26 28 00 - Overcurrent and Short Circuit Protective Devices.
   5. Section 26 43 13 - Surge Protection Devices for Low-Voltage Electrical Power Circuits.
   6. Section 01 11 00 – Summary of Work.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
      b. PB 2, Deadfront Distribution Switchboards.
   2. Underwriters Laboratories, Inc. (UL):
      a. 891, Switchboards.

B. Verify the space required for the switchboard is equal to or less than the space allocated.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Product technical data.
      a. Provide submittal data for all products specified in PART 2 of this Specification Section.
   2. See Specification Section 26 05 00 for additional requirements.
   3. Fabrication and/or layout drawings:
      a. Switchboard layout with alphanumeric designation, protective devices size and type, as indicated in the one-line diagram or switchboard schedule.
      b. Front elevation and plan drawing of the assembly.
      c. Three-line or single line and schematic diagrams.
      d. Conduit space locations within the assembly.

B. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
   2. Fabrication and/or layout drawings updated with as-build conditions

C. Informational Submittals:
   1. Equipment marking and documentation.
   2. Ground fault protection system test report signed by the projects supervising electrical foreman.

1.4 WARRANTY

A. Minimum of a three year Warranty from date of shipment against failure when installed in compliance with applicable national/local electrical codes and the manufacturer's installation,

operation and maintenance instructions. Manufacturer shall warranty all parts, devices and components provided as swicthboard assembly.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Eaton.
   2. GE by ABB.
   3. Square D by Schneider Electric.
   4. Siemens Corporation.

2.2 SWITCHBOARDS

A. Ratings:
   1. Voltage, number of phases, number of wires, and main bus current rating as indicated on the Drawings.
   2. Assembly short circuit current and interrupting device rating of 100 KAIC RMS symmetrical minimum.
   3. When low voltage power circuit breakers are utilized, the switchboard shall have a 30 cycle withstand rating corresponding to the breaker rating.
   4. Service Entrance Equipment rated when indicated on the Drawings.
   5. 100% rated when 100% rated breakers are installed.

B. Construction:
   1. Standards: NEMA PB 2, UL 891.
   2. Completely enclosed, dead-front, self-supporting metal structure.
   3. Vertical panel sections bolted together.
   4. Frames bolted together to support and house bus, cables and other equipment.
   5. Frames and insulating blocks to support and brace main buses for short circuit stresses up to ratings indicated on the Drawings.
   6. All sections front and rear aligned.
   7. Devices front removable and load connections front accessible for mounting switchboard against a wall.
   8. NEMA 1 rated enclosure.
   9. Interior and exterior steel surfaces cleaned and painted with rust inhibiting primer and manufacturer's standard paint.

C. Buses:
   1. Material: Tin-plated copper.
   2. Main horizontal bus:
      a. Fully rated and continuous over length of switchboard with all three phases arranged in the same vertical plane.
      b. Sufficient size to limit temperature rise to 65 degrees C over average air temperature outside the enclosure of 40 degrees C.
   3. Neutral bus: Fully rated and continuous over length of switchboard.
   4. Ground bus: 1/4 x 2 inches copper, continuous over length of switchboard and solidly grounded to each vertical section structure.
   5. Bus joints connected using through bolts and conical spring-type washers for maximum conductivity.

D. Overcurrent and Short Circuit Protective Devices:
   1. Main overcurrent protective device:
      a. Individually mounted molded case circuit breaker.
      b. Individually mounted low voltage power circuit breaker.
   2. Feeder overcurrent protective devices:

a. Group mounted molded case circuit breaker.
3. See Specification Section 26 28 00 for overcurrent and short circuit protective device requirements.
4. Factory installed.
5. Means to padlock all main and feeder devices in the open position.

E. Surge Protective Device: Integrally mounted, see Specification Section 26 43 13.

F. Metering:
1. Power monitor:
a. Through cabinet mounting.
b. See Specification Section 26 09 13 for meter requirements.

G. Accessories:
1. Thermograph viewing windows for infrared surveys without opening doors:
a. Provide windows at manufacturer's recommended locations to view cable connections and bus connections.

PART 3 - EXECUTION (INSTALLING CONTRACTOR'S SCOPE)

3.1 INSTALLATION

A. Install switchboards in accordance with manufacturer's instructions.

B. Arrange switchboard as shown on the Drawings.

C. Indoor Locations:
1. NEMA 1 enclosure.
2. Install on concrete housekeeping pad, align front of switchboard with top edge of pad chamfer and securely fasten to pad.

D. Equipment Marking and Documentation:
1. Provide labeling per NFPA 70 and other applicable codes.
2. Service equipment:
a. Arc-flash hazard warning label. (Ref. NFPA 70 Article 110.16(A) and (B))
b. Available fault current label and documentation of the calculations made for compliance with marking requirements. (Ref. NFPA 70 Article 110.24)
3. Other than service equipment:
a. Arc-flash hazard warning label. (Ref. NFPA 70 Article 110.16(A))
b. Available fault current label. (Ref. NFPA 70 Article 408.6)
4. Identify (tag) all equipment and equipment components.
5. Provide labels and tags in accordance with Section 10 14 00.
6. Available fault current and other required label data from Coordinated Power System Study as required by the contract documents.

E. Miscellaneous:
1. Provide circuit protective devices and other associated equipment as indicated on the Drawings.
2. All control wiring shall be neatly laced and have flexibility at hinge locations.

3.2 FIELD QUALITY CONTROL

A. Test the ground fault protection system as indicated in Specification Section 26 28 00.

END OF SECTION

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SECTION 26 24 16
PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Branch circuit panelboards.

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 10 14 00 – Identification Devices.
   2. Section 26 05 00 - Electrical - Basic Requirements.
   3. Section 26 28 00 - Overcurrent and Short Circuit Protective Devices.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
      b. PB 1, Panelboards.
   2. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).
   3. Underwriters Laboratories, Inc. (UL):
      a. 50, Enclosures for Electrical Equipment, Non-Environmental Considerations.
      b. 67, Standard for Panelboards.

1.3 DEFINITIONS

A. Branch Circuit Panelboard: Bus rating of 400A and less or where labeled as Branch Circuit Panelboard on the Drawings.

1.4 SUBMITTALS

A. Shop Drawings:
   1. Product technical data.
      a. Provide submittal data for all products specified in PART 2 of this Specification Section.
      b. See Specification Section 26 05 00 for additional requirements.
   2. Fabrication and/or layout drawings:
      a. Panelboard layout with alphanumeric designation, branch circuit breakers size and type, as indicated in the panelboard schedules.

B. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
   2. Panelboard schedules with as-built conditions.

C. Informational Submittals:
   1. Service equipment marking and documentation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Eaton.

2. GE by ABB.
3. Square D by Schneider Electric.
4. Siemens Corporation.

2.2 MANUFACTURED UNITS

A. Standards: NEMA PB 1, NFPA 70, UL 50, UL 67.

B. Ratings:
1. Current, voltage, number of phases, number of wires as indicated on the Drawings.
2. Short Circuit Current Rating (SCCR) and/or Ampere Interrupting Current (AIC) ratings equal to or greater than the interrupting rating indicated on the Drawings or in the schedule.
   a. Series rating is not acceptable.
   b. When fault current or minimum interrupting rating is not indicated, use rating of upstream equipment or infinite bus calculation of transformer secondary.
3. Service Entrance Equipment rated when indicated on the Drawings or when shown to be fed from a utility source.

C. Construction:
1. Interiors factory assembled and designed such that switching and protective devices can be replaced without disturbing adjacent units and without removing the main bus connectors.
2. Multi-section panelboards: Feed-through or sub-feed lugs.
3. Main lugs: Solderless type approved for copper and aluminum wire.

D. Bus Bars:
1. Main bus bars:
   a. Tin plated aluminum or tin-plated copper sized to limit temperature rise to a maximum of 65 degrees C above an ambient of 40 degrees C.
   b. Drilled and tapped and arranged for sequence phasing of the branch circuit devices.
2. Ground bus and isolated ground bus, when indicated on the Drawings: Solderless mechanical type connectors.
3. Neutral bus bars: Insulated 100% rated or 200% rated, when indicated on the Drawings and with solderless mechanical type connectors.

E. Overcurrent and Short Circuit Protective Devices:
1. Main overcurrent protective device:
   a. Molded case circuit breaker.
2. Branch overcurrent protective devices:
   a. Molded case circuit breaker.
3. See Specification Section 26 28 00 for overcurrent and short circuit protective device requirements.
4. Factory installed.

F. Integral surge protective device:
1. Provide for panelboards where indicated on the Drawings
2. See Specification Section 26 43 13.

G. Enclosure:
1. Boxes: Code gage galvanized steel, furnish without knockouts.
2. Trim assembly: Code gage steel finished with rust inhibited primer and manufacturers standard paint inside and out.
3. Branch circuit panelboard:
   a. Trims supplied with hinged door-in-door construction.
      1) Outer door:
         a) Allows access to the interior of the enclosure.
         b) Hinged to the enclosure.
         c) Opened by removal of screws or by operating a mechanical latch located behind the inner door.
      2) Inner door:

a) Allows access to breakers (non-live parts).
b) Hinged to outer door.
c) Opened by operation of a keyed corrosion resistant chrome-plated combination lock and catch. Locks for all branch circuit panelboards keyed alike.

b. Trims for surface mounted panelboards, same size as box.
c. Trims for flush mounted panelboards, overlap the box by 3/4 inches on all sides.
d. Nominal 20 inches wide and 5-3/4 inches deep with gutter space in accordance with NFPA 70.
e. Clear plastic cover for directory card mounted on the inside of each door.
f. Where NEMA 3R or NEMA 12 rating is indicated: Door gasketed.
g. Where NEMA 4X is indicated: Stainless Steel.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install as indicated on the Drawings, in accordance with the NFPA 70, and in accordance with manufacturer's instructions.

B. Support panelboard enclosures from wall studs or modular channels support structure, per Specification Section 26 05 00.

C. Provide NEMA rated enclosure as indicated on the Drawings. Where enclosure type is not indicated, provide enclosure rating suitable for the atmosphere where equipment is installed.

D. Equipment Marking and Documentation:
1. Provide labeling per NFPA 70 and other applicable codes.
2. Service equipment:
   a. Arc-flash hazard warning label. (Ref. NFPA 70 Article 110.16(A) and (B))
   b. Available fault current label and documentation of the calculations made for compliance with marking requirements. (Ref. NFPA 70 Article 110.24)
3. Other than service equipment:
   a. Arc-flash hazard warning label. (Ref. NFPA 70 Article 110.16(A))
   b. Available fault current label. (Ref. NFPA 70 Article 408.6)
4. Identify (tag) all equipment and equipment components.
5. Provide labels and tags in accordance with Section 10 14 00.
6. Available fault current and other required label data from Coordinated Power System Study as required by the contract documents.

E. Provide each panelboard with a typed directory:
1. Identify all circuit locations in each panelboard with the load type and location served.
2. Use Owner-furnished mechanical equipment designation if different than designation indicated on the Drawings.
3. Use final building room names and numbers as identified by the Owner if different than designation indicated on the Drawings.
4. Identify spare overcurrent devices.

END OF SECTION

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SECTION 26 24 19
MOTOR CONTROL EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Motor control centers.
   2. Separately mounted motor starters (including those supplied with equipment).
   3. Manual motor starters.

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 26 05 00 - Electrical - Basic Requirements.
   2. Section 26 29 23 - Variable Frequency Drives - Low Voltage.
   3. Section 26 28 00 - Overcurrent and Short Circuit Protective Devices.
   4. Section 26 43 13 - Surge Protection Devices for Low-Voltage Electrical Power Circuits.
   5. Section 26 09 13 - Electrical Metering Devices.
   6. Section 26 09 16 - Control Equipment Accessories.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. International Electrotechnical Commission (IEC).
   2. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volt Maximum).
      b. ICS 2, Controllers, Contactors and Overload Relays Rated 600 V.
      c. ICS 18, Motor Control Centers.
   3. Underwriters Laboratories, Inc. (UL):
      a. 508, Standard for Industrial Control Equipment.
      b. 845, Motor Control Centers.

B. Miscellaneous:
   1. Verify motor horsepower loads, other equipment loads, and controls from approved shop drawings and notify Engineer of any discrepancies.
   2. Verify the required instrumentation and control wiring for a complete system and notify Engineer of any discrepancies.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Product technical data:
      a. Provide submittal data for all products specified in PART 2 of this Specification Section.
      b. See Specification Section 26 05 00 for additional requirements.
   2. Fabrication and/or layout drawings:
      a. Motor control center:
         1) Elevation drawing with overall dimensions.
         2) Starter and component schedule.
         3) Identification of units and their location in the MCC.
         4) Location of incoming line terminals.
         5) Mounting dimensions.
         6) Available conduit entrance areas.
         7) Nameplate schedule.
         8) Assembly ratings (amps, volts, short circuit, etc.).
         9) Unit ladder logic wiring for each unit depicting electrical interlocking and wiring between units (NEMA ICS 18 Class II) and identification of terminals where field

devices or remote control signals are to be terminated (NEMA ICS 18 Class II-S) including industry standard symbology of the field devices as indicated on the Drawings, product specification and/or loop descriptions. Drawings indicate basic control functionality, provide diagrams for the manufacturer's product(s) meeting the required functionality.

b. Separately mounted combination starters:
   1) Unit ladder logic wiring for each unit depicting electrical wiring and identification of terminals where field devices or remote control signals are to be terminated including industry standard symbology of the field devices as indicated on the Drawings, specification and/or loop descriptions. Drawings indicate basic control functionality, provide diagrams for the manufacturer's product(s) meeting the required functionality.
   2) Short Circuit Current Rating (SCCR) nameplate marking per NFPA 70, include any required calculations.

B. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
      b. Fabrication and/or layout drawings updated with as-built conditions.

C. Informational Submittals:
   1. Equipment marking and documentation.

D. Refer to Section 01 81 33 – Cyber Security Requirements for required cyber security related submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Eaton.
   2. ABB.
   3. Square D by Schneider Electric.
   4. Siemens Corporation.

2.2 MOTOR CONTROL CENTERS

A. Ratings:
   1. 600 V class, 3 PH, 60 Hz with operating voltage and number of wires as indicated on the Drawings.
   2. Assembly short circuit current and interrupting device rating as indicated on the Drawings.
   3. Service Entrance Equipment rated when indicated on the Drawings.

B. Construction:
   1. Standards: UL 845.
   2. Totally enclosed, dead front, free standing assemblies, bolted together to form a single assembly.
   3. Fabricate of not less than 14 GA steel with 16 GA steel doors in standardized units.
   4. Nominal size per section: 20 inches wide, 20 or 21 inches deep, and 90 inches high.
   5. Enclosure:
      a. NEMA 1 gasketed.
   6. Horizontal wireways:
      a. At the top, isolated from the main bus
      b. At the bottom.

c. Easily accessible.
d. Full length of the MCC.

7. Vertical wireway:
   a. Located in each MCC section that accepts plug-in units.
   b. Connect to top and bottom wireways.
   c. Isolated from the unit interiors.
   d. Accessible through a separate hinged door.
   e. Cable tie supports to hold wiring in place.
8. Unit doors:
   a. Formed round corners and rolled edges.
   b. Minimum of two heavy-duty hinges or continuous piano hinge.
   c. Held closed by means of captive fasteners.
   d. Fabricate to be a part of the structure and not part of the starter.
9. Unit cubicles:
   a. Draw-out type for motor starters through NEMA Size 5, breakers through 400A frame and fusible switches through 400A.
   b. Guide rails for supporting and aligning starters.
      1) Larger motor starters, breakers and fusible switches to be bused or cabled to the main horizontal bus.
   c. Operating handle:
      1) With the unit stabs engaged and door closed the handle mechanism allows complete ON/OFF control of the unit disconnect and clear indication of the disconnect status.
      2) Circuit breaker and MCP operators includes a separate TRIPPED position.
      3) Mechanical interlock to prevent the opening of the door when the disconnect is in the ON position with a defeater mechanism.
      4) Mechanical interlock to prevent the placement of the disconnect in the ON position with the door open with a defeater mechanism.
      5) Non-defeatable interlock to prevent the installation or removal of a unit unless the disconnect is in the OFF position.
      6) Padlockable in the OFF position.
   d. Control panel:
      1) Provide control devices (selector switch, indicating devices, etc.) as indicated on the Drawings per Specification Section 26 09 16.
   e. Control power:
      1) Control power transformer:
         a) 120 V secondary.
         b) Fused on primary and secondary side.
         c) Sized for 140% of required load.
   f. Minimum of one full size space unit (12 inches) for any combination magnetic motor starter or starter without overload relay.
   g. One-half full size space unit (6 inches) for circuit breakers 100 A and less.
   h. Effectively baffled to isolate any ionized gases which may occur within unit starter.
10. Externally mounted overload relay pushbutton.
11. Assemblies effectively ventilated to allow relocation of starters and other components:
    a. Within the assembly and with the same load.
    b. Without having to compensate for changes in location.
12. Finish: Rust inhibited primer and manufacturer's standard paint inside and out.
13. Provide ample unrestricted space for conduit entry from the bottom.
14. Wiring: NEMA ICS 18 Class II, Type B-D.

C. Buses:
   1. Material: Tin-plated copper.
   2. Main horizontal bus:
      a. 600 A unless otherwise indicated on the Drawings.

b. Extend the full-length of the MCC with provisions for splicing additional sections to either end.

3. Vertical buses:
   a. 300 A minimum.
   b. Securely bolted to the horizontal main bus with joint easily accessible for maintenance.
   c. Completely isolated and insulated by means of a barrier.
   d. Extended full length of vertical section to distribute incoming power to each circuit breaker and starter in structure.
      1) Starters NEMA Size 5 and larger and certain other components may be cable connected to the main bus with the approval of the Engineer.
   e. Extend Vertical bus to spaces provided for future equipment.
4. Ground bus:
   a. Extend the full-length of the MCC with provisions for splicing additional sections to either end.
   b. 300 A tin-plated copper.
   c. Solidly grounded to each structure.
   d. Locate near bottom of structure.
   e. Provide for lug connection of equipment ground wires.

D. Overcurrent and Short Circuit Protective Devices:
   1. Main device:
      a. Molded case circuit breaker.
      b. Low voltage power circuit breaker.
   2. Feeder devices:
      a. Molded case circuit breaker.
   3. Motor protection with full voltage starters:
      a. Motor circuit protector.
      b. Molded case circuit breaker.
   4. Motor protection with reduced voltage starters:
      a. Molded case circuit breaker.
      b. Motor circuit protector.
   5. See Specification Section 26 28 00 for overcurrent and short circuit protective device requirements.
   6. Factory installed.

E. Motor Starters: See requirements within this Specification Section.

F. Surge Protective Device: Integrally mounted, see Specification Section 26 43 13.

G. Power Monitor Metering:
   1. Separate compartment.
   2. See Specification Section 26 09 13 for meter requirements.

H. Miscellaneous:
   1. See Drawings for items provided by other but factory installed (e.g., submersible motor temperature/leak controller, control system gateways or switches).

I. Ethernet Switch/IP Devices:
   1. Motor Control Center assemblies shall be provided with a factory assembled EtherNet/IP field bus communications network providing direct connectivity between MCC devices and the system controller and/or HMI.
   2. Ethernet 10/100 auto negotiate layer 2 managed industrial switches shall be provided as required in the MCC lineup. The Ethernet switch shall have sufficient ports available to connect to each EtherNet/IP device and have at least 2 open ports for a customer connection and a PC connection for maintenance. The Ethernet switch shall be mounted in the top removable unit of each vertical section or shipping split and not in the vertical wireway. If required by the application, the switch shall be capable of connecting to multiple sections. Ethernet switch shall be powered by MCC and not through an external device.

3. The EtherNet/IP system installed in the MCC shall include a complete and tested cabling system. The cabling system shall be 600V Cat 6 and consist of home run connections from the device to a switch located in the MCC and in accordance with the ODVA specification. Non-standard, non-shielded cable will not be accepted.
4. It shall be permissible to daisy chain Ethernet/IP devices using a 2-port switch configuration in each device unit or bucket and not use the home run topology as long as it is supported by the devices supplied by the manufacturer.
5. All cabling shall be securely supported and attached to the MCC structure in accordance with the contract drawings and the manufacturer's recommendations.
6. EtherNet/IP communications modules shall be provided at each device interfacing to the EtherNet/IP field bus. The communications modules shall be installed in the unit device compartment or bucket, and shall be direct-connected to the EtherNet/IP Ethernet cable. Each device shall be provided with the appropriate factory fabricated cable for interfacing the communications module with the associated EtherNet/IP device.

2.3 SEPARATELY MOUNTED COMBINATION STARTERS

A. Standards:
   1. NEMA 250, NEMA ICS 2.
   2. UL 508.

B. Enclosure:
   1. NEMA 4 rated:
      a. Body and cover: Sheet steel finished with rust inhibiting primer and manufacturer's standard paint inside and out.
      b. No knockouts, external mounting flanges, hinged and gasketed door.
   2. NEMA 4X rated:
      a. Body and cover: Type 304 or 316 stainless steel.
      b. No knockouts, external mounting flanges, hinged and gasketed door.
   3. NEMA 12 rated:
      a. Body and cover: Sheet steel finished with rust inhibiting primer and manufacturer's standard paint inside and out.
      b. No knockouts, external mounting flanges, hinged and gasketed door.

C. Operating Handle:
   1. With the door closed the handle mechanism allows complete ON/OFF control of the unit disconnect and clear indication of the disconnect status.
   2. Circuit breaker and MCP operators includes a separate TRIPPED position.
   3. Mechanical interlock to prevent to prevent the opening of the door when the disconnect is in the ON position with a defeater mechanism for use by authorized personnel.
   4. Mechanical interlock to prevent the placement of the disconnect in the ON position with the door open with a defeater mechanism for use by authorized personnel.
   5. Padlockable in the OFF position.

D. External mounted overload relay pushbutton.

E. Control Devices:
   1. Provide control devices as indicated on the Drawings per Specification Section 26 09 16.
   2. Devices will be accessible with the door closed.

F. Control Power Transformer:
   1. 120V secondary.
   2. Fused on primary and secondary side.
   3. Sized for 140% of required load.

G. Fault Current Withstand Rating: Equal to the rating of the electrical gear from which it is fed.

H. Motor Starters: See requirements within this Specification Section.

I. Disconnect Switch, Overcurrent and Short Circuit Protective Devices:
   1. Motor circuit protector.
   2. Molded case circuit breaker.
   3. See Specification Section 26 28 00 for overcurrent and short circuit protective device requirements.
   4. Factory installed.

2.4 MOTOR STARTERS

A. Standards:
   1. NEMA ICS 2.
   2. UL 508.

B. Full Voltage Non-Reversing (FVNR) Magnetic Starters:
   1. NEMA full size rated contactor.
      a. NEMA half sizes and IEC contactors are not permitted.
   2. Double-break silver alloy contacts.
   3. Overload relays:
      a. Ambient compensated, bimetallic type with interchangeable heaters, 24% adjustability, single phase sensitivity, an isolated arm contact and manual reset.
   4. Interlock and auxiliary contacts, wired to terminal blocks:
      a. Holding circuit contact, normally open.
      b. Overload alarm contact, normally open.
      c. Normally open auxiliary contact, for remote run status.
      d. Additional field replaceable auxiliary contacts as required per the Sequence of Operation.
      e. Two additional normally open spare field replaceable auxiliary contacts.

C. Variable Frequency Drives: See Specification Section 26 29 23.

2.5 MANUAL MOTOR STARTERS

A. Standards:
   1. NEMA 250, NEMA ICS 2.
   2. UL 508.

B. Quick-make, quick-break toggle mechanism that is lockable in the OFF position.

C. Types:
   1. Horsepower rated, for ON/OFF control.
   2. Horsepower rated, for ON/OFF control and thermal overload protection.
      a. Switch to clearly indicate ON, OFF, and TRIPPED position.
   3. DC rated, for On/Off control of DC motors up to 1.5 hp.

D. Voltage and current ratings and number of poles as required for the connected motor.

E. Enclosures:
   1. NEMA 1 rated:
      a. Galvanized steel or steel finished with rust inhibiting primer and manufacturer's standard paint inside and out.
      b. With or without concentric knockouts.
   2. NEMA 4 rated:
      a. Sheet steel finished with rust inhibiting primer and manufacturer's standard paint inside and out or cast gray iron alloy or copper-free aluminum with manufacturer's standard finish.
      b. No knockouts, external mounting flanges.
   3. NEMA 4X rated:
      a. Type 304 or 316 stainless steel.
      b. No knockouts, external mounting flanges.
   4. NEMA 12 rated:

a. Body and cover: Sheet steel finished with rust inhibiting primer and manufacturer's standard paint inside and out.
b. No knockouts, external mounting flanges.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install as indicated on the Drawings and in accordance with manufacturer's recommendations and instructions.

B. New equipment to be installed in existing motor control centers shall be made by the existing MCC manufacturer.

C. Mounting height for surface mounted equipment: See Specification Section 26 05 00.

D. Mount MCC on 4 inches high concrete pad:
1. Install two, 4 inches wide channel sills flush in pads to support and maintain alignment of the MCC.
2. Align front of MCC with top edge of pad chamfer.

E. Equipment Marking and Documentation:
1. Provide labeling per NFPA 70 and other applicable codes.
2. Service equipment:
   a. Arc-flash hazard warning label. (Ref. NFPA 70 Article 110.16(A) and (B))
   b. Available fault current label and documentation of the calculations made for compliance with marking requirements. (Ref. NFPA 70 Article 110.24)
3. Other than service equipment:
   a. Arc-flash hazard warning label. (Ref. NFPA 70 Article 110.16(A))
   b. Available fault current label. (Ref. NFPA 70 Article 408.6)
4. Identify (tag) all equipment and equipment components.
5. Provide labels and tags in accordance with Section 10 14 00.
6. Available fault current and other required label data from Coordinated Power System Study as required by the contract documents.

F. Provide separately mounted combination starters with Short Circuit Current Rating (SCCR) labeling as required by NFPA 70 and other applicable codes.
1. Determine the SCCR rating by one of the following methods:
   a. Method 1: SCCR rating meets or exceeds the available fault current of the source equipment when indicated on the Drawings.
   b. Method 2: SCCR rating meets or exceeds the source equipment's Amp Interrupting Current (AIC) rating as indicated on the Drawings.
   c. Method 3: SCCR rating meets or exceeds the calculated available short circuit current at the control panel.
2. The source equipment is the switchboard, panelboard, motor control center or similar equipment where the equipment or control panel circuit originates.
3. For Method 3, provide calculations justifying the SCCR rating. Utilize source equipment available fault current or AIC rating as indicated on the Drawings.

G. Overload Heaters:
1. Size for actual motor full load current of the connected motor.
2. For motors with power factor correction capacitors, size to compensate for the capacitors effect on load current.

H. Combination and Manual Starter Enclosures:
1. Permitted uses of NEMA 1 enclosure:
   a. Surface or flush mounted in architecturally finished areas.
   b. Surface mounted above 10 feet in areas designated as dry in architecturally and non-architecturally finished areas.

2. Permitted uses of NEMA 4 enclosure:
   a. Surface mounted in areas designated as wet.
3. Permitted uses of NEMA 4X enclosure:
   a. Surface mounted in areas designated as wet and/or corrosive.
4. Permitted uses of NEMA 12 enclosure:
   a. Surface mounted in areas designated as dry.

3.2 FIELD QUALITY CONTROL

A. Acceptance Testing: See Specification Section 26 08 13.

3.3 CLOSEOUT ACTIVITIES

A. Refer to Section 01 81 33 – Cyber-Security Requirements for cyber security related closeout requirements.

END OF SECTION

SECTION 26 26 13
PACKAGE POWER SUPPLY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Package power supply consisting of a transformer and panelboard.

B. Related Sections include but are not necessarily limited to:
   1. Section 26 05 00 - Electrical - Basic Requirements.
   2. Section 26 05 26 - Grounding.
   3. Section 26 28 00 - Overcurrent and Short Circuit Protective Devices.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
      a. C57.96, Guide for Loading Dry-Type Distribution and Power Transformers.
   2. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
      b. PB 1, Panelboards.
      c. ST 20, Dry Type Transformers for General Applications.
   3. Underwriters Laboratories, Inc. (UL):
      a. 67, Standard for Panelboards.
      b. 1561, Standard for Safety Dry-Type General Purpose and Power Transformers.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Product technical data:
      a. Provide submittal data for all products specified in PART 2 of this Specification Section.
      b. See Specification Section 26 05 00 for additional requirements.
   2. Fabrication and/or layout drawings:
      a. Nameplate drawing.
      b. Panelboard layout with alphanumeric designation, branch circuit breakers size and type, as indicated in the panelboard schedules.

B. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. GE by ABB.
   2. Hammond Power Solutions.
   3. Square D by Schneider Electric.
   4. Eaton.
   5. Siemens Corporation.

2.2 PACKAGED POWER SUPPLY

A. General:
   1. Standards: IEEE C57.96, NEMA PB 1, NEMA ST 20, UL 67 and UL 1561.
   2. Package power supply includes a main primary circuit breaker, an encapsulated dry-type transformer and a secondary panelboard with main circuit breaker.

B. Ratings:
   1. Single or three-phase as indicated on the Drawings.
   2. KVA and voltage ratings as indicated on the Drawings.
   3. Suitable for use as service entrance equipment.

C. Transformer:
   1. Non-ventilated, air cooled, two winding type.
   2. Core and coil assembly encapsulated in a proportioned mixture of resin and aggregate to provide a moistureproof, shock resistant seal.
   3. Cores:
      a. High grade, non-aging silicon steel with high magnetic permeability, and low hysteresis and eddy current losses.
      b. Magnetic flux densities are to be kept well below the saturation point.
   4. Coils: Continuous wound with electrical grade aluminum and grounded to the enclosure.
   5. Insulation system: 185 degrees C with a 115 degrees C rise.
   6. Taps: Two, 5% FCBN.
   7. Sound levels:
      a. Manufacturer shall guarantee not to exceed the following:
         1) 9 kVA and less: 40 dB.
         2) 10 to 30 kVA: 45 dB.

D. Panelboard and Protective Devices:
   1. Bus: Aluminum.
   2. Factory installed wiring between primary breaker and transformer, secondary breaker and transformer and distribution section.
   3. 480 VAC primary circuit breaker: 14,000 amp minimum interrupting rating.
   4. 240 VAC or less secondary circuit breaker: 10,000 amp minimum interrupting rating.
   5. Feeder breakers:
      a. Plug-in type with 10,000 amp minimum interrupting rating.
      b. See Section 26 28 00 for additional requirements.

E. Enclosure:
   1. Main, secondary and feeder circuit breakers enclosed with a padlockable hinged door.
   2. Wiring compartment suitable for conduit entry and large enough to allow convenient wiring.
   3. Totally enclosed, non-ventilated, NEMA4X, stainless steel finished.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Ground in accordance with Section 26 05 26 or as indicated on the Drawings.

END OF SECTION

SECTION 26 27 26
WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Material and installation requirements for:
      a. Wall switches.
      b. Receptacles.
      c. Device wallplates and coverplates.

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 26 05 00 - Electrical - Basic Requirements.
   2. Section 26 05 33 - Raceways and Boxes.
   3. Section 26 24 19 - Motor Control Equipment.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
      b. WD 1, General Color Requirements for Wiring Devices.
      c. WD 6, Wiring Devices - Dimensional Requirements.
   2. Underwriters Laboratories, Inc. (UL):
      a. 20, General-Use Snap Switches.
      b. 498, Standard for Attachment Plugs and Receptacles.
      c. 514A, Metallic Outlet Boxes.
      d. 894, Standard for Switches for Use in Hazardous (Classified) Locations.
      e. 943, Ground-Fault Circuit-Interrupters.
      f. 1010, Standard for Receptacle-Plug Combinations for Use in Hazardous (Classified) Locations.
      g. 1310, Standard for Class 2 Power Units.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Product technical data:
      a. Provide submittal data for all products specified in PART 2 of this Specification Section.
      b. See Specification Section 26 05 00 for additional requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Wall switches and receptacles:
      a. Bryant Electric.
      b. Cooper Wiring Devices by Eaton.
      c. Hubbell Incorporated Wiring Device-Kellems.
      d. Leviton Manufacturing Company.
      e. Legrand/Pass & Seymour.
      f. Eaton Crouse-Hinds.
      g. Appleton Electric Co.

h. Hubbell Killark.

2.2 WALL SWITCHES

A. Basic requirements unless modified in specific requirements paragraph of switches per designated areas or types:
   1. Industrial Specification Grade.
   2. Quiet action, snap switch.
   3. Self-grounding with grounding terminal.
   4. Back and side wired.
   5. Solid silver cadmium oxide contacts.
   6. Rugged thermoplastic and/or nylon housing and one-piece switch arm.
   7. Ratings: 20 A, 120/277 VAC.
   8. Switch handle type: Toggle.
   9. Switch handle color: Gray.
   10. Types as indicated on the Drawings:
      a. Single-pole.
      b. Double-pole.
      c. 3-way.
      d. 4-way.
      e. Momentary contact.
   11. Standards: UL 20, UL 514A, NEMA WD 1, NEMA WD 6.

B. Specialty Switch Specific Requirements:
   1. Momentary Contact Switch for Lighting Control:
      a. SPDT, 3-position, center "off".
      b. Rating: 15A, 120/277VAC.

C. Dry Non-architecturally Finished Area Specific Requirements:
   1. Coverplate for use on surface mounted outlet boxes:
      a. Raised steel, galvanized.
      b. Single or multiple gang as required.
   2. Wallplate for use on recessed outlet boxes:
      a. Steel, galvanized.
      b. 302 or 304 brushed finish stainless steel.
      c. Single or multiple gang as required.

D. Dry and Dusty Non-Architecturally Finished Area Specific Requirements:
   1. Coverplate:
      a. Cast aluminum, gasketed, stainless steel hardware, natural, lacquer, or factory painted finish.
      b. Operator type:
         1) Side mounted rocker type handle to operate snap switch.
         2) Front mounted lever type handle to operate snap switch.
         3) Push/pull operator to operate snap switch.
         4) Spring type door to cover snap switch.
      c. Single or multiple gang as required.

E. Wet or Damp Non-Architecturally Finished or Exterior Area Specific Requirements:
   1. Coverplate:
      a. Cast aluminum, gasketed, stainless steel hardware, natural, lacquer, or factory painted finish.
      b. Operator type:
         1) Side mounted rocker type handle to operate snap switch.
         2) Front mounted lever type handle to operate snap switch.
         3) Push/pull operator to operate snap switch.
         4) Spring type door to cover snap switch.
      c. Wet location rated.

d. Single or multiple gang as required.

F. Corrosive and Wet or Damp Area Specific Requirements:
1. Corrosion resistant nickel plated metal parts.
2. Coverplate for use on metallic outlet boxes:
a. Cast aluminum, gasketed, stainless steel hardware, natural, lacquer, or factory painted finish.
b. Operator type:
1) Front mounted lever to operate snap switch.
2) Push/pull operator to operate snap switch.
3) Spring type door to cover snap switch.
c. Wet location rated.
d. Single or multiple gang as required.
3. Coverplate for use on non-metallic outlet boxes:
a. High impact thermoplastic, gasketed, stainless steel screws.
1) Front mounted lever to operate snap switch.
2) Spring type door to cover snap switch.
b. Wet location rated.
c. Single or multiple gang as required.

G. Hazardous and Corrosive or Highly Corrosive and Dry, Wet or Damp Area Specific Requirements:
1. Rated for Class I, Division 1 and 2, Groups C and D; and Class II, Division 1 and 2 areas, Groups E, F, and G.
2. Assembly consists of outlet box, snap switch and coverplate.
a. NEMA 3, 7 and 9 rated.
3. Outlet box:
a. PVC coated galvanized cast iron alloy.
b. PVC coated cast aluminum.
c. Cast iron alloy, galvanized and factory painted finish.
d. Cast aluminum, natural, lacquer, or factory painted finish.
4. Snap switch (EDS Type):
a. Enclosed in separate sealing chamber and approved for installation without additional external sealing fittings.
b. Sealing chamber has prewired factory sealed pigtail leads.
5. Snap switch (EFS Type):
a. Not enclosed in separate sealing chamber requiring external sealing fittings.
6. Coverplate:
a. PVC coated galvanized cast iron alloy, gasketed, stainless steel hardware.
b. PVC coated cast aluminum, gasketed, stainless steel hardware.
c. Cast iron alloy, stainless steel hardware, galvanized and factory painted finish.
d. Cast aluminum, stainless steel hardware, natural, lacquer, or factory painted finish.
e. Operator type:
1) Front mounted lever to operate snap switch.
2) Side rocker arm operator to operate snap switch.
7. Standards: UL 894.

2.3 RECEPTACLES

A. Basic requirements unless modified in specific requirements paragraph of receptacles and per designated areas:
1. Industrial Specification Grade.
2. Straight blade.
3. Brass triple wipe line contacts.
4. One-piece grounding system with double wipe brass grounding contacts and self-grounding strap with grounding terminal.
5. Back and side wired.

6. Rating: 20 A, 125 VAC.
7. High impact nylon body.
8. Receptacle body color:
   a. Normal power: Gray.
   b. Generator or UPS power: Red.
9. Duplex or simplex as indicated on the Drawings.
10. Configuration: NEMA 5-20R.
11. Standards: UL 498, UL 514A, NEMA WD 1, NEMA WD 6.

B. Receptacle Type Specific Requirements:
   1. Basic receptacles:
      a. Weather-resistant when located in exterior locations or interior damp or wet areas as indicated on the Drawings.
         1) Identification: Letters "WR" on face of receptacle.
   2. Ground Fault Circuit Interrupter (GFCI):
      a. Specification Grade.
      b. Class A protection.
      c. Feed through type.
      d. Test and reset buttons.
      e. Self-testing.
      f. Visual indicator light.
      g. Weather-resistant when located in exterior locations or interior damp or wet areas as indicated on the Drawings.
         1) Identification: Letters "WR" on face of receptacle.
      h. Tamper resistant (TR) when indicated on the Drawings.
      i. Additional standards: UL 943.

C. Dry Non-Architecturally Finished Areas Specific Requirements:
   1. Coverplate for use on surface mounted outlet boxes:
      a. Raised steel, galvanized.
      b. Single or multiple gang as required.
   2. Wallplate for use on recessed outlet boxes:
      a. Steel, galvanized.
      b. Single or multiple gang as required.

D. Dry and Dusty Non-Architecturally Finished Areas Specific Requirements:
   1. Coverplate:
      a. Cast aluminum, gasketed, self-closing cover, stainless steel hardware, natural, lacquer or factory painted finish.
      b. Single or multiple gang, as required.

E. Damp Non-Architecturally Finished Areas Specific Requirements:
   1. Coverplate:
      a. Cast aluminum, gasketed, self-closing cover, stainless steel hardware, natural, lacquer or factory painted finish.
      b. Weatherproof when receptacle is covered.
      c. Single or multiple gang as required.

F. Wet Non-architecturally Finished Areas Specific Requirements:
   1. Coverplate:
      a. Extra-duty rated, weatherproof (NEMA 3R) while in use, gasketed, stainless steel hardware, copper-free aluminum, 3.2 inches minimum cover depth for #12 AWG cords.

G. Exterior Locations Specific Requirements:
   1. Coverplate:
      a. Extra-duty rated, weatherproof (NEMA 3R) while in use, gasketed, stainless steel hardware, copper-free aluminum, 3.2 inches minimum cover depth for #12 AWG cord.

H. Corrosive and Wet or Damp Area Specific Requirements:

1. Corrosion resistant nickel plated metal parts.
2. Receptacle body color: Gray.
3. Weather-resistant.
   a. Identification: Letters "WR" on face of receptacle.
4. Coverplate for use on metallic outlet boxes:
   a. Extra-duty rated, weatherproof (NEMA 3R) while in use, gasketed, stainless steel hardware, copper-free aluminum, 3.2 inches minimum cover depth for #12 AWG cord.
5. Coverplate for use on non-metallic outlet boxes:
   a. Extra-duty rated, weatherproof (NEMA 3R) while in use, gasketed, stainless steel hardware, flame retardant, UV stabilized polycarbonate, 3.2 inches minimum cover depth for #12 AWG cords.

I. Hazardous and Corrosive or Highly Corrosive and Dry, Wet or Damp Area Specific Requirements:
   1. Rated for Class I, Division 1 and 2, Groups C and D; and Class II, Division 1 and 2 areas, Groups E, F, and G.
   2. Assembly consists of outlet box and a combination receptacle/switch and housing.
      a. NEMA 3, 7 and 9 rated.
   3. Outlet box (EDS Type):
      a. PVC coated galvanized cast iron alloy.
      b. PVC coated cast aluminum.
      c. Cast iron alloy, galvanized and factory painted finish.
      d. Cast aluminum, natural, lacquer, or factory painted finish.
   4. Receptacle/switch and housing:
      a. Receptacle and switch enclosed in a factory sealed chamber and approved for installation without additional external sealing fittings.
      b. Insertion of "interchanger" plug and plug rotation will close the switch to energize receptacle and lock plug into the receptacle.
      c. "Interchanger" plug to be compatible with other manufacturers hazardous receptacle and work in ordinary convenience receptacles.
      d. Ordinary equipment plugs will not active the hazardous receptacle.
      e. Housing:
         1) Cast iron alloy, stainless steel hardware, galvanized and factory painted finish.
         2) Cast aluminum, stainless steel hardware, natural, lacquer, or factory painted finish.
         3) Spring-loaded door seats against neoprene gasket. Stainless steel spring.
   5. Ground Fault Circuit Interrupter (GFCI):
      a. Mount in same type of outlet box as receptacle.
      b. Enclosed in factory sealed chamber.
      c. Cover cast aluminum, stainless steel hardware, natural, lacquer, or factory painted finish.
      d. Buttons stainless steel and gasketed.
      e. Standards: UL 943.
   6. "Interchanger" plug:
      a. Aluminum housing.
      b. 30% Glass-reinforced thermoplastic polyester housing.
      c. Provide five plugs for Owners use.
   7. Standards: UL 894 and 1010.

J. Special Purpose Receptacles:
   1. NEMA configuration as indicated on the Drawings.
   2. Coverplate: See requirements per area designations herein.

2.4 MISCELLANEOUS WIRING DEVICES

A. Manual Motor Starters: Horsepower rated with or without thermal overloads, see Specification Section 26 24 19.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Mount devices where indicated on the Drawings and as scheduled in Specification Section 26 05 00.

C. See Specification Section 26 05 33 for device outlet box requirements.

D. Where more than one receptacle is installed in a room, they shall be symmetrically arranged.

E. Provide blank plates for empty outlets.

F. Momentary contact switches shall be installed and connected such that the up position is 'on only' and the down position is 'off only.'

END OF SECTION

SECTION 26 28 00
OVERCURRENT AND SHORT CIRCUIT PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Low voltage circuit breakers.

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 26 05 00 - Electrical - Basic Requirements.
   2. Section 26 08 13 - Acceptance Testing.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
      a. C37.13, Standard for Low-Voltage AC Power Circuit Breakers Used in Enclosures.
      b. C37.16, Low-Voltage Power Circuit Breakers and AC Power Circuit Protectors - Preferred Ratings, Related Requirements, and Application Recommendations.
      c. C37.17, Trip Devices for AC and General Purpose DC Low Voltage Power Circuit Breakers.
   2. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).
   3. Underwriters Laboratories, Inc. (UL):
      a. 489, Standard for Safety Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.
      b. 943, Standard for Safety for Ground-Fault Circuit-Interrupters.
      c. 1066, Standard for Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Product technical data including:
      a. Provide submittal data for all products specified in PART 2 of this Specification Section.
      b. See Specification Section 26 05 00 for additional requirements.

B. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

C. Informational Submittals:
   1. Reports:
      a. Short circuit study report.
      b. Protective coordination study report.
      c. As-left condition of all circuit breakers that have adjustable settings.

D. Refer to Section 01 81 33 – Cyber Security Requirements for required cyber security related submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Circuit breakers:
      a. Eaton.
      b. GE by ABB.
      c. Square D Company.
      d. Siemens.

2.2 CIRCUIT BREAKERS

A. Molded Case Type:
   1. General:
      a. Standards: UL 489.
      b. Unit construction.
      c. Over-center, toggle handle operated.
      d. Quick-make, quick-break, independent of toggle handle operation.
      e. Manual and automatic operation.
      f. All poles open and close simultaneously.
      g. Three position handle: On, off and tripped.
      h. Molded-in ON and OFF markings on breaker cover.
      i. One-, two- or three-pole as indicated on the Drawings.
      j. Current and interrupting ratings as indicated on the Drawings.
   2. Thermal magnetic type:
      a. Inverse time overload and instantaneous short circuit protection by means of a thermal magnetic element.
      b. Frame size 150 amp and below:
         1) Non-interchangeable, non-adjustable thermal magnetic trip units.
      c. Frame sizes 225 to 400 amp (trip settings less than 400A):
         1) Interchangeable and adjustable instantaneous thermal magnetic trip units.
      d. Ground Fault Circuit Interrupter (GFCI) Listed:
         1) Standard: UL 943.
         2) One- or two-pole as indicated on the Drawings.
         3) Class A ground fault circuit.
         4) Trip on 5 mA ground fault (4-6 mA range).
   3. Solid state trip type:
      a. Inverse time overload, instantaneous short circuit and ground fault protection by means of a solid state trip element, associated current monitors and flux shunt trip mechanism.
      b. Frame size 400 amp to 1200 amp (trip settings between 400 and 1200A):
         1) Standard rating.
         2) Interchangeable current sensor or rating plug.
         3) Adjustable long time pick-up setting.
            a) Adjustable from 50 to 100% of the current sensor or rating plug.
         4) Adjustable short time pick-up setting.
         5) Adjustable instantaneous pick-up.
         6) Fixed ground fault pick-up, when indicated on the Drawings.
      c. Adjustable arc energy-reducing maintenance system.
         1) Frame size 1200A or when indicated on the Drawings for less than 1200A frame size.
         2) Activate and deactivate without opening door and exposing operators to energized parts.
         3) System status indicator adjacent to activation switch.
      d. Frame size 1600 amp and above:
         1) 100% rated.

2) Interchangeable current sensor or rating plug.
3) Adjustable long time pick-up setting.
a) Adjustable from 50 to 100% of the current sensor or rating plug.
4) Adjustable long time delay setting.
5) Adjustable short time pick-up setting.
6) Adjustable instantaneous pick-up setting.
7) Adjustable ground fault pick-up setting, when indicated on the Drawings.
8) Adjustable ground fault delay setting, when indicated on the Drawings.

e. Adjustable arc energy-reducing maintenance system.
1) Activate and deactivate without opening door and exposing operators to energized parts.
2) System status indicator adjacent to activation switch.

4. Motor circuit protector:
a. Adjustable instantaneous short circuit protection by means of a magnetic or solid state trip element.
b. Sized for the connected motor.

B. Low Voltage Power Type:
1. Inverse time overload, instantaneous short circuit and ground fault protection by means of a solid state trip element, associated current monitors and two-step stored energy trip mechanism.
2. Standards: IEEE C37.13, IEEE C37.16, IEEE C37.17, UL 1066.
3. 100% rated.
4. Electrically operated (EO) or manually operated (MO) as indicated on the Drawings.
5. Manually operated breakers:
a. Close/Open pushbuttons.
b. Red and green indicators to indicate breaker position.
c. Trip unit power: Internal CPT of the electrical gear.
6. Motor driven operator for charging mechanism with open, close and charge push button.
7. Stored energy mechanism position indicator.
8. Contact position indicator: Reversible 52a/52b contacts, quantity as indicated on the Drawings.
9. Truck operated cell switch (52TOC) when indicated on the Drawings.
10. Bell alarm with manual reset when indicated on the Drawings.
11. Draw out construction:
a. Roll out type operated by removable crank handle and interlocked with the door.
b. Four positions: Connected, test, disconnected and removed.
12. Current and interrupting ratings as indicated on the Drawings and a 30-cycle short-time withstand ratings equal to their symmetrical interrupting ratings, regardless of whether equipped with instantaneous trip protection or not.
13. Current limiters:
a. Integrally mounted on 2000 amp frames and less and separate draw-out limiter on 3200 amp and larger.
b. Coordinated with the trip unit to avoid unnecessary blowing of the current limiters.
c. Anti-single-phasing device to trip breaker in the event of a blown limiter, indicator to indicate which limiter is blown and prevent breaker from being re-closed on a single-phase condition.
14. Frame size 800 amp and above:
a. Interchangeable current sensor or rating plug:
b. Adjustable long time pick-up setting.
1) Adjustable from 50 to 100% of the current sensor or rating plug.
c. Adjustable long time delay setting.
d. Adjustable short time pick-up setting.
e. Adjustable instantaneous pick-up setting.
f. Adjustable ground fault pick-up setting, when indicated on the Drawings.
g. Adjustable ground fault delay setting, when indicated on the Drawings.

h. Adjustable arc energy-reducing maintenance system.
    1) Frame size 1200A or larger or when indicated on the Drawings for 800A frame size.
    2) Activate and deactivate without opening door and exposing operators to energized parts.
    3) System status indicator adjacent to activation switch.
i. Unit status indicator.
j. Cause of trip indicator.
k. Current display.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Current and interrupting ratings as indicated on the Drawings.

B. Series rated systems not acceptable.

C. Devices shall be ambient temperature compensated.

D. Circuit Breakers:
    1. Molded case circuit breakers shall incorporate the following, unless indicated otherwise on the Drawings:
        a. Frame sizes 400 amp and less with trip setting less than 400A shall be thermal magnetic type.
        b. Frame sizes 400amp and larger shall be solid state trip type.
        c. Motor circuit protectors sized for the connected motor.
    2. Low voltage power circuit breakers shall incorporate the following, unless indicated otherwise on the Drawings:
        a. Set current sensor or rating plugs long time pick-up setting so that the indicated trip level is near the 75% trip point.
        b. Remove, override or turn off instantaneous setting when indicated on the Drawings.

3.2 FIELD QUALITY CONTROL

A. Coordinated Power System Protection:
    1. Prepare a study to demonstrate that the equipment and system constructed within the scope of these Contract Documents, meet the specified requirements for equipment ratings, coordination and protection.
    2. Perform the studies in accordance with IEEE 242 and IEEE 399.
    3. Include the name of the software developer, software package and software version number in the computer generated studies.
    4. System short circuit study report:
        a. Begin the study at the connection point of the new equipment to the existing equipment and extend down the system through all buses.
            1) Perform a balanced three-phase fault, bolted line-to-line fault and line-to-ground fault study.
        b. Prepare a one-line diagram to show the electrical system buses, transformers and all sources of fault current including generators and motors.
        c. Utilize manufacturer's data for the actual proposed equipment (e.g., transformer impedance).
        d. Coordinate the available utility fault current with the power utility company.
        e. Show input data in tabular form in the report and/or on the one-line diagram.
            1) Input data shall include but is not limited to:
                a) Utility fault current or MVA and X/R ratio.
                b) Bus voltages.
                c) Conductor sizes and type of conduit.
                d) Generator and motor sizes and contributions.

e) Transformer sizes and impedances.

f. Show available fault current at each bus in tabular form in the report and/or on the one-line diagram.

g. Perform studies for both normal power and emergency/standby power scenarios.

5. System protective coordination study report:
   a. Begin the study at the protective device upstream of the connection point of the new equipment and extend down the system through all buses as required to ensure a coordinated power system.
   b. Demonstrate that the maximum possible degree of selectivity has been obtained between devices specified for the protection of equipment and conductors from damage from overloads and fault conditions.
      1) Where necessary, an appropriate compromise shall be made between system protection and service continuity.
      2) Consider system protection and service continuity to be of equal importance.
   c. Prepare a one-line diagram to show the electrical system buses, transformers and protective devices.
   d. Utilize manufacturer's data for the actual proposed protective devices.
   e. Summarize the coordination study, conclusions and recommendations.
      1) As a minimum, include the following:
         a) The manufacturer's information used to prepare the study.
         b) Assumptions made during the study.
         c) Recommended taps and settings of all adjustable devices in tabulated form.
         d) Composite coordination time-current curves on log-log paper showing:
            (1) That the settings for each protective device will provide protection and selectivity.
            (2) Identify each curve.
            (3) Cable and equipment damage points.
            (4) Circuit interrupting device operating and interrupting times.
            (5) One-line sketch of the part of the system being investigated.
            (6) Include as many curves as possible on a graph while maintaining readability.
         e) Position time-current curves for each device to provide for maximum selectivity to minimize system disturbances during fault clearing.
         f) Advise the Engineer of potential coordination problems discovered during the study and include recommendations to resolve the problem.
            (1) Provide time-current curves for the "as found" and "proposed" conditions for upgrade/retrofit projects.
         g) Submit the report for approval 90 days prior to equipment energization.

B. Adjustable Circuit Breakers:
   1. Set all circuit breaker adjustable taps as defined in the coordination study, except adjust motor circuit protectors per the motor nameplate and NFPA 70 requirements.

C. Ground Fault Protection System:
   1. Single source system:
      a. Main breaker using the residual sensing method system coordinated with individual feeder breakers using the residual sensing method.

D. Testing:
   1. Acceptance testing: See Specification Section 26 08 13.
   2. Adjustable circuit breakers:
      a. Test and verify all circuit breaker trip functions using a test set provided by the manufacturer for that purpose for circuit breakers 1200 A and above.
   3. Ground fault protection system testing:
      a. Performance test installed ground fault protection system as required by the NFPA 70.
      b. Use high current injection method to test system.
      c. Test report shall indicate:

1) Device settings.
2) Tripping time in cycles for each device.
3) Test current.
4) Date of test.
5) Name of certified testing firm that performed the test.

SECTION 26 28 16
SAFETY SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Safety switches.

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 26 05 00 - Electrical - Basic Requirements.
   2. Section 26 28 00 - Overcurrent and Short Circuit Protective Devices.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
      b. KS 1, Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum).
   2. Underwriters Laboratories, Inc. (UL):
      a. 98, Enclosed and Dead-Front Switches.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Product technical data:
      a. Provide submittal data for all products specified in PART 2 of this Specification Section.
      b. Provide a Summary Table or use Exhibit A that associates the safety switch features with connected equipment tag number. Exhibit A indicates minimum data required.
      c. See Specification Section 26 05 00 for additional requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following safety switch manufacturers are acceptable:
   1. Eaton.
   2. GE by ABB.
   3. Square D by Schneider Electric.
   4. Siemens Corporation.
   5. Appleton by Emerson Electric Co.
   6. Crouse-Hinds by Eaton.
   7. Killark by Hubbell.

2.2 SAFETY SWITCHES

A. General:
   1. Non-fusible or fusible as indicated on the Drawings.
   2. Suitable for service entrance when required.
   3. NEMA Type HD heavy-duty construction.
   4. Switch blades will be fully visible in the OFF position with the enclosure door open.
   5. Quick-make/quick-break operating mechanism.
   6. Deionizating arc chutes.
   7. Manufacture double-break rotary action shaft and switchblade as one common component.
   8. Clear line shields to prevent accidental contact with line terminals.

9. Operating handle (except NEMA 7 and NEMA 9 rated enclosures):
    a. Red and easily recognizable.
    b. Padlockable in the OFF position.
    c. Interlocked to prevent door from opening when the switch is in the ON position with a defeater mechanism.

B. Ratings:
1. Horsepower rated of connected motor.
2. Voltage and amperage: As indicated on the Drawings.
3. Short circuit withstand:
    a. Non-fused: 10,000A.
    b. Fused: 200,000A.

C. Accessories, when indicated in PART 3 of this Specification Section or on the Drawings:
1. Neutral kits.
2. Ground lug kits.
3. Auxiliary contact kits:
    a. Opens before main switch.
    b. Rated 10A at 125/250 VAC.
    c. One N.O. and one N.C. contact.

D. Enclosures:
1. NEMA 1 rated:
    a. Body and cover: Sheet steel finished with rust inhibiting primer and manufacturers standard paint inside and out.
    b. With or without knockouts, hinged and lockable door.
2. NEMA 4X rated (metallic):
    a. Body and cover: Type 304 or 316 stainless steel.
    b. No knockouts, external mounting flanges, hinged and gasketed door.
3. NEMA 7 and NEMA 9 rated:
    a. Cast gray iron alloy or copper-free aluminum with manufacturer's standard finish.
    b. Drilled and tapped openings or tapered threaded hub.
    c. Gasketed cover bolted-down with stainless steel bolts.
    d. External mounting flanges.
    e. Operating handle padlockable in the OFF position.
4. NEMA 12 rated:
    a. Body and cover: Sheet steel finished with rust inhibiting primer and manufacturers standard paint inside and out.
    b. No knockouts, external mounting flanges, hinged and gasketed door.

E. Overcurrent and short circuit protective devices:
1. Fuses.
2. See Specification Section 26 28 00 for overcurrent and short circuit protective device requirements.

F. Standards: NEMA KS 1, UL 98.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install as indicated and in accordance with manufacturer's instructions and recommendations.

B. Install switches adjacent to the equipment they are intended to serve unless otherwise indicated on the Drawings.

C. Provide auxiliary contact kit on local safety switches for motors being controlled by a variable frequency drive.
1. The VFD is to be disabled when the switch is in the open position.

D. Permitted uses of NEMA 1 enclosure:
   1. Surface or flush mounted in areas designated dry in architecturally finished areas.

E. Permitted uses of NEMA 4X metallic enclosure:
   1. Surface mounted in areas designated as wet and/or corrosive.

F. Permitted uses of NEMA 7 enclosure:
   1. Surface mounted in areas designated as Class I hazardous.

G. Permitted uses of NEMA 12 enclosure:
   1. Surface mounted in areas designated as dry in non-architecturally finished areas.

END OF SECTION

EXHIBIT A

Safety Switch Summary Table					
Equipment Tag	Switch Model Number	Rated Amps	Fused / Non-fused	Enclosure Type	Accessories
Example	Per MFR	60A	NF	NEMA 4X non-metallic	Ground lug, Aux Contact

SECTION 26 28 17
SEPARATELY MOUNTED CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Separately mounted circuit breakers.

B. Related Sections include but are not necessarily limited to:
   1. Section 26 05 00 - Electrical - Basic Requirements.
   2. Section 26 28 00 - Overcurrent and Short Circuit Protective Devices.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
   2. Underwriters Laboratories, Inc. (UL):
      a. 489, Molded Case Circuit Breakers, Molded Case Switches, and Circuit Breaker Enclosures.
      b. 1203, Standard for Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Product technical data:
      a. Provide submittal data for all products specified in PART 2 of this Specification Section.
      b. Provide a table that associates equipment model number with equipment tag number.
      c. See Specification Section 26 05 00 for additional requirements.

B. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
   2.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Eaton.
   2. GE by ABB.
   3. Square D by Schneider Electric.
   4. Siemens Corporation.
   5. Appleton by Emerson Electric Co.
   6. Crouse-Hinds by Eaton.
   7. Killark by Hubbell.

2.2 COMPONENTS

A. Ratings:

1. Voltage, number of phases, number of wires, and current rating as indicated on the Drawings.
2. Assembly short circuit current and interrupting device rating as indicated on the Drawings.
3. Service Entrance Equipment rated when indicated on the Drawings.
4. 100% rated when 100% rated breakers are installed.

B. Standards: UL 489 and UL 1203 for hazardous locations.

C. Overcurrent and short circuit protective devices:
1. Molded case circuit breaker.
2. See Section 26 28 00 for overcurrent and short circuit protective device requirements.
3. Factory installed.

D. NEMA 1 rated:
1. Body and cover: Sheet steel finished with rust inhibiting primer and manufacturers standard paint inside and out.
2. With or without knockouts, hinged or unhinged cover.
3. Breaker is front operable and padlockable in the OFF position.
4. Suitable for service entrance.

E. NEMA 4X rated:
1. Body and cover: Type 304 or 316 stainless steel.
2. No knockouts, external mounting flanges, hinged and gasketed door.
3. Front operating handle padlockable in the OFF position and interlocked to prevent door from opening when the breaker is ON.
4. Suitable for service entrance.

F. NEMA 7 and 9 rated:
1. Cast gray iron alloy or copper-free aluminum with manufacturer's standard finish.
2. Drilled and tapped openings or tapered threaded hub.
3. Gasketed cover bolted-down with stainless steel bolts.
4. External mounting flanges.
5. Front operating handle padlockable in the OFF position.
6. Suitable for service entrance.

G. NEMA 12 rated:
1. Body and cover: Sheet steel finished with rust inhibiting primer and manufacturers standard paint inside and out.
2. No knockouts, external mounting flanges, hinged and gasketed door.
3. Front operating handle padlockable in the OFF position and interlocked to prevent door from opening when the breaker is ON.
4. Suitable for service entrance.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install as indicated and in accordance with manufacturer's recommendations and instructions.

B. Permitted uses of NEMA 1 enclosure:
1. Surface or flush mounted in areas designated dry in architecturally finished areas.

C. Permitted uses of NEMA 4X enclosure:
1. Surface mounted in areas designated as wet and/or corrosive.

D. Permitted uses of NEMA 7 enclosure:
1. Surface mounted in areas designated as Class I hazardous.

E. Permitted uses of NEMA 12 enclosure:
1. Surface mounted in areas designated as dry in non-architecturally finished areas.

F. Equipment Marking and Documentation:
   1. Provide labeling per NFPA 70 and other applicable codes.
   2. Service equipment:
      a. Arc-flash hazard warning label. (Ref. NFPA 70 Article 110.16(A) and (B))
      b. Available fault current label and documentation of the calculations made for compliance with marking requirements. (Ref. NFPA 70 Article 110.24)
   3. Other than service equipment:
      a. Arc-flash hazard warning label. (Ref. NFPA 70 Article 110.16(A))
      b. Available fault current label. (Ref. NFPA 70 Article 408.6)
   4. Identify (tag) all equipment and equipment components.
   5. Provide labels and tags in accordance with Section 10 14 00.
   6. Available fault current and other required label data from Coordinated Power System Study as required by the contract documents.

END OF SECTION

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SECTION 26 29 23
VARIABLE FREQUENCY DRIVES - LOW VOLTAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Variable frequency drives (VFDs) for operation of inverter duty motors.

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 10 14 00 - Identification Devices.
   2. Section 26 05 00 - Electrical - Basic Requirements.
   3. Section 01 61 03 - Equipment - Basic Requirements.
   4. Section 40 61 96 – Process Control Descriptions.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American National Standards Institute (ANSI).
   2. ETL Testing Laboratories (ETL).
   3. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
      a. 399, Recommended Practice for Industrial and Commercial Power Systems Analysis.
      b. 519, Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.
      c. C62.41, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
   4. National Electrical Manufacturer's Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
      b. MG 1, Motors and Generators.
   5. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC):
         1) Article 430, Motors Motor Circuits, and Controllers..
   6. Occupational Safety and Health Administration (OSHA).
   7. Underwriters Laboratory, Inc. (UL):
      a. 508, Standard for Industrial Control Equipment.
      b. 508A, Standard for Industrial Control Panels.

B. Qualifications:
   1. Provide drives that are listed and labeled by UL, ETL, or other Nationally Recognized Testing Laboratory (NRTL) as defined by OSHA regulations, or that have been inspected and subsequent field-labeled by such NRTL.
   2. Where listed drives and other components are installed in a common enclosure, the assembly shall be listed and labeled per UL 508 and UL 508A or equivalent NRTL standard.
      a. Entire assembly shall be affixed with a UL 508A label "Listed Enclosed Industrial Control Panel" or equivalent NRTL label prior to shipment to the jobsite.
   3. VFD Supplier shall maintain an authorized service organization within 100 miles of the Project Site.

C. Coordination:
   1. The intent of this Specification Section is to allow the VFD manufacturer to provide the best solution for the harmonic and motor protection outlined herein.
      a. This solution shall include, but not be limited to, all aspects of the distribution system including standby generation, motor feeder cable type and available floor space.
   2. Motor and VFD coordination: See Specification Section 01 61 03.
   3. VFD shall be supplied complete with all required control components.

a. Provide control as indicated:
    1) On the electrical drawings.
    2) As specified in this Specification Section.
    3) As specified in the process control system loop descriptions.
        a) See Specification Section 40 61 96.
b. VFD manufacturer shall review the application and provide, at no additional cost to the Owner, the hardware and software necessary to allow the VFD to control the driven equipment motor over its required operating range.
    1) These may include, but are not limited to, analog and digital interface modules, communication interface modules, switches, lights and other devices.
c. Coordinate control devices with devices furnished with driven equipment such as vibration switches, thermal sensors, leak detectors, etc.

4. Verify plan dimensions with equipment space requirements as indicated on the Drawings.
    a. Equipment which exceeds the allotted maximum dimensions may not be acceptable.
    b. Equipment which reduces clear work space below the minimums established by the NFPA 70 will not be acceptable.

1.3 DEFINITIONS

A. Variable Torque (VT):
    1. Defines a load characteristic in which the torque delivered from the motor to the load is reduced as speed is reduced below full rated.
    2. This type of load permits the VFD and the motor to operate at reduced output current at reduced speed.

B. Constant Torque (CT):
    1. Defines a load characteristic in which the torque delivered from the motor to the load remains constant as speed is varied.
    2. This type of load requires the VFD to be able to continuously deliver rated output current over the entire speed range.

C. Constant Horsepower:
    1. Defines a load characteristic in which the torque delivered from the motor to the load is reduced as the speed is increased.
    2. This characteristic is required for operation of the VFD and motor above rated frequency to maintain output current within the rated value.

D. Inverter Duty Motor: An AC induction motor complying with all requirements of NEMA MG 1 Part 31 for definite-purpose inverter-fed motors.

E. Standard Motor: An AC induction motor that fails to comply with one or more requirements of NEMA MG 1 Part 31.

F. Low Voltage: 600 VAC or less.

1.4 SUBMITTALS

A. Shop Drawings:
    1. Provide a schedule for each VFD including the following information:
        a. Equipment Tag Number.
        b. VFD Complete Catalog Number.
        c. VFD Amp Frame Size.
        d. Variable or Constant Torque Rating Basis.
        e. Rated Input Current.
        f. Rated Continuous Output Current.
        g. Rated Short Circuit Current.
        h. VFD cable type specified (shielded or non-shielded).
        i. VFD Maximum Motor Lead Length for the type of cable used.
        j. Motor Manufacturer.
        k. Motor Frame Size.

l. Motor Full Load Amps.
m. Motor Service Factor.
n. As installed motor Lead Length.
o. VFD options provided to meet harmonic or motor protection specifications.

2. Submit VFD Shop Drawings concurrently with driven equipment and motor Shop Drawings.
3. Product technical data:
   a. Complete electrical ratings and performance specifications confirming compliance with specified ratings and performance.
   b. Maximum rate of heat rejection from VFD and all related components and associated cooling requirements.
   c. Manufacturer's installation instructions.
   d. Manufacturer's programming and operating instructions.
   e. See Specification Section 26 05 00 for additional requirements.
4. Fabrication and/or layout drawings:
   a. Top, front and side exterior views, with details showing maximum overall dimensions of enclosure, mounting provisions and conduit/cable entry provisions.
   b. Identify minimum clearances from other VFDs or electrical equipment required for proper cooling at top, bottom, side and back of enclosure.
   c. Three-line diagrams showing AC schematic of VFD, input, output and bypass devices including device ratings.
   d. Interior layout drawings showing location of all components within enclosure, field wiring terminal boards, and power and grounding connections.
   e. Field wiring diagrams showing locations and sizes of all electrical connections, ground terminations, and requirements for shielded wire usage or any other special installation considerations.
   f. Short Circuit Current Rating (SCCR) nameplate marking per NFPA 70, include any required calculations.
5. Certifications:
   a. Submit with Shop Drawings:
      1) Identification and location of closest authorized service organization.
      2) Harmonic analysis at each PCC per Harmonic Protection Requirements Article.
   b. Submit prior to shipment:
      1) Certified factory test reports confirming compliance with specified requirements.
   c. Submit after installation:
      1) Certified field service reports showing:
         a) Each VFD is operational.
         b) Each VFD and its driven equipment motor are compatible.
         c) Each VFD responds correctly to the input control signals.
         d) Critical frequencies of the drive system and that the VFD has been set to lockout these frequencies.
         e) Measured harmonic levels per Harmonic Protection Requirements Article.
         f) Measured motor terminal peak voltages per Motor Protection Requirements Article.

B. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
   2. Approved copy of VFD schedule per Submittals Article.
   3. Manufacturer's instruction manuals.
   4. Troubleshooting procedures with a cross-reference between symptoms and corrective recommendations.
   5. Connection data to permit removal and installation of recommended smallest field-replaceable parts.
   6. Recommended spare parts list.

7. Commissioning sheets showing "as-left" values of all user-programmable or adjustable drive parameters.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Allen Bradley.
   2. ABB.
   3. Eaton.
   4. Danfoss.
   5. Siemens/Robicon.
   6. Siemens.
   7. Square D Company.

2.2 GENERAL

A. VFDs shall consist of a rectifier-DC bus-inverter combination producing a sine-coded pulse-width-modulated (PWM) output voltage waveform.

B. VFDs, whether installed in motor control center (MCC) construction or separately-mounted, shall constitute a complete combination motor controller per NFPA 70, Article 430 and shall provide the following per the requirements of that article without the addition of any external components or devices.
   1. Motor control.
   2. Motor overload protection.
   3. Motor and motor branch circuit short circuit and ground fault protection.
   4. Motor and controller disconnecting means.

C. It is the intent of this Specification that VFDs shall be an "engineered" or "configured" drive package in which the VFD chassis, all input, output and bypass power devices, VFD accessories, ancillary switches, contactors, relays, and related control devices are selected, furnished, factory-assembled and -tested by the VFD manufacturer in a single enclosure requiring only connection of the power supply circuit, motor branch circuit, and external control wiring in the field.

2.3 PERFORMANCE AND DESIGN REQUIREMENTS

A. Application:
   1. VFD(s) shall be of sufficient capacity and shall provide a quality of output waveform for stepless motor control from 10 to 100% of base speed of the driven equipment.
   2. VFDs shall be compatible with:
      a. Inverter duty induction motors.
      b. Special purpose submersible induction motor/pump.
   3. VFDs shall be suitable for Constant Torque (CT) or Variable Torque (VT) applications.
      a. VFD manufacturer shall coordinate with the manufacturer of the driven equipment to identify CT and VT applications.
   4. VFDs shall be designed to operate successfully under the following site conditions:
      a. Ambient:
         1) Temperature: 0-40 degrees C.
         2) 95% non-condensing relative humidity.
      b. Elevation: Less than 3,300 feet above MSL.
      c. Power supply characteristics:
         1) 480Vac, 3 PH, 60 Hz, 3 wire, (±10%).
         2) Effectively grounded.

B. Ratings and Performance Specifications:
   1. Voltage rating:

a. Nominal: 460 or 480 VAC, 3 PH, 60 Hz.
b. Range for continuous full load operation: ±10% of nominal.
c. Voltage imbalance tolerance for full load operation: 3% minimum.

2. Current ratings:
   a. Continuous:
      1) Equal to or greater than the motor nameplate full load.
   b. Short-term overload:
      1) VT: 110% for 1 minute.
      2) CT: 150% for 1 minute.
      3) Permissible for 1 minute every 10 minutes continuously.
   c. Short circuit:
      1) 65,000 A RMS SYM, minimum .
      2) Where a short circuit rating is not indicated or specified for individual VFDs, each VFD shall have a rating not less than indicated on the Drawings for the MCC, switchboard or panelboard the VFD is supplied from.
      3) Where specified short circuit rating indicates additional input impedance is required to protect semiconductors, provide input AC line reactors, whether required to meet harmonic performance specifications or not.
3. Efficiency:
   a. 97%, minimum, at full speed and full load.
   b. 93%, minimum at 1/2 speed and full load.
4. Displacement power factor:
   a. 95%, minimum from 50% to 100% speed and load.
5. Efficiency and power factor criteria apply from the input terminals to the output terminals of the VFD alone, excluding losses of input and output power circuit accessories.
6. Frequency drift:
   a. +0.5% of set frequency.
7. Speed regulation (motor dependent): 3%.
8. Speed range: 10:1.
9. Control type:
   a. Volts/Hertz ratio; constant over the entire operating range of the VFD except:
      1) When operating under voltage boost.
      2) At frequencies over 60 Hz.

C. Operational Features:
   1. Insensitive to input phase sequence.
   2. Continued operation with momentary voltage dips of 25% of rated voltage, or single phase condition: 4 seconds, minimum.
   3. Controls power loss ride-through: 500 MSEC, minimum.
   4. Electronic reversing.
   5. DC injection braking.
   6. Anti-windmilling: Synchronization of VFD starting frequency with spinning or coasting load, forward or reverse.
   7. Critical frequency band lockout:
      a. Minimum of three settings.
      b. Adjustable bandwidth, 1 - 5 Hz.
   8. Capable of operating without the motor connected for start-up and troubleshooting.

D. The VFD shall be provided with the following minimum user-programmable parameters:
   1. Carrier frequency.
   2. Independent maximum and minimum speeds for forward and reverse operation.
   3. Start frequency and hold time.
   4. Independent linear acceleration and deceleration time.
   5. Preset "jog" speed.
   6. Three critical frequency bands.
   7. One preset speed selectable by logic input.

8. Volts/Hertz ratio.
9. Voltage boost, magnitude and frequency range.
10. Process controller gain, offset and bias.
11. Current limit.
12. Overcurrent pickup.
13. Overcurrent delay.
14. Ground fault pickup.
15. DC injection level and time.

E. The VFD shall be designed such that the power circuit components are fully protected from line side disturbances and load side faults:
   1. General:
      a. Shutdown conditions associated with supply circuit conditions which can be corrected external to the VFD-motor system shall be provided with automatic reset, with shutdown cause logged in memory:
         1) Input under voltage.
         2) Input over voltage.
         3) Input under frequency.
         4) Input over frequency.
         5) Input Phase loss.
         6) DC Bus under voltage.
      b. Shutdown conditions which indicate overload or fault within the VFD, the output circuit, or the motor shall require local manual reset at the VFD, requiring operator intervention.
         1) Over temperature.
         2) Blown fuse.
         3) Component failure.
         4) Overload.
         5) Short circuit.
         6) Ground fault.
         7) DC Bus over voltage.
         8) External safety input (e.g., motor thermal protection).
         9) Logic fault.
      c. When automatic shutdown occurs, VFD shall restart only when remote run signal is removed and reapplied.
      d. VFD shall hold cause of trip data for a minimum of four shutdowns in memory.
         1) Data to be accessible through the keypad, local communication link and remotely.
   2. Input protection:
      a. Input circuit breaker or current-limiting fuses with externally operable disconnect.
         1) Fault current interrupting rating equal to or greater than the specified withstand rating of the VFD.
         2) Handle padlockable in the OFF position.
      b. Provide full protection for semiconductors integral to the VFD; units requiring current-limiting fuses or circuit breakers in the supply circuit are not acceptable.
      c. Incoming line transient suppression.
         1) 6000V peak per IEEE C62.41.
         2) Phase-to-phase and phase-to-ground protection.
      d. Sustained over voltage trip.
   3. Internal protection:
      a. Surge suppression and power device snubbers.
      b. Power devices rated at 2.5 times line voltage.
      c. Instantaneous over current trip.
      d. DC bus over voltage trip.
      e. Power device over temperature trip.
      f. Control logic circuit malfunction trip.
   4. Output protection:

a. Inverse-time overload trip:
   1) UL Class 10 characteristic.
b. Over voltage trip.
c. Over frequency trip.
d. Short circuit trip.
   1) Line to line and line to ground.
e. Ground fault trip.

2.4 OPERATOR AND REMOTE CONTROL INTERFACE

A. Drive controls shall be microprocessor-based with on-board human machine interface and both local and remote digital communications capability.
   1. All monitoring and control functions, other than those shutdowns specified to be manual reset only, shall be available both locally and remotely.

B. Control circuits shall be 120 VAC or 24 VAC or 24 VDC.
   1. 120 VAC supplied by CPT in the VFD.
      a. CPT shall have minimum additional capacity of 60 VA greater than that required by control devices.
      b. CPT shall have two fuses on the primary side and one fuse on the secondary side.
      c. CPT shall have surge protection on the primary side independent of any other surge protection in the VFD.
   2. 24 VAC or 24 VDC supplied by Class 2 power supply in the VFD.
      a. Power supply shall have minimum additional capacity of 33% greater than that required by control devices.
      b. Provide two current-limiting fuses on the AC supply to the power supply.
      c. Power supply shall have surge protection on the primary side independent of any other surge protection in the VFD.

C. Operator Interface:
   1. Door mounted sealed keypad, membrane type with LED or LCD display.
      a. Messages shall be in English and engineering units.
      b. Drive operating parameters shall be programmable.
      c. Menu driven.
      d. Password security.
      e. Display fault and diagnostic data.
      f. Operating parameters, fault and diagnostic data maintained in non-volatile memory with historic log of fault and diagnostic data.
      g. Gold plated plug-in contacts.
   2. Provide indication and control interface, integral in the keypad, as required in the sequence of operation and Drawings.
      a. Minimum indications:
         1) Run.
         2) Stop.
         3) Ready.
         4) Alarm.
         5) Fault.
         6) Local control.
         7) Remote control.
         8) Control source local.
         9) Control source remote.
         10) Speed indication.
      b. Minimum control functions:
         1) Local/Remote switch.
         2) Stop button.
         3) Start button.
         4) Reset button.

5) Speed control buttons.

3. Diagnostic indicators located externally on the face of the drive shall show the type of fault responsible for drive warning, shutdown or failure.
   a. On occurrence of more than one condition, each shall be recorded or indicated by the diagnostics.

D. Remote Control Interface:
   1. Local portable computer interface via RS232/RS242 serial communications port:
      a. Capability to:
         1) Start-Stop VFD.
         2) Control VFD Speed.
         3) Access fault and diagnostic data.
   2. Analog and discrete inputs:
      a. Speed reference (setpoint) signal 4-20 mA DC.
      b. Isolated process PID controller with user-programmable setpoint, gain, rate, reset and span for accepting a remote 4-20 mA DC process variable signal.
   3. Analog and discrete outputs:
      a. 4-20 mA DC output for remote speed indication, as a function of frequency, calibrated 0 to 100%.
      b. Drive FAULT contacts.
      c. Drive RUNNING contacts.
      d. Drive selector switch in AUTO status contacts.
   4. Contacts:
      a. Contacts shall be rated 2 A inductive at 120 VAC.
      b. All contacts shall be wired to field wiring terminal boards.
   5. Drive shutdown on external fault input:
      a. Provide isolated input for dry contact from external motor or system safety devices to cause immediate shutdown of VFD.
      b. Safety shutdown to be operable in all operating modes of drive, including local operation from keypad.
      c. Local safety switch, to driven equipment, auxiliary contact to lock-out VFD from running when safety switch is open.
   6. Network communications capability:
      a. Provide VFD with communication card, protocol and required programming for digital communication of all VFD program and operational parameters to plant control system via:
         1) Ethernet IP.

2.5 HARMONIC PROTECTION REQUIREMENTS

A. All VFDs shall be capable of satisfactory operation from a source having voltage distortion and notch characteristics identified as acceptable for a "dedicated system" in IEEE 519 Table 10.2.

B. With all VFDs operating under worst-case harmonic current conditions, and the facility supplied from either or both the utility and generator sources, the VFDs shall not produce harmonic effects in excess of the following limits at any point of common coupling (PCC).
   1. Voltage distortion and notch characteristics: IEEE 519 Table 10.2 for General System.
   2. Current distortion: IEEE 519 Table 10.3 based on $I_{SC}/I_L < 20$.

C. PCC shall be considered:
   1. Building service entrance switchgear, switchboard or MCC.

D. The Engineer has performed preliminary calculations based on typical VFD data which indicate that the minimum mitigation measures required to meet the specified harmonic criteria are one of the following topologies:
   1. 6-pluse rectifier topology with tuned passive filter with controls such that the filter is not energized when VFD is off or starting for each VFDs.
   2. 18-pulse rectifier topology for each VFDs with input current ratings in excess of 65A.

E. VFD manufacturer shall determine, for their proposed equipment, uncorrected harmonic distortion levels and mitigation techniques required to meet the specified limits and shall furnish the VFD types and all accessory items and equipment necessary to do so, whether specified herein or not.

F. VFD manufacturer shall provide a harmonic analysis of the distribution system based on their proposed specific equipment characteristics and mitigation techniques confirming that the specified levels are not exceeded.
   1. Analysis shall be based on the methodology of IEEE 519 and IEEE 399.
   2. Power system data for analysis shall be taken from the electrical drawings and approved equipment submittals.
      a. VFDs provided in a package with equipment specified elsewhere, shall be included in the analysis.

G. Following start-up, with facility at full load operation, provide measurement of harmonic voltage, current and notch characteristics at each PCC according to the requirements of IEEE 519 Section 9.
   1. Values in excess of specified limits require correction by contractor and re-measurement.
   2. Provide certification of compliant measurements as part of Field Service Engineer's final report.

2.6 MOTOR PROTECTION REQUIREMENTS

A. The VFD shall produce a quality of output waveform adequate to allow the motor to produce rated torque at rated RPM continuously without exceeding the temperature rise given in NEMA MG 1 Table 31-2.

B. Provide motor overload, short circuit and ground fault protection integral to drive electronics.

C. The VFD shall not produce voltage spikes in excess of the following values at the motor terminals when operated with the feeder types shown on the Drawings and the actual installed feeder lengths.
   1. If unmitigated voltage peaks exceed the specified limits, provide output line reactors, filters, or other devices as required to meet the specified limits:
      a. Inverter duty motors: 1280 V.
      b. Rise time shall be greater than or equal to 0.1 microsecond.
      c. Motor lead length and data shall be determined by the Contractor based on the actual routing of the conductors.

D. Following start-up, provide measurement of peak voltage at the terminals of each motor, unless the lead lengths are 10% shorter than the manufacturers published literature for maximum lead length for the type of cable installed.
   1. Values in excess of specified limits require correction by contractor and re-measurement.
   2. Provide certification of compliant measurements as part of Field Service Engineer's final report.

2.7 EQUIPMENT CONSTRUCTION

A. Fabrication and Assembly:
   1. Each VFD system shall be factory-assembled for installation in an MCC or in an enclosure for remote mounting, and shall utilize interchangeable plug-in printed circuit boards and power conversion components wherever possible.
      a. Factory assembly shall be performed by the VFD manufacturer or authorized agent.
      b. Systems fabricated or assembled in whole or in part by parties other than the VFD manufacturer or authorized agent will not be acceptable.
   2. Reactors and/or filters, where required, shall be mounted within or in an ancillary enclosure adjacent to the drive enclosure, or with the Engineer's permission may be mounted in a separate enclosure.

3. Cooling fans, as required, shall be provided to run when drive is running.
4. Enclosures for separately mounted VFD's:
    a. NEMA Type 1 for installation in Electrical Rooms.
    b. NEMA Type 12 for installation in other unclassified areas.

B. Wiring:
1. The wiring in the VFD shall be neatly installed in wire ways or with wire ties where wire ways are not practical.
    a. Where wire ties are used, the wire bundles are to be held at the back panel with a screw-mounted wire tie mounting base.
    b. Bases with a self-sticking back will not be allowed.
2. All plug-in contacts shall be gold-plated.
3. Provide terminal boards for all field wiring and inter-unit connections, including analog signals.
    a. Provide terminals for shield continuity where required.
4. Terminal blocks shall be complete with marking strip, covers and pressure connectors.
    a. Non-brittle, interlocking, track-mounted type.
    b. Screw terminals will not be allowed.
    c. A terminal for each conductor of external circuits plus one ground for each shielded cable.
    d. For free-standing panels, 8 inches of clearance shall be provided between terminals and the panel base for conduit and wiring space.
    e. Not less than 25% spare terminals shall be provided.
    f. Terminals shall be labeled to agree with identification indicated on the suppliers submittal drawings.
    g. Individually fuse each control loop or system and all fuses or circuit breakers shall be clearly labeled and located for easy maintenance.
5. All grounding wires shall be attached to the enclosure sheet metal with a ring tongue terminal.
    a. The surface of the sheet metal shall be prepared to assure good conductivity and corrosion protection.
6. Wiring shall not be kinked or spliced and shall have markings on both ends or be color coded.
    a. Markings or color code shall match the manufacturer's drawings.
7. With the exception of electronic circuits, all interconnecting wiring and wiring to terminals for external connection shall be stranded copper, type MTW or SIS, insulated for not less than 600 V, with a moisture-resistant and flame-retardant covering rated for not less than 90 DegC.

C. Nameplates:
1. All devices mounted on the face of the drive shall be provided with a suitable nameplate as specified in Specification Section 10 14 00.
2. Push buttons, selector switches, and pilot lights shall have the device manufacturer's standard legend plate.
3. Relays, terminals and special devices inside the control enclosure shall have permanent markings to match identification used on manufacturer's wiring diagrams.

D. Painting: Enclosure, after being phosphate washed, shall be thoroughly cleaned and given at least one (1) coat of rust-inhibiting primer on all inner surfaces prior to fabrication.

2.8 COMPONENTS AND ACCESSORIES

A. Reactors:
1. Impedance: 5%.
2. Continuous current: Not less than drive rating.
3. Current overload: 150% for 1 minute.
4. Insulation temperature rating: 180 degrees C.
5. Copper windings.

6. Saturation current rating: 3.5 to 5 times rated current.
7. Hi-potential rating: 2500 VAC line to ground and line to line, for 1 minute.
8. Noise reduction features:
    a. Epoxy over cast coil.
    b. Extra dips and bakes of varnish over continuous wound coil.

B. The selection of input and output harmonic and voltage spike protection shall also be made on the available physical space.
    1. The space available on the Drawings shall not be exceeded.

2.9 SOURCE QUALITY CONTROL

A. Factory Tests:
    1. Conduct all standard tests in accordance with NEMA and ANSI standards to ensure conformance to Specification requirements.

2.10 MAINTENANCE MATERIALS

A. Provide manufacturer's recommended renewable spare parts (e.g., power and control fuses).

B. Spare parts utilized during pre-start-up or start-up and demonstration testing shall be immediately restocked, at no cost to the Owner.

PART 3 - EXECUTION (INSTALLING CONTRACTOR'S SCOPE)

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions and as indicated on the Drawings.

B. Provide separately mounted VFD enclosure with Short Circuit Current Rating (SCCR) labeling as required by NFPA 70 and other applicable codes.
    1. Determine the SCCR rating by one of the following methods:
        a. Method 1: SCCR rating meets or exceeds the available fault current of the source equipment when indicated on the Drawings.
        b. Method 2: SCCR rating meets or exceeds the source equipment's Amp Interrupting Current (AIC) rating as indicated on the Drawings.
        c. Method 3: SCCR rating meets or exceeds the calculated available short circuit current at the control panel.
    2. The source equipment is the switchboard, panelboard, motor control center or similar equipment where the equipment or control panel circuit originates.
    3. For Method 3, provide calculations justifying the SCCR rating. Utilize source equipment available fault current or AIC rating as indicated on the Drawings.

C. Verify the installed motor nameplate electrical requirements do not exceed the VFD capacity.

D. Provide services of manufacturer's representative to perform start-up services.

3.2 START UP

A. Pre-start-up Services:
    1. Shall be completed a minimum of 30 days prior to the start-up and demonstration period described in Specification Section 01 75 00.
    2. Shall consist of:
        a. Physical and electrical installation check.
        b. Final adjustments and calibration of drive parameters.
        c. VFD operation from simulated input signals.
    3. Shall be complete when VFD(s) are fully operational.

B. Field Quality Control:

1. Perform field measurement of harmonics at each PCC per Harmonic Protection Requirements Article.
    a. For each individual VFD.
    b. For the maximum number of VFDs that will be operational at the same time.
    c. When all loads are at 75% load minimum.
    d. Duration: 1 hour minimum.
2. Perform field measurement of the maximum voltage peak at the terminals of each motor fed from a VFD per Motor Protection Requirements Article.
    a. Use a high speed oscilloscope to produce a plot of Voltage (Y axis) versus Time (X axis).
        1) Time shall be measured in microseconds.
    b. Tests shall be performed at full:
        1) Full voltage and speed.
        2) Loaded to 75% minimum.
        3) Duration: 1 hour minimum.
3. Record all data necessary for the preparation of required test reports.

C. Start-up and Demonstration Services:
1. Supervise start-up of all units including recheck of settings made during the pre-start-up tests.
    a. Perform all work in the presence of the Owner's designated representatives.
2. Setup all VFDs with carrier frequency at minimum value consistent with proper operation; inform Engineer of carrier frequencies set in excess of 5 kHz and reason for setting.
3. Simulate operation of the VFD and its associated control and instrumentation system in both the manual and automatic modes.
    a. Ensure compatibility of VFD with associated control and instrumentation signals.
4. Simulate VFD failures and demonstrate troubleshooting aids.

D. Instruct Owner's designated personnel:
1. Minimum of 8 hours at the jobsite.
2. Include both field and classroom instruction.
3. Instructions shall include proper operation and maintenance procedures including, but not limited to:
    a. Lubrication.
    b. Troubleshooting.
    c. Repair and replacement.
    d. Parts inventory.
    e. Maintenance records.

SECTION 26 43 13

SURGE PROTECTION DEVICES FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Type PC1 SPD - High exposure locations (switchgear, switchboard, panelboard or motor control center), integrally mounted.
   2. Type PC4 SPD - Medium exposure location (switchboard, panelboard and motor control center), externally mounted.
   3. Type PC5 SPD - Medium or low exposure locations at individual equipment locations, external, parallel connection.

B. Related Sections include but are not necessarily limited to:

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
      a. C62.41, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
      b. C62.41.1, Guide on the Surge Environment in Low-Voltage (1000V and Less) AC Power Circuits.
      c. C62.41.2, Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits.
      d. C62.45, Recommended Practice on Surge Testing For Equipment Connected to Low-Voltage (1000V and Less) AC Power Circuits.
   2. Military Standard:
      a. MIL-STD-220B, Method of Insertion Loss Measurement.
   3. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
   4. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).
   5. Underwriters Laboratories, Inc. (UL):
      a. 1283, Standard for Electromagnetic Interference Filters.
      b. 1449, Standard for Surge Protective Devices.

B. Qualifications:
   1. Provide devices from a manufacturer who has been regularly engaged in the development, design, testing, listing and manufacturing of SPDs of the types and ratings required for a period of 10 years or more and whose products have been in satisfactory use in similar service.
      a. Upon request, suppliers or manufacturers shall provide a list of not less than three customer references showing satisfactory operation.

1.3 DEFINITIONS

A. Clamping Voltage:
   1. The applied surge shall be induced at the 90 degrees phase angle of the applied system frequency voltage.
   2. The voltage measured at the end of the 6 inches output leads of the SPD and from the zero voltage reference to the peak of the surge.

B. Let-Through Voltage:

1. The applied surge shall be induced at the 90 degrees phase angle of the applied system frequency voltage.
2. The voltage measured at the end of the 6 inches output leads of the SPD and from the system peak voltage to the peak of the surge.

C. Maximum Continuous Operating Voltage (MCOV): The maximum steady state voltage at which the SPD device can operate and meet its specification within its rated temperature.

D. Maximum Surge Current:
1. The maximum 8 x 20 microsecond surge current pulse the SPD device is capable of surviving on a single-impulse basis without suffering either performance degradation or more than 10% deviation of clamping voltage at a specified surge current.
2. Listed by mode, since number and type of components in any SPD may very by mode.

E. MCC: Motor Control Center.

F. Protection Modes: This parameter identifies the modes for which the SPD has directly connected protection elements, i.e., line-to-neutral (L-N), line-to-line (L-L), line-to-ground (L-G), neutral-to-ground (N-G).

G. Surge Current per Phase:
1. The per phase rating is the total surge current capacity connected to a given phase conductor.
   a. For example, a wye system surge current per phase would equal L-N plus L-G; a delta system surge current per phase would equal L-L plus L-G.
   b. The N-G mode is not included in the per phase calculation.

H. System Peak Voltage: The electrical equipment supply voltage sine wave peak (i.e., for a 480/277 V system the L-L peak voltage is 679V and the L-N peak voltage is 392 V).

1.4 SUBMITTALS

A. Shop Drawings:
1. Product technical data including:
   a. Manufacturer's qualifications.
   b. Standard catalog cut sheet.
   c. Electrical and mechanical drawing showing unit dimensions, weights, mounting provisions, connection details and layout diagram of the unit.
   d. Testing procedures and testing equipment data.
   e. Create a Product Data Sheet for each different model number of SPD provided (i.e., Model XYZ with disconnect and Model XYZ without disconnect, each require a Product Data Sheet).
      1) Data in the Product Data Sheet heading:
         a) SPD Type Number per PART 2 of the Specification.
         b) Manufacturer's Name.
         c) Product model number.
      2) Data in the Product Data Sheet body:
         a) Column one: Specified value/feature of every paragraph of PART 2 of the Specification.
         b) Column two: Manufacturer's certified value confirming the product meets the specified value/feature.
         c) Name of the nationally recognized testing laboratory that preformed the tests.
         d) Warranty information.
      3) Data in the Product Data Sheet closing:
         a) Signature of the manufacturer's official (printed and signed).
         b) Title of the official.
      4) Date of signature.

B. Operation and Maintenance Manuals:
1. See Specification Section 01 78 23 for requirements for:

a. The mechanics and administration of submittal process.
b. The content of the Operation and Maintenance Manuals.
2. Warranty.

1.5 WARRANTY

A. Minimum of a five year Warranty from date of shipment against failure when installed in compliance with applicable national/local electrical codes and the manufacturer's installation, operation and maintenance instructions.

PART 2 - PRODUCTS

2.1 GENERAL

A. Standards: IEEE C62.41.1, IEEE C62.41.2, IEEE C62.45, MIL-STD 220B, UL 1283, UL 1449.

2.2 TYPE PC1 SPD

A. Product:
1. Integrally mounted in switchgear, switchboards or MCCs.
2. Hybrid solid-state high performance suppression system.
a. Do not use a suppression system with gas tubes, spark gaps or other components which might short or crowbar the line resulting in interruption of normal power flow to connected loads.
3. Do not connect multiple SPD modules in series to achieve the specified performance.
4. Designed for parallel connection.
5. Field connection: Use mechanical or compression lugs for each phase, neutral and ground that will accept bus bar or #10 through #1/0 conductors.
6. Device monitor:
a. Long-life, solid state, externally visible indicators and Form C dry contact(s) that monitors the on-line status of each mode of the units suppression filter system and power loss in any of the phases.
b. A fuse status only monitor system is not acceptable.

B. Operating Voltage: The nominal unit operating voltage and configuration as indicated on Drawings.

C. Modes of Protection: All modes.
1. Three phase (delta): L-L, L-G.
2. Three phase (wye): L-N, L-L, L-G and N-G.
3. Single phase (2-pole): L-L, L-N, L-G and N-G.
4. Single phase: L-N, L-G and N-G.

D. Maximum Continuous Operating Voltage: Less than 130% of system peak voltage.

E. Operating Frequency: 45 to 65 Hz.

F. Short Circuit Rating: Equal to or greater than rating of equipment SPD is connected to.

G. Maximum Surge Current: 240,000 A per phase, 120,000 A per mode minimum.

H. Minimum Repetitive Surge Current Capacity: 4000 IEEE C High waveform impulses with no degradation greater than 10% deviation of the clamping voltage.

I. SPD Protection:
1. Integral unit level and/or component level overcurrent fuses and sustained overvoltage thermal cutout device.
2. An IEEE C High waveforms shall not cause the fuse to open and render the SPD inoperable.

J. Maximum Clamping Voltages: Dynamic test at the 90 degree phase angle including 6 inches lead length and measured from the zero voltage reference:

System Voltage	Test Mode	IEEE C62.41		UL 1449
		C High V & I Wave	B Combination Wave	
L-L < 250 V **L-N < 150 V**	L-L	1470 V	1000 V	800 V
	L-N	850 V	600 V	500 V
	L-G	1150 V	800 V	600 V
	N-G	1150 V	800 V	600 V
L-L > 250 V **L-N > 150 V**	L-L	2700 V	2000 V	1800 V
	L-N	1500 V	1150 V	1000 V
	L-G	2000 V	1550 V	1200 V
	N-G	2000 V	1550 V	1200 V

K. EMI-RFI Noise Rejection: Attenuation greater than 30 dB for frequencies between 100 kHz and 100 MHz.

2.3 SOURCE QUALITY CONTROL

A. SPD approvals and ratings shall be obtained by manufacturers from nationally recognized testing laboratories.

B. The SPD are to be tested as a complete SPD system including:
1. Integral unit level and/or component level fusing.
2. Neutral and ground shall not be bonded during testing.
3. 6 inches lead lengths.
4. Integral disconnect switch when provided.

C. The "as installed" SPD system including the manufacturers recommended circuit breaker, the SPD is connected to, will not open when tested with a IEEE C3 combination waveform.

D. Tests to be performed in accordance with IEEE C62.45:
1. Clamping voltage performance testing using IEEE C62.41 Category waveforms.
2. Single pulse surge current capacity test.
3. Repetitive surge current capacity testing.
4. Spectrum analysis for EMI-RFI noise rejection.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Type PC1 SPD:
1. Connected in parallel to the equipment.
2. Install in dedicated electrical equipment compartment, bucket or panelboard box at the factory before shipment.
3. Provide leads that are as short and straight as possible.
4. Maximum lead length: 12 inches.
5. Minimum lead size: #2 stranded AWG or bus bar.
6. Connect leads to the equipment to be protected by one of the following means:
   a. Through a circuit breaker or molded case switch mounted in the equipment.
   b. Use manufacturer recommended circuit breaker size.
   c. Circuit breaker or switch to be operable from the equipment exterior or from behind a hinged door.

SECTION 26 50 00
INTERIOR AND EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Material and installation requirements for:
      a. Interior building and exterior building mounted luminaires.
      b. Exterior and site luminaires.
      c. LEDs.
      d. Drivers.
      e. Light poles.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 03 - Concrete.
   2. Section 26 05 00 - Electrical - Basic Requirements.
   3. Section 26 05 19 - Wire and Cable - 600 Volt and Below.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American National Standards Institute (ANSI):
      a. C78.377, Specification for the Chromaticity of Solid State Lighting Products.
   2. Federal Communications Commission (FCC):
      a. Code of Federal Regulations (CFR), 47 CFR 18, Industrial, Scientific and Medical Equipment.
   3. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
      a. C62.41, Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
   4. Illuminating Engineering Society of North America (IESNA):
      a. LM-79, Electrical and Photometric Measurements of Solid-State Lighting Products.
      b. LM-80, Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays and Modules.
   5. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
      b. 410, Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts.
      c. LE 4, Recessed Luminaires, Ceiling Compatibility.
   6. National Electrical Manufacturers Association/American National Standards Institute (NEMA/ANSI):
      a. SSL 1, Electronic Drivers for LED Devices, Arrays or Systems.
   7. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).
      b. 101, Life Safety Code.
   8. Underwriters Laboratories, Inc. (UL):
      a. 248-4, Low-Voltage Fuses - Part 4: Class CC Fuses.
      b. 844, Standard for Luminaires for Use in Hazardous (Classified) Locations.
      c. 924, Standard for Emergency Lighting and Power Equipment.
      d. 1012, Power Units Other Than Class 2.
      e. 1310, Standard for Class 2 Power Units.
      f. 1598, Luminaires.
      g. 8750, Standard for Light Emitting Diode (LED) Equipment for Use in Lighting Products.
   9. United States Department of Energy (USDOE):
      a. EPAct, the National Energy Policy Act.

1.3 DEFINITIONS

A. Useful Life for LED luminaire light sources:
   1. The operating hours before reaching 70% of the initial rated lumen output (L70) with no catastrophic failures under normal operating conditions.
   2. This is also known as 70% "Rated Lumen Maintenance Life" as defined in IESNA LM-80.

1.4 SUBMITTALS

A. Shop Drawings:
   1. Product technical data:
      a. Provide submittal data for all products specified in PART 2 of this Specification Section.
      b. Identify luminaire by Luminaire Schedule designation.
      c. Luminaire data sheet:
         1) Name of manufacturer.
         2) Complete order information (catalog number).
         3) Description of construction and optics.
         4) Total input wattage.
         5) Luminous efficacy (lumens/Watt).
         6) Photometric performance data including candlepower distribution and coefficient of utilization (CU) table.
         7) Dimensional size.
         8) Weight.
         9) UL nameplate data for luminaires used in Class 1, Division 1 and 2 areas.
         10) Effective Projected Areas (EPA) for pole mounted luminaires.
      d. Solid state Luminaire additional data:
         1) Voltage.
         2) Initial and IES L70 lumens.
         3) Luminous efficacy (lumens/Watt).
         4) Correlated Color Temperature (CCT).
         5) Color Rendering Index (CRI).
         6) Total Harmonic Distortion (THD).
         7) Lamp life.
         8) Driver manufacturer and model number.
         9) Driver life.
         10) Driver type (0-10V, constant voltage, constant current).
         11) Dimming range and control device compatibility.
         12) Remote driver: Maximum wire length to luminaire.
         13) Emergency battery driver:
            a) Compatibility with lighting module.
            b) Lumen output of lighting module in emergency operation.
            c) Battery life.
            d) Description of testing.
            e) Ambient operating temperature.
         14) Toxicity Characteristic Leaching Procedure (TCLP) compliance.
         15) DesignLights Consortium (DLC) Listing.
         16) Warranty information.
      e. Pole data sheet:
         1) Name of manufacturer.
         2) Complete order information (catalog number).
         3) Description of construction.
         4) Length, shaft size and thickness.
         5) Wind loading (available luminaire EPA per wind speed).
         6) Anchor bolt template.
         7) Bolt size and material.
      f. Photometric calculation for manufacturers not listed in the Luminaire Schedule:

1) Location: Per Table on the Drawings.
a) Calculation method: Zonal Cavity.
b) Required footcandle level: 30 FC for Electrical/Blower Rooms, 5 FC for walkways.
c) Light loss factor: 0.9.

g. See Specification Section 26 05 00 for additional requirements.

2. Test Reports:
a. IESNA LM-79 Test Report for Solid-State Luminaire.
b. IESNA LM-80 Test Report Solid-State Light Source.

3. Certifications: Solid-state Luminaire Useful Life Certificate.

B. Contract Closeout Information:
1. Operation and Maintenance Data:
a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
b. Submittal data for each component covered by warranty.
c. Warranty.

1.5 WARRANTY

A. Minimum of a five year Warranty from date of manufacture against failure for solid-state luminaire including LED arrays, LED drivers and integral control devices. The solid-state product is considered defective if more than 15% of the individual light emitting diodes fail to illuminate.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Luminaires: Per Luminaire Schedule or equal.
2. Solid State Light Sources:
a. Cree.
b. Xicato.
c. Luminaire manufacturer's proprietary system.
3. LED Driver: Luminaire manufacturer's standard.
4. Emergency ballasts:
a. Iota Engineering.
b. Philips Bodine.
5. Emergency transfer devices: Philips Bodine.
6. Poles: Luminaire manufacturer's standard.

2.2 GENERAL REQUIREMENTS

A. Luminaires complete with LED modules and drivers.

B. Rated for area classification as indicated on the Drawings.
1. In Class I, Division 1 and 2 areas, the temperature rating of the luminaires and LED combination shall not exceed the auto-ignition temperature of the atmosphere in which the Luminaire is used.

C. Provide all recessed luminaires with gaskets of rubber, fiberglass, or equivalent material to prevent light leaks around flush trim.
1. Provide recessed luminaires with trim gaskets cemented in proper position.

D. Provide standard plaster frame for all recessed luminaires installed in plaster walls or ceilings.
1. Design, finish and fabricate material to preclude possibility of rust stain in plaster.

E. Coordinate luminaire mounting where recessed into building canopies prior to Submitting Shop Drawings. Confirm clearances and luminaire flange compatibility with construction.

F. Electrical components of recessed luminaires shall be accessible and removable through luminaire without having to remove luminaire from ceiling.

G. No live parts normally exposed to contact.

H. When intended for use in wet areas: Mark luminaire "Suitable for wet locations."

I. When intended for use in damp areas: Mark luminaire "Suitable for damp locations" or "Suitable for wet locations."

2.3 LUMINAIRES

A. Standards and Listings:
   1. DesignLights Consortium (DLC).
   2. UL 1598.
   3. UL 844 for hazardous locations.
   4. NEMA LE 4 for recessed locations.

B. Housings:
   1. As indicated in the Luminaire Schedule and the following:
      a. Troffer luminaires:
         1) Minimum 22 gage sheet steel.
         2) Integral end plates and trim flanges to suit ceiling construction.
         3) Wire way covers with captive retainers to allow access to electrical components without use of tools.
      b. Extruded aluminum housings, where scheduled, shall be at least 1/8 inches thick.
      c. Punch and form housings prior to finishing (post-paint).

C. Castings:
   1. As indicated in the Luminaire Schedule and the following:
      a. Uniform quality, free from imperfections affecting strength and appearance.
      b. Exterior surfaces, if not receiving a finish coat, shall be smooth and match adjacent surfaces. At least one coat of clear methacrylate lacquer shall be applied unless a painted finish is specified.

D. Fasteners:
   1. As indicated in the Luminaire Schedule and the following:
      a. Aluminum or steel luminaires: Zinc-Nickel plated, stainless steel, or equivalent.
      b. Stainless steel luminaires: Stainless steel.
      c. Bronze luminaires: Bronze or stainless steel.
      d. Non-metallic luminaires: Stainless steel.

E. Finishes:
   1. As indicated in the Luminaire Schedule and the following:
      a. Painted surfaces:
         1) Manufacturer's standard metal pretreatment and baked or air-dried, light-stabilized enamel finish, acrylic, alkyd, epoxy, polyester, or polyurethane.
         2) White finishes shall have minimum 85% reflectance.
      b. Unpainted surfaces:
         1) Interior: Clear anodic coating, satin finish.
         2) Exterior: Clear anodic coating.

F. Lens/Louver Frames:
   1. As indicated in the Luminaire Schedule and the following:
      a. Extruded aluminum with mitered corners.
      b. Hinging or other normal motion shall not cause lens or louver to drop out.
      c. No light leak between frame and housing.

G. Lenses:
   1. As Indicated in the Luminaire Schedule and the Following:
      a. 100% virgin, UV stabilized acrylic.
      b. Held securely in place but must also be removable for cleaning and servicing.
      c. Luminaires with directional lenses shall include a lens orientation device to ensure that lens installation provides light distribution as designed.
      d. No light leaks between the lens and the luminaire.

H. Reflectors:
   1. As Indicated in the Luminaire Schedule and the Following:
      a. Down Light Reflector and Baffle Finishes: First-quality "Alzak" anodized specular finish.
      b. Troffer reflector finish: Integral reflectors shall be painted white after fabrication with a minimum reflectance value of 90%.

I. Gaskets:
   1. As Indicated in the Luminaire Schedule and the Following:
      a. Gaskets at face plates or frames of recessed luminaires which serve as ceiling trim and allow interior access.
      b. Moisture seal gaskets at exterior locations and in other designated wet areas.
      c. Secure frames to luminaire bodies with screws or other means, to result in tight installation, without light leaks.

J. Ventilation:
   1. Ventilation openings of adequate size and quantity to permit operation of driver without affecting rated output or life expectancy. Include wire mesh screens.

K. Wiring:
   1. Factory-wired to be compatible with the project electrical and controls systems.

L. Mounting Accessories:
   1. Provide appropriate mounting accessories for each luminaire, compatible with various structural conditions encountered.
   2. All luminaires with adjustable beam angles shall have a locking device to ensure that the beam distribution is not effected during servicing or cleaning.
   3. Recessed Luminaires:
      a. Plaster Frames: Provide frames for luminaires installed in gypsum board and concealed suspension system ceiling tile. Make frames of non-ferrous metal or suitably rustproof after fabrication.
      b. Baffles and Gaskets: As required to prevent light leakage.
      c. Flanged luminaires are required in all ceiling systems except exposed grid lay-in panel type.
   4. Luminaire Suspension Material:
      a. Unfinished Spaces:
         1) 1/2 inches minimum diameter swivel stem, unless otherwise noted.
         2) Safety chain on high bay type.
      b. Finished Spaces: Unless otherwise noted.
         1) Manufactured cable or stem and outlet box canopy.
            a) Contemporary design with swivel self-aligning features.
            b) Size canopy to cover outlet box, minimize size of canopy not associated with outlet box.
            c) Finish to match luminaire.
         2) Coordinate pendant location with ceiling tiles/ceiling grid.
            a) Submit coordinated mounting accessories as part of Shop Drawing submission.
         3) Luminaires mounted on suspended ceiling grids should be provided with outlet box designed for grid mounting with direct cord entry and supported by outlet box.

2.4 SOLID-STATE LUMINAIRES - ADDITIONAL REQUIREMENTS

A. Standards:
   1. IESNA LM-79, IESNA LM-80.
   2. NEMA SSL 1.
   3. UL 1012, 1310, and 8750.
   4. UL 844 for hazardous locations.

B. Solid state modules and driver to be provided and warrantied by luminaire manufacturer.

C. Solid-State Modules:
   1. Uniform color temperature of 4000K unless otherwise noted on the Luminaire schedule.
      a. Color temperature measurement shall have a maximum 3 SDCM on the MacAdam Ellipse for frosted lensed luminaires, and 2 SDCM for other luminaire types (ANSI C78.377).
   2. Minimum color rendering index (CRI) of 80 for indoor and 70 for outdoor applications.
   3. LED module light output and efficacy: Measured in accordance with IESNA LM-79 standards.
   4. LED useful life and lumen maintenance: Measured in accordance with IESNA LM-80 standards.
   5. Driver and LED module: Minimum useful life of 50,000 hours (L70).
   6. Individual LEDs connected such that a failure of one LED will not result in a light output loss of the entire luminaire.

D. Driver:
   1. Compatible with solid-state modules and control devices specified.
   2. Operate from 60 Hz input source of 120V through 277V with sustained variations of ±10% (voltage and frequency).
   3. Input current Total Harmonic Distortion (THD): Less than 20% when operated at nominal line voltage.
   4. Power Factor: Greater than 0.90.
   5. Avoid interference with infrared devices and eliminate visible flicker.
   6. Comply with ANSI C62.41 Category A for Transient protection.
   7. Comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 18, Non-Consumer (Class A) for EMI/RFI (conducted and radiated).
   8. Dimmable drivers capable of continuous dimming over a range of 100% to 10% of rated lumen output, unless otherwise specified in Luminaire Schedule. Dimming controlled by a 0 - 10 VDC signal, unless otherwise specified in Luminaire Schedule.
   9. Control device must be compatible with type of driver and coordinated prior to submission of Shop Drawings. List of compatible dimming controllers must include the range of perceived brightness. No visible flicker throughout the dimming range.
   10. Remote-mounting:
      a. Provide maximum allowable distances for secondary wire runs to luminaires.
      b. Provide remote mounting hardware and enclosures as required.
   11. Operating temperature range must be suitable for site temperature conditions within exterior and gasketed luminaires.

E. Emergency Battery Driver:
   1. UL 924.
   2. Confirm compatibility with LED modules utilized.
   3. Consist of a high temperature, maintenance-free nickel cadmium battery, charger, and electronic circuitry.
   4. A solid state charging indicator light to monitor the charger and battery.
   5. Single-pole test switch.
   6. The following product family shall be selected based on coordination with LED lamp type:
      a. Philips Bodine "BSL23C": can operate up to 4.5W at 410mA.
      b. Philips Bodine "BSL26C": can operate up to 5.1W at 265mA.

c. Philips Bodine "BSL722 inches: can operate up to 23W at 770mA.
d. Philips Bodine "BSL23C": can operate up to 23W at 770mA in operating conditions ranging from -20 degrees C (-4 degrees F) to 60 degrees C (140 degrees F).
e. Alternate manufacturer: Iota.

F. Luminaire properly heat sinked to assure LED junction temperature ratings are not exceeded.
1. Provide ambient operating temperature range for which product is warrantied.

2.5 EXIT SIGNS AND EMERGENCY LIGHTING UNITS

A. Standards:
1. UL 924.
2. NFPA 101.
3. Local State or City requirements.

B. Exit Signs:
1. Housing and finish: As indicated in the Luminaire Schedule.
2. LED illuminated with integral driver.
3. AC powered or AC and battery powered: As indicated in the Luminaire Schedule.
4. Battery powered units:
a. Battery type: As indicated in the Luminaire Schedule.
b. Self-testing/self-diagnostic.
1) Electronic circuitry automatically test emergency lighting for a minimum of 30 seconds every 30 days and 90 minutes once a year.
c. Consist of battery, charger, and electronic circuitry.
d. Solid state charging indicator light to monitor the charger and battery.
e. Single-pole test switch.
f. A user selectable audible alarm. The alarm shall be engaged unless noted otherwise on the Drawings.

C. Emergency Lighting Units:
1. Housing: As indicated in the Luminaire Schedule.
2. Lamps: As indicated in the Luminaire Schedule.
3. Battery type: As indicated in the Luminaire Schedule.
4. Self-testing/self-diagnostic.
a. Electronic circuitry automatically test emergency lighting for a minimum of 30 seconds every 30 days and 90 minutes once a year.
5. Consist of battery, charger, and electronic circuitry.
6. Solid state charging indicator light to monitor the charger and battery.
7. Single-pole test switch.
8. A user selectable audible alarm. The alarm shall be engaged unless noted otherwise on the Drawings.

D. Emergency Circuit Transfer Device:
1. Transfer device permits emergency lights to be switched under normal conditions and automatically transfers to unswitched emergency circuit upon power interruption.
2. Multiple luminaire switching:
a. Up to 20A.
b. Mounting as indicated on the Drawings.
c. Acceptable product family:
1) Philips Bodine GTD20A or equal.
3. Individual luminaire switching:
a. Mount on top of luminaire or in ballast channel.
b. Acceptable product family:
1) Philips Bodine GTD or equal.

2.6 POLES

A. As Indicated in the Luminaire Schedule and the Following:

1. Designed for attached luminaire EPA with a 110 MPH maximum wind velocity at the base with a 1.3 wind gust factor.
2. Additional features:
   a. Handhole near base of pole.
   b. Grounding lug accessible at handhole.
   c. Galvanized anchor bolts.
   d. Anchor bolt covers.
   e. Vibration dampener(s).

B. Metal Poles:
1. Material: Aluminum.
2. Shaft shape: Straight.
3. Pole cross section: Square.
4. Pole height: 30 feet.
5. Designed for attached luminaire EPA with a 110 MPG maximum wind velocity at the base with a 1.3 wind gust factor.
6. Additional features:
   a. Luminaire mounting provisions.
   b. Handhole near base of pole.
   c. Grounding lug accessible at handhole.
   d. Galvanized anchor bolts.
   e. Anchor bolt covers.
   f. Vibration dampener(s).
7. Aluminum pole finish: [Dark bronze polyester powder.

2.7 MAINTENANCE MATERIALS

A. Furnish a minimum of 10% of total of each type and amperage of fuses for fixtures indicated to be fused.

B. Spare parts are to be stored in a box clearly labeled as to its contents.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Coordinate Luminaire Types with Ceiling Construction:
1. Provide mounting hardware for the ceiling system in which the luminaire is to be installed.

B. Fasten luminaires supported by suspended ceiling systems to ceiling framing system with hold down clips.

C. Provide mounting brackets and/or structural mounting support for wall-mounted luminaires.
1. Do not support luminaire from conduit system.
2. When luminaire is supported from outlet boxes, install per NFPA 70.
3. Supports for luminaire mounted on exterior walls shall not be attached to exterior face of the wall.

D. Support surface mounted luminaires from the building structure and not from the ceiling suspension system.
1. Luminaires up to 4 feet wide and 4 feet long: A minimum of four supporting points, one at each corner.
2. Luminaires 8 feet long: A minimum of five support points, one at center of luminaire and one at each corner.
3. Luminaires smaller than 2 feet in length: A minimum of two supporting points.

E. Provide pendant luminaires with swivel hangers which will allow luminaire to swing in any direction but will not permit stem to rotate.
1. Provide hangers with enclosure rating (NEMA 1, 4, or 7) equal to enclosure requirements of area in which they are installed.

2. Swivel hangers for luminaires in mechanical equipment areas: Shock absorbing type.
3. Secure low and high bay luminaires with safety chain or safety aircraft cable to the building structure.
    a. Chain or cable to prevent luminaire from falling more than 3 inches before the luminaire is caught by the chain or cable.

F. Pendant Mounted, Open, Industrial Luminaire:
1. Not in continuous rows:
    a. Supported by conduit or by approved chains or cable:
    b. Hardwired to ceiling mounted junction box.
2. In continuous rows:
    a. Supported rigidly with conduit and fasten luminaire to each other or mount on continuous metal channel per Specification Section 26 05 00.
    b. Hardwired to ceiling mounted junction box.
    c. Provide reflector alignment clips.

G. Provide access panels for recessed luminaires that require access for maintenance when such access is not provided for in design of luminaire.
1. Locate luminaires in accordance with reflected ceiling plans.

H. Locate luminaire in exact center of ceiling tile unless otherwise indicated.
1. Relocate incorrectly installed luminaire and replace damaged ceiling materials.

I. Mount luminaire at heights indicated in Specification Section 26 05 00 or per Luminaire Schedule or as indicted on the Drawings.

J. Install exterior luminaires so that water cannot enter or accumulate in the wiring compartment.

K. Luminaires with Emergency Battery:
1. Where luminaires with emergency battery are shown controlled via switching device, connect the emergency battery to corresponding unswitched circuit so emergency battery will not operate when normal power is available and switching device turns lights off. Upon failure of normal power, luminaire will operate in emergency mode regardless of switch position.
2. Luminaire manufacturer to supply the emergency battery with luminaire.

L. Ground luminaire.

3.2 POLE INSTALLATION

A. Drawings Indicate the Intended Location of Light Pole:
1. Field conditions may affect actual location.
2. Coordinate location with all existing or new utilities and pavement.

B. Anchor Base Plated Poles:
1. Mounted on cast-in-place foundations, as detailed on the Drawings.
    a. Concrete and reinforcing steel, in accordance with Division 03 Specification Sections.
    b. Concrete:
        1) Minimum compressive strength: 4000 psi at 28 days.
        2) Concrete work in accordance with ACI 301.
    c. Reinforcing steel:
        1) ASTM A615/A615M, Grade 60.
2. Mount on power installed pole foundation anchor.
    a. Anchor base plate to be approximately 2 inches above final grade.
3. Protect pole finish during installation.
    a. Repair damage to pole finish with manufacturer approved repair kit.

C. Ground poles as indicated on the Drawings.

D. Conductors:
1. See Specification Section 26 05 19 for required underground conductors.

2. Use interior building wire, as specified in Specification Section 26 05 19, from pole base to luminaire, #12 AWG minimum.

E. Overcurrent and Short Circuit Protection:
   1. Protect each phase with a UL Class CC fuse:
      a. Size: Three times load current.
      b. Standard: UL 248-4.
   2. Fuseholder:
      a. Watertight, in-line and break-a-way style.
      b. Accept up to a 30 A, 600 V fuse.
      c. Neutral conductor shall utilize a fuseholder with a solid copper rod.
      d. Conductor terminal: Adequate size for the installed conductors.

3.3 LIGHTING CONTROL

A. See Specification Section 26 09 16 for lighting control equipment.

B. Exterior wall mounted and pole mounted fixtures controlled as detailed on the Drawings.

3.4 ADJUST AND CLEAN

A. See Specification Section 01 74 00.

B. Aim all emergency lighting units, so that, the path of egress is illuminated.

END OF SECTION

SECTION 26 52 13
CENTRAL EMERGENCY LIGHTING INVERTER

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Material and installation requirements for:
      a. Central emergency lighting inverter.

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 26 05 00 - Electrical - Basic Requirements.
   2. Section 26 08 13 - Acceptance Testing.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. National Electric Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
   2. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).
      b. 101, Life Safety Code.
   3. Underwriters Laboratories, Inc. (UL):
      a. 924, Standard for Emergency Lighting and Power Equipment.

1.3 SYSTEM DESCRIPTION

A. An off-line uninterruptible power supply for the emergency operation of, incandescent and fluorescent emergency lighting loads.
   1. The system shall provide full light output for a minimum of 1.5 hours.

1.4 SUBMITTALS

A. Shop Drawings:
   1. Product technical data:
      a. Provide submittal data for all products specified in PART 2 of this Specification Section.
      b. Descriptive bulletins.
      c. Installation instructions.
      d. See Specification Section 26 05 00 for additional requirements.
   2. Fabrication and/or layout drawings:
      a. Cabinet outline drawings indicating dimensions, weights, heat loss, input/output connection locations and required clearances.
      b. Wiring diagrams.

B. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Controlled Power Company.

2. LightGuard.
3. Lithonia Lighting.
4. Myers Power Products.
5. PowerClone.

2.2 COMPONENTS

A. Standards: UL 924.

B. Electrical Characteristics:
   1. System configuration:
      a. Off-line (Standby): 50 MS transfer time for non-HID lighting loads.
   2. System capacity:
      a. As indicated in the Schedule.
      b. When normally off system is utilized, the unit shall have the capacity for the required amount of inrush current expected from luminaire ballasts.
   3. Input and output:
      a. Voltage: As indicated in the Schedule.
      b. Number of phases: As indicated in the Schedule.
      c. Frequency: 60 Hz.
   4. Total Harmonic Distortion:
      a. Less than 3% with linear load.
      b. Less than 5% with non-linear load.
   5. System efficiency:
      a. Off-line: 95%.

C. Rectifier and/or Battery Charger:
   1. Solid-state equipment.
   2. Controls necessary to convert incoming AC power to regulated DC power for input to the inverter and for battery charging.
   3. Battery charger voltage: 2% RMS maximum.

D. Inverter:
   1. Solid-state equipment.
   2. Controls to convert DC power from the rectifier or battery to regulated AC power for supporting critical load.

E. Maintenance Bypass Switch:
   1. An external or internal, wrap around, make-before-break switch for complete isolation of the inverter output terminals.

F. Battery:
   1. Maintenance free, sealed lead calcium.
   2. 90 minutes of run time at full load.
   3. Battery charger to recharge fully discharged batteries within 24 hours.

G. Input Protection:
   1. Input circuit breaker.
   2. Overload capacity:
      a. 100% continuous.
      b. Minimum of 115% for 5 minutes.

H. Output Distribution:
   1. Normally ON terminals for hardwire connections.

I. Display, Alarm and Testing Functions:
   1. Supervision and display panel:
      a. Microprocessor controlled.
      b. Alphanumeric display and optional indicator lights.
      c. Touch pad.

d. Control, programming and data logging functions.

2. Alphanumeric display or in combination with indicating lights shall display, at a minimum:
   a. Input voltage.
   b. Output voltage.
   c. Battery voltage.
   d. Battery current.
   e. Output current.
   f. Output VA.
   g. On AC power.
   h. On battery power.
   i. Battery charging.
   j. System temperature.
   k. System fault.
3. Audible alarm for alarm conditions.
   a. High and low battery charger voltage.
   b. High and low AC input voltage.
   c. Near low and low battery voltage.
   d. Load reduction fault.
   e. High ambient temperature.
   f. Inverter fault
   g. Output fault and overload.
4. Common output contact for remote monitoring of alarm conditions.
5. Programmable self-diagnostics test with user selectable battery test intervals.

J. Enclosure:
   1. Minimum of 14 GA steel.
   2. Free standing.
   3. NEMA 1.
   4. Forced air cooling as required by manufacturer.
   5. Factory-applied paint coating system.

2.3 PERFORMANCE

A. Normal Operation:
   1. Off-line system shall supply power to the load directly from the AC source.
   2. Battery charger to maintain a ripple free float charge on the batteries.

B. Emergency Operation:
   1. Upon the failure or unacceptable AC power, supply power to the load to be derived from the batteries through the inverter.
   2. An off-line system shall have a 50 MS transfer time between AC power and battery power to the load on failure or restoration of AC power.

C. Automatic Restart:
   1. If the power outage exceeds 90 minutes and the batteries are fully discharged, the unit may shut down, but automatically restart once the AC power returns to power the load and recharge the batteries.

D. Automatic Battery Testing:
   1. The unit shall automatically test the batteries at the programmed intervals.
   2. The test data shall be logged into the data logger.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions, NFPA 70 and NFPA 101.

B. Arrange as shown on the Drawings.

3.2 FIELD QUALITY CONTROL

A. Acceptance Testing: See Specification Section 26 08 13.

B. A qualified factory-trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.

3.3 TRAINING

A. Provide 4 hours of on-site training in the operation and maintenance of the central emergency lighting inverter and its components.

SECTION 31 10 00
SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Site clearing Work, including:
      a. General provisions for site clearing Work.
      b. Preparation for site clearing Work.
      c. Clearing and grubbing.
      d. Tree protection, selective removals, and selective trimming.
      e. Disposal and cleaning.
      f. Stripping and stockpiling of topsoil.

B. Related Requirements: Include but are not necessarily limited to:
   1. Section 02 41 00 - Demolition.
   2. Section 31 23 05 - Excavation and Fill.

1.2 REFERENCES

A. Terminology:
   1. Terms indicated below are not defined terms indicated with initial capital letters but, when used in this Section, have the meanings indicated below:
      a. "Arborist" means Subcontractor retained to perform Work requiring a specialist in trees, shrubs, brush, other vegetation of the types existing at the Site, and possessing not less than the required qualifications indicated in this Section.
      b. "Clearing and grubbing" means removing and disposing of all: (1) trees, brush, and other vegetation, logs, and similar items ("clearing"); and (2) stumps, roots, logs, rubbish, and debris on or in the soil ("grubbing") after Clearing. Clearing and grubbing includes grinding and removing of stumps. When clearing and grubbing, topsoil stripping and stockpiling, and required demolition Work is complete, the Site will be ready for grading and other new construction.
      c. "Demolition" means removal, whether in whole or in part, of existing human-made construction, such as removal of buildings, structures, and building systems; site work (such as pavement, curbs, sidewalks, gutters) and the like; Underground Facilities; and other existing construction.
      d. "Selective removal" means removal of specific trees, shrubs, brush, and other vegetation, whether as shown or indicated in the Contract Documents or as directed at the Site by Engineer.
      e. "Selective trimming" means removal of selected parts of trees, shrubs, brush, and other vegetation, performed by arborist, for the purpose of either: (1) allowing installation of new construction adjacent to or through the tree, shrub, brush, or vegetation, or)2) removing damaged or unhealthy growth, to allow balance of the subject tree, shrub, brush, or vegetation to continue normal, healthy growth.
      f. "Site clearing" means all the Work required by this Section and related Drawings.
      g. "Topsoil" means existing material at the Site, visible after clearing and grubbing, to be stripped, when such material is friable, clay loam, surface soil present in depth of not less than four inches. Topsoil shall be free of subsoil, clay lumps, stones, and other objects over two-inch diameter and other objectionable material. Topsoil required for planting and landscaping Work in the Specifications of Division 32 may differ from the meaning indicated in this Section.

B. Reference Standards:
   1. ASTM International (ASTM):

a. C700, Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated.
b. D448, Standard Classification for Sizes of Aggregate for Road and Bridge Construction.

2. American National Standards Institute (ANSI):.
   a. A300, Standard for Tree Care Operations – Tree, Shrub, and Other Woody Plant Maintenance – Standard Practices.
3. International Society of Arboriculture (ISA):
   a. Container Rootball Shaving.
   b. Crown Correction.
   c. Balled and Burlapped Root Correction.
   d. Container Root Correction.
   e. High Branched Crown Observation.
   f. Low Branched Crown Observation.
   g. Multiple Low Branches Crown Observation.
   h. Balled and Burlapped Root Observation.
   i. Container Root Observation - Tree.
   j. Protection Maintenance.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-Clearing Conference:
   1. Prior to commencing site clearing Work, actively participate in conference regarding site clearing Work. Date and time of conference will be mutually established by Contractor and Engineer.
   2. Location: Conference will be held at the Site.
   3. Participants:
      a. Required Participants: Contractor's project manager, Contractor's site superintendent, arborist, Engineer, Resident Project Representative , Owner's Site Representative].
      b. Potential Participants: Owner, facility manager (if applicable), and representative of properties (other than Owner) affected by site clearing Work,
   4. Engineer will chair the conference, prepare and distribute an agenda, and prepare and distribute a record of the conference.
   5. Participants shall be prepared to discuss:
      a. Project requirements and the Contract requirements for site clearing Work.
      b. Submittals required for site clearing Work.
      c. Schedule for site clearing Work and availability of resources.
      d. Locations and types of site clearing Work, with specific attention to areas of selective removals, selective trimming, and notable species. Limits of clearing and grubbing. Proposed locations for stockpiles and temporary storage of cuttings and debris.
      e. Environmental and other conditions at the Site.
      f. Growth, vegetation, and existing construction requiring protection.
      g. Required observations and field quality control for site clearing Work.
   6. If additional information affecting site clearing Work subsequently comes to light, reconvene the conference at earliest opportunity.

1.4 QUALITY ASSURANCE

A. Qualifications:
   1. Arborist:
      a. Where selective removal, selective trimming, or both are required or necessary, retain the services of, and employ in the Work, accredited arborist, possessing qualifications acceptable to Engineer.
      b. Arborist shall be skilled, trained, and possess documented experience in successfully protecting, trimming, and restorative care of trees and shrubs of the types necessary for the Work.

c. Certification: Arborist shall be certified by either International Society of Arboriculture (ISA) or American Society of Consulting Arborists (ASCA).
d. Arborist shall use in selective removal and selective trimming Work only workers with specific skill and successful experience in this type of Work required. Such workers shall work under the direct, personal supervision of arborist.
e. Submit to Engineer names, employer(s), certifications, other relevant qualifications and record of relevant experience, as indicated below, for not less than three successful projects involving same species of trees, shrubs, and vegetation as involved in the site clearing Work:
    1) Names and telephone numbers of site owners, architects or engineers responsible for projects.
    2) Approximate contract price of the selective removal and selective trimming of trees, shrubs, and vegetation.
    3) Approximate time of year work was performed on each referenced project.
    4) Approximate quantity and types of selective removal and selective trimming of performed.
    5) General indication of species of trees, shrubs, and vegetation involved.

1.5 SUBMITTALS

A. Action Submittals: Submit the following:
    1. Shop Drawings:
        a. Limits of Site Clearing Work: When limits of site clearing Work are not expressly shown on the Drawings, or where Contractor proposes alternative limits of site clearing Work, submit drawings, developed from the Drawings, clearly indicating proposed limits of site clearing Work, with dimensions indicated where appropriate.
        b. Where proposed limits of clearing and grubbing, selective removals, and topsoil stripping are not identical with each other, clearly and expressly indicate limits of each on the Shop Drawings.

B. Informational Submittals: Submit the following:
    1. Permits and Approvals:
        a. Submit copy of each permit required and obtained for site clearing Work, issued by authority having jurisdiction.
        b. Where Owner's permission or approval is required for selected site clearing activities, submit copy of Owner's written permission or approval for such activity.
        c. When approval of owner of property (other than Owner) is required for selected site clearing activity, submit to Engineer written copy of such approval.
    2. Certificates:
        a. Arborist's certification that trees and shrubs shown or indicated to remain were protected during the site clearing Work in accordance with the Contract Documents.
        b. Where trees or shrubs (shown or indicated to remain) were damaged during site clearing Work, submit arborist's certification that such trees and shrubs were promptly and properly treated or, where successful treatment was not feasible, were replaced.
    3. Qualifications Statements:
        a. Arborist qualifications.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Tree Wound Dressing:
    1. Provide tree wound dressing, waterproof, adhesive and elastic with an antiseptic, free from kerosene, coal tar, creosote, and other material injurious to life of tree or other plant.

B. Drain Tile:
    1. Provide four-inch diameter, standard strength, perforated wall, bell-and- spigot clay pipe, in accordance with ASTM C700.

C. Filter Fabric:
   1. In accordance with requirements for temporary erosion and sediment controls indicated in Section 01 57 05 - Temporary Controls.

D. Drainage Fill:
   1. Selected crushed stone, or crushed or uncrushed gravel, washed.
   2. Size 24 (in accordance with ASTM D448), with 90 to 100 percent passing 2.5-inch sieve and not more than 10 percent passing 3/4-inch sieve.

E. Burlap:
   1. Jute, not less than 7.2 ounces per square yard.

F. For other materials needed for site clearing Work, such as stone, topsoil, or other, comply with requirements of the Contract Documents.

PART 3 - EXECUTION

3.1 SITE CLEARING – GENERAL

A. Limits of Site Clearing Work:
   1. Limits of site clearing Work are shown and indicated on the Drawings.

B. General Provisions for Site Clearing:
   1. Contractor shall provide all labor, materials, equipment, tools, services, and incidentals necessary and required to perform site clearing Work in accordance with the Contract Documents.
   2. Perform site clearing Work to avoid creating nuisances, pollution, and preventable adverse effects on the environment.
   3. Comply with Section 01 71 33 - Protection of the Work and Property, and this Section's Article, "Tree Protection, Selective Removals, and Selective Trimming".
   4. Excavation required for site clearing shall comply with Section 31 23 05 - Excavation and Fill.
   5. Requirements of Authorities Having Jurisdiction:
      a. Perform site clearing Work in accordance with Laws and Regulations.
      b. Obtain, pay for, and comply with permits required for site clearing Work. Obtain from authorities having jurisdiction and furnish copy of each permit as a Submittal.
   6. Site clearing Work shall comply with ANSI A300 and applicable ISA standards indicated in this Section's "References" Article, unless the Contract Documents indicate more-stringent requirements.
   7. Demolition Work is indicated in Section 02 41 00 - Demolition, including removal of site improvements and Underground Facilities.

3.2 PREPARATION

A. Permits and Approvals:
   1. Do not commence site clearing Work until necessary permits and approvals are obtained and copies furnished to Engineer as Submittals.

B. Delineation of Limits of Site Clearing Work Areas:
   1. Locate and clearly flag at the Site:
      a. Limits of site clearing Work.
      b. Trees, shrubs, vegetation, and other materials to remain within limits of site clearing Work.
      c. Trees, shrubs, and other vegetation to be selectively trimmed.
      d. Trees, shrubs, and vegetation to be selectively removed.
      e. Salvageable trees, shrubs, and vegetation (to be relocated) within limits of site clearing Work.
   2. Flagging:

a. Flagging shall be high-visibility type. Where necessary, provide lath or stakes driven into the ground, with flagging, to clearly delineate limits.
b. Provide different-colored flagging for each type of delineation required by this Article.
c. Promptly replace lost, moved, or destroyed flagging until Engineer concurs that flagging is no longer needed.

3. Review with Engineer:
a. Before starting site clearing Work, other than flagging, review at the Site with Engineer.
b. Make corrections as necessary.
c. Review all trees, 12-inch diameter (measured one foot above ground) and larger, to be removed or selectively trimmed.
d. Review with Engineer at the Site trees and shrubs to be selectively trimmed, to reach mutual agreement on extent of selective trimming required.

C. Protection: Establish protection of trees, shrubs, and vegetation to remain, in accordance with this Section's Article, "Tree Protection, Selective Removals, and Selective Trimming", and other applicable provisions of the Contract Documents.

D. Temporary Erosion and Sediment Controls:
1. Provide applicable temporary erosion and sediment controls before commencing clearing and grubbing and topsoil stripping Work.
2. Comply with temporary erosion and sediment control requirements of Section 01 57 05 - Temporary Controls.
3. Continue providing temporary erosion and sediment controls as clearing and grubbing and topsoil stripping and stockpiling Work progresses into previously uncleared, ungrubbed areas of the Site...

3.3 CLEARING AND GRUBBING

A. Clearing and Grubbing – General:
1. Remove and dispose of all materials constituting clearing and grubbing Work within limits shown and indicated in the Contract Documents.
2. After grubbing Work is complete, properly fill holes resulting from grubbing before commencing site grading Work.

B. Trees and Shrubs Improperly Destroyed or Damaged:
1. Refer to this Section's Article, "Tree Protection, Selective Removals, and Selective Trimming".

C. Trees and Shrubs to Remain:
1. Trees and shrubs to remain shall be protected, and trimmed where necessary or required, in accordance with this Section's Article, "Tree Protection, Selective Removals, and Selective Trimming".

3.4 TREE PROTECTION, SELECTIVE REMOVALS, AND SELECTIVE TRIMMING

A. General Provisions for Tree Protection, Selective Removals, and Selective Trimming:
1. Provide temporary fencing, barricades, or guarding measures, as recommended by arborist, outside drip line of trees and shrubs to remain.
2. Protect root systems from damage caused by noxious materials, storm water runoff, site clearing, planting and landscaping, other Work, and storage of materials and equipment. Protect root systems from flooding, erosion, and excessive wetting resulting from dewatering of excavations, drainage of tanks, and other construction activities.
3. Fires are not allowed under or adjacent to trees, shrubs, and other vegetation to remain.
4. Do not store matter resulting from site clearing or demolition, topsoil, or other excavated material within drip line of trees and shrubs to remain. Vehicles are not allowed within drip line. Restrict foot, vehicle and equipment traffic to prevent compaction of soil over root systems. Where such activities are unavoidable, and only as acceptable to Engineer, provide temporary, continuous, heavy-duty wood planking effectively fastened together and

capable of distributing loads from such activities. Temporary planking shall be underlaid by layer of filter fabric covered with two-inch layer of gravel.

5. Cut branches and roots, when necessary, with sharp pruning instruments; do not break or chop. Fully paint cuts 1/2-inch and larger in size with tree wound dressing.

B. Excavation and Protection of Trees and Shrubs:
   1. Excavate within drip line of trees only where shown.
   2. Where trenching for utilities is required within drip line, tunnel under or around main lateral feeder roots by drilling, auger boring, pipe jacking, or digging by hand under supervision of arborist. Do not cut main lateral roots or tap roots; cut smaller roots, which interfere with installation of the Work.
   3. Where excavation for the Work is required within drip line of trees or shrubs, hand excavate to minimize damage to root systems. Perform excavation under supervision of arborist. Provide temporary shoring or other protective support systems at excavations, to minimize sloping and benching of excavations. Use narrow tine spading forks and comb excavated material to expose roots.
   4. Relocate roots in backfill areas wherever possible. If large, main lateral roots are encountered, expose beyond excavation limits as required to bend and relocate without breaking. If encountered immediately adjacent to location of construction and relocation is not practical, cut roots approximately three inches back from construction.
   5. Do not allow exposed roots to dry out before permanent backfill is provided; provide temporary earth cover. Water and maintain in moist condition and temporarily support and protect from damage until permanently relocated and covered with earth.

C. Grade Adjustments and Tree Protection:
   1. Maintain existing grade within drip line of trees, unless otherwise shown or indicated.
   2. Lowering of Preconstruction Grade:
      a. Where required finish grade is below preconstruction grade around trees and shrubs, grade beyond drip line. Maintain preconstruction grade within drip line of trees and shrubs.
      b. Prune tree and shrub roots exposed during grade lowering, or provide permanent protections as recommended by arborist. Do not cut main or lateral roots or tap-roots; cut only smaller roots.
      c. Compensate for loss of roots and prune branches to stimulate root growth.
      d. Provide extended service through completion of the Contract correction period as recommended by arborist.
   3. Minor Fills:
      a. Where preconstruction grade is six inches or less below elevation of finish grade shown, fill with topsoil complying with quality requirements of Specifications for finish grading and landscaping.
      b. Place in single layer and do not compact.
      c. Hand-grade to required finish elevations.
   4. Moderate Fills:
      a. Where preconstruction grade is more than six inches, but less than 16 inches, below finish grade elevation, provide layer of drainage fill and filter fabric on preconstruction grade prior to placing topsoil that complies with quality requirements of Specifications on finish grading and landscaping.
      b. Carefully place drainage fill against trunk of tree or shrub approximately two inches above elevation of finish grade and extend not less than 1.5 feet from tree or shrub trunk on all sides.
      c. Provide filter fabric with edges overlapping by 6 inches, minimum.
      d. Place fill layer of topsoil to finish grade elevation.
      e. Do not compact stone, gravel or topsoil layers. Hand-grade to required finish elevations.
   5. Deep Fills:

a. Provide an open dry circular well of durable, unmortared stone, located not less than two feet s from trunk of associated tree or shrub.
b. To facilitate proper drainage, provide eight to 10 continuous runs of four-inch drain tiles horizontally on the preconstruction ground surface under the complete spread of branches in radial pattern around the tree or shrub.
c. Slope drain tiles away from tree or shrub.
d. Provide drainage fill on preconstruction ground surface in depth of two inches under and six inches over drain tiles.
e. Provide filter fabric over entire top surface of drainage fill.
f. Provide eight to 10 drainage tiles, each four-inch diameter, vertically in radial pattern around tree or shrub, located five feet from trunk of tree or shrub. Extend vertical drainage tiles from the filter fabric layer above the horizontal drainage tiles to postconstruction finished grade.
g. Hold drainage tiles in place with drainage fill.
h. Hand-grade to required finish grade elevation.

D. Tree and Shrub Pruning (Selective Trimming):
1. Perform pruning and selective trimming under the supervision of arborist.
2. Remove branches from trees and shrubs to remain only after Engineer's concurrence, only to extent necessary to clear location of permanent construction, using branch removal methods in accordance with ANSI A300 and applicable ISA standards indicated in this Section's "References" Article.
3. Extend pruning operation to restore natural shape of entire tree or shrub where pruning is approved by Engineer and as recommended by arborist.
4. Prune branches to balance loss to root system caused by damage or cutting of root system.
5. Chip branches removed from trees and shrubs. Stockpile and spread chips as directed by Engineer, with arborist's recommendation.

E. Selective Trimming:
1. In addition to pruning (as required above), perform other selective trimming under direction of arborist.
2. Comply with ANSI A300 and applicable ISA standards indicated in this Section's "References" Article.
3. Where shown or indicated, and as directed by Engineer with arborist's recommendation, carefully remove larger branches, when necessary, using appropriate methods.
4. Repair cut branches in accordance with this Section.
5. During selective trimming, avoid damaging healthy (to remain) elements of trees and shrubs.
6. Dispose of trimmings as indicated in this Section's "Disposal and Cleaning" Article.

F. Selective Removals:
1. Perform selective removals under direction of arborist.
2. Comply with ANSI A300 and applicable ISA standards indicated in this Section's "References" Article.
3. Fully remove trees and shrubs shown or indicated for selective removal.
4. Remove stumps to not less than one feet below preconstruction ground surface.
5. During selective removals, avoid damaging adjacent trees and shrubs to remain, and other property.
6. Remove larger branches before cutting the trunk of tree or shrub being selectively removed.
7. Dispose of trees and shrubs selectively removed as indicated in this Section's "Disposal and Cleaning" Article.

G. Repair and Replacement of Trees and Shrubs:
1. Perform tree and shrub repair under direction of arborist.
2. Cavity Repair:
a. Remove decayed areas to depth that exposes healthy tissue.
b. Shape cavities to provide drainage.

c. Paint inside of cavity with antiseptic tree wound dressing material.
d. Do not fill cavities.
e. When cavity's cross-section exceeds 60 percent of cross-section of tree or shrub branch, selectively trim subject branch. When cavity's cross-section exceeds 60 percent of cross-section of trunk of tree or shrub, remove tree or shrub upon Engineer's authorization. Engineer will consider arborist's recommendation. Comply with this Section's requirements for selective trimming and selective removals.

3. Repair trees and shrubs damaged by construction operations, or selectively trimmed, within 24 hours of occurrence of such damage or selective trimming. Treat damaged trunks, branches, and roots according to written instructions of arborist, in accordance with ANSI A300 and applicable ISA standards indicated in this Section's "References" Article.
4. Remove and replace trees and shrubs that are (1) dead or destroyed due to construction operations, or (2) damaged beyond reasonable hope of recovery (as determined by arborist) following repairs, or (3) damaged and determined by arborist to be incapable of resuming normal growth pattern after repairs.,
5. Obtain opinion from arborist regarding whether damaged trees, shrubs, and other vegetation is repairable with reasonable chance of success. Submit arborist's certification required in this Section's "Submittals" Article.
6. For each tree or shrub to remain but is destroyed or damaged (beyond repair) by Contractor:
   a. For trees 8 inches or more in diameter (measured one foot above preconstruction ground surface), provide two replacements of the same species. Each replacement shall be four inches diameter (measured one foot above top of root ball).
   b. For trees smaller than eight inches diameter, and for shrubs, provide one replacement for each, of same species. Replacements shall be equal in size to original, up to maximum oof four inches (measured one foot above root ball).
   c. Provide replacement at locations at the Site as directed by Engineer.
   d. Provide replacements in accordance with the Contract Documents, including Specifications on planting and landscaping.

3.5 DISPOSAL AND CLEANING

A. Disposal – General:
   1. Dispose of matter resulting from clearing and grubbing, selective removals, and selective trimming, at appropriate offsite location, unless otherwise expressly allowed by the Contract Documents or mutual agreement of Owner and Contractor.
   2. Do not use cleared, grubbed, or trimmed material as fill, backfill, or in embankments.
   3. Dispose of cleared, grubbed, and trimmed material, and other materials, rubbish, and debris, in accordance with Laws and Regulations.
   4. Pay all costs associated with transporting and disposing of materials and debris resulting from site clearing Work.
   5. Cleared lumber and trimmings from trees are Contractor's property and, at Contractor's option, may be sold or salvaged offsite.

B. Cleaning:
   1. Perform progress cleaning and other cleaning Work, and disposal of resulting materials and debris, in accordance with Section 01 74 00 - Cleaning.

C. Burning:
   1. Burning of trees, shrubs, brush, other vegetation, and other materials at, or adjacent to, the Site, whether in-place or cut, is prohibited unless: (a) burning is not prohibited by Laws or Regulations, and (b) required permits, if any, are obtained by Contractor from authorities having jurisdiction and are furnished to Engineer as Submittals; and (c) written approval of Owner is obtained and furnished to Engineer as a Submittal; and (d) when burning will be performed on lands at the Site not owned by Owner, obtain and submit to Engineer as Submittals written approval of owners of such properties.
   2. Before burning, alert local fire department (both orally and in writing) not less than 72 hours before burning, and provide at location of burning appropriate emergency materials, tools,

and equipment to contain and extinguish fires. Use such items and furnish necessary labor to prevent fire from burning other than intended trees, shrubs, brush, and vegetation.

3. If burning is allowed, exercise appropriate care and judgement. Do not perform burning in high wind conditions. Do not perform burning when areas adjacent to burning are of dryness that will foster wildfires.
4. Promptly and fully extinguish fires before they burn unintended areas or materials, and when burning is completed.
5. Dispose of ashes and burned materials off-site at appropriate location.

3.6 TOPSOIL STRIPPING AND STOCKPILING

A. Stripping:
   1. Before commencing topsoil stripping:
      a. Perform clearing and grubbing and selective removals.
      b. Remove grass and other vegetation that may remain following clearing and grubbing.
      c. Provide necessary and required temporary erosion and sediment controls.
   2. Strip topsoil to depths encountered, in manner that prevents intermingling of topsoil with underlying subsoil and other objectionable material. Remove heavy growths of grass and vegetation and material below topsoil.
   3. Before stockpiling, separate objectionable material from topsoil.
   4. Do not strip topsoil from within drip line of trees and shrubs to remain as part of the completed Project.

B. Stockpiling:
   1. Construct and maintain topsoil stockpiles in accordance with Section 01 66 00 - Product Storage and Handling Requirements, at locations in accordance with Section 01 14 19 - Use of Site.

C. Reuse of Stripped Topsoil:
   1. Reuse in the finish grading and landscaping Work topsoil that complies with the Contract Documents for such Work.
   2. Where topsoil stripped from the Site does not comply with the Contract Documents relative to quality required for use in finish grading and landscaping Work, provide appropriate soil amendment material, properly and fully mixed into topsoil stripped from the Site, so that amended material complies with quality requirements for topsoil required for finish grading and landscaping Work.

D. Disposal of Excess Topsoil:
   1. Topsoil in excess of quantity required for finished Project becomes Contractor's property when Engineer indicates finish grading and landscaping Work is complete. Properly dispose of excess topsoil offsite. Contractor may sell excess topsoil at offsite location.

END OF SECTION

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SECTION 31 22 19
FINISH GRADING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Topsoil quality and placing.
   2. Finish grading.

B. Related Requirements: Include, but are not necessarily limited to, the following:
   1. Section 31 10 00 - Site Clearing.
   2. Section 31 23 05 - Excavation and Fill.

1.2 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment:
   1. Perform the Work of this Section for all areas within limits of grading and all areas outside limits of grading disturbed during construction.
   2. Perform the Work of this Section as part of the Lump Sum bid/pay item(s) indicated in the Contract.

1.3 REFERENCES

A. Reference Standards:
   1. American Association of State Highway and Transportation Officials (AASHTO):
      a. T194, Standard Method of Test for Determination of Organic Content of Soils by Loss on Ignition.
   2. ASTM International (ASTM):
      a. D2974, Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils.
      b. D4221, Standard Test Method for Dispersive Characteristics of Clay Soil by Double Hydrometer.
      c. D4972, Standard Test Methods for pH of Soils.
      d. D5268, Standard Specification for Topsoil Used for Landscaping and Construction Purposes.
      e. D6913, Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis.
      f. D7928, Standard Test Method for Particle-Size Distribution (Gradation) of Fine-Grained Soils Using the Sedimentation (Hydrometer) Analysis.
      g. E329, Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.

1.4 QUALITY ASSURANCE

A. Qualifications:
   1. Contractor's Testing Laboratory:
      a. Retain the services of independent testing laboratory to perform testing and determine compliance with the Contract Documents of materials specified in this Section.
      b. When Contractor is expressly required, by this Section's "Quality Assurance" Article, "Source Quality Control" Article or elsewhere in the Contract Documents, to retain testing laboratory for tests required under this Section's "Quality Assurance" Article or "Source Quality Control" Article, retain one testing laboratory for quality assurance testing and field quality control testing.
      c. Testing laboratory shall comply with ASTM E329.
      d. Testing laboratory shall be experienced in the types of testing required.

e. Selection of testing laboratory is subject to Engineer's acceptance. Upon Engineer's request, submit qualifications statement for testing laboratory, including name of entity, location, copies of applicable certifications, summary of entity's experience, and names and qualifications of personnel who will perform the subject sampling and testing.

B. Quality Assurance Testing:
   1. Quality assurance testing, which may also be regarded as source quality control testing when topsoil to be installed will be topsoil originally stripped from the Site, is in addition to field quality control activities required by this Section's "Field Quality Control" Article.
   2. Allow free access to material stockpiles and borrow areas at all times. Tests shall be at Contractor's cost.
   3. Contractor's Testing Laboratory Scope:
      a. Obtain samples and perform testing of proposed topsoil materials, whether obtained from offsite borrow sources or stockpiled topsoil originally stripped from the Site, to provide assurance that the Work will comply with the Contract Documents.
   4. Required Quality Assurance Material Testing by Contractor's Testing Laboratory:
      a. Perform the following quality assurance tests for every 1,000 cubic yards of topsoil, or part thereof, to be incorporated into the Work. Submit results of such tests to Engineer and obtain Engineer's acceptance thereof prior to incorporating the subject topsoil into the Work.
         1) Gradation in accordance with ASTM D6913 and D7928.
         2) Clay content in accordance with ASTM D4221.
         3) pH in accordance with ASTM D4972.
         4) Organic content in accordance with ASTM D2974 or AASHTO T194.

1.5 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Product Data:
      a. Borrow Soil Materials: Name and address of Supplier of borrow soil materials, gradation, and Supplier's certification that materials are sufficiently free of Constituents of Concern so that a Hazardous Environmental Condition will not be created or exacerbated.
      b. If no soil materials will be obtained from any borrow location, expressly so indicate to Engineer in writing.
   2. Samples:
      a. Submit Sample of topsoil material required by this Section. Furnish Samples in durable, tightly-sealed containers; plastic bags are unacceptable. Samples shall be of sufficient quantity and material size to demonstrate the array of gradation and material types expected in the Work.

B. Informational Submittals: Submit the following:
   1. Quality Assurance Test Results Submittals:
      a. Submit results of quality assurance testing performed in accordance with this Section's "Quality Assurance" Article, unless included as part of another submittal under this Section.
         1) Tests on materials from onsite and borrow sources.
   2. Qualifications Statements:
      a. Quality assurance testing laboratory, when requested by Engineer.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Topsoil:
   1. All soil accepted as topsoil, whether obtained from onsite or offsite sources, shall comply with requirements of this Section.

2. Topsoil Source: Reuse surface soil stockpiled on Site, where possible. Verify suitability of stockpiled surface soil to produce topsoil, as specified. Clean surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.
   a. Supplement acceptable onsite soil with manufactured topsoil from offsite sources, when quantities available on-Site are insufficient to complete the Work.
   b. When existing soil material stripped from the Site and stockpiled does not comply with requirements of this Section, such soil may be provided as topsoil when addition of amendments and fertilizers will bring such soil material into compliance with this Section's topsoil requirements. Furnish to Engineer written advisory of Contractor's intent to amend existing soil materials to be compliant with topsoil requirements.
3. Provide fertile, friable, natural loam, surface soil, capable of sustaining vigorous plant growth; free of any admixture of subsoil, clods of hard earth, plants or roots, sticks, stones larger than 3/8 inch diameter, or other extraneous material harmful to plant growth, in compliance with ASTM D 5268.
4. Provide topsoil of the following characteristics:
   a. Required gradation:

Sieve Size	Percent Passing
3/4 inch mesh	100
No. 4-sieve	90 to 100
No. 200-sieve	0 to 10

   b. Clay content of material passing No. 200-sieve shall be not greater than 60 percent, as determined by hydrometer tests.
   c. pH-adjusted with ferrous sulphate or ground limestone to provide pH 5.5 to 7.0 at time of installation of lawns and meadow areas, unless particular species of planting requires a different pH for optimal growth.
   d. Electrical conductivity of a 1:2 soil-water suspension shall not exceed 1.0 milliohm per centimeter and with less than 200 parts per million of extractable aluminum.
   e. Cation Exchange Capacity: 5, minimum.
   f. Organic content not less than five percent, as determined by ignition loss of oven-dried samples passing No. 10-sieve (Muffle Furnace Temperature: 110 plus or minus five degrees C for eight hours).
   g. Free of pests and pest larvae.
   h. Relative to Constituents of Concern, topsoil shall be in accordance with Laws and Regulations. Constituents of Concern, if any, in topsoil furnished shall not constitute or result in a Hazardous Environmental Condition.

2.2 SOURCE QUALITY CONTROL

A. Tests and Inspections at Source of Supply:
   1. Perform quality assurance testing, and submit results to Engineer, in accordance with the "Quality Assurance" Article in Part 1 of this Section.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protection of In-place Conditions:
   1. Protect structures, utilities, sidewalks, pavements, and other facilities, and lawns and existing plants from damage caused by finish grading.

B. Preparation – General:

1. In accordance with Section 01 57 05 - Temporary Controls, provide temporary measures for controlling erosion and sedimentation, airborne dust, and fugitive dust emissions from the Site.
2. Topsoil stripping and stockpiling requirements are indicated in Section 31 10 00 - Site Clearing.
3. Adjust rough grading to within 0.1 foot of required elevations. Properly compact sub-grades. Rough grading shall provide for appropriate drainage in accordance with the Contract Documents.
4. Before applying topsoil:
    a. Remove from exposed subgrade all stones and debris over one inches in any dimension and properly dispose of such items at an appropriate, offsite location.
    b. Apply superphosphate fertilizer directly to subgrade before loosening.
    c. Loosen sub-grade surface to depth of not less than two inches.

3.2 INSTALLATION

A. Installation Requirements:
1. Required Depth of Topsoil:
    a. For areas of gardens, shrubs and similar plantings, provide finished, lightly compacted, topsoil depth of not less than 6 inches.
    b. For all other areas requiring topsoil, including lawns and meadows, provide finished, lightly compacted, topsoil depth of not less than 4 inches.
2. Do not place topsoil when subgrade is muddy, wet or frozen enough to cause clodding.
3. Provide finished surface smooth and true to required grades, in accordance with this Article's "Installation Tolerances" provision. Provide finished surface of topsoil equal to required finished elevations after light rolling and natural settlement.
4. Grade topsoil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to provide required finish grades.
5. Restore topsoil if eroded or otherwise disturbed after finish grading and before planting.
6. Topsoil Quantity Differentials:
    a. If quantity of required topsoil exceeds the quantity, if any, of topsoil stockpiled at the Site and available for use by Contractor, provide the additional required quantity from appropriate offsite borrow sources at no additional cost to Owner.
    b. When quantity of topsoil obtained from offsite borrow sources exceeds the required quantity of topsoil, remove excess from the Site, unless Owner allows such excess to be stockpiled at an appropriate location at the Site.
    c. When quantity of required topsoil is less than quantity of onsite stockpiles, following installation of topsoil, properly grade remaining stockpile for appropriate drainage without undue erosion and seed stockpile as required for other areas of lawn restoration in accordance with the Contract Documents.

B. Installation Tolerances:
1. Finish Grading Tolerance: ±0.1 foot from finish elevation required by the Contract Documents. Ensure adequate drainage.

3.3 FIELD QUALITY CONTROL

A. Tests and Inspections:
1. Upon completion of topsoil installation, obtain Engineer's concurrence regarding grades and drainage.
2. Where directed by Engineer, provide test holes to demonstrate that required depth of topsoil was provided. After observation and measurement by Engineer, properly refill test holes.
3. Where insufficient depth of topsoil is revealed, remedy by providing required depth and quantity in accordance with the Contract Documents. When additional topsoil is added after initial establishment of plant growth, re-establish required plantings to provide compliance with the Contract Documents.

3.4 PROTECTION

A. Commencing immediately after topsoil installation, protect installed topsoil from erosion and damage from other causes, including personnel, vehicles, and equipment. Promptly perform seeding, sodding (as applicable), mulching, and other measures to permanently stabilize soils and prevent erosion, in accordance with Section 32 92 00 - Seeding, Sodding, and Landscaping.

END OF SECTION

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SECTION 31 23 05
EXCAVATION AND FILL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Requirements for excavating, filling, and other earth Work, including:
      a. Field conditions.
      b. Soil and aggregate materials.
      c. Test pits.
      d. Excavation.
      e. Preparation of subgrades.
      f. Filling and compacting.
      g. Rough grading.
      h. Disposal of excavated spoil materials.

B. Related Requirements Include, but are not necessarily limited to, the following:
   1. Section 03 31 30 - Concrete Materials and Proportioning.
   2. Section 03 31 31 - Concrete Mixing, Placing, Jointing, and Curing.
   3. Section 03 35 00 - Concrete Finishing and Repair of Surface Defects.
   4. Section 31 10 00 - Site Clearing.
   5. Section 31 22 19 - Finish Grading.
   6. Section 31 23 16.43 - Temporary Support of Excavations.
   7. Section 31 23 19 - Dewatering.

1.2 PRICE AND PAYMENT PROCEDURES

A. Measurement:
   1. Contractor shall provide all labor, materials, construction equipment and machinery, tools, and incidentals required or necessary for performing all excavation and fill Work for the Contract, including all Work related to excavating, preparing subgrades, providing and stockpiling materials, filling with required materials, compacting, grading, proper disposal of excess spoil materials, and all other Work required by this Section. This Section includes excavation and fill Work required for constructing: structures; site improvements (including pavement, sidewalks, curbs, and the like); Underground Facilities; subgrade preparation for other Work; and all other excavation and fill Work required by the Contract Documents and not addressed under other Specifications sections.
   2. The Work of this Section is included in the lump sum bid item for the Contract.
   3. All Work under this Section is unclassified and covered by this Section and the associated bid/payment item(s). No separate payment will be made for removing, handling, or disposing of rock (unless the Contract includes a separate bid/pay item specifically for rock excavation or rock removal), stones, concrete (whether or not reinforced), debris, stumps, and other material, regardless of moisture content, unless such material constitutes an unforeseen Hazardous Environmental Condition and Work associated with such Hazardous Environmental Condition is not included in the Contract.

1.3 REFERENCES

A. Terminology:
   1. The following terms are not defined and are not indicated with initial capital letters but, when used in this Section, have the following meaning:
      a. "Borrow" means material required for earth work construction in excess of quantity of suitable material available from required grading, cuts, and excavations at the Site. Borrow may be necessary even though not otherwise expressly required by the Contract Documents.

b. "Cohesive soil" means clay (fine grained soil), or soil with a high clay content, which has cohesive strength. Cohesive soil does not crumble, can be excavated with vertical or near-vertical side slopes for short periods of time and limited heights, and is plastic when moist. Cohesive soil is difficult to break up when dry and exhibits significant cohesion when submerged. Cohesive soils include sandy clay, silty clay, clay and organic clay.

c. "Cohesionless soil" means fill material that does not clump together; its grains remain separate and apart from each other. Cohesionless soils typically have a low proportion of fine (no. 200 mesh size and less) particles and may be soil material or granular material. The terms "cohesionless soils", "cohesionless materials", "non-cohesive soils", and the like have the same meaning.

d. "Fill" means soil material, granular material, or other material indicated in this Section required for backfilling excavations or as material for achieving required rough grading. Unless indicated otherwise in the context of a specific provision, the terms "fill" and "backfill" have the same meaning, as do derivative terms such as, "filling" and "backfilling". When used by itself, the term "backfill" means material required for refilling an excavation.

e. "Foundations" means footings, base slabs (slabs-on-grade), foundation walls, concrete mats, grade beams, piers, piles, and other supporting element (of buildings or structures) bearing directly on soil or rock.

f. "Granular material" means gravel or sand, (coarse grained soil) with little or no clay content. Granular soil has no cohesive strength. Some moist granular soils exhibit apparent cohesion. Granular soil cannot be molded when moist and crumbles easily when dry. The terms "granular material", "aggregate material, and "granular soil" have the same meaning. Detailed requirements for specific types of granular material are indicated in Article 2.1 of this Section.

g. "Rock" means: Igneous, metamorphic, or sedimentary rock or stone; boulders over two cubic yards in volume in open areas and boulders over one cubic yard in volume in trenches; and mass concrete; that cannot be removed using rippers and therefore requires drilling and blasting or use of large excavator-mounted pneumatic breakers. If rock is encountered during the Work, promptly furnish notice of differing subsurface condition in accordance with the General Conditions (as may be modified by the Supplementary Conditions); when necessary, Engineer will furnish requirements for rock removal via appropriate Contract modification. The following do not qualify as rock:
   1) Soft, weathered or disintegrated rock that can be removed by normal excavating equipment, including bulldozers with rippers and large trackhoes with rock teeth or rock buckets.
   2) Loose or previously blasted rock.
   3) Broken stone in rock fills.
   4) Rock or stone that falls into the excavation from outside limits of excavation shown or indicated in the Contract Documents.
   5) Boulders that can be removed without drilling, blasting, or pneumatic breakers.
   6) Pavements, sidewalks, and gutters of concrete, asphalt, or masonry.

h. "Subgrade" means the uppermost surface of native soil material unmoved from cuts; the bottom of excavation.

i. "Unauthorized excavation" means removing materials beyond limits shown or indicated in the Contract Documents or otherwise directed by Engineer.

j. "Unclassified", when used in referring to excavating or excavations, means excavation and disposal of all materials, of any description whatsoever, encountered in performing the Work, unless otherwise shown or indicated in the Contract Documents.

k. "Unsuitable soil materials" means soil or other materials encountered at or below subgrade elevation of insufficient strength, stiffness, or characteristics to support the Work in accordance with the Contract Documents or as determined by Engineer. The

terms "unsuitable soil material", "unsuitable soil", and "unsuitable material" have the same meaning.

B. Reference Standards: Standards referenced in this section include, but are not necessarily limited to, the following:
   1. American Association of State Highway and Transportation Officials (AASHTO):
      a. AMRL R18 - AASHTO Accreditation Procedure Manual.
   2. ASTM International (ASTM):
      a. D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).
      b. D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method.
      c. D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).
      d. D2166 - Standard Test Method for Unconfined Compressive Strength of Cohesive Soil.
      e. D2216 - Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
      f. D2434 - Standard Test Methods for Measurement of Hydraulic Conductivity of Coarse-Grained Soils.
      g. D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
      h. D2850 - Standard Test Method for Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils.
      i. D3740 - Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
      j. D4253 - Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
      k. D4254 - Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
      l. D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
      m. D6913 - Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis.
      n. D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
      o. D7928 - Standard Test Method for Particle-Size Distribution (Gradation) of Fine-Grained Soils Using the Sedimentation (Hydrometer) Analysis.
      p. E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.
   3. Texas Department of Transportation (TxDOT):
      a. Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges.
         1) Item 247, Flexible Base.
      b. Tex-113-E, Laboratory Compaction Characteristics and Moisture-Density Relationship of Base Materials.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Applicable construction codes including building code are indicated in Section 01 42 00 - References.

B. Qualifications:
   1. Contractor's Testing Laboratory:
      a. Retain the services of independent testing laboratory to perform testing and determine compliance with the Contract Documents of materials specified in this Section.

b. When Contractor is expressly required, by this Section's "Field Quality Control" Article or elsewhere in the Contract Documents, to retain testing laboratory for tests required under this Section's "Field Quality Control" Article, retain one testing laboratory for quality assurance testing and field quality control testing.
c. Retain testing laboratory different from testing laboratory and special inspectors retained by Owner or Owner's consultant for code-required tests and special inspections for the Project, if any.
d. Testing laboratory shall possess current, valid accreditation from the AASHTO Materials Reference Laboratory (AMRL), in accordance with AASHTO AMRL R18, for ASTM D3740, for tests required for quality assurance testing indicated in this Article and field quality control testing indicated to be Contractor's responsibility.
e. Testing laboratory shall comply with ASTM E329.
f. Testing laboratory shall be experienced in the types of testing required.
g. Selection of testing laboratory is subject to Engineer's acceptance. Upon Engineer's request, submit qualifications statement for testing laboratory, including name of entity, location, copies of applicable certifications, summary of entity's experience, and names and qualifications of personnel who will perform the subject sampling and testing.

C. Quality Assurance Testing:
1. Quality assurance testing, which may also be regarded as source quality control testing, is in addition to field quality control testing required by this Section's "Field Quality Control" Article.
2. Materials used in the Work may require testing and retesting, as directed by Engineer, during the Project. Allow free access to onsite material stockpiles, borrow sources, and other sources of aggregate and soil materials at all times. Tests not specifically indicated to be performed at Owner's expense, including retesting of defective materials and defective Work, shall be at Contractor's cost.
3. Contractor's Testing Laboratory Scope:
a. Obtain samples and perform testing of proposed fill materials in the laboratory, at the Site, and at borrow locations (if any) to provide assurance that the Work will comply with the Contract Documents.
b. Testing laboratory shall perform testing required to obtain data for selecting moisture content for placing and compacting fill materials.
c. Submit to Engineer, via Contractor, written results of each test.
4. Required Quality Assurance Material Testing by Contractor's Testing Laboratory:
a. Perform the following quality assurance tests on materials to be incorporated into the Work. Submit results of such tests to Engineer and obtain Engineer's acceptance thereof prior to incorporating the subject materials into the Work.
b. Gradation in accordance with ASTM D6913 and ASTM D7928. Perform one test for every 1,000 cubic yards of each material to be incorporated into the Work.
c. Atterberg limits in accordance with ASTM D4318. Perform one test for every 1,000 cubic yards of the following types of materials to be incorporated into the Work: suitable soil material, and soil structural fill.
d. Moisture/density relationship for fill in accordance with ASTM D698, ASTM D1557, ASTM D4253, or ASTM D4254, as applicable. Perform one test for every 1,000 cubic yards of each material to be incorporated into the Work.
e. Moisture content of stockpiled or borrow material in accordance with ASTM D2216. Perform one test for every 1,000 cubic yards of each material to be incorporated into the Work.

1.5 SUBMITTALS

A. Action Submittals: Submit the following:
1. Shop Drawings:
a. Schedule (table or written narrative) indicating, for each specific area of the Work, type of fill materials proposed, together with indication of whether source of materials is

onsite or borrow source. Identification of each type of material shall employ material names/designations identical to those in the Contract Documents.

2. Product Data:
   a. Borrow Soil Materials: Name and address of Supplier of borrow soil materials, gradation, and Supplier's certification that materials are sufficiently free of Constituents of Concern so that a Hazardous Environmental Condition will not be created or exacerbated. If no soil materials will be obtained from any borrow location, expressly so indicate to Engineer in writing.
   b. Aggregate: Supplier's published description of aggregate materials, including name and address of Supplier, certification of material's compliance with AASHTO and state department of transportation standards, and gradation.

B. Informational Submittals: Submit the following:
   1. Procedure Submittals:
      a. Excavation plan indicating:
         1) Excavation Method(s): Indicate high-level methods to be used for excavating, such as use of backhoe or other earth moving construction equipment, use of explosives in excavating (when allowed), trenchless excavating methods, micro-trenching, hydro-excavating (when allowed), air vacuum excavating (when allowed), or other. Where different methods will be used, indicate locations of each in the Work. Purpose of indicating high-level excavating methods is for Owner's information regarding effect of excavating method on Owner's or facility manager's (if other than Owner) property and operations.
         2) Copies of permits and approvals required for excavation and fill Work, obtained from authorities having jurisdiction, including owners of affected utilities and transportation facilities, for excavation methods proposed.
      b. Compaction procedure and compaction equipment proposed for use. Where different procedures or equipment will be used for compacting different types of material or at different locations at the Site, indicate where each procedure and equipment item will be used.
      c. Engineer's acceptance of excavation plan does not, in any way, modify Contractor's sole responsibility for complying with the Contract Documents, construction means, methods, procedures, techniques, or sequences, and safety and protection measures incident thereto.
   2. Quality Assurance Test Results Submittals:
      a. Submit results of quality assurance testing performed in accordance with this Section's "Quality Assurance" Article, unless included as part of another submittal under this Section. Submit results for the following quality assurance testing:
         1) Tests on materials from onsite and borrow sources.
         2) Optimum moisture – maximum dry density curve for each type of fill material.
   3. Field Quality Control Submittals:
      a. Submit results of testing and inspection performed in accordance with the field quality control Article in Part 3 of this Section, including:
         1) Indication of soil classification in accordance with ASTM D2487.
         2) Field density testing.
   4. Qualifications Statements:
      a. Quality assurance testing laboratory, when requested by Engineer.

1.6 FIELD CONDITIONS

A. Existing Conditions:
   1. Subsurface Conditions:
      a. Subsurface Information: The Supplementary Conditions indicate information (if any) that is Technical Data on subsurface conditions at the Site. Such information and data are not intended as a representation or warranty of continuity of conditions between soil borings or test pits, nor of groundwater levels at dates and times other than date and time when measured, nor that purpose of obtaining the information and data were

appropriate for use by Contractor. Owner and Engineer are not responsible for interpretations or conclusions drawn therefrom by Contractor.

b. Contractor's Explorations: Soil borings and other exploratory operations may be made by Contractor, at no additional cost to Owner. Coordinate Contractor-performed test borings and other exploratory operations with Owner, utility owners, and owners of transportation facilities as appropriate. Perform such explorations without disrupting or otherwise adversely affecting operations of Owner and others.

2. Where subsurface conditions or locations of Underground Facilities and structures are unforeseen or differ substantively from that shown or indicated in the Contract Documents, comply with Contract requirements for giving notice and other actions.
3. Existing Structures and Underground Facilities:
   a. The Contract Documents show or indicate certain structures and Underground Facilities adjacent to the Work. Such information was obtained from existing records and is not guaranteed to be correct or complete. Contractor shall explore ahead of the excavation to determine the exact location of all existing structures and Underground Facilities. Existing structures and Underground Facilities shall be supported and protected from damage by Contractor. Immediately repair and restore existing structures and Underground Facilities damaged by Contractor without additional cost to Owner.
   b. Movement or operation of construction equipment and machinery over Underground Facilities shall be at Contractor's sole risk. When required by owner of the Underground Facility, prepare and submit to owner of such Underground Facility, and obtain their acceptance, of Contractor's plan presenting Contractor's analysis of the loads to be imparted during construction (including transient loading by construction equipment, machinery, and vehicles) and Contractor's proposed measures to protect structures and Underground Facilities during the Work.
   c. Acceptance of or approval by utility owner or Engineer of Contractor's proposed evaluation and method(s) for protecting Underground Facilities in no way modifies or reduces Contractor's sole responsibility for complying with the Contract Documents, means, methods, procedures, techniques, and sequences of construction, and the safety and protection measures incident thereto.
   d. Coordinate with utility owners for shut off of services in active piping and conduits. When required by utility owner, Owner will assist Contractor with utility owner notifications. Completely remove buried piping and conduits indicated for removal and not otherwise indicated as being abandoned or to remain in place.
   e. Do not interrupt existing utilities serving facilities occupied and used by Owner or others, except when such interruption is indicated in the Contract Documents or when allowed in writing by Engineer after acceptable temporary utility services are provided by Contractor for the affected structure or property.

PART 2 -PRODUCTS

2.1 MATERIALS

A. Flexible Base:
   1. Provide flexible base under foundations, manholes, handholes, and similar Work unless other under-slab material is required by the Contract Documents.
   2. TxDOT Item 247, Type A, Grade 1 or 2.

B. Select Fill:
   1. Select fill is required for improving subgrade (after removal of unsuitable material), as backfill for excavations in areas that, after restoration, will be subject to vehicular traffic, and at other locations shown or indicated for such material in the Contract Documents.
   2. Free of organic and deleterious matter, frozen material and debris.
   3. Liquid limit: Less than 35.
   4. Minimum plasticity index: 8.
   5. Maximum plasticity index: 17.

6. Fines passing No. 200 sieve: Less than 70 percent.

C. Structural Fill:
   1. Free of organic and deleterious matter, frozen material and debris.
   2. Low-volume change cohesive soil material:
      a. ASTM D2487 classification: CL.
      b. Liquid limit: Less than 45.
      c. Maximum plasticity index: 20.
      d. Maximum particle size: 2 inches.
   3. Granular soil material:
      a. ASTM D2487 classification: SC.
      b. Maximum particle size: 2 inches.
   4. Previously-excavated materials complying with the Contract Documents requirements for structural fill may be used for structural fill.
   5. When onsite materials are unsuitable for use as structural fill, provide select fill or approved borrow material as structural fill. Prior to using borrow material as structural fill, furnish product data Submittal and quality assurance Submittal for proposed material and obtain Engineer's approval and acceptance (as applicable) of the proposed material.

D. Non-Structural Fill:
   1. Provide non-structural fill as fill for the Work unless other material is required.
   2. Material shall be:
      a. On-site soils free of rock larger than three inches in any dimension, debris, waste, frozen materials, organic material, and other deleterious material.
   3. Previously-excavated materials complying with the Contract Documents requirements for non-structural fill may be used for non-structural fill.
   4. When onsite materials are unsuitable for use as non-structural fill, provide structural fill or approved borrow material as non-structural fill. Prior to using borrow material as non-structural fill, furnish product data Submittal and quality assurance Submittal for proposed material, and obtain Engineer's approval and acceptance (as applicable) of the proposed material.

E. Clay Cap:
   1. Soils free of frozen material, deleterious material, and debris.
   2. ASTM D2487 classification: CL or CH.
   3. Less than 2% of organic matter.
   4. Plasticity index range: 25-40.
   5. More than 50% by weight fines passing No. 200 sieve.
   6. Less than 15% by weight retained on No. 4 sieve.

F. Subbase Material:
   1. Subbase material is granular material underlying pavement, sidewalks, and at other locations shown or indicated for such material in the Contract Documents.
   2. Material shall be:
      a. Item 247, Type A or D, Grade 1 or 2 of State of Texas Department of Transportation Specifications.

G. Pipe Bedding Material:
   1. Materials: Unless otherwise expressly required in the Contract Documents, pipe bedding material shall be material as follows and be free of: debris, waste, frozen materials, organic material and other deleterious matter.
      a. Pipe bedding material: ASTM C33 No 67.

   2. Flowable Fill – where expressly required by the Contract Drawings.

H. Geosynthetics:
   1. Install geotextile pipe wrap as shown on drawing details, and in accordance with Section 31 32 19.16 - Geotextile Soil Stabilization.

I. Flowable Fill, also known as Controlled Low Strength Material (CLSM):
   1. Description: Flowable fill shall be a mixture of cement, fly ash, fine sand, water, and air having a consistency which will flow under a very low head.
   2. Material characteristics:
      a. The approximate quantities of each component per cubic yard of mixed material shall be as follows:
         1) Cement (ASTM C150 Type I/II): 50 pounds.
         2) Fly ash (ASTM C618, Class C or F): 200 pounds.
         3) Fine sand: 2,700 pounds.
         4) Water: 420 pounds.
         5) Air content: 10%.
      b. Actual quantities shall be adjusted to provide a yield of 1 cubic yard with the materials used.
      c. Approximate 28-day compressive strength should be 85 to 175 psi.
      d. Fine sand shall be an evenly graded material having not less than 95% passing the No. 4 sieve and not more than 5% passing the No. 200 sieve.
      e. Mixing and handling of the material shall be in accordance with Specification Section 03 31 31.
   3. Material provided shall be excavatable by ordinary mechanical excavation equipment, such as backhoes.

2.2 SOURCE QUALITY CONTROL

A. Tests and Inspections at Source of Supply:
   1. Perform quality assurance testing, and submit results to Engineer, in accordance with the "Quality Assurance" Article in Part 1 of this Section.

PART 3 -EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:
   1. Provide Engineer with sufficient notice and with means to examine areas and conditions under which excavating, filling, and grading will be performed. Engineer will advise Contractor in writing when Engineer is aware of conditions that may be detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.
   2. This Article, however, in no way modifies or reduces Contractor's sole responsibility for complying with the Contract Documents, for construction means, methods, procedures, techniques, and sequences, and for the safety and protection measures incident thereto.
   3. Nothing in this Article, including action by Engineer or Resident Project Representative (if any), is for benefit of Contractor.

B. Installing the Work constitutes Contractor's approval of underlying work, subgrades, and field conditions prevailing at the time of the Work.

3.2 TEST PITS

A. Test Pits - General:
   1. Test Pit Locations Not Shown or Indicated in the Contract Documents and Test Pits Not Part of a Dedicated Bid/Pay Item:
      a. In advance of other construction, excavate test pits, make observations and measurements, and promptly fill test pits.
      b. Purpose of test pits is to determine existing subsurface conditions and locations of Underground Facilities and structures.
      c. Perform all work required in connection with excavating, stockpiling, maintaining, temporarily supporting excavations, filling, and replacing pavement for test pits. Contractor is responsible for the definite location of each existing Underground

Facilities involved within the area of excavation for the Work. Exercise care during such location work to avoid damaging and disrupting affected Underground Facility or structure. Contractor is responsible for repairing, at Contractor's cost, damage to Underground Facility or structure caused during the Work.

B. Payment for Test Pits:
   1. All payment for test pits shown or indicated in the Contract Documents will be part of the lump sum Contract Price.

C. Results of Test Pits:
   1. Document results of all test pits excavated by Contractor.
   2. Submit to Engineer written results of test pits expressly required by the Contract Documents or directed by Engineer. Furnish such Submittal within three days of excavation of associated test pit unless Engineer allows more time. When Engineer requests written results of test pits performed for Contractor's own use, promptly furnish such information as Informational Submittal.
   3. Required documentation of test pits shall include:
      a. Identification of Project, Site, and Contractor.
      b. Date and time of test pit excavation, indication of weather conditions, and names of personnel present and employer of each.
      c. Detailed description of location of test pit, including, where necessary, measurements to landmarks shown on the Drawings. Where appropriate, include sketch of location from the Drawings.
      d. Indication of approximate dimensions of test pit, including length, width, and depth.
      e. Verbal (written) description of observed subsurface conditions, including apparent strata, rock (if any), groundwater conditions, and approximate depth at which each was observed.
      f. Verbal (written) description of unusual conditions observed, including potential existence of Hazardous Environmental Condition, if any. Include pertinent data, such as readings from instrumentation used.
      g. Description and sketch, with appropriate dimensions, of Underground Facilities and structures in the test pit. Sketches shall be clearly legible with clear, well-written annotations and dimensions.
      h. Other pertinent information and data from observations made while test pit was open.
      i. Brief written description of backfilling and restoration of test pit, including time operations were completed.

3.3 PREPARATION

A. Site Preparation:
   1. Comply with Section 31 10 00 - Site Clearing.
   2. Comply with this Section's "Erosion and Sediment Control During Construction" Article.

B. Dust Control:
   1. Relative to controlling dust during construction, comply with Section 01 57 05 - Temporary Controls and Section 01 74 00 - Cleaning.

C. Maintenance and Protection of Traffic:
   1. Keep all streets and traffic ways open for passage of traffic and pedestrians during the Project, unless otherwise approved by owner of the street, traffic way, or right-of-way, as applicable. Construction traffic shall access the Site only via entrance(s) indicated in Section 01 55 13 - Vehicular Access and Parking.
   2. When required to cross, obstruct, or temporarily close a street or traffic way, provide and maintain suitable bridges, detours, and other acceptable temporary expedients to accommodate traffic. Closings of streets or traffic ways shall be for shortest time practical, and passage shall be restored immediately after completion of filling and temporary paving or bridging.

3. Give required advance notice to fire department, police department, and other emergency services as applicable of proposed construction operations.
4. Give reasonable notice to owners or tenants of private property who may be affected by construction operations. Give such notice not less than 30 days prior to construction that will affect the property.
5. All hydrants, valves, fire alarm boxes, mailboxes, express courier drop boxes, and other facilities that may require access during construction shall be kept accessible for use.
6. Provide temporary signage, signals, barricades, warning lights, lighting and other equipment, service, and personnel necessary and required to regulate and protect traffic and warn of hazards. Such Work shall comply with requirements of owner of right-of-way and authorities having jurisdiction at the Site. Remove temporary equipment and facilities when no longer required, and restore grounds to original or to specified conditions, as applicable.

3.4 EROSION AND SEDIMENT CONTROLS DURING CONSTRUCTION

A. Temporary Erosion and Sediment Controls - General:
   1. Provide temporary erosion and sediment controls in accordance with Section 01 57 05 - Temporary Controls, and other requirements of the Contract Documents.
   2. When applicable, also comply with requirements of the erosion and sediment control plan approved by authorities having jurisdiction and the Project's storm water pollution prevention plan and permit, if any.

3.5 EXCAVATION

A. Excavation - General:
   1. Perform all excavation required to complete the Work as shown, specified, and required. Excavating Work includes removing, handling, and proper disposal of earth, sand, clay, expansive-type soils, other unsuitable soil materials, gravel, hardpan, soft, weathered or decomposed rock, concrete and masonry (reinforced or unreinforced), pavements, rubbish, debris, stumps, and other materials, regardless of moisture content, within the excavation limits.
   2. Excavation and filling Work shall comply with the Contract Documents, including required contours, elevations, general dimensions, and alignment shown or indicated on the Drawings including cuts, fills, and embankments, as applicable.
   3. Protect existing buildings and structures against undermining and destabilization. If excavations affect adjacent foundations, advise Engineer in writing.
   4. If unsuitable material and obstructions are encountered during excavation, remove material and replace as directed by Engineer.

B. Excavation Methods:
   1. Traditional Excavation Methods: Excavation via traditional methods, such as backhoe, bulldozer, other earth moving construction equipment or machinery, or excavation using hand tools, is acceptable for all excavating Work.
   2. Use of Explosives:
      a. Use of explosives is not allowed.

C. Excavation Protection:
   1. Provide excavation protection system(s) in accordance with Laws and Regulations to prevent injury to persons and property, including Underground Facilities.
   2. Provide safe access to excavations, including emergency exit, and safe access for construction equipment and machinery, where applicable, in accordance with laws and Regulations.
   3. Comply with Section 31 23 16.43 - Temporary Support of Excavations, regarding temporary support of excavations during construction.
   4. Comply with Section 31 23 19 - Dewatering, regarding dewatering of excavations and related matters.

D. Excavations for Buildings, Structures, and Footings:

1. Elevation of bottom of footings shown is approximate. Engineer may direct, via appropriate Contract modifications, such minor changes in dimensions and elevations as may be required to ensure a stable bearing surface.
2. Extend excavations sufficiently on each side of structures, footings, and similar construction for installing forms, temporary supports of excavations, observation and inspection of the Work, and safe sloping of sides of excavations, as necessary.

E. Subgrades - General:
1. Provide firm, dense, thoroughly compacted, consolidated subgrades, free of mud, muck, and other soft and unsuitable materials. Subgrades shall remain firm and intact under all construction operations. Reinforce subgrade by providing flexible base on subgrades that are otherwise solid but become soft or muddy on top due to construction operations. Finished elevation of stabilized subgrades shall not be above subgrade elevations shown on the Drawings.
2. If, in Engineer's opinion, subgrade becomes soft, muddy, or both, because of construction delays, failure to dewater properly, or other cause within Contractor's control, excavate subgrade to firm material, trim the subgrade, and backfill with flexible base material at Contractor's cost.
3. Remove unsuitable subgrade materials below foundations. Limits of required removal of unsuitable material, when not otherwise expressly shown or indicated in the Contract Documents, shall be outside exterior limits of foundations around perimeter of building or structure by not less than the greater of the following horizontal distances:
   a. Distance equal to depth of required removal of unsuitable material, below bottom of foundations.
   b. Three feet.
   c. As directed by Engineer, in consultation with geotechnical engineering special inspector or consultant (if any).
4. Preparation of Subgrades for Subsequent Work:
   a. Level off subgrades to receive foundations or compacted fill.
   b. Where subgrades are to receive subsequent fill or construction of buildings or structures, remove loose materials and bring subgrades into compliance with the Contract Documents.
   c. Where compacted fill material is required to bring subgrade up to underside of construction, scarify existing subgrade upon which fill material will be placed to depth of twelve inches and then compact to density required in this Section before fill material is placed thereon.
   d. Do not excavate lower than required for foundations, unless directed otherwise by Engineer.
   e. Where excavation extends below required elevation without authorization, promptly advise Engineer and remedy unauthorized excavation in accordance with the Contract Documents. Corrections may include:
      1) Under soil-supported foundations:
         a) Fill unauthorized excavation by extending shown or indicated bottom elevation of foundation to excavation bottom, without altering required top elevation.
         b) Concrete fill is acceptable for bringing elevations to proper position.
      2) For locations other than those indicated above including slabs-on-grade and pier-supported foundations:
         a) Backfill and compact unauthorized excavations as indicated for authorized excavations of same classification, unless otherwise directed by Engineer.
      3) Contractor is not eligible for change in Contract Price or Contract Times for remedying unauthorized excavations.
5. Proof-rolling:
   a. Proof-roll subgrades required to receive fill or other subsequent construction of building or structure after subgrade is scarified and compacted.
   b. Proof-roll in presence of Engineer or their representative.

c. Furnish and use heavy pneumatic tired roller, tandem axle dump truck carrying a full load or other appropriate equipment with gross weight of not less than 25 tons.

6. Evaluation and Protection of Subgrade:
   a. Advise Engineer as soon as excavation is completed for Engineer's observation of subgrades and, where necessary or required, inspection and testing of subgrades by special inspectors.
   b. If Engineer determines that bearing materials at required subgrade elevations are unsuitable, provide subgrade stabilization as indicated in this Article.
   c. Do not commence further construction until subgrade under compacted fill material, under foundations and retaining walls is acceptable (in accordance with the Contract Documents) to Engineer, who may consider results of required testing and special inspections (if any), and who may elect to consult with geotechnical special inspector or other consultant (if any).
   d. Engineer shall have sufficient opportunity to observe subgrade, after successful completion of special inspections (if any), and other tests and inspections required by the Contract Documents.
   e. Place fill material and perform subsequent construction after subgrade is acceptable in accordance with the Contract Documents.
   f. Protect subgrade from becoming loose, wet, frozen, or soft due to weather, construction operations, or other reasons.
7. Subgrade stabilization:
   a. If subgrade under foundations or fill material, is frozen, loose, wet, or soft before construction is placed thereon, remove frozen, loose, wet, or soft material and replace with approved compacted material as directed by Engineer, who may consult with geotechnical special inspector or other consultant.
   b. Loose, wet, or soft materials, when approved by Engineer, may be stabilized by a compacted working mat of well graded crushed stone.
   c. Stabilization shall be in accordance with the Contract Documents. Where the Contract Documents do not address subgrade stabilization, promptly submit to Engineer written request for clarification or interpretation, or other written instrument in accordance with the Contract Documents. In such event, do not proceed until response is obtained from engineer.

F. Pipe Trench Preparation:
1. Not more than 100 feet of trench may be opened in advance of installing pipe in trench.
2. Trench width shall be minimized to greatest extent practical, and shall comply with the following:
   a. Trench width shall be sufficient to provide space for installing, jointing and inspecting piping. The Drawings show additional requirements for trenches. In no case shall trench be wider at top of pipe than pipe barrel's outside diameter (OD) plus two feet, unless otherwise shown or indicated.
   b. Enlargement of trench width at pipe joints may be made when required and approved by Engineer.
   c. For excavating and backfilling for manholes, chambers, and vaults associated with buried piping, excavation at widest point of manhole, chamber, or vault shall be not wider than two feet greater than widest outside dimension (including bottom footings or flanges, if any, of concrete structures) of the associated manhole, chamber, or vault. For cast-in-place concrete manholes, chambers, and vaults, excavation at widest point of such structure shall be not greater than four feet wider than widest point of the associated structure.
   d. Trench width shall be sufficient for Contractor's means of temporarily supporting the excavation and dewatering.
   e. Trench width shall be sufficient to allow thorough compaction of fill adjacent to bottom half of pipe.
   f. Do not use construction equipment or machinery that necessitates trench to be excavated to excessive width.

3. Depth of trench shall be as shown or indicated in the Contract Documents. If required and approved by Engineer in writing (such as a duly issued Contract modification), depths may be revised.
4. Where Engineer considers existing subgrade (beneath intended bedding material) unsuitable, remove and replace such unsuitable material with select fill material for full width of trench, down to suitable material.

G. Preparation for Slabs-on-Grade and Equipment Support Pads:
1. Do not place floor slabs-on-grade including equipment support pads until all the following conditions are met:
a. Subgrade is acceptable in accordance with the Contract Documents.
b. Required fill material (where applicable) has been provided on subgrade in accordance with the Contract Documents.
c. Underground Facilities are installed and have successfully completed required field testing and inspections.
d. Contractor obtains Engineer's acceptance of required field quality control Submittals for subgrade and under-slab materials required by the Contract.

H. Freeze Protection:
1. Do not place foundations or fill material on frozen subgrade.
2. When freezing temperatures are expected, based on widely-recognized, reputable source for weather forecasts at or near the Site, do not excavate to full depth indicated, unless foundations or fill material can be placed immediately after excavation has been completed and is acceptable in accordance with the Contract Documents.
3. Protect from freezing excavation, subgrade, and fill materials when subsequent Work thereon is delayed.
4. Where concrete slab is a base slab-on-grade under and within building or structure that will not be heated, protect subgrade under slab from freezing until Substantial Completion.
5. Protect subgrade under foundations (supporting building or structure that will include environmental controls such as heating or air conditioning) from freezing until associated building structure is completed and heated to not less than 50 degrees F.

3.6 FILLING AND COMPACTING

A. Filling and Compacting - General:
1. Provide and compact all fill required for the finished grades as shown and as indicated in this Section.

B. Place fill as promptly as progress of the Work allows, but not until completing the following:
1. Obtaining Engineer's concurrence, after observation by Engineer or Resident Project Representative (if any) of construction below finish grade, including removal of formwork, removal of trash and debris from excavations, dampproofing, waterproofing, perimeter insulation, concrete finishing and related Work.
2. Successful completion of required field quality control activities for Work that will be covered or concealed by filling, including field quality control testing of buried piping, conduits that will convey fluid or gas, structures that will contain fluid or gas, and exfiltration testing (where performed or required) of manholes, chambers, vaults, and similar items. For manholes, chambers, and vaults, where infiltration testing or vacuum testing is performed or required, such testing may be performed following backfilling. Completion of proper documentation of as-constructed conditions and existing conditions (such as locations of Underground Facilities) in accordance with Section 01 78 39 - Project Record Documents.
3. Removal of temporary supports of excavations and, where applicable, filling voids in concrete where such voids resulted from temporary support of excavations.
4. Permanent or temporary horizontal bracing is in place on horizontally-supported walls.
5. Remove fill that includes organic materials or other unacceptable material and replace with fill material complying with the Contract Documents.

C. Placement - General:
   1. Place fill to the grades shown or indicated. Bring up evenly on all sides fill around buildings, structures, individual walls, piers, or columns, and Underground Facilities.
   2. Management of Moisture Content:
      a. Place fill materials at moisture content and density as indicated in this Article's requirements on compaction density. Prior to placing fill material, optimum moisture and maximum density properties for proposed material shall be obtained from Engineer, who may consult with geotechnical special inspector, if any, or geotechnical consultant, if any. Furnish and use construction equipment and machinery capable of adding measured amounts of water to fill materials to bring fill materials to a condition within required moisture content range. Control moisture for each lift necessary for required compaction.
      b. Furnish and use construction equipment and machinery capable of discing, aerating, and mixing fill materials to ensure reasonable uniformity of moisture content throughout fill materials, and to reduce moisture content of borrow materials by air drying, when necessary.
      c. When subgrade or fill materials requires moisture-conditioning before compaction, fill material shall be sufficiently mixed or worked on the subgrade to ensure uniform moisture content throughout the lift of material to be compacted.
      d. Materials at moisture content in excess of specified limit shall be dried by appropriate means, such as aeration or stockpiling for gravity drainage and air drying.
   3. Compaction:
      a. Compaction Equipment:
         1) Perform compaction with construction equipment and machinery suitable for the type of fill material placed. Unless otherwise required, compact cohesive soils using sheepsfoot compactor, and compact granular materials using pneumatic rollers, vibrators, or other construction equipment or machinery to obtain required density.
         2) Select and use equipment capable of providing the minimum density required in the Contract Documents.
         3) Use light compaction equipment and machinery, with equipment or machinery gross weight not exceeding 5,000 pounds within horizontal distance of 10 feet from the wall of completed, below-grade structures.
         4) Furnish and use construction equipment and machinery capable of compacting in restricted areas next to structures and around piping and Underground Facilities.
      b. Compaction Test Area:
         1) Effectiveness of construction equipment and machinery selected by Contractor for compacting, shall be tested at start of compacted fill Work by constructing a small section of fill within the area where fill will be placed.
         2) If tests on the test section of fill indicate that required compaction is not obtained, do one or more of the following: increase the quantity of coverages, decrease the lift thicknesses, or use different compactor equipment or machinery.
   4. Placement of Lifts and Compaction:
      a. Place fill materials in horizontal, loose lifts, not exceeding specified thickness prior to compacting.
      b. Place fill in manner ensuring uniform lift thickness after placing.
      c. Preparation of surfaces for placement of fill:
         1) Before commencing placing of fill, scarify underlying material to depth of twelve inches.
         2) Where ground surface is steeper than one vertical to four horizontal ("1V:4H"), plow surface to bench and break up surface so that fill material will bind with existing surface. For slopes steeper than 1V:4H and less than 1V:1.5H, bench shall be six feet wide. For slopes steeper than or equal to 1V:1.5H and less than 1V:0.5H, bench shall be four feet wide.

d. Mechanically compact each lift, by not less than two complete coverages of compactor. One coverage is defined as the conditions reached when all portions of the fill lift have been subjected to the direct contact of compactor's compacting surface.
e. Compaction of fill materials by inundation with water is unacceptable.

5. Restrictions:
   a. Do not place fill materials when standing water is present on surface of area where fill will be placed.
   b. Do not compact fill when standing water is present on the fill to be compacted.
   c. Do not place or compact fill in frozen condition or on top of frozen material.
   d. Fill containing organic or deleterious materials or other unacceptable material previously described shall be removed and replaced prior to compaction.
6. If required densities are not obtained because of improper control of placement or compaction procedures, or because of inadequate or improperly-functioning compaction equipment or machinery, perform all work necessary to provide required densities. Such work shall include, at no additional cost to Owner, complete removal of unacceptable fill areas and replacement and re-compaction until acceptable fill is provided.
7. Repair, at Contractor's cost, observed or measured settlement. Make repairs and replacements as necessary and required within 30 days after being so advised by Engineer, unless more-timely action is necessary to avoid or reduce the potential for safety hazards or damage to property.

D. Fill Against Concrete:
1. Structures shall be complete prior to backfilling, including foundations, walls, and slabs, including top slabs, unless shown or indicated otherwise in the Contract Documents.
2. Placing fill against concrete below finished grade is not allowed until concrete has attained its specified full design compressive strength in accordance with Section 03 31 30 - Concrete Materials and Proportioning, as determined by duration of concrete curing and testing of field-cured concrete cylinders. Requirements for strength and curing time are in the Specifications in Division 03 - Concrete.
3. Elevation of fill placed against concrete walls shall not differ by more than two feet on each side of walls, unless walls are adequately braced or all floor framing is in place up to and including grade level slabs.
4. Backfill structural foundation elements as soon as practicable, in accordance with this Section, after concrete has gained sufficient strength to avoid damage, to avoid ponding of surface water and accumulation of debris.
5. Where fill is placed against waterproofed surface, exercise care that waterproofing material is not damaged.

E. Fill Placed in Electrical Ductbank Trenches:
1. Provide suitable soil material for full depth of electrical ductbank trench, below and above electrical ductbank. Where one ductbank passes beneath another Underground Facility, provide select fill to the elevation of the bottom of upper ductbank or Underground Facility, as applicable.
2. Placing and compacting fill placed in electrical ductbank trenches shall comply with requirements of this Article's provision titled, "Fill Placed in Pipe Trenches".

F. Fill Placed in Pipe Trenches:
1. Piping Installed in Fills Above Pre-construction Grade:
   a. Prior to installing piping, place the fill in accordance with the Contract Documents until the fill reaches a minimum elevation two feet higher than the top of piping to be installed. Excavate the trench; install the piping and backfill. Subsequently provide the remainder of the fill required for the Work.
2. Piping trenches may be backfilled prior to testing of piping, unless nature of test requires observation of pipe or manholes, chambers, vaults, or similar items during testing. Do not construct building or structure over piping until piping has been successfully tested and passed.
3. Pipe Bedding: Pipe bedding material shall be as follows:

a. Unless otherwise shown or indicated, install buried piping on not less than six-inch layer of pipe bedding material underneath piping.
b. Pipe bedding material shall extend upward as shown on the drawings.
c. Pipe bedding material shall be spread and the surface graded to provide a uniform and continuous support beneath piping at all points between bell holes or pipe joints.
d. Install initial layer of pipe bedding material on prepared subgrade and compact as required. Provide appropriate divot in the bedding material to accommodate each pipe bell or joint. Install piping so that pipe barrel carries the weight of each pipe segment, rather than pipe bells or joints bearing the pipe's weight.
e. Slight disturbance of installed pipe bedding material surface during withdrawal of pipe slings or other lifting tackle is acceptable.
f. After each pipe's bedding material has been graded, and the piping has been aligned, joined in accordance with the Contract Documents, and placed in final position on bedding material, provide and compact sufficient pipe trench fill material under and around each side of pipe and back of bell or end thereof to hold piping in proper position and maintain alignment during subsequent pipe jointing and embedment operations.
g. Subsequent to forming pipe joint, place additional pipe bedding material, in required lifts, to required top elevation of pipe bedding material. Ensure bedding material is properly and fully placed under pipe "haunches" for proper support of piping. Compact lifts of pipe bedding material in accordance with this Article prior to placing subsequent backfill material.

4. Placing and Compacting Pipe Trench Fill: Unless otherwise shown, placing and compacting of pipe trench fill materials shall comply with the following:
a. Deposit and compact pipe trench fill material uniformly and simultaneously on each side of piping to prevent lateral displacement of piping.
b. Each layer of pipe trench fill material shall be compacted by not less than two complete coverages of all portions of surface of each lift using appropriate compaction equipment or machinery.
c. Method of compaction and compaction equipment and machinery used shall be appropriate for material to be compacted and shall not transmit damaging shocks to piping.

G. Installation of Flowable Fill, also known as Controlled Low Strength Material (CLSM):
1. Discharge flowable fill from ready-mix delivery vehicle into excavation, or other space to be backfilled with such material, via chutes, pumping, or hand-carried in buckets, in accordance with the Contract Documents (including the Specifications of Division 03 - Concrete) and requirements of flowable fill ready-mix Supplier.
2. Subgrade on which flowable fill is placed shall be free of disturbed or softened material and water.
3. Place flowable fill in lifts not greater than four feet depth.
4. Placing of each lift of flowable fill shall be a continuous operation, to the extent practicable.
5. Place flowable fill in manner that prevents flotation of piping or other damage to the Work, other Underground Facilities, and adjacent property.
6. Cold Weather Placing:
a. Do not place flowable fill on frozen subgrade.
b. Flowable fill batching, mixing, and placing may be performed when weather conditions are favorable, and ambient air temperature is 34 degrees F and rising.
c. At the time of placing, flowable fill must have a temperature of not less than 40 degrees F.
d. Discontinue placing flowable fill when ambient air temperature is 38 degrees F or less and falling.
7. After placing flowable fill, allow not less than 12 hours before placing subsequent lift or approved otherwise by Engineer.

8. Prevent contact with flowable fill by construction vehicles and equipment, or other traffic, for not less than 24 hours after placing, or until flowable fill is sufficiently hard to prevent rutting or other damage by vehicles and construction equipment.

H. Fill Required Under Subbase for Pavement and Other Traveled Ways:
   1. Where bottom of pavement or surfacing of other traveled way will be at elevation equal to or less than preconstruction ground surface, after required excavation and preparation of subgrade, provide required subbase material to required depth. At underside of pavement or other surfacing of traveled way, subbase material shall extend horizontally six inches beyond edges of pavement or other surfacing. Exterior edges of subbase material shall be placed and compacted at uniform slope of one foot vertical-to-one foot horizontal away from top edge of subbase down to subgrade.
   2. Where bottom of pavement or surfacing of other traveled way will be at elevation greater than preconstruction ground surface, after required preparation of subgrade, provide required fill material and subbase material to required depth. At underside of pavement or other surfacing of traveled way, subbase material shall extend horizontally six inches beyond edges of pavement or other surfacing. Exterior edges of subbase material and fill material shall be placed and compacted at uniform slope of one foot vertical-to-one foot horizontal away from top edge of subbase down to subgrade.

I. Temporary Pavement:
   1. Provide not less than 1.5 inches of temporary bituminous pavement immediately after filling excavations in paved roads and other pavement subject to vehicular traffic, where such pavement will remain permanently.
   2. Maintain surface of paved area over the fill in good and safe condition during progress of the Work, and promptly fill depressions over and adjacent to the fill area caused by settlement of fill.
   3. Permanent replacement pavement shall be equal to that of the existing roadways, unless otherwise shown or specified.

J. Compaction Density Requirements:

   1. Compaction Density and Moisture Requirements Based on Fill Materials:

FILL MATERIAL	COMPACTION DENSITY	MOISTURE CONTENT
Sandy Clay (CL) and Clayey Sand (SC)	95% per ASTM D698	0 to +4% of optimum
Fat Clay (CH)	95% per ASTM D698	-1 to +4% of optimum
Select Fill	95% per ASTM D698	-1 to +3% of optimum
Subbase Material	98% per Tex-113-E	-2 to +2% of optimum
Flexible Base	98% per Tex-113-E	-2 to +2% of optimum

   2. Fill Lift Thickness:
      a. Unless expressly shown or indicated otherwise, place fill in trenches, below piping, below foundations, or under paved areas in horizontal uncompacted layers not exceeding nine inches deep, and thoroughly compact each before next layer is placed.
      b. In pipe trenches, above elevation of bottom of pipe, horizontal uncompacted layers shall be six inches deep.
   3. Fill Moisture Content: Fill shall be wetted and thoroughly mixed to achieve moisture content to within the required range indicated in the table above.
   4. Replace natural, undisturbed soils or compacted soil subsequently disturbed or removed by construction operations with materials compacted as indicated.
   5. Field quality control testing for density; to verify that specified density was obtained, will be performed during each day of compaction Work. Responsibility for field quality control testing is indicated in this Section's "Field Quality Control" Article.

6. When field quality control testing indicates unsatisfactory compaction, provide additional compaction necessary to obtain the required compaction. Perform additional compaction Work at no additional cost to Owner until required compaction is achieved. Such work includes complete removal of unacceptable (as determined by Engineer) fill areas and replacement and re-compaction until acceptable fill is provided in accordance with the Contract Documents.

K. Replacement of Unacceptable Excavated Materials:
   1. In cases where over-excavation to replace unacceptable soil materials is required, backfill the excavation to required subgrade with soil structural fill material and thoroughly compact in accordance with applicable table in this provision. Slope the sides of excavation in accordance with the maximum allowable inclinations specified for each structure location.

3.7 UNAUTHORIZED EXCAVATION

A. Unauthorized Excavation – General:
   1. Excavations outside lines and grades shown or indicated and that are not approved by Engineer (including excavations below required subgrade elevation, unless Engineer directs removal of unsuitable subgrade material), together with removing and disposing of the associated material, shall be at Contractor's cost and risk.
   2. Fill unauthorized excavations with properly-compacted soil structural fill material at Contractor's cost.

3.8 PAVEMENT SUBBASE COURSE

A. Pavement Subbase - General:
   1. Place subbase material, in layers of specified thickness, over subgrade to support pavement base course.
   2. Prepare subgrade underlying subbase course in accordance with this Section's general requirements for subgrades.

B. Grade Control:
   1. During construction, maintain lines and grades including crown and cross-slope of subbase course.

C. Placing of Pavement Subbase Course:
   1. Provide subbase material where required to the limits shown or indicated.
   2. Place subbase course material on prepared subgrade in layers of uniform thickness, in accordance with indicated cross-section and thickness. If the Contract Documents do not show or indicate required section of replacement paving (if any), replacement subbase course shall be of thickness equal to existing subbase course.
   3. Maintain optimum moisture content for compacting subbase material during placing operations.
   4. After completing compaction, other than that necessary for bringing material for the next course, do not haul or drive over compacted subbase.
   5. To prevent softening of subgrade, do not install pavement subbase in excess of 500 feet in length without compacting.
   6. If subgrade material becomes churned up into or mixed with subbase material, remove the mixed material and replace with clean, compacted subbase material.

3.9 GRADING

A. Grading - General:
   1. Uniformly grade areas within limits of grading under this Section, including adjacent transition areas.
   2. Smooth subgrade surfaces within specified tolerances, compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades.

B. Grading Outside Building Lines:

1. Grade areas adjacent to building lines to drain away from buildings and structures.
2. Grade to prevent ponding of water. Provide grades and slopes as shown on the Drawings and to allow effective drainage to proper drainage routes, such as catch basins, ditches or swales intended to convey storm water, and other storm water drainage routes. Where intended grade for effective drainage is unclear, promptly submit to Engineer request for interpretation and obtain Engineer's interpretation or clarification before proceeding,
3. Provide final surfaces free of irregular surface changes, in accordance with the following:
   a. Grassed Areas and Areas Covered with Gravel, Stone, Wood Chips, or Other Special Cover: Finish areas to receive topsoil or special cover to within not more than one inch above or below required subgrade elevations. Requirements for topsoil and finish grading are in Section 31 22 19 - Finish Grading.
   b. Sidewalks: Shape surface of areas under sidewalks to line, grade, and cross section, with finish surface not more than one inch above or below required subgrade elevation.
   c. Pavement (including hard-surfaced pavement and areas with stone surfacing): Shape surface of areas under pavement to line, grade, and cross section, with finish surface not more than 0.5-inch above or below required subgrade elevation.

C. Grading Surface of Fill Under Concrete Slabs-on-Grade and Concrete Mats:
   1. Grade smooth and even, free of voids, compacted as specified, and to required elevation.
   2. Provide final grades within tolerance of 0.5-inch when tested with a ten-foot straight edge.

3.10 DISPOSAL OF EXCAVATED SPOIL MATERIALS

A. Spoil Disposal - General:
   1. Contractor shall haul away excavated material that does not comply with requirements for fill, or is in excess of quantity required for fill.
   2. Disposal of materials shall comply with Laws and Regulations, at no additional cost to Owner.

3.11 FIELD QUALITY CONTROL

A. Site Tests and Inspections:
   1. Comply with Section 01 45 33 - Code-Required Special Inspections and Procedures.
   2. Testing Laboratory:
      a. Owner will employ a testing laboratory to perform field quality control testing.
      b. Testing Laboratory Scope:
         1) Perform field moisture content tests (in accordance with ASTM D2216 or ASTM D6938) and density tests (in accordance with ASTM D1556 or ASTM D6938) to verify that required compaction of fill materials was provided.
         2) Furnish to Engineer and Contractor written results of each test.
      c. Authority and Duties of Testing Laboratory:
         1) Testing laboratory representatives ("technician") shall inspect the materials in the field, perform testing, and report findings to Engineer and Contractor. When the Work is defective, technician will direct attention of Engineer and Contractor to such defective Work.
         2) Technician will not supervise performance of any of Contractor's Work. Technician shall not perform other duties for Contractor.
         3) Work will be tested and inspected by testing laboratory as the Work progresses, but failure to detect defective Work (including defective materials) shall not, in any way, prevent later rejection when defect is discovered, nor shall it obligate Engineer for Substantial Completion or final acceptance. Technicians are not authorized to revoke, alter, relax, enlarge, or release requirements of the Contract Documents, or to approve or accept any portion of the Work.
   3. Responsibilities and Duties of Contractor:
      a. Use of testing laboratory in no way relieves Contractor of responsibility to provide Work in compliance with the Contract Documents.
      b. When Owner furnishes services of testing laboratory, special inspector, consultant, or any combination thereof, for excavation and fill Work, Owner and Engineer do not

represent that the sampling and testing performed by Owner-hired testing laboratory or inspections by Owner-hired special inspectors or consultants, is sufficient for Contractor's purposes, or to monitor all aspects of the excavation and fill Work. If additional quality control is needed to verify that the Work performed and materials delivered to the Site are in accordance with the Contract Documents, Contractor may retain its own, independent testing laboratory to perform additional sampling and testing for Contractor's purposes.

c. To facilitate testing laboratory, special inspectors, and consultants, Contractor shall advise testing laboratory, special inspectors, and consultants not less than two days in advance of filling operations to allow for completion of field quality control testing and for assignment of personnel.

d. Contractor shall be responsible for providing required compaction for fill and other earthwork. Contractor shall control construction operations by performing confirming tests to verify that Contractor has complied with the Contract Documents relative to compaction and moisture content.

e. Contractor shall demonstrate adequacy of compaction equipment and procedures before exceeding one or more of the following quantities of earthwork. Each test location shall include tests for each layer, type, or class of fill to finish grade.
   1) 200 linear feet of trench fill on each compacted lift.
   2) 10 cubic yards of flexible base, select fill, or structural fill.
   3) 100 cubic yards of suitable soil material.
   4) 50 cubic yards of subbase material.

4. Testing laboratory will inspect and indicate acceptable subgrades and fill layers before construction work is performed thereon. Testing of subgrades and fill layers shall be as follows:
   a. Trenches for Structures, and Underground Facilities (including buried ductbanks):
      1) In Open Fields: Two locations every 1,000 linear feet.
      2) Along Dirt or Gravel Roads or Off Traveled Right-of-Way: Two locations every 500 linear feet.
      3) Crossing Paved Roads: Two locations along each crossing.
      4) Under Pavement Cuts or Within Two Feet of Pavement Edges: One location every 400 linear feet.
   b. Footing Subgrade: For each stratum of soil on which footings will be placed, perform not less than one test to verify required design bearing capacities. Subsequent verification and approval of each footing subgrade may be based on a visual comparison of each subgrade with related tested strata, when acceptable to Engineer.
   c. For flex base and select fill: Once per lift for each 1,000 square feet placed and compacted.
   d. For structural fill:
      1) On 30-foot intervals on all sides of the building or structure for every compacted lift, but not less than one per lift on each side of the building or structure for buildings or structures less than 60 feet long on a side.
      2) For material not used as fill against buildings or structures, once per lift for each 1,000 square feet placed and compacted.
   e. For Suitable Soil Material: One per 1,000 square feet on every compacted lift.
   f. Subbase Material: One per 1,000 square feet on every compacted lift.
5. Periodic compliance tests will be made by Engineer to verify that compaction is in accordance with the Contract Documents, at no cost to Contractor. Contractor shall remove overburden above the level at which Engineer wishes to test and shall fill and re-compact the material after testing is complete.

B. Defective Work:
   1. If testing laboratory reports or inspections indicate subgrade, fill, or bedding compaction less than specified density, Contractor shall remove unacceptable materials as necessary and replace with specified materials and provide additional compaction at Contractor's cost until subgrades, bedding, and fill are acceptable.

2. Costs for retesting of subgrade, fill, or bedding materials that did not originally comply with the Contract Documents, including required density, shall be paid by Contractor.

3.12 RESTORATION

A. Restoration - General:
   1. Perform finish grading, including providing topsoil, in accordance with Section 31 22 19 - Finish Grading.
   2. Provide replacement paving, sidewalks, curbs, gutters, and similar items in accordance with the Contract Documents including the Specifications of Division 32 - Exterior Improvements.
   3. Restore landscaping including lawn and meadow areas, in accordance with the Contract Documents including the Specifications of Division 32 - Exterior Improvements.

END OF SECTION

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SECTION 31 23 16.43
TEMPORARY SUPPORT OF EXCAVATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Requirements for temporary (during construction) support of excavations including:
      a. Qualifications of Contractor's professional engineer (if any) retained for designing temporary support of excavations.
      b. Contractor's additional investigations and evaluations necessary for designing temporary support of excavations.
      c. Performance criteria and general provisions for temporary support of excavations.
      d. General provisions for temporary support of excavations, including supports Contractor proposes remain in place following construction.
      e. Trench boxes.
      f. Maintenance and removal of temporary support of excavations.

B. Related Requirements: Include, but are not necessarily limited to:
   1. Section 31 23 05 - Excavation and Fill.

1.2 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment:
   1. Temporary support of excavations is part of the Work associated with excavating and filling. Include costs for temporary support of excavations under bid/pay items for excavating and related Work. No separate payment will be made for temporary support of excavations.
   2. In the event Engineer directs that temporary sheeting, shoring, or other excavation supports originally intended as temporary are to remain in place, and the Contract includes an appropriate item of Unit Price Work for permanent sheeting (or other appropriate material) to remain in place, then payment for such temporary sheeting ordered to remain by Engineer will be at the unit price indicated in the Contract. Where Engineer directs temporary sheeting, shoring, or other temporary support of excavations is to remain and the Contract does not include an appropriate item of Unit Price Work, then an appropriate price for such support of excavations will be mutually agreed upon by the parties and either an appropriate Contract modification or allowance authorization, if any, will be issued in accordance with the Contract Documents.

1.3 REFERENCES

A. Terminology:
   1. Terminology indicated below are not defined terms and are not indicated with initial capital letters, but when used in this section have the meaning indicated below:
      a. "Sheeting" means: Long, structural sections of steel with a vertical interlocking system that create a continuous wall, often used for retaining soil or water. The terms "sheet piling", "sheeting", and "piling" (and derivative terms, such as "piles") have the same meaning. Certain types of soldier piles may qualify as sheeting.
      b. "Shoring" means: Temporary means of supporting the walls of an excavation or existing structure, that does not qualify as sheeting. Two basic types of shoring for excavations are timber shoring and aluminum hydraulic shoring; the latter is a lightweight system and equipment used for supporting trench excavations.
      c. "Subgrade" means: The uppermost surface of native soil material unmoved from cuts; the bottom of excavation.
      d. "Tie-backs" means: A method of laterally supporting sheeting or shoring when congestion within the limits of the excavation need to be minimized. Tiebacks generally

consist of a central steel bar (or strand tendon), embedded in the soil, surrounded by an annulus of grout.

e. "Trench box" means: A one- or two-sided shield, placed temporarily in an excavation, typically a trench, which protects workers inside the trench box in the event of collapse of the excavation wall. Trench boxes may be relocated within the excavation as the Work progresses. Trench boxes also shield workers from falling or dislodged materials. Trench boxes are not intended to shore up excavation walls or prevent collapse. The terms "trench box", "trench shield", and "shore shield" have the same meaning.

f. "Wales" means: Beams that span across the face of sheeting or shoring distributing the earth and water pressures to either a raker or cross-strut. Struts, as used in this Section, are structural elements that transfer the load from a temporary excavation support wall to an adjacent, parallel structure. Rakers are struts that are positioned at an angle extending from a temporary excavation support wall to a foundation block or supporting substructure. In this Section, the words "wales" and "walers" have the same meaning.

B. Reference Standards: Standards referenced in this section include, but are not necessarily limited to, the following:
   1. American Institute of Steel Construction (AISC):
      a. ANSI/AISC 360 - Specification for Structural Steel Buildings.
   2. American Welding Society (AWS):
      a. D1.1/D1.1M - Structural Welding Code – Steel.
   3. United States Army Corps of Engineers (USACOE)
      a. Engineer Manual 1110-2-2504 - Design of Sheet Pile Walls.
   4. United States Department of Transportation, Federal Highway Administration (FHWA)
      a. FHWA-IF-99-015 Geotechnical Engineering Circular No . 4 - Ground Anchors and Anchored Systems.

1.4 QUALITY ASSURANCE

A. Qualifications:
   1. Contractor's Professional Engineer:
      a. Where necessary for performing the Work in accordance with this Section and when required by Laws or Regulations governing the practice of the associated design discipline or Laws or Regulations governing excavation safety and trench safety in construction, retain the services of a professional engineer, licensed and registered in the same jurisdiction as the Site, to evaluate subsurface conditions and design systems for temporary support of excavations.
      b. Professional engineer shall be appropriately licensed and registered for the professional services required by this Section and shall be appropriately experienced in evaluating subsurface conditions and excavation conditions affecting health and safety of personnel and protection of property similar to those at the Site, and in designing and evaluating systems for temporary support of excavations.
      c. Responsibilities shall include:
         1) Evaluating existing subsurface data and information for the Site and adjacent areas, available to Contractor.
         2) Advising Contractor regarding additional subsurface investigations necessary to provide temporary support of excavations as required by this Section.
         3) Evaluating the potential effect on existing facilities, at and adjacent to the Site, of installing and removing temporary systems for supporting excavations.
         4) Personally designing or supervising the design of temporary supports for excavations, including preparing drawings, performance requirements, and specifications for temporary support of excavations, such as temporary sheeting, shoring, bracing, wales, tie-backs, and similar systems.

5) Sealing and signing instruments of service developed for the Work, including calculations, evaluation reports, recommendations of a technical nature, drawings, specifications, and similar documents.
6) Assisting Contractor with obtaining permits and approvals necessary for temporary support of excavations.
7) Consulting with Contractor, including visiting the Site during construction as required by Contractor, during installation, use, and removal of temporary supports of excavations.

1.5 SUBMITTALS

A. Informational Submittals: Submit the following:
1. Advisory on Approach for Temporary Support of Excavations:
a. Furnish document regarding Contractor's proposed approach for temporary support of excavations, indicating the following:
1) General indication of Contractor's overall, intended approach for temporary support of excavations; for example, indicate whether excavations will be supported by a trench box, temporary sheeting, shoring, wales, tie-backs, or other method. Indicate where different approach will be used for different excavations or portions of excavations.
2) Indication of whether Contractor or Subcontractor intends to retain services of a professional engineer relative to temporary support of excavations. When such individual or entity will be so retained, indicate name of entity and specific, individual design professional-in-responsible-charge, together with indication of type of license and registration and associated license and registration number and jurisdiction. If not previously furnished with Contractor's insurance documentation, furnish evidence that such professional engineer possesses professional liability insurance in accordance with the Contract Documents, including indication of whether required coverage limits have been eroded during the current policy by prior claims.
3) Contractor-proposed modifications to the permanent Work requested to accommodate temporary support of excavations. In the event such changes are proposed, approval, if any, of such changes will be only via an appropriate Contract modification. If no such request is submitted prior to start of the Work of this Section, Engineer will proceed on the premise that Contractor-proposed modifications are not intended.
4) Where temporary steel sheeting will be used for temporary support of excavations, indicate anticipated dates for installing such items and anticipated dates for removing such items.
5) Description of how temporary support of excavations and operations will, or may, affect Owner, facility manager (if other than Owner), and other property owners and occupants.
6) Indication of locations, if any, where temporary support of excavations are proposed to remain in place following construction and backfilling, and extent of Contractor's proposed modifications or partial removals of such systems.
7) Indicate Project-specific sequence of installation and removal of temporary supports of excavations, including: installation and removal of wales, struts, and other supports; and locations and approximate elevations of interim (partial) backfilling against foundations, when interim (partial) backfilling is proposed.
8) Where applicable, indicate intended monitoring including monitoring of deflection of permanent construction and settlement outside of excavations.
b. Engineer's (or Owner's) review, comments upon, acceptance, or other appropriate action on such Submittal does not, in any way, reduce or mitigate Contractor's sole responsibility for construction means, methods, techniques, procedures, sequences, and associated safety and protection measures.

c. Do not include in such Submittal: calculations, evaluation reports, recommendations, drawings, or specifications developed, sealed, and signed by Contractor or Subcontractor or by professional engineer retained by Contractor or Subcontractor. However, in the event of alleged or potential effect of temporary support of excavations on facilities or property, or in the event of disagreement between the parties concerning allegedly differing subsurface or physical conditions, promptly furnish such documents to Engineer and Owner upon request. Should such request be received by Contractor, furnishing such documents to Engineer and Owner will not, in any way, reduce or mitigate Contractor's sole responsibility for construction means, methods, techniques, procedures, sequences, or associated safety and protection measures.

1.6 FIELD CONDITIONS

A. Existing Conditions:
   1. Refer to Section 31 23 05 - Excavation and Fill.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Description:
   1. Provide temporary support of excavations comprised of materials and systems suitable for the intended purpose, excavation depth, subsurface conditions, other environmental factors, installation and removal methods, and duration of use.
   2. Contractor shall determine necessary elements for temporary support of excavations for compliance with Laws and Regulations and the Contract Documents, while considering subsurface conditions, construction means, methods, techniques, procedures, and sequences, and associated safety and protection measures.
   3. Previously-used materials, where used for temporary support of excavations, shall be in good condition and be neither damaged nor excessively pitted.
   4. Steel materials and fabrications for temporary support of excavations shall be in accordance with ANSI/AISC 360 and welding shall be in accordance with AWS D1.1/D1.1M.
   5. Steel sheeting that Contractor proposes remain in place following construction shall consist of rolled sections of continuous interlocking type. Type and design of the sheeting and bracing shall comply with this Article's requirements, above, for steel work for all temporary support of excavations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification, Evaluation, and Assessment of Existing Conditions:
   1. Evaluate information and data available to Contractor regarding subsurface and physical conditions at the Site and adjacent areas relative to temporary support of excavations. Perform additional investigations as necessary to enable Contractor to provide appropriate temporary support of excavations required to comply with Laws and Regulations and the Contract Documents.
   2. Such investigations and evaluations by Contractor may include excavating (and subsequently backfilling), test pits to visually observe subsurface conditions and groundwater, test borings, sampling, and laboratory analyses. Obtain and record data and perform evaluations necessary for Contractor to provide temporary support of excavations as required.
   3. As the Work progresses, evaluate performance of temporary support of excavations as necessary and modify temporary support of excavations as appropriate to comply with Laws and Regulations and the Contract Documents.

B. Installing the Work constitutes Contractor's approval of field conditions prevailing at the time of the Work and materials and design of temporary support of excavations used by Contractor.

3.2 GENERAL PROVISIONS FOR TEMPORARY SUPPORT OF EXCAVATIONS

A. Excavations in stable rock may be made with vertical sides without temporary support of the excavation. Under all other conditions, excavations shall be sloped and benched as appropriate for the subsurface conditions or provided with temporary support of excavations.

B. Temporary Support of Excavations - General:
   1. Provide temporary sheeting, shoring, wales, tie-backs, trench boxes, cofferdams, and other excavation supports as necessary and required for the Work, in accordance with Laws and Regulations and the Contract Documents.
   2. Clearances and types of temporary sheeting, shoring, wales, tie-backs, and other excavation supports, insofar as they may affect the finished character of the Work and the design of sheeting to be left in place, will be subject to Engineer's approval; but Contractor is solely responsible for adequacy of all temporary sheeting, shoring, wales, tie-backs, cofferdams, and other excavation supports, Contractor proposes remain in place following construction.
   3. Performance and Design: Design and provide temporary supports of excavations and excavation supports Contractor proposes to remain in place in conformance with USACOE Engineer Manual 1110-2-2504 and FHWA-IF-99-015 Geotechnical Engineering Circular No. 4, unless more-stringent requirements are expressly indicated in the Contract Documents or by Laws or Regulations.
   4. Installation:
      a. Steel work for temporary support of excavations shall be in accordance with ANSI/AISC 360 and AWS D1.1/D1.1M.
   5. As excavation progresses, carry down temporary supports of excavation to required elevation at or below subgrade.

C. Sheeting Left in Place:
   1. Temporary Excavation Supports Contractor Proposes to Remain in Place Following Construction:
      a. Installation:
         1) Steel sheeting proposed by Contractor to remain in place shall be driven straight to lines and grades as shown, indicated, or directed. Sheeting shall penetrate into firm materials below subgrade with secure interlocking throughout pile's entire length. Remove sheeting that is damaged or that has defective alignment and replace with acceptable sheeting.
         2) Type of guide structure used and method of driving steel sheeting to remain in-place shall be determined by Contractor's professional engineer. Line jetting is unacceptable.
      b. Cut off at elevation directed by Engineer, sheeting proposed by Contractor to remain in place and remove cut off pilings from the Site for proper disposal. When cut-off elevation is not otherwise directed by Engineer, remove tops of sheeting down to three feet below finished grade.
      c. Clean wales, braces, and all other items to be embedded in the permanent structure and ensure that concrete surrounding the embedded element is sound and free of air pockets and harmful inclusions. Provisions shall include the cutting of holes in the webs and flanges of wales and bracing members, and welding of steel diaphragm waterstops perpendicular to the centerline of brace-ends that are to be embedded. Wales or bracing proposed to be left in place shall be coordinated and require Engineer's express, written approval.
      d. Subsequent to removing the inside face forms, and when removal of bracing is allowed, cut back steel not less than two inches inside the wall face, coat with a corrosion inhibitor (in accordance with Specifications of Division 03 - Concrete), and patch opening with concrete patch mortar in accordance with Section 03 35 00 - Concrete Finishing and Repair of Surface Defects. Comply with details on the Drawings.

Concrete shall be thoroughly worked beneath wales and braces, around stiffeners, and at other place where voids may be formed.

e. Portions of sheeting or soldier piles and breast boards that are in contact with structure foundations concrete shall be left in place, together with wales and bracing members that are cast into foundation or superstructure concrete.

3.3 TRENCH BOXES

A. Installing and Using Trench Boxes:
   1. Excavation of unclassified and other materials below bottom of trench box shall not exceed limits established in Laws and Regulations.
   2. When using trench box for installing piping:
      a. Portions of trench box extending below the mid-diameter of an installed, rigid pipe, such as prestressed concrete pipe and other types of rigid pipe, shall be raised above the pipe's mid-diameter elevation prior to relocating the trench box within the excavation for further construction.
      b. Bottom of trench box shall not at any time extend below mid-diameter of installed pipe that is flexible or has flexing capability, such as steel, ductile iron, PVC, CPVC, polyethylene, and other pipe that has flexing capability.
   3. When using trench box for installing structures, bottom of trench box shall not extend below elevation of top of granular base material of structure.

B. Removal or Relocation of Trench Boxes:
   1. When removing trench box or relocating trench box within the excavation, exercise extreme care to prevent moving piping, structures, and other Underground Facilities, and prevent disturbance of bedding material for piping, structures, and other Underground Facilities.
   2. When piping, structures, or other Underground Facilities are disturbed, remove and reinstall the disturbed items in accordance with the Contract Documents.

3.4 MAINTENANCE AND REMOVAL OF TEMPORARY SUPPORT OF EXCAVATIONS

A. Maintenance of Temporary Support for Excavations:
   1. During construction, maintain temporary support of excavations as long as necessary until removal or Engineer's concurrence that such temporary support of excavations may remain in place following construction.
   2. As necessary, promptly remedy deficiencies in temporary support of excavations.

B. Removal of Temporary Support of Excavations:
   1. When temporary support of excavations are no longer necessary, remove from the Site all elements of temporary systems supporting excavations unless Owner (through Engineer) approves temporary support of excavations, or part thereof, continuing existence at the Site after final payment.
   2. Perform such removal in manner not injurious to buildings, structures, Underground Facilities, and other facilities, their appearance, and adjacent construction.
   3. Removal of Temporary Sheeting and Bracing:
      a. Remove from excavations sheeting, shoring, wales, and other elements of temporary supports, unless otherwise directed by Engineer in writing. Perform removal to avoid damaging the Work and adjacent construction. Removal shall be equal on both sides of excavation to ensure no unequal loads on buildings, structures, Underground Facilities, and other facilities.
      b. Defer removal of sheeting, shoring, wales, and other elements, where removal may cause soil to come into contact with concrete, until the following conditions are satisfied:
         1) Concrete has cured for not less than seven days and reached full design strength as indicated in the Contract Documents.
         2) Wall and floor framing, up to and including grade level floors, is in place.

c. When temporary support of excavations is allowed to remain in-place following construction, accurately record locations on the record drawings, in accordance with Section 01 78 39 - Project Record Documents.

4. Requirements for removing and relocating trench boxes are indicated in the "Trench Boxes" Article of this Section.
5. Restore disturbed areas in accordance with the Contract Documents. Where the Contract Documents do not indicate requirements for restoration, restore such areas in accordance with Section 01 71 33 - Protection of the Work and Property.

END OF SECTION

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SECTION 31 23 19
DEWATERING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Requirements for temporary (during construction) dewatering of excavations including:
      a. Qualifications of Contractor's design professional retained for designing temporary dewatering systems.
      b. Contractor's additional investigations and evaluations necessary for designing temporary dewatering systems.
      c. Performance criteria and general provisions for temporary dewatering systems.
      d. Disposal of water discharged from temporary dewatering systems.
      e. Operation, maintenance, and removal of temporary dewatering systems.

B. Related Requirements: Include, but are not necessarily limited to:
   1. Section 31 23 05 - Excavation and Fill.

1.2 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment:
   1. Dewatering of excavations is part of the Work associated with excavating and temporary control of water and water pollution. Include costs for dewatering of excavations under bid/pay items for excavating and related Work. No separate payment will be made for dewatering of excavations or temporary control of water and water pollution.

1.3 REFERENCES

A. Terminology:
   1. Terminology indicated below are not defined terms and are not indicated with initial capital letters, but when used in this section have the meaning indicated below:
      a. "Dewatering" means: Lowering of groundwater surface elevation and intercepting horizontal water seepage to prevent groundwater from entering excavations; removal of water accumulated within excavations; and conveyance of groundwater and water removed from excavations to proper discharge location.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Comply with Section 01 41 26 - Stormwater Pollution Prevention Plan and Permit.
   2. Comply with Section 01 57 05 - Temporary Controls, regarding permits and approvals of authorities having jurisdiction necessary for disposal of groundwater and water removed from excavations, and temporary erosion and sediment controls.
   3. When Contractor intends to use temporary pumps equipped with gasoline- or diesel-fueled engines, obtain and comply with necessary permits and Laws and Regulations, and comply with Section 01 57 05 - Temporary Controls, regarding exhaust emissions, air pollution controls, and noise controls.

B. Qualifications:
   1. Professional Engineer or Other Appropriate Design Professional:
      a. Where necessary for performing the Work in accordance with this Section and when required by Laws or Regulations governing the practice of the associated design discipline, retain the services of professional engineer or other appropriate design professional, licensed and registered in the same jurisdiction as the Site, to evaluate groundwater conditions and design temporary systems and equipment for temporary dewatering of excavations.

b. Professional engineer or other appropriate design professional, as applicable, shall be appropriately licensed and registered for the professional services required by this Section, and shall be appropriately experienced in evaluating groundwater conditions and conductivity in subsurface conditions similar to those at the Site, and in designing and evaluating temporary dewatering systems of the type necessary for the Work.

c. Responsibilities shall include:
   1) Evaluating existing subsurface data and information for the Site and adjacent areas, available to the Contractor.
   2) Advising Contractor regarding additional subsurface investigations necessary to provide temporary dewatering systems that will result in dewatering of excavations as required by this Section.
   3) Evaluating the potential effect of temporary dewatering system operation on existing facilities at and adjacent to the Site.
   4) Personally designing or supervising the design of temporary dewatering systems necessary for the Work, including preparing drawings, performance requirements, and specifications for temporary dewatering systems such as wells, pumps, and related systems.
   5) Sealing and signing instruments of service developed for the Work, including calculations, evaluation reports, recommendations of a technical nature, drawings, specifications, and similar documents.
   6) Assisting Contractor with obtaining permits and approvals necessary for temporary dewatering systems.
   7) Consulting with Contractor, including visiting the Site during construction as required by Contractor, during installation, operation, and removal of temporary dewatering systems.

1.5 SUBMITTALS

A. Informational Submittals: Submit the following:
   1. Advisory on Dewatering Approach:
      a. Furnish document regarding Contractor's proposed approach for temporary dewatering of excavations, indicating the following:
         1) General indication of Contractor's overall, intended approach for temporary dewatering of excavations; for example, indicate whether a system of temporary wells and pumps will be provided by Contractor, whether Contractor intends or proposes using existing wells and pumps for temporary dewatering of excavations, whether temporary dewatering will be accomplished only via temporary pumps placed in or adjacent to excavations, other approaches, or a combination thereof.
         2) Indication of whether Contractor or Subcontractor intends to retain services of a professional engineer or other appropriate design professional relative to temporary dewatering systems. When such individual or entity will be so retained, indicate name of entity and specific, individual design professional-in-responsible-charge, together with indication of type of license and registration and associated license and registration number and jurisdiction. If not previously furnished with Contractor's insurance documentation, furnish evidence that such professional engineer or other appropriate design professional (as applicable) possesses professional liability insurance in accordance with the Contract Documents, including indication of whether required coverage limits have been eroded during the current policy by prior claims.
         3) Contractor-proposed modifications to the permanent Work requested to accommodate temporary dewatering systems. In the event such changes are proposed, approval, if any, of such changes will be only via an appropriate Contract modification. If no such changes or modifications are requested prior to start of the Work of this Section, Engineer will proceed on the premise that Contractor-proposed modifications are not intended.

4) When existing facilities, such as existing wells and pumps are proposed for use by Contractor, clearly indicate the specific facilities, expected start and end dates of use, anticipated level or extent of use (such as percentage of available pumping capacity), and proposed responsibility for operating and maintenance labor, parts, and costs during such use.
5) Propose locations for discharges from temporary dewatering systems, together with indication of typical anticipated rate of discharge. Also indicate intended approximate locations of aboveground conveyance piping and how Contractor will mitigate effect on Owner, facility manager, and other property owners and occupants where such piping would restrict use or access to existing facilities or property.
6) Anticipated start and end dates for temporary dewatering operations.
7) Description of how temporary dewatering systems and operations will, or may, affect Owner, facility manager (if other than Owner), and other property owners and occupants.
8) Indication of Contractor's proposed actions regarding temporary dewatering systems after temporary dewatering operations cease; for example, when temporary wells and pumps are provided by Contractor, indicate whether such items will remain in place and, if so, how they will be prepared for abandonment by Contractor.

b. Engineer's (or Owner's) review, comments upon, acceptance, or other appropriate action on such Submittal does not, in any way, reduce or mitigate Contractor's sole responsibility for construction means, methods, techniques, procedures, sequences, and associated safety and protection measures.
c. Do not include in such Submittal: calculations, evaluation reports, recommendations, drawings, or specifications developed, sealed, and signed by Contractor or Subcontractor or by professional engineer or other appropriate design professional retained by Contractor or Subcontractor. However, in the event of alleged or potential effect of temporary dewatering systems on facilities or property, or in the event of disagreement between the parties concerning allegedly differing subsurface or physical conditions, promptly furnish such documents to Engineer and Owner upon request. Should such request be received by Contractor, furnishing such documents to Engineer and Owner will not, in any way, reduce or mitigate Contractor's sole responsibility for construction means, methods, techniques, procedures, sequences, or associated safety and protection measures.

1.6 FIELD CONDITIONS

A. Existing Conditions:
1. Refer to Section 31 23 05 - Excavation and Fill.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT FOR TEMPORARY DEWATERING SYSTEMS

A. Description:
1. Provide temporary dewatering systems comprised of materials and equipment suitable for the intended purpose, service environment (including subsurface and groundwater conditions), and duration of use.
2. Contractor shall determine required capacities for elements of temporary dewatering systems necessary for compliance with requirements of this Section and other relevant provisions of the Contract Documents.
3. Provide temporary dewatering system materials and equipment in accordance with Laws and Regulations and generally accepted practices in the industry for temporary systems for dewatering of excavations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification, Evaluation, and Assessment of Existing Conditions:
   1. Evaluate information and data available to Contractor regarding subsurface and physical conditions at the Site and adjacent areas relative to groundwater and temporary dewatering systems. Perform additional investigations as necessary to enable Contractor to provide appropriate temporary dewatering systems required to comply with this Section.
   2. Such investigations and evaluations by Contractor may include excavating (and subsequently backfilling), test pits to visually observe subsurface conditions and groundwater, test borings, sampling and laboratory analyses, providing monitoring wells and obtaining measurements of groundwater surface elevations, performing drawdown tests using existing wells and pumping equipment, and determining capacities and operating characteristics of existing wells, pumping equipment, and related systems. Obtain and record data and perform evaluations necessary for Contractor to provide temporary dewatering systems as required.
   3. Where applicable, Contractor should perform monitoring of adjacent structures for movements. Monitoring requirements should be included in dewatering submittal or as separate document.
   4. As the Work progresses, evaluate performance of temporary dewatering systems as necessary and modify temporary dewatering systems as appropriate to comply with this Section and other provisions of the Contract Documents.

B. Installing the Work constitutes Contractor's approval of field conditions prevailing at the time of the Work and condition and operability of existing materials, equipment, and systems (if any) used by Contractor for temporary dewatering.

3.2 TEMPORARY DEWATERING DURING CONSTRUCTION

A. Performance Criteria:
   1. Provide and maintain adequate drainage and dewatering equipment to remove and dispose of all surface water and ground water entering excavations, or other parts of the Work and work areas. Keep each excavation dry during excavation, subgrade preparation, and continually thereafter until temporary dewatering system is no longer required, in accordance with Article 3.3 of this Section.
   2. Temporary dewatering systems shall depress and maintain groundwater surface level three feet below bottom elevation of each excavation during the Work.
   3. Operation Relative to Existing Buildings, Structures, and Facilities:
      a. Provide, operate, and maintain temporary dewatering systems to avoid settlement and damage to buildings, structures, Underground Facilities, and other facilities.
      b. Prevent softening and disturbance of subgrade below new construction and fill material, to allow the Work to be constructed in dry conditions, and to maintain stable excavation side slopes and stable temporary supports of excavations.
   4. If, in Engineer's opinion, groundwater surface elevations are not as required by the Contract Documents, provide additional or alternative temporary dewatering system components or elements as necessary, at no additional cost to Owner.
   5. Groundwater surface elevation shall be lowered in advance of excavating for a sufficient period to allow dewatering of fine-grain soils.
   6. Remove water from excavations as fast as water collects.

B. Related Work:
   1. Provide temporary erosion and sediment controls in accordance with Section 01 57 05 - Temporary Controls.
   2. Comply with Section 01 57 05 - Temporary Controls, regarding control of surface water, storm water runoff, water pollution, air pollution, noise, and others as applicable.
   3. Comply with Section 01 41 26 - Stormwater Pollution Prevention Plan and Permit.

C. Temporary Dewatering Systems - General:

1. Design, provide, operate, and maintain temporary systems for dewatering of excavations in accordance with the Contract Documents, Laws and Regulations, and prevailing practice typical in the industry. In the event of conflict between such requirements, obtain interpretation or clarification from Engineer before proceeding.
2. Temporary dewatering systems, may include the following temporary elements: swales, sumps, pumps, hoses, piping, wells (whether dewatering wells, monitoring wells, or other wells), and similar facilities.
3. Furnish, either at the Site or within reasonably close proximity thereto, available standby items, such as pumps, piping, hoses, instrumentation, controls, and others, should elements of operating temporary dewatering system fail.
4. Locate elements of temporary dewatering systems to allow continuous dewatering operation without interfering with the Work, and the work of other contractors (if any), to the extent practicable.

D. Disposal of Water Removed by Dewatering System:
1. Water conveyed by temporary dewatering systems that includes oils, sediments, or Constituents of Concern that will reduce the quality of surface water or groundwater downstream of the point of discharge, shall not be directly discharged. Divert such waters through temporary settling basin, or filters before discharging to surface water, groundwater, or drainage routes.
2. Temporary dewatering systems shall not discharge across roadways, driveways, parking areas, other travelled ways, sidewalks, or overland across other property adjacent to the Site. Where hoses that are part of temporary dewatering system discharge to existing gutters or swales, such discharge shall not exceed capacity of such swales and gutters especially during precipitation and runoff events.
3. Unless discharge location is shown on the Drawings, Contractor's temporary dewatering systems shall discharge to location at the Site acceptable to Owner and Engineer, in accordance with Laws and Regulations.
4. Convey water from excavations in closed conduits or appropriate drainage swales. Do not use trench excavations as temporary drainage ditches.
5. Dispose of water removed from excavations in a manner that does not endanger health and safety, property, the Work, and other portions of the Project.
6. Dispose of water in manner that causes no inconvenience to Owner, others involved in the Project, and adjacent and downstream property owners and occupants.

3.3 OPERATION, MAINTENANCE, AND REMOVAL OF TEMPORARY DEWATERING SYSTEMS

A. Operation and Maintenance of Temporary Dewatering Systems:
1. Contractor shall operate temporary dewatering systems continuously, 24 hours per day, seven days per week, until such system is no longer necessary or required.
2. Not less than once per working day, visit and visually inspect temporary dewatering system, operating components, including pumps, instrumentation, and controls, and verify proper operation. At the same time, visually observe discharge location of temporary dewatering systems to verify operations. Establish and maintain written records of each location checked, observations made, readings and data taken or recorded (if any) and furnish copies of such records to Engineer upon request.
3. Contractor shall be responsible for condition of piping, conduits, and channels used for drainage and such piping, conduits, and channels shall be clean and free of oils, sediments, and Constituents of Concern.
4. Provide temporary electricity, temporary fuel, and other temporary facilities as necessary in accordance with Section 01 51 05 - Temporary Utilities.
5. Perform pumping of water from excavations in a manner that prevents carrying away of unsolidified concrete materials, and that avoids damaging the subgrade.
6. During construction, Contractor shall maintain all materials, equipment, and systems used for temporary dewatering regardless of whether such items were provided by Contractor or existed prior to commencement of temporary dewatering, in accordance with operating

instructions and recommendations of manufacturer of the associated equipment and systems, Laws and Regulations, the Contract Documents, and practice typical in the industry. Perform routine, preventative, and troubleshooting maintenance. Where temporary dewatering system fails or becomes inoperable, immediately remedy the situation, whether by appropriate repairs or operation of standby equipment.

B. Criteria for Discontinuation of Temporary Dewatering Operations:
   1. Operate and maintain temporary dewatering systems until building, structure, or other facility to be constructed in the excavation is completed to a sufficient extent and has achieved structural strength and integrity sufficient for discontinuation of operation of temporary dewatering systems, and backfilling Work is reasonably complete. Facilities constructed in excavations shall be able to withstand horizontal and vertical soil and water pressures from natural groundwater prior to discontinuation of temporary dewatering.
   2. Control of ground water shall continue until the permanent construction provides sufficient dead load to withstand hydrostatic uplift of the normal groundwater, until concrete has attained sufficient strength to withstand earth and hydrostatic loads, and until waterproofing Work is completed.
   3. Before discontinuing dewatering operations or permanently allowing rise in groundwater surface elevation, prepare computations to demonstrate that buildings, structures, Underground Facilities, and other facilities affected by the rise in groundwater surface elevation are protected by fill or other means to sustain uplift. Use a safety factor of not less than 1.30 when preparing such calculations. Submit such calculations to Engineer upon request. Maintain temporary dewatering systems in operation until Contractor's evaluations and calculations establish appropriate resistance of facilities against uplift and other damage caused by rising groundwater surface elevations.
   4. Do not discontinue dewatering operations without first obtaining Engineer's concurrence for such discontinuation.
   5. Shut off dewatering system at such a rate to prevent quick upsurge of water that might weaken the subgrade.

C. Removal of Temporary Dewatering Systems:
   1. When temporary dewatering system is permanently deactivated, remove from the Site all elements of temporary dewatering system unless Owner (through Engineer) approves temporary dewatering system's, or part thereof, continuing existence at the Site after final payment.
   2. Where wells provided by Contractor (whether for dewatering, monitoring, or other purpose) or piping are allowed to remain following permanent discontinuation of dewatering operations, accurately record their locations on the record drawings, in accordance with Section 01 78 39 - Project Record Documents.
   3. When a well includes power supply for electric pump, remove and disconnect electrical power supply from well casing back to source. Where wells provided by Contractor will be abandoned in place, remove the well casing to not less than two feet below finished grade and provide secure, removeable cap on well casing. Provide stake, visible at finished grade but not protruding above finished grade, indicating location of well casing.
   4. Restore disturbed areas in accordance with the Contract Documents. Where the Contract Documents do not indicate requirements for restoration, restore such areas in accordance with Section 01 71 33 - Protection of the Work and Property.

END OF SECTION

SECTION 31 32 19.16
GEOTEXTILE SOIL STABILIZATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Nonwoven geotextile material.

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 31 23 05 - Excavation and Fill.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Association of State Highway Transportation Officials (AASHTO):
      a. M288, Standard Specification for Geotextile Specification for Highway Applications.
   2. ASTM International (ASTM):
      a. D3786, Standard Test Method for Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method.
      b. D4355, Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus.
      c. D4491, Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
      d. D4533, Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
      e. D4632, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
      f. D4751, Standard Test Method for Determining Apparent Opening Size of a Geotextile.
      g. D4759, Standard Practice for Determining the Specification Conformance of Geosynthetics.
      h. D4833, Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products.
      i. D4873, Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples.
      j. D5261, Standard Test Method for Measuring Mass per Unit Area of Geotextiles.

B. Qualifications:
   1. Each manufacturing, fabricating firm shall demonstrate five years continuous experience, including a minimum of 10,000,000 square feet of geotextile installation in the past three years.
   2. Installing firm shall demonstrate that the site Superintendent or Foreman has had responsible charge for installation of a minimum of 1,000,000 square feet of geotextile.
   3. Installer shall attend pre-installation conference.

1.3 DEFINITIONS

A. Manufacturer: Manufacturer producing geotextile sheets from resin and additives.

B. Installer: The Installers are the individuals actually performing the hands-on work in the field.

1.4 SUBMITTALS

A. Shop Drawings:
   1. Manufacturer's documentation that raw materials and roll materials comply with required geotextile physical properties.
   2. Manufacturer and Installer quality control manuals.
   3. Original test results for resins, roll material and factory seam tests at frequency specified in respective quality control manuals.
      a. Results shall include or bracket the rolls delivered for use in the Work.

4. Geotextile layout plan with proposed size, number, position and sequencing of geotextile rolls and direction of all field seams.
5. Proposed details of anchoring and overlapping if different than included in Contract Documents.

1.5 DELIVERY, STORAGE AND HANDLING

A. Label, handle, and store geotextiles in accordance with ASTM D4873 and as specified herein.

B. Wrap each roll in an opaque and waterproof layer of plastic during shipment and storage.
   1. Do not remove the plastic wrapping until deployment.

C. Label each roll with the manufacturer's name, geotextile type, lot number, roll number, and roll dimensions (length, width, gross weight).

D. Repair or replace geotextile or plastic wrapping damaged as a result of storage or handling, as directed.

E. Do not expose geotextile to temperatures in excess of 71 degrees C (160 degrees F) or less than 0 DEGC (32 degrees F) unless recommended by the manufacturer.

F. Do not use hooks, tongs or other sharp instruments for handling geotextile.
   1. Do not lift rolls lifted by use of cables or chains in contact with the geotextile.
   2. Do not drag geotextile along the ground.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. GSE Lining Technology.
   2. Propex Geosynthetics.
   3. SKAPS Industries.
   4. TenCate Mirafi.
   5. Tenax.

2.2 MATERIALS AND MANUFACTURE

A. Geotextile:
   1. Nonwoven pervious sheet of polymeric material.
   2. Geotextile fibers:
      a. Long-chain synthetic polymer composed of at least 85% by weight polyolefins, polyesters, or polyamides.
      b. Filaments resistant to deterioration by ultraviolet light, oxidation, and heat exposure.
      c. Do not as reclaimed or recycled fibers or polymer to the formulation.
   3. Form geotextile into a network such that the filaments or yarns retain dimensional stability relative to each other, including the selvages.
   4. The geotextile physical properties shall equal or exceed the minimum average roll values listed below.
      a. Values shown are for the weaker principal direction.
      b. Acceptance of geotextile shall be in accordance with ASTM D4759.
      c. Type I Geotextile: AASHTO M288 Class 2, for use in demolition fill.

PROPERTY	TEST METHOD	MINIMUM AVERAGE ROLL VALUE
Mass per Unit Area, OZ/SY	ASTM D5261	=10
AOS, U.S. Standard Sieve	ASTM D4751	70-100

PROPERTY	TEST METHOD	MINIMUM AVERAGE ROLL VALUE
Permittivity, SEC-1	ASTM D4491	=0.5
Puncture, LBS	ASTM D4833	=90
Grab Tensile, LBS	ASTM D4632	=250
Trapezoidal Tear, LBS	ASTM D4533	=90
Burst Strength, PSI	ASTM D3786	=190
Ultraviolet Degradation % retained @ 500 hours	ASTM D4355	=50
Sewn Seam Strength, LBS	ASTM D4632	=220

d. Type 2 Geotextile: AASHTO M288 Class 2, for use in drainage composite and other areas shown on the Drawings.

PROPERTY	TEST METHOD	MINIMUM AVERAGE ROLL VALUE
Mass per Unit Area, OZ/SY	ASTM D5261	=8
AOS, U.S. Standard Sieve	ASTM D4751	70-100
Permittivity, SEC-1	ASTM D4491	=0.5
Puncture, LBS	ASTM D4833	=90
Grab Tensile, LBS	ASTM D4632	=250
Trapezoidal Tear, LBS	ASTM D4533	=90
Burst Strength, PSI	ASTM D3786	=190
Ultraviolet Degradation % retained @ 500 hours	ASTM D4355	=50
Sewn Seam Strength, LBS	ASTM D4632	=220

B. Thread:
1. High-strength polyester, nylon, or other approved thread type.
2. Equivalent chemical compatibility and ultraviolet light stability as the geotextile.
3. Contrasting color with the geotextile.

PART 3 - EXECUTION

3.1 PREPARATION

A. Construct the surface underlying the geotextiles smooth and free of ruts or protrusions which could damage the geotextiles.

3.2 INSTALLATION

A. Install geotextiles in accordance with manufacturer's written recommendations.

B. Hand place geotextile.
1. No equipment will be permitted to traffic in direct contact with the geotextile.

C. Lay geotextile smooth so as to be free of tensile stresses, folds, and wrinkles.

D. Seam Construction:

1. Sew all Type 1 geotextile seams.
2. Broom clean existing geotextile and cut off to provide a clean area for seaming with the new geotextile.
3. Sew seams continuously using an SSA flat seam with one row of a two-thread 401 chain stitch unless otherwise recommended by the manufacturer.
4. Minimum distance from the geotextile edge to the stitch line nearest to that edge: 2 inches unless otherwise recommended by the manufacturer.
5. Test seams at the frequency specified in the FIELD QUALITY CONTROL Article in PART 3 of this Specification Section.
6. Tie off thread at the end of each seam to prevent unraveling.
7. Construct seams on the top side of the geotextile to allow inspection.
8. Sew skipped stitches or discontinuities with an extra line of stitching with 18 inches of overlap.
9. Type 2 geotextile seams may be sewn or overlapped.
    a. Construct overlapped seams in accordance with manufacturer's recommendations or as shown on Drawings.

E. Heat tack the geotextile overlaps as shown on the Drawings.

F. Backfill anchor trenches in accordance with Specification Section 31 23 05 - Excavation and Fill.

G. Place cover soil in accordance with Specification Section 31 23 05 - Excavation and Fill.

H. Protect geotextiles from clogging, tears, and other damage during installation.

I. Geotextile Repair:
1. Place a patch of the same type of geotextile which extends a minimum of 12 inches beyond the edge of the damage or defect.
2. Fasten patches continuously using a sewn seam or other approved method.
3. Align machine direction of the patch with the machine direction of the geotextile being repaired.
4. Replace geotextile which cannot be repaired.

J. Use adequate ballast (e.g., sand bags) to prevent uplift by wind.

K. Do not use staples or pins to hold the geotextile in place.

L. Do not leave geotextile uncovered for more than 14 days.

3.3 FIELD QUALITY CONTROL

A. Conduct destructive seam testing at locations identified by Owner.
1. Minimum testing will be at a frequency of one test per 2,000 linear feet of seam.

B. Provide as-constructed drawing showing roll number; layout; joint locations; and destructive sample repair, and patch locations.

END OF SECTION

SECTION 31 37 00
RIPRAP

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Dry riprap.
2. Subgrade preparation.
3. Aggregate material underlying the riprap armor stone.
4. Appurtenant Work.

B. Related Requirements: Include, but are not necessarily limited to:
1. Section 31 23 05 - Excavation and Fill.
2. Section 31 32 19.16 - Geotextile Soil Stabilization.

1.2 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment:
1. Riprap Work is part of the lump sum bid/pay item indicated on the Bid Form, and part of the Contract, and in Section 01 22 00 - Measurement and Payment.
2. Measurement of riprap Work for payment will be in accordance with Section 01 29 73 - Schedule of Values and other relevant provisions of the Contract Documents.

1.3 REFERENCES

A. Terminology:
1. The following terms are not defined and are not indicated with initial capital letters but, when used in this Section, have the following meaning:
   a. "Borrow" means riprap material required in excess of quantity available from appropriate sources at the Site. Borrow may be necessary even though not otherwise expressly required by the Contract Documents. No representation is made that any material existing at the Site prior to construction is suitable for use in the riprap Work.
   b. "Riprap" means materials and Work required by this Section, regardless of whether the word "riprap" is followed by the word "Work". The terms "riprap", "rip-rap", "rip rap", rock slope protection, and "stone revetment" refer to the complete layered system of riprap (including aggregate filter, bedding stone, and geotextile fabric as required), and are derivative terms that have the same meaning. Related terms include:
      1) "Aggregate Filter" means the granular material (aggregate) that may be required underneath riprap armor stone to prevent finer material from the subgrade from passing into or through the riprap armor stone.
      2) "Bedding Stone" means the granular material (aggregate) used to protect underlying geotextile separation fabric from damage resulting from placing riprap armor stone.
      3) "Dry riprap" means riprap where joints or gaps between riprap armor stone are not filled with any type of grout. Dry riprap shall consist of a fitted layer of shaped and graded riprap armor stone.
      4) "Grouted riprap" means riprap, generally similar to dry riprap, where the joints or gaps between riprap armor stone are filled or stabilized with cementitious grout.
      5) "Riprap armor stone" means the individual stones or rock that comprise surficial protective barrier for shoreline or other marine structure or surface.
   c. "Subgrade" means the uppermost surface of native soil material unmoved from cuts; the material on which riprap will be installed.

B. Reference Standards: Standards referenced in this section include, but are not necessarily limited to, the following:

1. ASTM International (ASTM):
    a. D3740 - Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
    b. D3744/D3744M - Standard Test Method for Aggregate Durability Index.
    c. D5312/D5312M - Standard Test Method for Evaluation of Durability of Rock for Erosion Control Under Freezing and Thawing Conditions.
    d. D5313/D5313M - Standard Test Method for Evaluation of Durability of Rock for Erosion Control Under Wetting and Drying Conditions.
    e. D5519-15 - Standard Test Methods for Particle Size Analysis of Natural and Man-Made Riprap Materials.
    f. D6473 - Standard Test Method for Specific Gravity and Absorption of Rock for Erosion Control.
    g. D6913 - Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis.
    h. E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.

1.4 QUALITY ASSURANCE

A. Qualifications:
    1. Contractor's Testing Laboratory:
        a. Retain the services of independent testing laboratory to perform testing and determine compliance with the Contract Documents of materials specified in this Section, unless this Section expressly allows the Contractor to escape this obligation. Requirements for escaping this obligation, if any, are part of this "Qualifications" provision.
        b. When Contractor is required by this Section's "Field Quality Control" Article, or elsewhere in the Contract Documents, to retain testing laboratory for tests required under this Section's "Field Quality Control" Article, retain one testing laboratory for quality assurance testing and field quality control testing.
        c. Testing laboratory shall possess current, valid accreditation in accordance with ASTM D3740 from the AASHTO Materials Reference Laboratory (AMRL), in accordance with AASHTO AMRL R18, for tests required for quality assurance testing indicated in this Article and field quality control testing indicated to be Contractor's responsibility.
        d. Testing laboratory shall comply with ASTM E329.
        e. Testing laboratory shall be experienced in the types of testing required.
        f. Selection of testing laboratory is subject to Engineer's acceptance. Upon Engineer's request, submit qualifications statement for testing laboratory, including name of entity, location, copies of applicable certifications, and summary of entity's experience.

B. Quality Assurance Testing:
    1. Quality assurance testing, which may also be regarded as source quality control testing, is in addition to field quality control testing required by this Section's "Field Quality Control" Article.
    2. Materials used in the Work may require testing and retesting, as directed by Engineer, during the Project. Allow free access to onsite material stockpiles, borrow sources, and other sources of riprap materials at all times. Tests not specifically indicated to be performed at Owner's expense, including retesting of defective materials and defective Work, shall be at Contractor's cost.
    3. Contractor's Testing Laboratory Scope:
        a. Obtain samples and perform testing of proposed riprap materials at sources of supply (unless otherwise allowed by Engineer), to provide assurance that the Work will comply with the Contract Documents.
        b. Submit to Engineer, via Contractor, written results of each test.
    4. Required Quality Assurance Material Testing by Contractor's Testing Laboratory:

a. Perform the following quality assurance tests on materials to be incorporated into the Work. Submit results of such tests to Engineer and obtain Engineer's acceptance thereof prior to incorporating the subject materials into the Work.
b. Gradation of Aggregate Underlying Riprap Armor Stone: Gradation in accordance with ASTM D6913. Perform one test for every 1,000 cubic yards of each material to be incorporated into the riprap Work.
c. Gradation of Riprap Armor Stone: Perform and submit results of gradation analysis in accordance with ASTM D5519, for riprap armor stone Sample size of not less than 20 times the size of largest riprap armor stone, unless smaller sample size is acceptable to Engineer. Required field Samples shall be consistent with submitted gradation test results.
d. Perform riprap material quality assurance testing to determine average apparent saturated surface dry specific gravity when one or more of the following apply:
    1) For not less than every 20,000 cubic yards of riprap armor stone; or
    2) When location from which materials are obtained changes; or
    3) When geologic characteristics of materials change.

    Requirements for determining quality of riprap armor stone are set fourth in the provision below.

5. Riprap material quality shall be evaluated using one of the following two methods:
    a. Rock Properties:
        1) Submit source rock test results completed on rock representative of the material proposed for the Project. Test results will be considered by Engineer when tests for results submitted were performed within five years of the Effective Date of the Contract and samples tested are representative of the source rock proposed for riprap armor stone.
        2) Submit test results for alternative source rock when riprap armor stone will be obtained from a location different from that represented by initial test results submitted, or when visual appearance of source rock changes.
    b. Testing Requirements for Riprap Armor Stone are as follows:
        1) Specific Gravity of not less than 2.5 in accordance with ASTM D6473.
        2) Wetting-drying test results shall indicate not greater than one percent loss to be acceptable. Wetting-drying testing shall be in accordance with ASTM D5313/D5313M.
        3) Freeze-thaw test result shall indicate not greater than five percent loss to be acceptable. Freeze-thaw testing shall be in accordance with ASTM D5312/D5312M.
    c. Ability of Rock to Perform Based on Previous Reference Project:
        1) Contractor may propose providing riprap armor stone from a source with documented record of acceptable performance for comparable applications and exposure conditions as those to which the riprap Work will be subjected. When requesting approval of riprap armor stone using this quality assurance approach, submit the following information to Engineer:
            a) Record drawings for a prior, completed project where riprap has been in place not less than 20 years prior to the Effective Date of the Contract.
            b) Documentation of source of riprap armor stone material for the same, prior completed project for which record drawings are submitted.
            c) Documentation, including still photographs obtained not more than six months prior to Contractor's initial riprap Submittal for the Project. Submit photographs in sufficient quantity to properly document current condition of such material. Photographs shall comply with requirements of Section 01 32 33 - Project Photographic Documentation, including requirements for indication of location of each image.
            d) Available material testing data for same qualities for which quality assurance testing is otherwise required in this Article.

e) Maintenance records for riprap installed for the same, prior completed project for which record drawings are submitted. Unless otherwise allowed by Engineer, maintenance records should include written documentation on the number and frequency of riprap inspections performed following installation, and number and frequency of riprap maintenance activities such as replenishment (e.g., adding riprap to replace rock that has washed away, broken down, or become degraded by any means).

f) Photographs, taken since the Effective Date of the Contract, of riprap installation for the same, prior completed project for which record drawings are submitted. Submit not less than eight photographs, including representative closeup and medium-distance images, in accordance with Section 01 32 33 - Project Photographic Documentation. Such photographs are not part of the quantities of still photographs required under Section 01 32 33.

g) Contact information for owner of the subject project, including contact person name (who must be current employee of such owner), entity name, complete mailing address, current office telephone number, and current email address. Contact person indicated shall be current employee of such owner, and shall be familiar with maintenance operations and conditions of the subject, existing riprap.

2) Engineer will review the submitted information and will endeavor to determine whether the in-place existing, installed riprap armor stone was subjected to conditions expected for the riprap to be provided as part of the Work, and weather the riprap armor stone performed satisfactorily as determined by the owner of existing riprap and Engineer.

3) In the Project's Schedule of Submittals, allow not less than 60 days, after complete, adequate information is received by Engineer, for Engineer's review, including potential visit to the site of the subject, existing, installed riprap.

4) Engineer has sole discretion to determine whether information furnished concerning the riprap reverence location is acceptable, and whether such material would be acceptable for use in the Work. If the submitted information or existing riprap armor stone is unacceptable, as deemed solely by Engineer, Contractor will be ineligible for change in the Contract Price and the Contract Times for additional costs and delays, if any, incurred resulting from Engineer's decision.

C. Field Samples:

1. Provide the following field Samples of riprap armor stone and aggregate materials (if any) underlying riprap armor stone:
   a. Provide representative Samples, indicating range of required gradation, acceptable material quality, and colors, at the material source at the Site adjacent to riprap material stockpiles.
   b. Representative gradation Samples shall be sufficient to demonstrate compliance with required gradation. Contractor and Supplier shall use ASTM D5519 Test Method A or B to determine gradation of riprap armor stone, and ASTM D6913 to determine gradation of other aggregate materials. Sample size or riprap armor stone shall be not less than 20 times largest individual stone of required gradation, unless smaller Sample size is acceptable to Engineer. Sample size of other aggregate materials shall be not less than one cubic yard.
   c. Clearly label each Sample with temporary signage appropriate for outdoor exposure, of sufficient size. Temporary signage for field Samples at borrow sources shall clearly identify Owner and Project designation.
   d. Maintain Samples until Substantial Completion, unless Engineer authorizes earlier removal of Samples, in writing.
2. Representative field Samples may be incorporated into the Work upon Engineer's concurrence.

1.5 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Product Data:
      a. Riprap Armor Stone: Name and address of riprap material Supplier, source of materials, Supplier's published description of material, Supplier's certification that materials are sufficiently free of Constituents of Concern so that a Hazardous Environmental Condition will not be created or exacerbated, certification of material's compliance with the associated state department of transportation standard specifications, and certification of material's compliance with requirements of the Contract Documents, including gradation and material quality, as applicable.
      b. Aggregate Layer Underlying Riprap Armor Stone: Supplier's description of aggregate materials, including name and address of Supplier, source of materials, certification of material's compliance with applicable reference standards indicated in this Section, the associated state department of transportation standard specifications, and other requirements of this Section, such as gradation, sizing, and material quality, as applicable.

B. Informational Submittals: Submit the following:
   1. Results of Field Surveys for Measurement for Payment:
      a. Submit results of field surveys, required for measurement for payment, indicated in the "Price and Payment Procedures" Article of this Section, including pre-construction measurements, interim measurements, and measurements upon completion of riprap Work. Submit within time limits indicated in the "Price and Payment Procedures" Article of this Section.
   2. Quality Assurance Test Results Submittals:
      a. Submit results of quality assurance testing performed in accordance with this Section's "Quality Assurance" Article, unless included as part of another submittal under this Section. Submit results of tests on materials from onsite and borrow sources.
      b. When this Section's "Quality Assurance Testing" provision allows submittal of alternative documentation of riprap quality based on a prior, reference project, submit such information together with other, required quality assurance testing results.
   3. Field Quality Control Submittals:
      a. Submit results of testing and inspection performed in accordance with the "Field Quality Control" Article in Part 3 of this Section.
      b. Submit results of gradation analysis required upon delivery of material to the Site, in accordance with the "Delivery, Storage, and Handling" Article of this Section.
   4. Qualifications Statements:
      a. Quality assurance testing laboratory, when requested by Engineer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance Requirements:
   1. Rip-rap from approved off-site sources shall be furnished together with delivery tickets, indicating Supplier's name, Supplier's location where material was obtained or produced, date, stockpile number, state department of transportation standard specifications item designation, and other delivery ticket information required by the associated state department of transportation.
   2. Contractor may arrange, pay for, and perform gradation measurements of riprap material rejected by Engineer. If Contractor's analysis proves rejected stone complies with the Contract Documents and Contractor has furnished results of such analysis to Engineer as a Submittal, then a Change Order will be issued to compensate Contractor for cost of gradation analysis. Contractor will not be eligible for a change in the Contract Times because of Engineer's good-faith rejection of apparently non-conforming materials.
   3. Representative gradation Samples shall be sufficient to demonstrate compliance with required gradation. Contractor shall use ASTM D5519 Test Method A or B to determine

gradation. Sample size shall be not less than 20 times largest individual stone of required gradation, unless smaller Sample size is acceptable to Engineer.

B. Storage and Handling Requirements:
   1. Locations where stockpiles will be established shall have compacted surface of not less than six-inches of sand-clay-gravel or crushed stone.
   2. Riprap material that becomes contaminated with soil materials, fine particles, or debris is unacceptable unless the contaminating material is removed from riprap materials prior to installation.
   3. Riprap armor stone stockpiles shall be not more than 12 feet high and shall be constructed and maintained so that stones are stable and will not dislodge unless being moved by Contractor.
   4. Riprap transport, handling, and installation shall not result in breakage of stones or segregation of riprap gradation.
   5. Do not drop riprap armor stone from height greater than one foot.
   6. Do not employ chutes or similar items in handling and installing riprap armor stone, or aggregate layer materials underlying riprap armor stone.

PART 2 - PRODUCTS

2.1 RIPRAP STONE

A. Description:
   1. Provide riprap at the locations shown or indicated on the Drawings, and as may be shown or indicated elsewhere in the Contract Documents, for protection of banks of surface waters, channels, support piers, and marine structures as shown or indicated.
   2. Furnished riprap armor stone gradation shall be produced at the material source and shall not be produced by supplementing and mixing at the Site.

B. Riprap Armor Stone:
   1. Material:
      a. Riprap shall be durable, angular, quarry stone, shaped as nearly as practicable in the form of right rectangular prisms.
      b. Material shall be resistant to weathering. Cracks, non-mineralized defects, shale, unsound sandstone, or organic material in riprap armor stone are unacceptable.
      c. Neither width nor thickness of any stone shall be less than one-third of stone's length.
   2. Materials shall be Item 432 of Texas Department of Transportation.

2.2 ACCESSORIES

A. Geotextile Separation Fabric:
   1. Provide required geotextile separation fabric directly below aggregate layer underlying riprap armor stone.
   2. Comply with Section 31 32 19.16 - Geotextile Soil Stabilization.

B. Aggregate Layer Underlying Riprap Armor Stone:
   1. Bedding Stone:
      a. Provide required bedding stone directly below riprap armor stone for all riprap Work.
      b. Materials: Riprap bedding stone shall be crushed stone and gravel, free of: rock or gravel larger than one-inch in any dimension, debris, waste, frozen materials, organic material and other deleterious matter.
         1) Materials shall be Item 432of Texas Department of Transportation.
   2. Aggregate Filter Material:
      a. Material shall be tough, durable particles free of organic matter, soft material, and friable particles.
      b. Material shall weigh not less than 135 pounds per cubic foot (saturated surface dry).
      c. Gradation:
         1) Per Texas Department of Transportation.

2.3 SOURCE QUALITY CONTROL

A. Tests and Inspections at Source of Supply:
   1. Perform quality assurance testing, and submit results to Engineer, in accordance with the "Quality Assurance" Article in "Part 1 – General" of this Section.
   2. Quality of riprap armor stone shall be determined at the material source. Stone with coloration or appearance dissimilar to field Samples will be rejected.
   3. Approval of riprap materials from a particular source does not constitute approval of all material that may potentially be obtained from such source. Engineer reserves the right to reject materials from localized areas, zones, strata, and other areas when such materials are deemed by Engineer to not be representative of acceptable field Samples or appears to be defective. Nothing in this Section, however, regardless of whether Engineer exercises Engineer's right to observe materials, the Work, or verify compliance with gradation and material quality requirements, is for Contractor's benefit. Contractor remains fully responsible for providing the Work in accordance with the Contract Documents.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:
   1. Provide Engineer with sufficient notice and with means to examine areas and conditions under which riprap Work will be performed. Engineer will advise Contractor in writing when Engineer is aware of conditions that may be detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.
   2. This Article, however, in no way modifies or reduces Contractor's sole responsibility for complying with the Contract Documents, for construction means, methods, procedures, techniques, and sequences, and for the safety and protection measures incident thereto.
   3. Nothing in this Article, including action by Engineer or Resident Project Representative (if any) or Owner's Site Representative, is for benefit of Contractor.

B. Installing the Work constitutes Contractor's approval of underlying work, subgrades, and field conditions prevailing at the time of the Work.

3.2 PREPARATION

A. Excavation and Subgrade Preparation:
   1. Advise Engineer, in writing, not less than five days in advance, of date when Contractor will commence performing riprap Work.
   2. Provide temporary erosion and sediment controls in accordance with Section 01 57 05 - Temporary Controls.
   3. Perform excavation and filling Work, including compaction of subgrades, in accordance with Section 31 23 05 - Excavation and Fill.
   4. Subgrade Preparation for Riprap:
      a. Provide subgrade elevations shown or indicated in the Contract Documents, within the following tolerances:
         1) For areas where installed riprap will not be subjected to immersion, and areas of immersion where installation location will be subjected to temporary dewatering during construction: Section 31 23 05 - Excavation and Fill.
         2) For areas where installed riprap will be, or may reasonably be, subjected to immersion and where installation location will not be subject to temporary dewatering during construction: Within 0.3 vertical feet of required elevation.
      b. At Contractor's option, Contractor may increase the thickness of riprap armor stone provided in lieu of adding fill to subgrade. Such modifications, if any, shall be approved in advance by Engineer via issuance of a Field Order.

c. Furnish to Engineer oral or written advisory that subgrade preparation is complete and allow Engineer not less than 24 hours to visit the Site to observe subgrade conditions. Do not proceed with riprap installation until defects are remedied.

3.3 INSTALLATION

A. Installation Requirements:
   1. Comply with this Section's "Field Quality Control" Article regarding Engineer's observations required prior to installing subsequent layers of riprap Work.
   2. Installation of geotextile separation fabric (if any), aggregate material (if any), underlying riprap armor stone, or riprap armor stone material, on frozen material, ice, or snow is unacceptable.
   3. Geotextile Separation Fabric:
      a. Install geotextile separation fabric in accordance with Section 31 32 19.16 - Geotextile Soil Stabilization, unless otherwise required in this Section or elsewhere in the Contract Documents.
      b. Ends of geotextile separation fabric shall be buried.
      c. Secure geotextile separation fabric by providing pins or weights to prevent displacement prior to or during riprap material installation.
      d. Install geotextile separation fabric only after observation of prepared subgrade by Engineer or Resident Project Representative, if any.
   4. Bedding Stone for Riprap:
      a. Install bedding stone following observation of geotextile separation fabric installation by Engineer or Resident Project Representative, if any, and Engineer's concurrence that bedding stone installation may proceed.
      b. Install bedding stone in accordance with Section 31 23 05 - Excavation and Fill, unless otherwise required in this Section or elsewhere in the Contract Documents.
      c. Compaction of installed bedding stone is not required.
      d. Promptly install subsequent materials on installed bedding stone. Contractor is solely responsible for loss, damage, and remedy of bedding stone prior to installation of riprap armor stone.
   5. Aggregate Filter Material:
      a. Install aggregate filter material following observation of subgrade installation by Engineer or Resident Project Representative, if any, and Engineer's concurrence that aggregate filter material installation may proceed.
      b. Install aggregate filter material in accordance with Section 31 23 05 - Excavation and Fill, unless otherwise required in this Section or elsewhere in the Contract Documents. Installed aggregate filter material shall be in layer of uniform thickness unless expressly required otherwise by the Contract Documents.
      c. Compaction of aggregate filter material is not required.
      d. Promptly install subsequent materials on installed aggregate filter material. Contractor is solely responsible for loss, damage, and remedy of aggregate filter material prior to installation of riprap armor stone.
   6. Riprap Armor Stone Installation:
      a. Install riprap armor stone following observation of supporting materials' installation by Engineer or Resident Project Representative, if any, and Engineer's concurrence that riprap armor stone installation may proceed.
      b. Install riprap armor stone on prepared surface in accordance with lines and grades shown or indicated in the Contract Documents.
      c. Installation Tolerances for Riprap Armor Stone:
         1) For riprap installed in dry conditions: Not greater than 0.5 foot, above required top surface elevation as measured over an area of 200 square feet. No tolerance below required top surface elevation.
         2) For riprap installed in submerged or partially submerged conditions: Not greater than 0.5 foot, above required top surface elevation as measured over an area of 400 square feet. No tolerance below required top surface elevation.

3) Top of riprap armor stone shall match adjoining grades, allowing positive drainage, especially for riprap installed at or above typical surface water level. Between tops of banks adjoining surface waters, installed riprap shall have smooth transitions that reduce the potential for flow turbulence.

d. Voids Between Riprap Armor Stones: Install riprap armor stone to produce a stable, homogenous mass with a minimum of voids between adjacent pieces of riprap armor stone. Rearranging individual riprap armor stones may be necessary or required to obtain suitable distribution of stone sizes. Fill spaces between stones with spalls of suitable size.

e. Riprap armor stone installation shall not result in the following: breakage of or damage to riprap armor stones, segregation of riprap armor stone by size, introduction of fine materials into riprap armor stone layer, or adverse effects on materials underlying riprap armor stone.

f. Install riprap armor stones so that weight of stone is carried by underlying material and not by adjacent stones.

g. When installing riprap armor stone on a slope, commence installing riprap armor stone at bottom of slope and continuously place stone evenly up to top of slope. On slopes, install largest stones at bottom of slope.

h. Install riprap armor stone to full thickness in a single operation.

i. Do not disturb, displace, or damage underlying material during installation of riprap armor stone.

j. Protect adjacent buildings and structures during riprap installation. Comply with Section 01 71 33 - Protection of the Work and Property.

3.4 FIELD QUALITY CONTROL

A. Field Tests and Inspections:

1. Furnish to Engineer oral or written advisory that riprap separating and supporting layers, where required, are complete and allow Engineer not less than 24 hours to visit the Site to observe such conditions. Do not install geotextile separation fabric, if any, or subsequent materials, prior to observation of conditions at the Site by Engineer or Resident Project Representative, if any. Do not proceed with riprap installation until defects are remedied.
2. If Engineer has reason to believe installed riprap does not comply with the Contract Documents and field Samples accepted by Engineer, then Engineer may elect to require use of ASTM D5519 Test Method D to determine if installed riprap material complies with the Contract Documents. When Engineer exercises such right, such testing shall be performed by Contractor's independent testing laboratory, unless Engineer or Owner elects to retain the services of a different, independent testing laboratory.
3. Compliance with required locations of riprap, surface elevations of riprap armor stone, and quantities of riprap provided will be determined in accordance with the "Measurements Upon Completion of Riprap Work" provision of this Section's "Price and Payment Procedures" Article, and other measurements and determinations by Engineer.

B. Defective Work:

1. Manual manipulation or redistribution of riprap armor stones may be necessary to correct defects such as abrupt transitions, non-uniform distribution of stone sizes, isolated depressions, holes, isolated raised areas, unstable or non-interlocked stones, other surface anomalies, and other potential defects.

END OF SECTION

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SECTION 31 63 29
DRILLED PIERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Drilled piers.

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 03 05 05 - Testing.
   2. Section 03 21 00 - Reinforcement.
   3. Section 03 31 30 - Concrete, Materials and Proportioning.

C. Unit Prices:
   1. Measurement:
      a. Length of drilled piers for payment to be measured from tip to cut off elevation.
      b. Any drilled pier length extending above cut off elevation indicated will not be measured for payment.
      c. Drilled pier lengths extending below authorized tip elevation will not be measured for payment.
   2. Payment:
      a. Contract bid price for piling to be based on the total number, length, and diameter of drilled piers, and reinforcing steel indicated on Drawings.
      b. Bid price to include all costs for drilled pier drilling; excavation for bells; removing excavated material; furnishing, placing, and removing casing where required; dewatering where necessary; furnishing and placing concrete; reinforcing steel; dowels; any other associated materials; and furnishing all labor, equipment, installation supervision and accessories required for complete pile installation as shown on the Drawings and indicated in this Specification Section.
      c. Adjustment to bid price for drilled pier length to be made in accordance with unit prices in the Bid Proposal.
         1) Indicate on Bid Proposal Form a single unit price per lineal foot, for each drilled pier of a given diameter as shown on the Drawings.
         2) These prices will be used to determine any additional amount due to Contractor if Engineer orders an increase in drilled pier length, or adjustments due to aborted piers, or credit due to Owner if decrease in drilled pier length is ordered.
         3) No payments for changes in length will be made unless changes are directed by Engineer and such order is verified in writing.
         4) No price adjustment will be made for individual drilled piers but will be made on the total lineal footage of drilled pier installed for each diameter.
      d. Payment will be made for piles for which driving is discontinued due to encountering obstructions and for additional piles and foundation construction required at locations of discontinued piles.
      e. No payment will be made for the following:
         1) Drilled piers placed outside of specified tolerances.
         2) Drilled piers disapproved by Engineer for reasons stated elsewhere in this Specification Section.
      f. Contractor will be paid for all shafts drilled and terminated and new foundations placed due to underground obstructions at unit price indicated in bid documents.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Concrete Institute (ACI):

a. 305R, Hot Weather Concreting.
b. 306R, Cold Weather Concreting.
2. ASTM International (ASTM):
a. A36, Standard Specification for Carbon Structural Steel.

B. Qualifications:
1. Installer to have a minimum of five years experience in installing drilled piers in soils similar to those to be encountered on this Project site.

1.3 DEFINITIONS

A. Installer or Applicator:
1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
2. Installer and applicator are synonymous.

1.4 SUBMITTALS

A. Shop Drawings:
1. Fabrication and/or layout drawings.
a. Log of installation of all drilled piers.
b. Shop Drawings of all reinforcing, anchor bolts, dowels and accessories required for the drilled piers.
2. Product technical data including:
a. Acknowledgement that products submitted meet requirements of standards referenced.
b. Manufacturer's installation instructions.
c. Proposed concrete mix design for drilled piers: See Specification Section 03 05 05 for information to be included in the mix design submittal.
3. Certifications.

B. Qualifications:
1. Records for a minimum of three previous installations by the Contractor of required type of pile and in similar soil conditions.

C. Informational Submittals:
1. Copies of concrete strength tests for concrete placed in the drilled piers.
2. Drilled pier installation log.

PART 2 - PRODUCTS

2.1 CONCRETE

A. Concrete:
1. 28-day minimum compressive strength: 4500 psi.
2. Comply with Specification Section 03 31 30.
3. Comply with changes as noted in this Specification Section.
4. Maximum slump: 6 inches.

2.2 REINFORCING STEEL

A. Provide reinforcing steel conforming to requirements of Specification Section 03 21 00.
1. Reinforcing sizes, number, configurations, spacing, and lengths to be as indicated on Drawings.

PART 3 - EXECUTION

3.1 LINES AND LEVELS

A. Furnish lines and levels necessary for drilled pier installation.
1. Contractor is solely responsible for final placement and location of drilled piers.

3.2 INSTALLATION

A. Provide drilled piers with straight shafts of uniform required diameter as indicated.
   1. Drill belled bottoms to accurate dimensions according to sizes indicated on the Drawings.

B. If installation of belled bottoms in encountered subgrade by use of drilling rig is not possible, hand excavate the bells at no additional cost to Owner.

C. Drilled pier bottom elevation or elevations indicated on the Drawings are to be used as a guide and shall be used for bid purposes.
   1. Final elevation or elevations of bottom of drilled piers shall be as determined and directed by Geotechnical Engineer.

D. Provide steel casing in drilled pier holes as required to allow cleaning and inspection of the bottom of each drilled pier, to prevent caving in and to prevent entering of ground water into the drilled pier holes.
   1. Casing to be steel cylinders of adequate thickness as required to support all loadings encountered during drilled pier installation.
   2. Casing steel to conform to requirements of either ASTM A252, Grade 2, or ASTM A36.
   3. Weld sections of casing together with continuous full penetration welds to make all joints watertight.

E. Maintain bottom of drilled pier excavations free of loose, wet, soft or frozen materials, mud, snow and water until drilled pier concrete is placed.
   1. Prevent, by whatever means are necessary, the drilled pier bottom excavations from becoming loose, wet, frozen or soft before drilled pier concrete is placed.
   2. In no case shall there be more than a 1 inch depth of water at bottom of drilled pier at time of concrete placement.
   3. Excavate drilled pier bottoms to a level plane.

F. Remove materials resulting from excavating for drilled piers to an area on-site.
   1. On site area to be designated by Engineer.
   2. Remove excavated materials from around drilled pier holes as soon as excavation for holes has been completed.

G. Provide gas testing equipment, ventilation equipment, protective cage, and other safety equipment required for inspection and cleaning of drilled pier excavations or for any other operations necessitating entry into drilled pier holes.

H. Do not begin excavation for any drilled piers until the Geotechnical Engineer is present to witness the excavation.
   1. The bottom subgrade of each drilled pier at time of placing pier concrete shall be at an elevation which will provide the drilled pier with the following properties:
      a. Free of loose, wet, soft or frozen materials.
      b. Free of water exceeding a 1 inch maximum depth.
      c. Is of sufficient bearing strength to provide an allowable bearing capacity of 20,000 PSF with a minimum factor of safety of 2 and a maximum settlement of 1/2 inches when supporting the above required allowable bearing capacity.
      d. Is at a sufficient depth for the drilled pier to be capable of resisting the following uplift force(s) with a minimum factor of safety of 2 and a maximum uplift movement of 1/2 IN:
         1) Indicate uplift force on the Drawings.
         2) Indicate the uplift force in the preceding paragraph plus the uplift force due to the expansive soil surrounding the drilled pier as determined by the Geotechnical Engineer.
      e. Is at a minimum depth of 6'-0" feet into the shale subgrade.
      f. Is at a minimum depth of 36'-0" feet below required drilled pier cut off top elevation.

I. Do not place drilled pier concrete until the Geotechnical Engineer approves the bottom subgrade of the drilled pier for the above requirements.

J. When drilled pier bottom subgrade does not meet the requirements of this Specification Section, take corrective action as directed by the Geotechnical Engineer to bring bottom subgrade into conformance to requirements.

K. After approval of drilled pier bottom subgrade is obtained and after Engineer approves placement of drilled pier reinforcing steel, dowels and anchor bolts, place drilled pier concrete as soon as possible, in manner that will preclude segregation of concrete aggregates, infiltration of water and soil, or any other occurrence which would tend to decrease strength of concrete or supporting capacity of finished drilled pier.
   1. Limit concrete free fall to 4 feet.
   2. Cover open holes for protection of workmen, and to keep out foreign materials until concrete is placed.
   3. Drill and place concrete for a drilled pier in one day's time.
   4. Place concrete in a continuous manner to prevent cold joints from forming.
   5. Do not allow concrete to free fall through reinforcing steel.

L. When concrete free fall is potentially greater than 4 feet, use tremie method to place concrete.
   1. Use tremie pipe between 6 inches and 8 inches diameter.
   2. Provide positive control to ensure that bottom of tremie pipe is at all times below concrete surface.

M. In withdrawing casing used to brace drilled pier excavation and maintain water tightness during concrete placement, always keep bottom of casing below top of concrete surface to prevent a reduction in diameter of drilled pier shaft due to earth pressure and to prevent soil and ground water from entering and mixing with the concrete.
   1. Pull casing by uniform vertical lifts, continuously plumb, in such a manner to allow continuous observation of interior level of concrete.
   2. Pull casing at a uniform rate.

N. Vibrate top 10 feet of drilled pier concrete.
   1. Vibrate each 2 feet lift of this top 10 feet prior to subsequent concrete being placed.
   2. Perform vibration after casing has been withdrawn if casing is not permanent.

O. Surface of drilled pier at cut off elevation to be level with diameter required by Drawings.
   1. Where top surface of drilled pier has a mushroomed configuration, remove excess concrete in such manner to prevent damage to top of drilled pier and to provide drilled pier of diameter required.

P. If during drilling, an underground obstruction prevents shaft from being drilled to required depth, terminate shaft and fill with concrete.
   1. Notify Engineer so a new drilled pier arrangement and foundation can be designed to replace terminated shaft.

Q. Do not place concrete for drilled piers against soft, loose or frozen ground.

R. Do not use concrete which has had water added more than 1 hour before placement.

S. After placement of concrete for a drilled pier is completed, cure exposed top surface of drilled pier for a minimum of seven days.
   1. When outside temperature falls below 40 degrees F, maintain temperature of exposed top surface of drilled piers at a minimum of 50 degrees F during the curing period.
   2. Follow recommendations of ACI 306R for curing concrete in cold weather and recommendations of ACI 305R for curing concrete in hot weather.

3.3 SUPERVISION AND INSPECTION

A. Drilled pier installer to provide qualified, experienced person in his employ to supervise all drilling and concrete filling of all drilled piers.

3.4 TOLERANCES

A. Place each drilled pier plumb at locations indicated.

1. Maximum allowable tolerance from true vertical measured from center of shaft shall not exceed more than 1.5% of the drilled pier length, 12.5% of shaft diameter, or 15 IN whichever is less.
2. Shaft at cut off elevation shall not be off center horizontally from its required location more than 1/24 of shaft diameter or 2 inches, whichever is less.
3. If tolerances are exceeded, Contractor to pay for corrective design and construction that may be required.

3.5 REINFORCEMENT

A. Place steel reinforcing cage in drilled pier holes as indicated after Geotechnical Engineer has approved drilled pier bottom subgrade and before placing concrete.
   1. Adequately support reinforcement by means to ensure indicated vertical position, concentric alignment and required concrete cover over reinforcing steel.
   2. Provide additional reinforcing steel in drilled piers as directed by Engineer due to revised condition of drilled pier installation.
   3. Place all dowels and anchor bolts extending from tops of drilled piers immediately after concrete shaft has been fully placed.

3.6 DISAPPROVED DRILLED PIERS

A. Drilled piers will be disapproved and replaced as directed by Engineer for following reasons:
   1. Concrete not reaching minimum required 28 day compressive strength, or containing cracks, voids, soft material, inclusions of earth or other foreign materials, or any other defect which, in the opinion of the Engineer, may affect the strength of the drilled pier.
   2. Drilled piers out of horizontal and vertical alignment in excess of tolerances specified.
   3. Drilled piers of improper size and depth, and drilled piers suspected to be of incorrect diameter due to any reason.

B. Any additional drilled piers or additional construction required due to disapproved drilled piers will be placed by Contractor at no additional expense to Owner.

C. Reimburse Engineer for any additional engineering work required for redesign due to disapproved drilled piers.

3.7 FIELD QUALITY CONTROL

A. Owner pays for inspection and testing:
   1. Owner will employ and pay for services of an independent testing/inspection agency to inspect drilled piers and provide the services indicated in this Section as being performed by the Geotechnical Engineer.

B. Contractor provides sufficient notification and access so inspection and testing can be accomplished.

C. Contractor pays for retesting of failed tests and for additional testing required when defects are discovered.

D. Responsibilities of Testing Agency and/or Special Inspector:
   1. Inspect piles which have been installed for general conformance with this Specification Section.
   2. Prepare and submit inspection and test reports to Engineer.
      a. Coordinate such work with other Special Inspectors.
      b. Assist Engineer to determine corrective measures necessary for defective work.

E. Make three (3) 6 inches diameter x 12 inches high concrete test cylinders for each 20 CY of concrete or fraction thereof placed.
   1. Indicate which drilled piers the test cylinders represent.
   2. Make cylinders and test in compliance with Specification Section 03 05 05.
   3. Along with each set of three cylinders, make one test each for slump, air content and concrete temperature.

4. Test one cylinder at seven days and two cylinders at 28 days.
5. Furnish a copy of all test results to Engineer.

3.8 DRILLED PIER RECORDS

A. Keep a log of each installed drilled pier including:
   1. Drilled pier location by column grid lines or by other means.
   2. Date drill pier was installed.
   3. Bottom elevation of drilled pier.
   4. Cut off elevation of drilled pier.
   5. Total length of drilled pier from bottom to cut off elevation.
   6. Diameter of drilled pier shaft.
   7. Diameter and height of belled bottom.
   8. Whether or not hole was cased.
   9. Deviation from allowable installation tolerances.
   10. Stratigraphy of subgrade materials encountered during drilling.
   11. Concrete delivery ticket truck numbers used to fill drilled pier.

B. After all drilled piers are installed, submit copy of complete drilled pier logs to Engineer.
   1. Report to be signed by Contractor and Testing Agency/Special Inspector.

END OF SECTION

SECTION 32 12 00
FLEXIBLE PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Hot-mix, hot-laid, flexible paving, also known as asphalt concrete paving, used for roadways, driveways, parking areas, asphalt concrete sidewalks, and other areas where flexible paving is required by the Contract Documents, including:
      a. Preparation, such as sawcutting, milling where shown or indicated, cleaning, and other preparation for installing flexible paving.
      b. Asphalt concrete paving materials.
      c. Prime coating.
      d. Tack coats.
      e. Joint adhesives.
   2. Pavement markings where shown or indicated.
      a. Quality control and testing.

B. Related Requirements: Include, but are not necessarily limited to:
   1. Section 31 23 05 - Excavation and Fill.

1.2 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment:
   1. Flexible paving Work is part of the lump sum bid/pay item indicated on the Bid Form, and part of the Contract, and in Section 01 22 00 - Measurement and Payment.
   2. Measurement of flexible paving Work for payment will be in accordance with Section 01 29 73 - Schedule of Values, and other relevant provisions of the Contract Documents.

1.3 REFERENCES

A. Terminology:
   1. Terminology indicated below are not defined terms and are not indicated with initial capital letters, but when used in this section have the meaning indicated below:
      a. "Flexible paving" means a composite material commonly used in construction projects such as road surfaces, driveways, parking areas, and similar paved surfaces. Flexible paving consists of asphalt (used as a binder) and a mineral aggregate (which may be augmented by recycled materials, such as recycled asphalt pavement or "RAP") mixed together, installed in layers (courses), and compacted. Flexible paving may be divided into different types of materials, such as base course, binder course, and top course. Appurtenant materials, such as prime coats, tack coats, joint adhesives, and similar Work, are part of flexible paving Work. The terms "flexible paving", "asphalt paving", "asphalt concrete paving", "bituminous paving", and derivative terms, such as when the word "pavement" is used in lieu of the word, "paving", have the same meaning. In this Section, the term "top course" is used, which has the same meaning as the terms "wearing course", and the final "surface course".
      b. "Milling" means shaping and removing portions of existing surfaces by the cold milling process and subsequent cleaning.
      c. "Subbase" means the layer of compacted aggregate material installed on either the subgrade or, when required, geotextile separation fabric. Courses of flexible paving material are subsequently installed on top of the subbase.
      d. "Subgrade" means the uppermost surface of native soil material unmoved from cuts; the bottom of excavation on which either geotextile or subbase is installed.

B. Reference Standards: Standards referenced in this section include, but are not necessarily limited to, the following:
   1. American Association of State Highway and Transportation Officials (AASHTO):
      a. AMRL - AASHTO Accreditation Procedures Manual for the Accreditation of Construction Materials Testing Laboratories.
      b. M320 - Specification for Performance-Graded Asphalt Binder.
      c. MP1 - Standard Specification for Performance Graded Asphalt Binder.
   2. Asphalt Institute (AI):
      a. MS-2 - Mix Design Methods.
   3. ASTM International (ASTM):
      a. D242/D242M - Standard Specification for Mineral Filler for Asphalt Mixtures.
      b. D692/D692M - Standard Specification for Coarse Aggregate for Asphalt Paving Mixtures.
      c. D946/D946M - Standard Specification for Penetration-Graded Asphalt Binder for Use in Pavement Construction.
      d. D977 - Standard Specification for Emulsified Asphalt.
      e. D1073 - Standard Specification for Fine Aggregate for Asphalt Paving Mixtures.
      f. D1188/D1188M - Standard Test Method for Bulk Specific Gravity and Density of Compacted Asphalt Mixtures Using Coated Samples.
      g. D2726/D2726M - Standard Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Asphalt Mixtures.
      h. D2950/D2950M - Standard Test Method for Density of Asphalt Mixtures in Place by Nuclear Methods.
      i. D3549/D3549M - Standard Test Method for Thickness or Height of Compacted Asphalt Mixture Specimens.
      j. D3666 - Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials
      k. D6690 - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.
      l. E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.
   4. Federal Specifications (FS):
      a. TT-B-1325D - Beads (Glass Spheres) Retro-Reflective
      b. TT-P-1952F - Paint, Traffic and Airfield Marking, Waterborne.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Review installation procedures under this and other Specifications and coordinate installation of items that must be installed with, or before, flexible paving Work.

B. Notify other contractors, utility owners, and owner's of transportation facilities (as applicable) in advance of installing flexible paving to provide such other entities with sufficient time for installing items included in their contracts or projects, as applicable, that must be installed with, or before, flexible paving Work. Sequencing and Scheduling:
   1. Schedule and perform flexible paving Work when local hot-mix asphalt concrete plants are open. Contractor's Progress Schedule shall include appropriate float, relative to flexible paving Work, to accommodate potential early and late seasonal closures and openings of hot-mix asphalt concrete plants and potential effect of weather on the Work.
   2. Perform flexible paving Work after other necessary and required Work has been performed, such as providing required traffic controls, adjusting rim elevations of buried items such as manhole covers, valve box covers, and stormwater inlets, and coordination with authorities having jurisdiction.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Areas requiring flexible paving Work are owned and under the jurisdiction of Owner, unless indicated otherwise elsewhere in the Contract Documents.

B. Qualifications:
   1. Asphalt Concrete Production Facility:
      a. Production facility for hot-mix asphalt concrete, , tack coat material, and other bitumastic materials shall be certified by the Texas Department of Transportation for furnishing such materials for highway construction within jurisdiction of such entity.
      b. Submit to Engineer documentation of compliance with requirements of this provision, either prior to, or together with, product data Submittals for materials required under this Section.
   2. Contractor's Testing Laboratory:
      a. Retain the services of independent testing laboratory to perform testing and determine compliance with the Contract Documents of materials specified in this Section.
      b. When Contractor is expressly required, by this Section's "Field Quality Control" Article or elsewhere in the Contract Documents, to retain testing laboratory for tests required under this Section's "Field Quality Control" Article, retain one testing laboratory for quality assurance testing and field quality control testing.
      c. Testing laboratory shall possess current, valid accreditation from the AASHTO Materials Reference Laboratory (AMRL), in accordance with AASHTO AMRL Procedures Manual for the Accreditation of Construction Materials Testing Laboratories, or ASTM D3666, for tests required for quality assurance testing indicated in this Article indicated to be Contractor's responsibility.
      d. Testing laboratory shall comply with ASTM E329.
      e. Testing laboratory shall be experienced in the types of testing required.
      f. Selection of testing laboratory is subject to Engineer's acceptance. Upon Engineer's request, submit qualifications statement for testing laboratory, including name of entity, location, copies of applicable certifications, summary of entity's experience, and names and qualifications of personnel who will perform the subject sampling and testing.
   3. Installer of Flexible Paving:
      a. Installer shall be experienced in providing flexible paving of the types required for the Project, and experienced in providing flexible paving in quantities similar to, or greater than, those required for the Project.
      b. Installer shall be experienced in performing flexible paving installation for the state department of transportation having jurisdiction at the Site.
      c. Upon Engineer's request, submit documentation of the proposed installer's compliance with qualifications requirements of this Article.

C. Quality Assurance Testing:
   1. Quality assurance testing is in addition to source quality control testing, when required, and field quality control testing required in the "Field Quality Control" Article of this Section.
   2. Materials used in the Work may require testing and retesting, as directed by Engineer, during the Project. Allow free access to stockpiles of materials used in producing flexible paving and material production facilities during the Work. Tests not specifically indicated to be performed at Owner's expense, including retesting of defective materials and installed Work, shall be performed at Contractor's expense.
   3. Contractor's Quality Assurance Testing Laboratory Scope:
      a. Use of testing laboratory shall not relieve Contractor of responsibility for providing materials and the Work in compliance with the Contract Documents.
      b. Quality assurance testing laboratory shall perform the following, unless evidence of material compliance with reference specifications indicated in the various provisions of material requirements in "Part 2 – Products" of this Section, is submitted to Engineer by Contractor and asphalt concrete production facility:
         1) Test in accordance with reference specifications indicated in requirements for materials in "Part 2 – Products" of this Section. In lieu of quality assurance testing, submit evidence and certification of material compliance with reference

specifications. When evidence of such compliance submitted is not acceptable to Engineer, perform quality assurance testing.

c. To facilitate testing services, Contractor shall:
   1) Secure and deliver to testing laboratory (when requested by Engineer) representative Samples of materials that Contractor proposes to furnish and that are required to be tested.
   2) Furnish such labor as is necessary to obtain and handle Samples at the Site or at asphalt concrete production facility and other material sources.
   3) Advise testing laboratory and Engineer sufficiently in advance of operations to allow for completion of quality assurance tests and for assignment of personnel.

1.6 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Submit proposed asphalt concrete mix design for each asphalt concrete material, and other bituminous materials, required under this Section, providing complete data on materials, including location in the Work, source, material content and percentages, temperatures, and other pertinent data. Indicate proportion of bituminous material from recycled asphalt pavement.
      b. Proposed gradation for each aggregate required in flexible paving. Submit gradation test results for identical material furnished on a previous project. Indicate proportion of recycled asphalt pavement.
      c. In lieu of information required in the two paragraphs immediately above this paragraph, submit certificates of compliance with reference specifications indicated in the requirements for asphalt concrete materials in "Part 2 – Products" of this Section, for each of the following:
         1) Each mix design required.
         2) Bituminous materials required.
         3) Aggregates required in flexible paving, from each material source and each required gradation.
         4) Density of uncompacted asphalt concrete material.
         5) Density of previously-compacted, previously-tested asphalt concrete material.
         6) Density and voids analysis for each asphalt concrete material test specimen.
         7) Evidence of asphalt concrete plant inspection and compliance with reference specifications indicated in "Part 2 – Products" of this Section.
         8) Proportion of recycled asphalt pavement in bituminous materials and aggregate.
   2. Product Data:
      a. Product manufacturer's published data sheet, written instructions for handling and installation, and similar published information for joint adhesive material.
      b. Manufacturer's complete product data on pavement marking materials proposed for use, including product literature, specifications, recommended application techniques, and other installation data.

B. Informational Submittals: Submit the following:
   1. Quality Assurance Test Data Submittals and Source Quality Control Submittals:
      a. Submit for quality assurance tests and source quality control tests required.
   2. Delivery Tickets:
      a. Submit copy of delivery ticket for each load of asphalt concrete, prime coat materials, tack coat materials, and other materials obtained from asphalt concrete production facility, signed by Contractor upon delivery to the Site.
   3. Field Quality Control Submittals:
      a. Submit results of required field quality control tests and inspections that are Contractor's responsibility.
   4. Qualifications:
      a. Asphalt concrete production facility.
      b. Contractor's testing laboratory, when required by Engineer.

c. Flexible paving installer, when required by Engineer.

1.7 FIELD CONDITIONS

A. Restrictions on temperature and weather conditions for installing flexible paving are indicated in the "Installation" Article in "Part 3 – Execution" of this Section.

PART 2 - PRODUCTS

2.1 ASPHALT CONCRETE MATERIALS:

A. ...Description:
   1. Provide all labor, materials, construction equipment and machinery, tools, services, and incidentals necessary and required to furnish and install flexible paving.
   2. Provide flexible paving at locations shown on the Drawings. When locations of flexible paving are not shown, provide flexible paving to restore areas where flexible paving existed on the Effective Date of the Contract where such areas were disturbed, damaged, or removed by Contractor.

B. Bituminous Materials:
   1. Bituminous Materials for Asphalt Concrete:
      a. Bituminous materials for asphalt concrete shall comply with the reference specifications indicated in the "Mixes" provision of this Article, for the associated flexible paving mix.
      b. Bituminous Materials from Recycled Asphalt Pavement (RAP): When use of RAP in asphalt concrete materials is acceptable, comply with requirements for RAP in the "Mixes" provision of this Article.
   2. Prime Coat:
      a. Prime coat shall be low-viscosity, emulsified asphalt.
      b. Provide prime coat in accordance with Texas Department of Transportation.
   3. Tack Coat:
      a. Tack coat shall be emulsified asphalt.
      b. Provide tack coat in accordance with Texas Department of Transportation.
   4. Joint Adhesive:
      a. Joint adhesive shall be a hot-applied asphalt product furnished as a solid and subsequently heated and applied to joints in asphalt concrete.
      b. Provide joint adhesive in accordance with Texas Department of Transportation.
   5. Crack Sealant:
      a. Provide crack sealant material in accordance with Texas Department of Transportation of.

C. Aggregate Materials:
   1. Aggregates for Asphalt Concrete – General:
      a. Aggregate materials for asphalt concrete used in flexible paving shall be in accordance with the reference specifications indicated in the "Mixes" provision of this Article, for the associated asphalt concrete mix.
   2. Recycled Asphalt Pavement (RAP):
      a. Processed material obtained by milling or full depth removal of existing flexible pavement may be used as aggregate in asphalt concrete base course, binder course , and top course.
      b. Maximum proportion of RAP in asphalt concrete provided shall be in accordance with reference specifications indicated in the "Mixes" provision of this Article, for the associated asphalt concrete mix.
      c. When RAP is used, comply with the Contract Documents relative to applicable asphalt concrete mix, bituminous materials, and aggregates.

D. Mixes:

1. Asphalt Concrete Mixtures: Provide the following materials designed and manufactured in accordance with Texas Department of Transportation:
    a. Base Course: Item 247.
    b. Binder Course: Item 360.
    c. Top Course (Surface Course, Wearing Course): Item 340.

2.2 PAVEMENT MARKING MATERIALS:

A. Description:
1. Provide pavement markings as shown on the Drawings. If not shown on the Drawings and flexible paving is either an extension of existing paving with markings, or restoration of paved areas with preconstruction markings, provide pavement markings equal to preconstruction markings in areas of pavement restoration and, in new pavement (in areas not paved prior to the Effective Date of the Contract) similar to pavement markings in adjacent, paved areas existing prior to the Effective Date of the Contract.

B. Materials:
1. Pavement Marking Paint:
    a. Provide low VOC, ready-mixed, one-component, 100 percent acrylic waterborne paint, suitable for marking pavement on highways and airfields.
    b. Suitable for application on flexible paving, concrete, tar, and previously painted areas of such surfaces.
    c. Materials shall be non-bleeding and shall comply with FS TT-P-1952F, Type III.
    d. Apply paint at thicknesses required in FS TT-P-1952F.

C. Pavement Marking Colors:
1. Roadway Center Markings Between Opposing Traffic Lanes: Yellow.
2. Roadway Side Striping: White, unless otherwise shown or indicated. On roads with divided median, right-side striping of each direction shall be white, and left-side striping shall be yellow.
3. Roadway Miscellaneous Lane Markings (turn lane arrows and text): White.
4. Crosswalks and Stop Lines: White.
5. Parking Space Delineation: White.
6. Accessible (Handicap) Parking Spaces: Unless otherwise indicated with signs, provide handicap symbol on pavement with white paint on blue background.
7. "No-Parking" Areas: Yellow.

2.3 SOURCE QUALITY CONTROL

A. Tests and Inspections:
1. Obtain and test Samples in accordance with AI MS-2. Testing is responsibility of Contractor or asphalt concrete production facility.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:
1. Examine subbase and base on which flexible paving will be installed.
2. Advise Engineer in writing of conditions detrimental to proper and timely completion of the Work.
3. Do not proceed with flexible paving Work until unsatisfactory conditions are corrected.

B. Installing the Work constitutes Contractor's approval of underlying work, surfaces upon which flexible paving will be installed and field conditions prevailing at the time of the Work.

3.2 PREPARATION

A. General Preparation: Before starting installation of flexible paving, perform the following:

1. Grade Control: Establish and maintain throughout flexible paving Work required lines and grades, including crown and cross-slope for each asphalt concrete course during construction.
2. Coordinate placement of flexible paving with new and existing curbs, gutters, sidewalks, drainage structures (such as catch basins, drop inlets, and similar items), manholes and associated frames and covers, valve boxes and associated covers, sensors and similar devices associated with traffic controls, signage, pavement markings and markers, and similar items. Where necessary, adjust rim elevations of manhole frames and covers, valve boxes and covers, and stormwater drainage inlets within areas of flexible paving Work to required final elevations.
3. Provide appropriate maintenance and protection of traffic measures during pavement installation and related Work.

B. Subgrade and Subbase:
   1. Prepare subgrade and provide subbase for flexible paving in accordance with Section 31 23 05 - Excavation and Fill. Before installing flexible paving Work, obtain Engineer's concurrence that subgrade and subbase are suitable for installing flexible paving.
   2. Prime Coat:
      a. Provide and use application equipment in accordance with requirements, in the "Installation" Article of this Section, for tack coat.
      b. Application Temperature: Material shall be 140 to 180 degrees F.
      c. Application Rate: 0.3 to 0.7 gallons per square yard, in accordance with applicable state department of transportation.
      d. Uniformly distribute prime coat at junction of adjacent applications.
      e. Following application, do not disturb prime coat. Allow prime coat material to penetrate treated surface of subbase and treated surface to absorb prime coat material until the prime coat material is completely cured.
      f. Apply additional prime coat materials to uncoated or lightly coated areas.
      g. Twenty-four hours after applying prime coat, cover areas evidencing excessive prime coat material with sufficient dry fine aggregate to blot up or remove excess prime coat material.
      h. Protection of Treated Surface: Maintain and protect treated surface against damage. Remedy damaged areas to Engineer's satisfaction before installing subsequent Work.

C. Milling:
   1. Mill existing pavement where shown, indicated, or otherwise required.
   2. Milling Equipment:
      a. Milling equipment shall be power operated, self-propelled machines capable of removing the desired thickness of existing surfaces. Equipment shall have sufficient power, traction, and stability to accurately maintain depth of cut and slope. Equipment shall produce finished profile and cross-slope to within 1/4-inch of that required and shall produce uniform surface texture free of gouges and ridges greater than 3/8-inch deep.
      b. Equipment shall include means of controlling dust and other particulate matter created by cutting and milling.
      c. Furnish and use equipment that removes millings as quickly as rate of milling.
      d. Furnish and use vacuum trucks, street sweepers, or power brooms to clean milled surfaces.
   3. Milling Operations:
      a. Perform milling so that when final course of flexible paving is placed, required elevations and grades are provided. Where necessary, establish a taut reference string line to control line and grade of milling.
      b. Control and Tolerances:
         1) Milling equipment shall control profile and cross-slope with a moving reference not less than 30 feet in length. Moving reference may be a floating beam, ski, or other suitable type, such that resulting milled surface is sufficiently even.

2) In areas accessible to milling equipment, provide milled surface to tolerance not greater than 1/2-inch.
3) When subsequently installed flexible paving is determined to not comply with tolerances indicated in this provision, based on visual observation or apparent riding quality, Engineer will direct Contractor to provide and test surface with 15 foot straight edge or string line parallel to pavement centerline and with 10 foot straight edge or string line placed transversely to pavement centerline on any portion of pavement.
4) Variations exceeding 1/2-inch shall be appropriately remedied at no additional cost to Owner.

c. To the extent practicable, minimize time between milling and placement of flexible paving on milled surface.
d. Areas not accessible to milling equipment, such as around or adjacent to drainage structures, manholes, curbs, and transverse joints on structures, may be removed using smaller milling equipment, by hand, other appropriate method, or combination thereof.
e. Remove milled material as soon as it is milled. Remove fines and other material prior to opening milled area to traffic. Control dust emissions resulting from milling to extent practicable. Comply with requirements of Section 01 57 05 - Temporary Controls. When traffic has been allowed onto milled surfaces, or when more than 48 hours have elapsed since milling, clean milled surfaces again prior to applying tack coat and performing other flexible paving Work.
f. Appropriately maintain drainage to drainage inlets and other drainage structures.
g. Properly dispose of milled material at location away from the Site, in accordance with Laws and Regulations, the Contract Documents, and requirements of owner of the disposal location.
h. Milled surfaces that will receive flexible paving, shall be covered with not less than one course of asphalt concrete before end of paving season and closure of hot-mix asphalt concrete plants in the vicinity of the Site.
i. Damage to milled surfaces resulting from traffic or other causes such as, but not limited to, raveling, petroleum spillage, or other contaminants that may potentially inhibit bonding of asphalt concrete to the milled surface, shall be appropriately repaired or re-milled by Contractor.

D. Potholes in Existing Paved Areas:
1. Before placing top course, correct irregularities in binder course. Repair potholes and gouges greater than one inch deep.
2. For potholes and abrupt depressions three inches and less in depth:
a. Repair such defects manually with required asphalt concrete top course.
b. Preparation:
1) Engineer , or Owner's Site Representative will mark locations of such potholes and other surface defects requiring repair, at the Site, using appropriate lumber crayon. Contractor shall furnish necessary lumber crayons.
2) Cut out and patch marked areas. Ensure each patch has an area of not less than one square foot.
3) Excavate marked area to sound, stable material. Using milling or planing equipment is acceptable. Cut all edges vertically.
4) After removing debris and unsound material, thoroughly clean area to be patched and adjacent pavement.
5) Thoroughly dry surfaces of area to be patched.
6) Apply tack coat to bottom and vertical surfaces of area to be patched as specified in the "Installation" Article of this Section.
c. Patching:
1) After tack coat is cured, place asphalt concrete top course material. Compact with steel wheeled roller or other appropriate compaction equipment. After compaction, surface of patch shall conform to grade of adjacent pavement. Fill excavated areas before close of each work day.

2) Potholes extending into shoulder do not require excavation beyond edge of roadway.

3. For potholes and abrupt depressions greater than three inches deep:
   a. Repair such defects manually with required asphalt top course material and asphalt binder course material.
   b. Perform preparation for patching as indicated above in this provision for potholes and abrupt depressions three inches and less in depth.
   c. Patching:
      1) After tack coat is cured, place asphalt binder course in lifts not exceeding three inches in uncompacted depth. After leveling each lift, compact using appropriate mechanical tamper.
      2) After compaction, surface of patch shall conform to grade of adjacent pavement. Provide asphalt concrete top course material in topmost 1.5 inches of patch.
      3) Compact last lift with steel wheeled roller or other appropriate compaction equipment. Fill excavated areas before close of each work day, except that required top course may be installed on following day.

E. Surface Preparation:
   1. Repair surface defects in existing pavement to provide uniform surface to receive new pavement.
   2. Provide crack sealant to completely fill cracks more than 1/16-inch wide in areas shown or indicated on the Drawings.
   3. Clean existing surfaces over which asphalt concrete pavement will be installed, by removing from surface foreign material, excess asphalt concrete, excess joint sealant, crack filler, and other undesirable matter.
   4. Where new flexible paving will abut existing paving, sawcut edges of existing paving in accordance with the "Installation" Article of this Section.
   5. Provide tack coat as indicated in the "Installation" provision of this Section.

3.3 INSTALLATION

A. Installation Requirements for Asphalt Concrete:
   1. Flexible Paving Installation - General:
      a. Provide final surfaces of flexible paving with uniform texture, at required locations and grades, with required cross-sections, as shown and indicated.
      b. Where new flexible paving top course (wearing course or surface course) is provided and connects to existing pavement, provide new top course that smoothly and evenly transitions to existing paved surfaces and grades.
   2. Joining of Pavements:
      a. When new flexible paving will connect to or abut existing or previously-installed pavement, existing or previously-installed pavement shall be neatly and carefully edged to allow overlapping and feathering of subsequent course of asphalt concrete material.
      b. Sawcutting of Edges:
         1) Where new flexible paving will meet existing pavement, existing pavement shall be sawcut and notched.
         2) Sawcut existing pavement with equipment and machinery specifically intended and assembled for sawcutting pavements of the type required.
         3) Edges of existing pavement shall be cleanly cut. Edges shall be linear and have vertical cut face.
         4) Where cut edges are not smooth, even, and straight, repair cut edge to remain to provide a smooth, even appearance.
         5) Sawcutting of concrete pavement, concrete curbs, concrete gutters, and sidewalks shall comply with Section 01 73 29 - Cutting and Patching, and Section 02 41 00 - Demolition.
      c. Where flexible paving will meet existing asphalt pavement, remove existing pavement 12 inches onto undisturbed existing pavement course at edges where new flexible paving will meet existing pavement.

d. Provide tack coat in accordance with requirements of this Article.

3. Tack Coat:
   a. Provide tack coat material at surface of existing or previously-installed pavement course over which new flexible paving will be installed, prior to installing subsequent pavement course..
   b. Tack Coat Installation: Install tack coat immediately prior to installing asphalt concrete. Install asphalt concrete while tack coat is wet. Apply tack coat in accordance with applicable state department of transportation.
4. Weather Limitations for Installing Asphalt Concrete:
   a. Temperature:
      1) For base course and binder course paving lifts equal to or greater than two inches thick, ambient temperature shall be 40 degrees F and rising.
      2) For top course paving or other pavement courses in lifts less than two inches thick, temperature of surface on which pavement will be placed shall be 50 degrees F or greater.
   b. Prohibitions:
      1) Do not install flexible paving materials during foggy conditions or during precipitation.
      2) Do not install flexible paving materials when base on which material will be installed contains moisture in excess of optimum.
      3) Install flexible paving materials only when Engineer concurs weather conditions are suitable.
5. Installation of Asphalt Concrete:
   a. Asphalt concrete mixture shall be transported to the Site and installed as soon as possible after mixing.
   b. Do not pave over existing manhole frames and covers, valve box covers, stormwater inlets, or similar items in areas of flexible paving Work. Where new asphalt concrete will be installed in areas of existing detectors for traffic controls, remove and properly reinstall such detectors in accordance with operation and maintenance instructions of detector's manufacturer. Subsequent to reinstallation, verify proper operation of detectors and associated traffic controls.
   c. Placement of each asphalt concrete course shall be completed over full width of section under construction during each day's flexible paving Work.
   d. Spread and finish asphalt concrete courses using self-propelled, mechanical spreading and finishing equipment. Initially placed thickness of courses shall not exceed 150 percent of required, compacted thickness unless approved in writing by Engineer.
   e. Compaction:
      1) Provide and use compacting rollers to properly compact and finish asphalt concrete. Provide not less than two rollers at the Site at all times during installation of asphalt concrete. One roller may be a pneumatic-tire roller.
      2) During compaction, roller speed shall not exceed three miles per hour. When sufficient quantity of rollers is unavailable, reduce quantity of asphalt concrete installed to accommodate quantity of available rollers.
      3) Required rollers shall be at the Site, in proper, operating condition, prior to placing asphalt concrete.
      4) Using vibratory rollers in lieu of steel-wheeled rollers is acceptable, however, when thickness of asphalt concrete is one-inch or less, rolling shall be via static mode.
      5) Rolling of initially placed asphalt concrete material, or breakdown rolling, shall begin as soon as asphalt concrete will bear roller without undue displacement.
      6) Rolling shall be longitudinal, overlapping on successive trips by not less than one-half roller rear wheel width, and not more than three-quarters of roller rear wheel width. Alternate trips of roller shall be of slightly different lengths.
      7) Roller motion shall be slow enough to avoid displacing asphalt concrete.

8) Operate rollers continuously from breakdown of laid asphalt concrete through finish rolling.
9) Perform finish rolling using a steel-wheeled roller or a vibratory steel-wheel roller operating in static mode.
10) Perform rolling with consecutive passes to achieve even, smooth finish without roller marks.
11) At each location not accessible to roller, thoroughly compact asphalt concrete using tampers and finish, where necessary, with hot smoothing iron to provide uniform, smooth layer over entire area so compacted.
12) Criteria for acceptance of installed density of asphalt concrete is indicated in the "Field Quality Control" Article of this Section.

f. Placement of Adjacent Strips of New Asphalt Concrete:
1) When more than one width of asphalt concrete material will be placed, six-inch wide strip of asphalt concrete adjacent to area on which future material will subsequently be placed, shall not be rolled until such subsequently-placed material is installed.
2) Do not leave unrolled strip unrolled for more than two hours after placing, unless six-inch unrolled strip is first heated with a joint heater.
3) After first strip or width of asphalt concrete is compacted, place, finish, and compact second width or strip as required for first width, except that rolling shall be extended to include six-inch strip of first width not previously compacted.

6. Joint Adhesive:
a. Provide joint adhesive at the following locations:
1) At edges where new flexible paving will connect to existing or previously-installed pavement, including transverse and longitudinal joints.
2) Where new pavement will abut curbing, concrete gutters, drainage structures and frames, manhole cover frames, valve boxes, and similar items.

b. Preparation: Prior to applying joint adhesive, properly clean surfaces to receive joint adhesive. Clean using pneumatic air discharge. Provide suitable traps or devices on compressed air equipment to prevent moisture and oil from contaminating surfaces to receive joint adhesive.

c. Equipment: Heat and melt joint adhesive in melter constructed either as double boiler filled with heat-transfer medium between inner and outer shells, or with internal tubes or coils carrying joint adhesive through heated oil bath and into heated double wall hopper. Insulate or provide heat tracing on hose used for conveying joint adhesive between melter or hopper and surfaces to receive joint adhesive. Equipment shall include appropriate temperature sensor and indicator to facilitate monitoring of material temperature during application.

d. Application:
1) Apply joint adhesive at temperatures and using procedures in accordance with material manufacturer's written instructions.
2) Apply joint adhesive to entire face of transverse and longitudinal joints in flexible paving.
3) Apply joint adhesive to full depth of top course where top course abuts curbing, concrete gutters, drainage structures and frames, manhole cover frames, valve boxes, and similar items.

7. Construction Joints:
a. Provide construction joints in flexible paving to provide neat junction, thorough compaction, and bond throughout.

b. Longitudinal joints in asphalt concrete top course shall correspond with edges of proposed traffic lanes. Other joint arrangements require Engineer's approval.

c. Provide transverse joint, perpendicular to centerline of asphalt concrete installed, extending across full width of strip being laid, at end of each workday, and at other times when placement of hot-mix asphalt concrete will be suspended for a period of

time allowing asphalt concrete mixture to chill. Transverse joints in adjacent lanes shall be staggered at not less than 10 feet.

d. Thoroughly compact, by rolling forward, end of freshly laid asphalt concrete before asphalt concrete becomes chilled. When work is resumed, vertically cut for full depth of course.

8. Curing:
   a. Do not allow traffic onto newly installed pavement until obtaining Engineer's concurrence. Do not allow traffic on flexible paving until surface temperature is less than 140 degrees F.
   b. Hold construction traffic on new pavement to a minimum.
9. Paver and Equipment Cleaning:
   a. Tools and equipment used for asphalt installation shall not be cleaned on pavement surface, or near streams, ponds, drainage structures, or other areas that are tributary to drainage routes or surface waters. Designated area, at location acceptable to Engineer, shall be used for cleaning paving equipment and tools.
   b. When petroleum products are used for cleaning, use tarpaulins, sand pails, other types of pails, or other methods to collect liquids produced by cleaning, to prevent contamination spills and release to the environment.
   c. Hand sprayers or other similar devices may be used to minimize the quantity of petroleum product applied. Sand, soil, and collected petroleum products resulting from cleaning shall be properly disposed of as petroleum contaminated soil in accordance with Laws and Regulations.

B. Installation Tolerances:
1. Milling: Tolerances for milling, are indicated in the "Milling" provision of the "Preparation" Article of this Section.
2. Thickness:
   a. Asphalt concrete provided as a truing and leveling course, if any, and conditioning of existing surface will not be considered in pavement thickness determinations.
   b. Allowable tolerance for asphalt concrete required for each separate type of asphalt concrete mixture required is as follows:
      1) Nominal pavement lift thicknesses of four inches or less, 1/4-inch.
      2) Nominal pavement lift thicknesses greater than four inches, 1/2-inch.
   c. Tolerance for total thickness of all asphalt concrete pavement courses shall be 1/4-inch. When asphalt concrete is installed on newly constructed subbase, additional tolerance of 1/4-inch is acceptable, both in nominal thickness of course installed directly on subbase, and total pavement thickness. No payment will be made for material provided in excess of indicated tolerance.
3. Surface Trueness:
   a. "Surface trueness", as used in this Section refers to new pavement constructed to required surface cross-section, with even surface, without abrupt changes or transitions in elevation or grade, and without ruts or raveling. Appropriately installed pavement results in no ponding of water and properly conveys stormwater runoff to appropriate drainage routes and stormwater inlets.
   b. Contractor shall construct each pavement course to 1/4-inch surface tolerance.
   c. Engineer will evaluate surface trueness and compliance with surface tolerance by directing Contractor to provide 16-foot straight edge or string line placed parallel to centerline of pavement and with 10-foot straight edge or string line placed transversely to centerline of pavement. Variations exceeding indicated tolerance shall be corrected or pavement remedied and replaced at no additional cost to Owner.
   d. Crowned Surfaces:
      1) Test crowned surfaces with a crown template, centered and at right angles to the crown.
      2) Surfaces will be acceptable when variance is equal to or less than 1/4-inch from the template.

4. Elevation: Finished surface of pavement shall be within plus or minus 1/2-inch of elevations shown or indicated. New pavement shall be equal in elevation to frames and covers of manholes, valve boxes and similar items, and allow appropriate stormwater drainage into stormwater inlets.

3.4 APPLICATION OF PAVEMENT MARKINGS:

A. Pavement Markings: Provide pavement markings where shown or indicated.
   1. Pavement Marking Installation – General
      a. Provide pavement markings, of the types required, at locations shown and indicated in the Contract Documents.
      b. Comply with paint manufacturer's written installation instructions.
      c. Where public traffic will be allowed to transit newly installed pavement prior to application of permanent pavement markings, provide appropriate temporary markings sufficient for safe use of the paved area during wet and dry conditions and during all hours of the day.
   2. Preparation:
      a. Sweep surface with power broom supplemented by hand brooms to remove loose material and dirt. Ensure surfaces to receive pavement markings are of appropriate cleanliness to receive pavement markings, in accordance with paint manufacturer's written instructions.
      b. Do not begin marking bituminous concrete pavement until obtaining Engineer's concurrence.
      c. Surfaces to receive pavement markings shall be completely dry at the time markings are applied.
      d. When reflective glass beads are required, mix with paint prior to paint application.
   3. Application:
      a. Do not apply pavement markings not less than five days from time surface is completed. Longer period when reasonably directed by Engineer.
      b. Do not apply pavement markings on wet surfaces, during wet or damp weather, or when ambient temperature is below 40 degrees F.
      c. Using mechanical equipment, provide uniform, straight edges in two separate coats. Apply in accordance with paint manufacturer's written instructions.
      d. Lay out markings and striping in accordance with the Contract Documents. Width of pavement striping for lane markings and parking spaces shall be four inches, unless otherwise shown or indicated on the Drawings.
   4. Protection:
      a. Do not allow vehicles or construction equipment or machinery to traverse pavement markings until applied markings are completely cured in accordance with manufacturer's written instructions and is dry.
      b. Properly remove defective pavement markings, including those damaged by untimely passage of vehicles, equipment, or machinery, and replace with required pavement marking in accordance with the Contract Documents.

3.5 FIELD QUALITY CONTROL

A. Field Tests and Inspections:
   1. Engineer's Field Quality Control Activities:
      a. Engineer may determine compliance with installation tolerances for surface trueness, and depth and trueness of milling (where required), as indicated elsewhere in this Section. Contractor shall furnish implements required for evaluating and determining trueness of asphalt concrete courses and milling.
      b. Engineer may identify, by visual observation, areas of apparent defective flexible paving Work and appropriately advise or notify Contractor of such defects.
   2. Responsibilities of Testing Laboratory:
      a. Field quality control testing laboratory will:

1) Test proposed materials for compliance with the Contract Documents, as directed by Engineer.
2) Perform field density tests, as indicated below in this provision, to verify required compaction of asphalt materials was provided obtained.
3) When directed by Engineer, perform coring of installed and compacted flexible paving to determine compliance with required course thickness and tolerances. Submit written results of tests to Engineer and Contractor.

b. Density:
1) Test Method: ASTM D2950; test one sample every 1,000 square yards of pavement. Test for each asphalt concrete course installed.
2) In addition, when directed by Engineer, compare density of in place flexible paving materials against laboratory specimen (as determined during required quality assurance testing) or certificates on same asphalt pavement mixture, using nuclear density device.
3) Criteria for Acceptance: Density of in-place, compacted asphalt pavement shall be not less than 90 percent of recorded laboratory specimen (as determined during required quality assurance testing) or certificate density. Compacted density shall be not be greater than 98 percent.

c. Thickness of Asphalt Concrete Pavement:
1) Contractor shall provide work zone traffic control and facilitate obtaining pavement cores by testing laboratory.
2) Measure in accordance with ASTM D3549; obtain and test one core sample from every 1,000 square yards of compacted pavement. Comply with thickness tolerance specified in Article 3.3 of this Section.
3) Engineer may use another acceptance method such as yield calculations to determine final thickness for acceptability and payment.
4) Contractor shall repair holes from test specimens in accordance with this Section's requirements for repairing defective Work.

d. Authority of Field Quality Control Testing Laboratory:
1) Technicians representing testing laboratory will inspect materials at the Site and perform required testing. When materials furnished or Work performed do not comply with the Contract Documents, field quality control testing laboratory technician shall promptly direct attention of Engineer and Contractor to such non-compliance.
2) Testing laboratory personnel shall not act as foreman or perform other duties for, or on behalf of, Contractor. The Work will be checked as it progresses, but failure to detect defective Work shall not in any way prevent later rejection of such defective Work when defect is discovered. Failure to detect defective Work as it occurs does not obligate Engineer to final acceptance. Testing laboratory personnel are not authorized to revoke, alter, relax, enlarge, or release requirements of the Contract Documents, nor to approve or accept any portion of the Work.

3. Asphalt Concrete Mix Temperature: Measure temperature at time of placement, record, and submit to Engineer.
4. Drainage:
a. Upon completion and curing of top course provided under the Contract. Engineer will direct Contractor to spray clean water (whether potable or non-potable, and without observable solid material, biological matter, and Constituents of Concern) thoroughly over top course of flexible paving Work, in presence of Engineer , or Owner's Site Representative.
b. Spray sufficient quantity of water over all top course areas to result in visually obvious runoff to drainage routes.
c. In lieu of water spray, Naturally occurring precipitation sufficient for visually observable runoff is acceptable.
d. Immediately following conclusion of spraying or precipitation event, as applicable, Engineer , or Owner's Site Representative will mark areas of ponding, if any, with

appropriate lumber crayon of high visibility color contrasting with pavement. Contractor shall furnish necessary quantity of lumber crayons. Immediately following marking, obtain digital photographic documentation of each marked area, in accordance with Section 01 32 33 - Project Photographic Documentation, and promptly submit to Engineer. Such photographic documentation does not count toward quantity of photographs required by Section 01 32 33 - Project Photographic Documentation.

e. Engineer or Owner may redesignate, re-mark, or both, areas of ponding as such areas become apparent to Engineer or Owner.

5. Surface Trueness:
   a. Contractor's obligations regarding assisting Engineer in determining compliance with milling tolerances are indicated in the "Milling" provision of Article 3.2 of this Section.
   b. Contractor's obligations regarding assisting Engineer in determining compliance with tolerance for trueness of installed asphalt concrete courses are indicated in the "Installation Tolerances" provision of Article 3.3 of this Section.

B. Defective Paving Work:
   1. The following constitutes defective flexible paving Work: ruts, ridges, roller marks, cracking, tearing, segregation, bleeding, ponding of stormwater, or other irregularities. Flexible paving Work that does not comply with required tolerances or other requirements of the Contract Documents, or that is damaged while protection is Contractor's responsibility will be considered as defective Work.
   2. When directed by Engineer, remove and replace defective flexible paving Work. Cut out such areas of defective pavement and fill with fresh asphalt concrete materials, compacted to required density. When performing such repairs, provide tack coats and joint adhesive as required elsewhere in this Section, and compact as required elsewhere in this Section. When pavement is cut out or removed for such remedies, the area removed shall be of regular shape with right angles. To extent practicable, cut-out areas shall be square or rectangular. Surface of repaired areas shall be flush with adjacent pavement.
   3. Completely fill holes in flexible paving, resulting from test specimens, using required asphalt concrete top course material, together with required tack coats and joint adhesive, compacted to required density.

3.6 CLEANING

A. Cleaning: After completing flexible paving installation, completely clean surfaces of excess and spilled bituminous materials, excess asphalt concrete, and foreign matter. Appropriately dispose of such material.

3.7 PROTECTION

A. Protect finished pavement until pavement is properly cured, hard, and cool.

B. Cover openings of drainage structures, manholes, valve boxes, and similar items in paved areas until permanent coverings are provided.

END OF SECTION

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SECTION 32 12 16
ASPHALT PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Asphalt materials.
2. Aggregate materials.
3. Aggregate subbase.
4. Asphalt paving base course, binder course, and wearing course.
5. Asphalt paving overlay for existing paving.
6. Surface slurry.

B. Related Sections include but are not necessarily limited to:
1. Division 00 - Procurement and Contracting Requirements.
2. Division 01 - General Requirements.
3. Section-32 16 13: Concrete Curb and Gutter.

1.2 QUALITY ASSURANCE

A. Reference Standards:
1. American Association of State Highway and Transportation Officials (AASHTO):
a. M17, Standard Specification for Mineral Filler for Bituminous Paving Mixtures.
b. M29, Standard Specification for Fine Aggregate for Bituminous Paving Mixtures.
c. M140, Standard Specification for Emulsified Asphalt.
d. M208, Standard Specification for Cationic Emulsified Asphalt.
e. M288, Standard Specification for Geotextile Specification for Highway Applications.
f. M320, Standard Specification for Performance-Graded Asphalt Binder.
g. M324, Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.
h. MP1a, Standard Specification for Performance-Graded Asphalt Binder.
2. Asphalt Institute (AI):
a. MS-2, Mix Design Methods for Asphalt Concrete and Other Hot- Mix Types.
b. MS-19, Basic Asphalt Emulsion Manual.
c. SP-2, Superpave Mix Design.
3. ASTM International (ASTM):
a. C1371, Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers.
b. C1549, Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer.
c. D242, Standard Specification for Mineral Filler for Bituminous Paving Mixtures.
d. D692, Standard Specification for Coarse Aggregate for Bituminous Paving Mixtures.
e. D946, Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction.
f. D977, Standard Specification for Emulsified Asphalt.
g. D1073, Standard Specification for Fine Aggregate for Bituminous Paving Mixtures.
h. D1188, Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples.
i. D2027, Standard Specification for Cutback Asphalt (Medium-Curing Type).
j. D2397, Standard Specification for Cationic Emulsified Asphalt.
k. D2726, Standard Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures.
l. D2950, Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Methods.

m. D3381, Standard Specification for Viscosity-Graded Asphalt Cement for Use in Pavement Construction.
n. D3515, Standard Specification for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.
o. D3549, Standard Test Method for Thickness or Height of Compacted Bituminous Paving Mixture Specimens.
p. D3910, Standard Practices for Design, Testing, and Construction of Slurry Seal.
q. D6690, Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.
r. E408, Standard Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques.
s. E903, Standard Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres.
t. E1918, Standard Test Method for Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field.
u. E1980, Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces.

B. Mixing Plant: Conform to of TXDOT standard.

C. Mixing Plant: Certified by of TXDOT.

D. Obtain materials from same source throughout.

E. Perform Work in accordance with of TXDOT standard.

F. Maintain one copy of eachdocument on site.

1.3 PRICE AND PAYMENT PROCEDURES

A. Section 01 22 00.

B. Aggregate Subbase:
1. Basis of Measurement: By ton.
2. Basis of Payment: Includes supplying and stockpiling aggregate, scarifying substrate surface, placing, and compacting subbase.

C. Asphalt Paving Base Course:
1. Basis of Measurement: By ton.
2. Basis of Payment: Includes priming surfaces, tack coating surfaces, furnishing, placing, compacting, and testing base course.

D. Asphalt Paving Binder Course:
1. Basis of Measurement: By ton.
2. Basis of Payment: Includes priming surfaces, tack coating surfaces, furnishing, placing, compacting, and testing binder course.

E. Asphalt Paving Wearing Course:
1. Basis of Measurement: By ton.
2. Basis of Payment: Includes priming surfaces, tack coating surfaces, furnishing, placing, compacting, and testing wearing course.

F. Tack Coat:
1. Basis of Measurement: By gallon.
2. Basis of Payment: Includes preparing surfaces and applying.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data:
1. Submit product information for asphalt and aggregate materials.
2. Submit mix design with laboratory test results supporting design.

C. Manufacturer's Certificate: Certify Products meet or exceed TXDOT.

1.5 SUSTAINABLE DESIGN SUBMITTALS

A. Manufacturer's Certificate: Certify products meet or exceed specified sustainable design requirements.
   1. Sustainable Sites Certificates:
      a. Certify paving materials solar reflectance index.
   2. Materials Resources Certificates:
      a. Certify recycled material content for recycled content products.
      b. Certify source for regional materials and distance from Project site.

B. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.
   1. Provide cost data for the following products:
      a. Products with recycled material content.
      b. Regional products.

1.6 QUALIFICATIONS

A. Installer: Company specializing in performing work of this section with minimum of 2years of documented experience.

1.7 AMBIENT CONDITIONS

A. Section 01 57 05 - Temporary Controls: Ambient conditions control facilities for product storage and installation.

B. Do not place asphalt mixture between November 1 and March 1.

C. Do not place asphalt mixture when ambient air or base surface temperature is less than 60deg F, or surface is wet or frozen.

D. Place asphalt mixture when temperature is not more than 15 deg F less than initial mixing temperature.

PART 2 - PRODUCTS

2.1 SUSTAINABILITY CHARACTERISTICS

A. Sustainable Sites Characteristics:
   1. Paving Surfaces: Minimum solar reflectance index (SRI) of 29, calculated in accordance with ASTM E1980.
      a. Reflectance: Measured in accordance with ASTM E903, ASTM E1918, or ASTM C1549.
      b. Emittance: Measured in accordance with ASTM E408 or ASTM C1371.

B. Materials and Resources Characteristics:
   1. Recycled Content Materials: Furnish materials with maximum available recycled content [including:] [.]
      a. [_____.]
   2. Regional Materials: Furnish materials extracted, processed, and manufactured within 500 miles 800 km of Project site [including:] [.]
      a. [_____.]

2.2 ASPHALT PAVING

A. Performance / Design Criteria: Refer to Project Geotechnical Engineering Report

B. Asphalt Materials: Refer to Project Geotechnical Engineering Report

C. Aggregate Materials: Refer to Project Geotechnical Engineering Report

2.3 MIXES

A. Refer to Project Geotechnical Engineering Report.

2.4 ACCESSORIES

A. Geotextile Fabric: AASHTO M288; non-woven, polypropylene.

B. Sealant: ASTM D6690, Type I; hot applied type.

2.5 SOURCE QUALITY CONTROL

A. Submit proposed mix design for review prior to beginning of Work.

B. Test samples in accordance with AI MS-2.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify utilities indicated under paving are installed with excavations and trenches backfilled and compacted.

B. Verify compacted subgrade subbase is dry and ready to support paving and imposed loads.
   1. Proof roll subbase with __Roller loaded to 30 Tons in minimum two perpendicular passes to identify soft spots.

C. Verify gradients and elevations of base are correct.

D. Verify manhole frames are installed in correct position and elevation.

3.2 PREPARATION

A. Prepare subbase in accordance with of TXDOT standards.

3.3 DEMOLITION

A. Saw cut and notch existing paving as indicted on Drawings.

B. Clean existing paving to remove foreign material, excess joint sealant and crack filler from paving surface.

C. Repair surface defects in existing paving to provide uniform surface to receive new paving.

3.4 INSTALLATION

A. Subbase:
   1. Prepare subbase in accordance with of TXDOT standards. _____.

B. Primer:
   1. Apply primer in accordance with TXDOT standards.
   2. Apply primer on aggregate subbase at uniform rate of 1/3 gal/sq yd 1.5 L/SQ M.
   3. Use clean sand to blot excess primer.

C. Tack Coat:
   1. Apply tack coat in accordance with of TXDOT standards.
   2. Coat surfaces of manhole frames with oil to prevent bond with asphalt paving. Do not tack coat these surfaces.

D. Single Course Asphalt Paving:
   1. Install Work in accordance with TXDOT.
   2. Place asphalt within 24 hours of applying primer or tack coat.
   3. Place asphalt wearing course to thickness indicated on Drawings.
   4. Compact paving by rolling to specified density. Do not displace or extrude paving from position. Hand compact in areas inaccessible to rolling equipment.

5. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks.

E. Double Course Asphalt Paving:
   1. Place asphalt binder course within 24 hours of applying primer or tack coat.
   2. Place binder course to thickness indicated on Drawings.
   3. Place wearing course within 24 hours of placing and compacting binder course. When binder course is placed more than 24 hours before placing wearing course, clean surface and apply tack coat before placing wearing course.
   4. Place wearing course to thickness indicated on Drawings.
   5. Compact each course by rolling to specified density. Do not displace or extrude paving from position. Hand compact in areas inaccessible to rolling equipment.
   6. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.

F. Surface Slurry.
   1. Install uniform thickness surface slurry over existing paving in accordance with ASTM D3910.
   2. Allow slurry to cure.
   3. Roll paving to achieve uniform surface.

3.5 TOLERANCES

A. Flatness: Maximum variation of 1/4 inches measured with 10 feet straight edge.

B. Scheduled Compacted Thickness: Within 1/4 inches.

C. Variation from Indicated Elevation: Within 1/2 inches.

3.6 FIELD QUALITY CONTROL

A. Take samples and perform tests in accordance with AI MS-2.

B. Asphalt Paving Mix Temperature: Measure temperature at time of placement.

C. Asphalt Paving Thickness: ASTM D3549; test one core sample from every 1000 square yards 836 square meter compacted paving.

D. Asphalt Paving Density: ASTM D1188 or ASTM D2726; test one core sample from every 1000 square yards compacted paving.

E. Asphalt Paving Density: ASTM D2950 nuclear method; test one location for every 1000 square yards compacted paving.

3.7 ATTACHMENTS

A. Paving at Truck Ramp and Garbage Area: Single course of 3-1/2 inches 89 mm compacted thickness, with surface slurry.

B. Paving at Parking Areas: Two courses; binder course of 2-1/2 inches 63 mm compacted thickness and wearing course of 1 inch compacted thickness.

C. Paving at Rear Bus Loading Area: Thickness and compaction of subbase to support vehicles up to 30,000 pound 13.600 kg.

D. Paving Front Sidewalks: Thickness and compaction of subbase to support moderate pedestrian traffic.

END OF SECTION

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SECTION 32 13 13
CONCRETE PAVEMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Concrete pavement.

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 03 05 05 - Testing.
   2. Section 03 31 30 - Concrete, Materials and Proportioning.
   3. Section 03 31 31 - Concrete Mixing, Placing, Jointing, and Curing.

C. Payment Adjustment for Deficient Thickness of Concrete Pavement:
   1. A deduction in price shall be made for each lane of concrete pavement one block (400 feet) or more in length, or for any lane less than one block (400 feet) in total length, if the average concrete pavement thickness, when determined as provided herein, is within 1 inch tolerance but not within the 1/4 inches tolerance permitted.
      a. Payment reduction formula:

      Payment = (Contract Price) [-2x(d/ts)x(Contract Price)]

      Where d = thickness deficiency determined by coring = ts - ta, but less than 1 inch
      ts = design thickness
      ta = actual thickness determined by coring

   2. When any core shows a deficiency of more than 1 inch, the length of adjacent pavement deducted, and for which payment shall be withheld, shall be the sum of the distance, measured parallel to the centerline, from the deficient boring to the nearest borings, in both directions, which show a thickness not more than 1 inch deficient.
   3. Deductions in all cases shall be for the full width of the lane which the borings represent.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Association of State Highway and Transportation Officials (AASHTO):
      a. M153, Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction (ASTM D1752).
      b. M171, Standard Specification for Sheet Materials for Curing Concrete (ASTM C1271).
      c. M182, Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats.
      d. M213, Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types) (ASTM D1751).
      e. M224, Standard Specification for Use of Protective Sealers for Portland Cement Concrete.
      f. M233, Standard Specification for Boiled Linseed Oil Mixture for Treatment of Portland Cement Concrete.
   2. American Concrete Institute (ACI):
      a. 305R, Guide to Hot Weather Concreting.
      b. 306R, Guide to Cold Weather Concreting.
   3. ASTM International (ASTM):
      a. A615/A615M, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

b. A1064/A1064M, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
c. C33/C33M, Standard Specification for Concrete Aggregates.
d. C150/C150M, Standard Specification for Portland Cement.
e. C174/C174M, Standard Test Method for Measuring Thickness of Concrete Elements Using Drilled Concrete Cores.
f. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
g. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 feet-LBF/FT^3 (600 kN-M/M^3)).
h. D1751, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
i. D1752, Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
j. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
k. D4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.

4. Federal Specification (FS):
   a. SS-S-1614, Sealants, Joint, Jet-Fuel-Resistant, Hot-Applied for Portland Cement and Tar Concrete Pavements (Withdrawn with no replacement).
   b. Concrete installer shall have successfully completed at least three other projects of similar size and type.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
   2. Mix design(s) in accordance with Specification Section 03 31 30 and Specification Section 03 05 05.
   3. Qualifications of concrete installer.
   4. Drawings detailing all reinforcing.
   5. Scaled cross section detail of crown template with dimensions showing off sets from level line.
   6. Concrete pavement joint pattern for paved areas.
   7. Test reports:
      a. Concrete cylinder test results from field quality control.

B. Samples:
   1. Samples of fabricated jointing materials and devices.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or II.

B. Aggregates:
   1. ASTM C33/C33M, gradation size #67, 3/4 inches to #4.
   2. Clean, crushed gravel.

C. Water: Potable quality.

D. Admixtures: Comply with Specification Section 03 31 30.

E. Reinforcing Bars: ASTM A615/A615M, Grade 60.

F. Welded Wire Reinforcement:
   1. ASTM A1064/A1064M.

2. Flat.
3. Clean, free from dirt, scale, rust.

G. Preformed Joint Filler:
1. Non-extruding cork, self-expanding cork, sponge rubber or cork rubber.
2. AASHTO M153 or AASHTO M213.

H. Hot-Poured Joint Sealing Material:
1. FS SS-S-1614.

I. Membrane Curing Compound: ASTM C309.

J. Cover Materials for Curing:
1. Burlap:
a. AASHTO M182.
b. Minimum Class 2, 8 oz material (1 yard x 42 inches).
2. Polyethylene film, AASHTO M171.

K. Paper Subgrade Cover: Polyethylene film, AASHTO M171.

L. Concrete Treatment:
1. Boiled linseed oil mixture.
2. AASHTO M233.

M. Traffic Paint: Thermoplastic FS TT-P-1952F, Type 1 - Alkyd.

N. Forms:
1. Steel or wood.
2. Size and strength to resist movement during concrete placement and able to retain horizontal and vertical alignment.
3. Free of distortion and defects.
4. Full depth.
5. Metal side forms:
a. Minimum 7/32 inches thick.
b. Depth equal to edge thickness of concrete.
c. Flat or rounded top minimum 1-3/4 inches wide.
d. Base 8 inches wide or equal to height, whichever is less.
e. Maximum deflection 1/8 inches under center load of 1,700 pounds.
f. Use flexible spring steel forms or laminated boards to form radius bends.

2.2 MIXES

A. Mix design to provide 4,000 psi 28-day compressive strength, 1 inches slump, 6 ±1% air.

PART 3 - EXECUTION

3.1 PREPARATION

A. Subgrade Preparation:
1. Prepare using methods, procedures, and equipment necessary to attain required compaction densities, elevation and section.
2. Scarify and recompact top 12 inches of fills and embankments which will be under paved areas.
3. Remove soft or spongy areas.
a. Replace with structural backfill.
b. Coordinate with Geotechnical Engineer.
4. Compact to the following densities:
a. Cohesive soils: 95% per ASTM D698.
5. Assure moisture content is within limits prescribed to achieve required compaction density.
6. Following compaction, trim and roll to exact cross section.

a. Check with approved grading template.
7. Perform density tests on subgrade to determine that subgrade complies with the specification.
8. Coordinate aggregate course with Structural Engineer and Soils/Geotechnical Engineer.

B. Aggregate Course:
1. Place material in not more than 6 inches thick layers.
2. Spread, shape, and compact all material deposited on the subgrade during the same day.
3. Compact to 95% relative per ASTM D4253 and ASTM D4254.

C. Loose and Foreign Material: Remove loose and foreign material immediately before application of paving.

D. Appurtenance Preparation:
1. Block out or box out curb inlets and curb returns.
2. Provide for joint construction as detailed and dimensioned on Drawings.
3. Adjust manholes, inlets, valve boxes and any other utility appurtenances to design grade.
a. Secure to elevation with concrete.
b. Place concrete up to 5 inches below design grade.
4. Headers:
a. Construct at open ends of pavements.
b. Use same concrete to construct headers as that used in the abutting structure.
c. Extend header full width of pavement and crown same as pavement.
5. Clean and oil forms.

3.2 INSTALLATION

A. Concrete Production: Comply with Specification Section 03 31 31.

B. Forms:
1. Form support:
a. Compact soil foundation and cut to grade to support forms and superimposed machine loads.
b. Use bearing stakes driven flush with bottom of form to supplement support as necessary.
c. Do not use earth pedestals.
2. Staking forms:
a. Joint forms neatly and tightly.
b. Stake and pin securely with at least three pins for each 10 feet section.
3. Clean and oil forms prior to placement of concrete.
4. Set forms sufficiently in advance of work (minimum of 2 hours) to permit proper inspection.
5. Previously finished concrete pavement, curb or sidewalk contiguous with new work may serve as side form when specifically approved.

C. Reinforcing:
1. Locate longitudinal edge bars between 3 and 6 inches from edge of slab.
2. Lap mats one full space.
3. Tie end transverse member of upper mat securely to prevent curving.
4. Lap nonwelded bars 12 inches minimum.
5. Support:
a. Place bars and heavy mats securely on chairs at called-for height.
b. Place other fabric on the first of a two-course pour and cover promptly with final pour, or place fabric by a fabric-placer if procedure is reviewed and approved by Engineer.

D. Joints:
1. Hold joint location and alignment to within +1/4 inches.
2. Finish concrete surface adjacent to previously placed slab to within +1/8 inches, with tooled radius of 1/4 inches.
3. Metal keyway joints:

a. Form by installing metal joint strip left in place.
b. Stake and support like side form.
c. Provide dowels or tie bars.

4. Weakened plane joints:
   a. Tooled joints:
      1) Form groove in freshly placed concrete with tooling device.
      2) Groove dimensions shall be 3/8 inches at surface and 1/4 inches at root.
   b. Sawed joints:
      1) Saw 1/4 inches groove in green concrete.
      2) Commence sawing as soon as concrete is hard enough to withstand operation without chipping, spalling or tearing, regardless of nighttime or weather.
      3) Thoroughly wet surface to protect membrane cure and recoat afterward.
      4) Complete saw cutting before shrinkage stresses cause cracking.
5. Stake in place load transfer device for expansion joints consisting of dowels:
   a. Supporting and spacing means and premolded joint filler as per Drawing details.
   b. Provide preformed joint filler at all junctions with existing curb, sidewalk, steps, or other structures.
6. Install construction joints at end of day's work or wherever concreting must be interrupted for 30 minutes or more.
7. Thoroughly clean and fill joints with joint sealing material as specified.
8. Fill joints without overflowing onto pavement surface.
9. Upper surface of filled joint to be flush to 1/8 inches below finish surface.

E. Place Concrete:
   1. Comply with Specification Section 03 31 31.
   2. Construct driveway openings, ramps, and other features as per Drawing details.

F. Cold and Hot Weather Concreting:
   1. Cold weather:
      a. Cease concrete placing when descending air temperature in shade falls below 40 DEGF.
      b. Do not resume until ambient temperature rises to minimum 40 degrees F.
      c. If placing below 40 degrees F is authorized by Engineer, maintain temperature of mix between 60 and 80 degrees F.
      d. Heat aggregates or water or both.
      e. Water temperature may not exceed 175 degrees F.
      f. Aggregate temperature may not exceed 150 degrees F.
      g. Remove and replace frost damaged concrete.
      h. Salt or other antifreeze is not permitted.
      i. Comply with ACI 306R.
   2. Hot weather:
      a. Cease concrete placing when plastic mix temperature cannot be maintained under 90 DEGF.
      b. Aggregates or water or both may be cooled.
      c. Cool water with crushed ice.
      d. Cool aggregates by evaporation of water spray.
      e. Never batch cement hotter than 160 degrees F.
      f. Comply with ACI 305R.

G. Finishing:
   1. As soon as placed, strike off and screed to crown and cross section, slightly above grade, so that consolidation and finishing will bring to final Drawing elevations.
   2. Maintain uniform ridge full width with first pass of first screed.
   3. Pavement and similar surfaces:
      a. Float by longitudinally reciprocating float, passing gradually from edge to edge.
      b. Assure successive advances do not exceed half the length of the float.
      c. Test level of slab with minimum 10 feet straightedge.

d. Fill depressions with fresh material, consolidate and refinish.
e. Cut down high areas and retest.
f. Belt surface with two-ply canvas belt, using transverse strokes while advancing along center line.
g. Provide final finish by full width burlap or carpet drag, drawn longitudinally.
h. Keep drag clean to avoid build up and consequent scarring.
i. Tool pavement edges with suitable edger.
j. Retest with straightedge and if pavement shows deviation of more than 1/8 inches in 10 feet, remove and replace.

H. Curing:
1. Apply membrane curing compound complying with ASTM C309, and in accordance with manufacturer's directions but at a minimum rate of 200 square feet/GAL.
2. Apply curing compound within 4 hours after finishing or as soon as surface moisture has dissipated.
3. Cure for minimum of seven days.
4. When average daily temperature is below 50 degrees F, provide insulative protection of 12 inches minimum thickness loose dry straw, or equivalent, for 10 days.
5. Linseed oil sealant:
a. Seal surface with linseed oil.
b. Apply linseed oil to clean surface as per AASHTO M224 after concrete has cured for one month.
c. Apply first application at minimum rate of 67 square yards per gallon.
d. Apply second application to a dry surface at minimum rate of 40 square yards per gallon.

I. Protection of Concrete:
1. Protect concrete surfaces and appurtenances from traffic for minimum of 14 days.
2. Erect and maintain warning signs, lights, watchmen to direct traffic.
3. Repair or replace parts of concrete surfaces damaged by traffic, or other causes, occurring prior to final acceptance.
4. Protect concrete pavement against public traffic, construction traffic and traffic caused by employees and agents.
5. No equipment shall be driven or moved across concrete surfaces unless such equipment is rubber-tired and only if concrete is designed for and capable of sustaining loads to be imposed by the equipment.
6. Do not drive over new or existing concrete with tracked vehicles and equipment.

J. Painting and Striping:
1. Stripe and mark pavement per the Drawings following sufficient cure time for pavement.
2. Lay out markings with guidelines, templates, and forms.
3. Apply 6 inches wide stripe with self-contained striping machine to a clean and dry pavement surface.
4. Temperature must be above 40 degrees F and precipitation should not be expected during drying period.
5. Use thermoplastic paint; color as approved by the local reviewing authority for the specific use (i.e., white, yellow, blue) complying with FS TT-P-1952F.
6. Apply at 1 GAL per 105 square feet.

K. Opening to Traffic:
1. After 14 days, pavement may, at Owner's discretion, be opened to traffic if job cured test cylinders have attained a compressive strength of 3,000 pounds per square inch when tested in accordance with ASTM standard methods.
2. Prior to opening to traffic, clean and refill joints as required with the specified filler material.

L. Clean Up:

1. Assure clean up work is completed within two weeks after pavement has been opened to traffic.
2. No new work will begin until clean up work has been completed, or is maintained within two weeks after pavement has been opened to traffic.

M. Pavement Patching:
1. Comply with material and density requirements as mentioned elsewhere in this Specification except provide minimum 6 inches aggregate immediately below the patch.
2. Place pavement patch providing a thickened edge.
3. Assure that patch in plane of "cold" joint has a thickness 6 inches greater than that of the existing pavement.
4. Extend patch under existing pavement for a distance of 6 inches minimum.
5. Fill void under existing pavement with concrete.
6. Undercut existing pavement 6 inches all around patch and to a depth of 6 inches.
7. Prior to placing patch, sawcut edge of existing concrete to 1/4 depth and remove to provide a vertical face for a straight and true joint.

3.3 FIELD QUALITY CONTROL

A. Provide test cylinders in accordance with Specification Section 03 05 05 for each 30 CUYD of concrete placed, as requested by the Quality Assurance Testing Engineer.

B. Pavement Thickness Testing:
1. General:
   a. Core pavement to determine the actual thickness as directed by Engineer.
   b. Determine thickness by ASTM C174/C174M.
   c. Fill holes from removal of cores with concrete of the same mixture as specified.
   d. Cost incidental to coring of cores showing a deficiency greater than 1/4 inches shall be paid by the Contractor.
   e. Cost of cores showing a deficiency of 1/4 inches or less shall be paid by the Owner.
   f. If average pavement thickness, as directed by core measurement, is outside specified tolerances, payment will be reduced per PART 1 of this Specification Section.
   g. If deficiency in pavement thickness is 1 inch or more, remove and replace pavement at Contractor's expense.
2. Core categories:
   a. In determining the average thickness of acceptable pavement for which payment will be made, utilize the following core categories:

CATEGORY NUMBER	CORE THICKNESS IN RELATION TO DESIGN	CORE LENGTH USED IN CALCULATING
1	1 inches or more deficiency	NOT USED
2	Less than 1 inch deficiency through 1/2 inches excess	Actual Core Thickness
3	More than 1/2 inches excess	Design Thickness plus 1/2 inches

   b. Core sampling:
      1) Take cores in each lane in each block.
   c. Take cores at locations where the cement content was found to be low when checking the quantities of cement used during the progress of the work.
   d. Each separately poured lane of the pavement to be considered as a unit.
   e. A lane shall be considered to be the pavement surface between longitudinal construction joints, between a longitudinal construction joint and the edge, or between two pavement edges in cases where the entire width of the pavement is poured in one operation.
   f. Should any core show a deficiency in thickness in excess of 1 inch, check cores shall be taken 5 feet on either side of this location parallel to the centerline of the pavement.

g. If both of these cores are within the 1 inch tolerance, no further special borings for this individual zone of deficiency will be made.
h. If either one or both of these cores are not within the 1 inch tolerance, the procedure will be to cut cores in the following order on either side of the original short core parallel to the centerline of the pavement:
    1) 25 feet, 50 feet, the same to be measured from the location of original core found to be deficient in thickness, then at 50 feet intervals until a thickness within the 1 inch tolerance is found in both directions.
    2) On either side of the original deficient core, the procedure will then be to make a coring approximately half the distance within the first core which comes within the 1 inch tolerance.
    3) Repeat the above procedure until the station (+5 feet), at which the pavement comes within the 1 inch tolerance is located.
    4) If for some reason two or more cores are taken at the same station and at least one of them is beyond the 1 inch tolerance, the section of pavement at the station shall be considered as unacceptable.

END OF SECTION

SECTION 32 16 13
CONCRETE CURB AND GUTTER

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Concrete curb and gutter.

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 03 31 30 - Concrete, Materials and Proportioning.
   2. Section 03 31 31 - Concrete Mixing, Placing, Jointing, and Curing.
   3. Section 03 05 05 - Testing.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Association of State Highway and Transportation Officials (AASHTO):
      a. M153,Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
      b. M171, Standard Specification for Sheet Materials for Curing Concrete.
      c. M182, Burlap Cloth Made from Jute or Kenef.
      d. M213, Preformed Expansion Joint Fillers for Concrete Paving and Structure Construction (Nonextruding and Resilient Bituminous Types).
      e. M233, Boiled Linseed Oil Mixture for Treatment of Portland Cement Concrete.
   2. American Concrete Institute (ACI):
      a. 305R, Hot Weather Concreting.
      b. 306R, Cold Weather Concreting.
   3. ASTM International (ASTM):
      a. A615, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
      b. C33, Standard Specification for Concrete Aggregates.
      c. C150, Standard Specification for Portland Cement.
      d. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
      e. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 feet-LB/FT^3).
      f. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
      g. D4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
   4. Federal Specification (FS):
      a. SS-S-1614, Sealants, Joint, Jet-Fuel-Resistant, Hot-Applied for Portland Cement and Tar Concrete Pavements.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
   2. Mix design(s) in accordance with Specification Section 03 31 30 and Specification Section 03 05 05.
   3. Drawings detailing all reinforcing.
   4. Test reports:
      a. Concrete cylinder test results from field quality control.

B. Samples:
   1. Samples of fabricated jointing materials and devices.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Chemical admixtures:
      a. Sika Chemical Corporation.
      b. Master Builders Solutions.
      c. Protex Industries.
      d. W. R. Grace and Company.

2.2 MATERIALS

A. Portland Cement:
   1. ASTM C150, Type I or II.

B. Aggregates:
   1. ASTM C33, gradation size #67, 3/4 inches to #4.

C. Water:
   1. Potable quality.

D. Admixtures:
   1. Comply with Specification Section 03 31 30.

E. Reinforcing Bars:
   1. ASTM A615, Grade 60.

F. Preformed Joint Filler:
   1. Nonextruding cork, self-expanding cork, sponge rubber or cork rubber.
   2. AASHTO M153 or AASHTO M213.

G. Hot-Poured Joint Sealing Material:
   1. FS SS-S-1614.

H. Membrane Curing Compound:
   1. ASTM C309.

I. Cover Materials for Curing:
   1. Burlap:
      a. AASHTO M182.
      b. Minimum Class 2, 8 oz material (1 yard x 42 inches).
   2. Polyethylene film, AASHTO M171.

J. Paper Subgrade Cover:
   1. Polyethylene film, AASHTO M171.

K. Concrete Treatment:
   1. Boiled linseed oil mixture.
   2. AASHTO M233.

L. Forms:
   1. Steel or wood.
   2. Size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment.
   3. Free of distortion and defects.
   4. Full depth.
   5. Metal side forms:

a. Minimum 7/32 inches thick.
b. Depth equal to edge thickness of concrete.
c. Flat or rounded top minimum 1-3/4 inches wide.
d. Base 8 inches wide or equal to height, whichever is less.
e. Maximum deflection 1/8 inches under center load of 1700 pounds.
f. Use flexible spring steel forms or laminated boards to form radius bends.

2.3 MIXES

A. Mix design to provide 4,000 psi 28-day compressive strength, 1-1/2 inches +1 inches slump, 6% air.

B. Comply with Specification Section 03 31 30 and Specification Section 03 31 31.

PART 3 - EXECUTION

3.1 PREPARATION

A. Subgrade Preparation:
1. Prepare using methods, procedures, and equipment necessary to attain required compaction densities, elevation and section.
2. Scarify and recompact top 6 inches of fills and embankments which will be under concrete curb and gutters.
3. Remove soft or spongy areas.
   a. Replace with aggregate material.
4. Compact to the following densities:
   a. Cohesive soils: 95% per ASTM D698.
   b. Noncohesive soils: 75% relative per ASTM D4253 and ASTM D4254.
5. Assure moisture content is within limits prescribed to achieve required compaction density.
6. Following compaction, trim and roll to exact cross section.
7. Check with approved grading template.
8. Perform density tests on subgrade to determine that subgrade complies with the specification.

B. Aggregate Course:
1. Place material in not more than 6 inches thick layers.
2. Spread, shape, and compact all material deposited on the subgrade during the same day.
3. Compact to 75% relative per ASTM D4253 and ASTM D4254.

C. Loose and Foreign Material:
1. Remove loose and foreign material immediately before application of paving.

D. Appurtenance Preparation:
1. Block out or box out curb inlets and curb returns.
2. Provide for joint construction as detailed and dimensioned on Drawings.
3. Adjust manholes, inlets, valve boxes and any other utility appurtenances to design grade.
   a. Secure to elevation with concrete.
   b. Place concrete up to 5 inches below design grade.
4. Clean and oil forms.

3.2 INSTALLATION

A. Concrete Production:
1. Comply with Specification Section 03 31 31.

B. Forms:
1. Form support:
   a. Compact soil foundation and cut to grade to support forms and superimposed machine loads.

b. Use bearing stakes driven flush with bottom of form to supplement support as necessary.
c. Do not use earth pedestals.

2. Staking forms:
   a. Joint forms neatly and tightly.
   b. Stake and pin securely with at least three pins for each 10 feet section.
3. Clean and oil forms prior to placement of concrete.
4. Set forms sufficiently in advance of work (minimum of 2 hours) to permit proper inspection.
5. Previously finished pavement or sidewalk contiguous with new work may serve as side form when specifically approved.

C. Reinforcing:
1. Lap nonwelded bars 12 inches minimum.
2. Support:
   a. Place bars securely on chairs at called-for height.

D. Joints:
1. Hold locations and alignment to within +1/4 inches.
2. Finish concrete surface adjacent to previous section to within +1/8 inches, with tooled radius of 1/4 inches.
3. Expansion joints:
   a. Locate at 48 feet intervals and at all intersection curb returns.
   b. Stake in place load transfer device consisting of dowels.
   c. Supporting and spacing means and premolded joint filler as per Drawing details.
   d. Provide preformed joint filler at all junctions with existing curb and gutter or other structures.
4. Contraction joints:
   a. Locate at 6 feet intervals.
   b. Use steel template at least 1/4 inches thick, conforming to cross section of curb and gutter.
   c. Remove template where concrete has set sufficiently to prevent spalling or adhesion of concrete.
   d. If machine placed, use tooled joint formed in freshly placed concrete.
   e. Groove dimensions shall be 3/8 inches at surface and 1/4 inches at root.
5. Install construction joints at end of day's work or wherever concreting must be interrupted for 30 minutes or more.
6. Thoroughly clean and fill joints with joint sealing material as specified.
7. Upper surface of filled joint to be flush to 1/8 inches below finished surface.

E. Place Concrete:
1. Comply with Specification Section 03 31 31.
2. Construct driveway openings, ramps, and other features as per Drawing details.

F. Cold and Hot Weather Concreting:
1. Cold weather:
   a. Cease concrete placing when descending air temperature in shade falls below 40 DEGF.
   b. Do not resume until ambient temperature has risen to 40 degrees F.
   c. If placing is authorized below 40 degrees F by Engineer, maintain temperature of mix between 60 and 80 degrees F.
   d. Heat aggregates or water or both.
   e. Water temperature may not exceed 175 degrees F.
   f. Aggregate temperature may not exceed 150 degrees F.
   g. Remove and replace frost-damaged concrete.
   h. Salt or other antifreeze is not permitted.
   i. Comply with ACI 306R.
2. Hot weather:

a. Cease concrete placing when plastic mix temperature cannot be maintained under 90 degrees F.
b. Aggregates or water or both may be cooled.
c. Cool water with crushed ice.
d. Cool aggregates by evaporation of water spray.
e. Never batch cement hotter than 160 degrees F.
f. Comply with ACI 305R.

G. Finishing:
1. Bring combination curb and gutter to grade by running straightedge over steel templates with sawing motion.
2. Float surface with a wood float to draw cement to surface.
3. Broom finish after floating.
4. Tool edges with suitable edger.
5. Upon removal of forms, fill honeycombed or unevenly filled sections immediately with cement mortar.
6. Assure that expansion joints are cleared of concrete, both at bottom of gutter and back of curb.

H. Curing:
1. Apply membrane curing compound complying with ASTM C309, and in accordance with manufacturer's directions but at a minimum rate of 200 square feet/GAL.
2. Apply curing compound within 4 hours after finishing or as soon as surface moisture has dissipated.
3. Cure for 7 days.
4. When average daily temperature is below 50 degrees F, provide insulative protection of 12 inches minimum thickness loose dry straw, or equivalent, for 10 days.

I. Protection of Concrete:
1. Protect new curb and gutter and its appurtenances from traffic for minimum of 14 days.
2. Repair or replace parts of curb and gutter damaged by traffic, or other causes, occurring prior to final acceptance.

J. Opening to Traffic:
1. After 14 days, area may, at Owner's discretion, be opened to traffic if job cured test cylinders have attained a compressive strength of 3,000 pounds per square inch when tested in accordance with ASTM standard methods.
2. Prior to opening to traffic, clean and refill joints as required with specified filler material.

K. Clean Up:
1. Assure clean up work is completed within two weeks after work has been opened to traffic.
2. No new work will begin until clean up work has been completed, or is maintained within two weeks after work has been opened to traffic.

3.3 FIELD QUALITY CONTROL

A. Provide test cylinders in accordance with Specification Section 03 05 05 for each __30___ CUYD of concrete placed.

END OF SECTION

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SECTION 32 92 00
SEEDING, SODDING AND LANDSCAPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Seeding, sodding and landscape planting:
      a. Soil preparation.

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 31 22 19 - Finish Grading.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Nursery and Landscape Association/American National Standards Institute (ANLA/ANSI):
      a. Z60.1, American Standard for Nursery Stock.
   2. AOAC International (AOAC).
   3. ASTM International (ASTM):
      a. D2028, Standard Specification for Cutback Asphalt (Rapid-Curing Type).
      b. D5276, Standard Test Method for Drop Test of Loaded Containers by Free Fall.

B. Quality Control:
   1. Fertilizer:
      a. If Engineer determines fertilizer requires sampling and testing to verify quality, testing will be done at Contractor's expense, in accordance with current methods of the AOAC.
      b. Upon completion of Project, a final check of total quantities of fertilizer used will be made against total area seeded.
      c. If minimum rates of application have not been met, Contractor will be required to distribute additional quantities to make up minimum application specified.

1.3 SUBMITTALS

A. Informational Submittals:
   1. Copies of invoices for fertilizer used on Project showing grade furnished, along with certification of quality and warranty.

1.4 SEQUENCING AND SCHEDULING

A. Installation Schedule:
   1. Provide schedule showing when trees, shrubs, groundcovers and other plant materials are anticipated to be planted.
   2. Show schedule of when lawn type and other grass areas are anticipated to be planted.
   3. Indicate planting schedules in relation to schedule for irrigation system installation, finish grading and topsoiling.
   4. Indicate anticipated dates Engineer will be required to review installation for initial acceptance and final acceptance.

B. Pre-installation Meeting:
   1. Meet with Engineer and other parties as necessary to discuss schedule and methods, unless otherwise indicated by Engineer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND SUPPLIERS

A. Subject to compliance with the Contract Documents, the manufacturers and suppliers listed in the applicable Articles below are acceptable.

2.2 MATERIALS

A. Sod:
   1. Viable, dense, strongly rooted, not less than two years old.
   2. 60% Kentucky Bluegrass, 30% Fescue, and 10% other grasses.
   3. Free of weeds and undesirable native grasses.
   4. Strips 12 to 18 inches wide.
   5. Mow prior to stripping from field.
   6. Cut so 3/4 inches of soil is firmly attached to roots.
   7. Not frozen or dormant.

B. Native Grass Seeding: Certified seed of locally adapted strains.

C. Soil Amendments:

D. Asphalt Binder: Emulsified asphalt per State specifications.

E. Water:
   1. Water free from substances harmful to grass or sod growth.
   2. Provide water from source approved prior to use.

PART 3 - EXECUTION

3.1 SOIL PREPARATION

A. General:
   1. Limit preparation to areas which will be planted soon after.
   2. Provide facilities to protect and safeguard all persons on or about premises.
   3. Protect existing trees designated to remain.
   4. Verify location and existence of all underground utilities.
      a. Take necessary precaution to protect existing utilities from damage due to construction activity.
      b. Repair all damages to utility items at sole expense.
   5. Provide facilities such as protective fences and/or watchmen to protect work from vandalism.
      a. Contractor to be responsible for vandalism until acceptance of work in whole or in part.

B. Preparation for Lawn-Type Seeding, Sprigging, Plugging or Sodding:
   1. Loosen surface to minimum depth of 4 inches.
   2. Remove stones over 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter.
   3. Prior to applying fertilizer, loosen areas to be seeded with a double disc or other suitable device if the soil has become hard or compacted.
   4. Correct any surface irregularities in order to prevent pocket or low areas which will allow water to stand.
   5. Distribute fertilizer uniformly over areas to be seeded:
      a. For lawn-type seeding: 30 pounds per 1000 square feet.
      b. For pasture seeding: 200 pounds per acre.
   6. Incorporate fertilizer into soil to a depth of at least 2 inches by disking, harrowing, or other approved methods.
   7. Remove stones or other substances from surface which will interfere with turf development or subsequent mowing operations.
   8. Grade lawn areas to a smooth, even surface with a loose, uniformly fine texture.

a. Roll and rake, remove ridges and fill depressions, as required to meet finish grades.
b. Limit fine grading to areas which can be planted soon after preparation.

9. Restore lawn areas to specified condition if eroded or otherwise disturbed after fine grading and before planting.

3.2 INSTALLATION

A. Lawn-Type and Pasture Seeding:
1. Do not use seed which is wet, moldy, or otherwise damaged.
2. Perform seeding work from April 20 to May 15 for spring planting, and August 1 to September 15 for fall planting, unless otherwise approved by Engineer.
3. Employ satisfactory methods of sowing using mechanical power-driven drills or seeders, or mechanical hand seeders, or other approved equipment.
4. Distribute seed evenly over entire area at rate of application not less than 4 pounds (PLS) of seed per 1000 square feet, 50% sown in one direction, remainder at right angles to first sowing.
5. Stop work when work extends beyond most favorable planting season for species designated, or when satisfactory results cannot be obtained because of drought, high winds excessive moisture, or other factors.
a. Resume work only when favorable conditions develop.
6. Lightly rake seed into soil followed by light rolling or cultipacking.
7. Immediately protect seeded areas against erosion by mulching.
a. Spread mulch in continuous blanket using 1-1/2 tons per acre to a depth of 4 or 5 straws.
8. Protect seeded slopes against erosion with erosion netting or other methods approved by Engineer.
a. Protect seeded areas against traffic or other use by erecting barricades and placing warning signs.
9. Immediately following spreading mulch, anchor mulch using a rolling coulter or a wheatland land packer having wheels with V-shaped edges to force mulch into soil surface, or apply evenly distributed emulsified asphalt at rate of 10-13 GAL/1000 square feet.
a. SS-1 emulsion in accordance with ASTM D5276 or RC-1 cutback asphalt in accordance with ASTM D2028 are acceptable.
b. If mulch and asphalt are applied in one treatment, use SS-1 emulsion with penetration test range between 150-200.
c. Use appropriate shields to protect adjacent site improvements.

3.3 PLANTING TREES, SHRUBS, AND GROUND COVERS

A. Notification:
1. Notify Engineer of source of plants and plant materials at least 30 days prior to planting to permit Engineer's inspection of source qualifications.

B. Preparation:
1. Handle plants so that roots or balls are adequately protected from breakage of balls, from sun or drying winds.
a. Ensure tops or roots of plants are not permitted to dry out.
2. During transportation, protect materials from wind and sun to prevent tops and roots from drying out.
3. Protect tops of plants from damage.
a. Plants with damaged tops will be rejected.
4. For purpose of inspection and planting identification, attach durable, legible labels to bundle or container of plant material delivered at the planting site.
a. State correct plant name and size of each plant in weather-resistant ink on labels.
5. Do not prune trees and shrubs at nursery.

C. Planting Season:

1. Plant deciduous shade trees and shrubs any time the ground is suitable between October 15 and June 1.
2. Plant evergreen material between September 1 and June 1.
3. Plant ground covers between March 15 to June 1.

D. Planting Procedure:
   1. Indicate locations of plants for approval by Engineer before excavating plant locations.
   2. In event underground construction, utilities, obstructions, or rock are encountered in excavation of plantings, secure alternate locations from Engineer.
      a. Make said changes without additional compensation.
      b. Where tree locations fall under existing overhead wires, or crowd existing trees, adjust locations as directed by Engineer.
   3. Excavate pits and beds as necessary and in accordance with ANLA/ANSI Z60.1.
      a. Loosen bottom of pits prior to planting.
      b. Excavation is unclassified, excavate all materials without additional cost.
   4. Tree and shrub pits to be circular in shape with vertical sides at least 1 foot greater in diameter than ball diameter.
      a. Pit to be of sufficient depth to provide 6 inches of planting soil under ball when set to natural grade.
   5. Shrub and ground cover beds:
      a. Plant shrubs used in mass plantings in individual holes of required size.
      b. Strip all sod from among mass planting.
      c. For ground cover beds, remove sod from within limits of bed.
      d. Add soil amendments as specified and mix or rototill with existing topsoil to a depth of 6 inches.
   6. Set plants straight or plumb, in locations when indicated and at such level that after settlement they bear same relationship to finished grade as they did in their former setting.
      a. Carefully tamp planting soil under and around base of balls to prevent voids.
      b. Remove burlap, rope and wires from top of balls.
      c. Do not remove burlap from sides and bottom of balls.
   7. Backfill plants with planting soil.
      a. Tamp to 1/2 depth of pit and thoroughly water and puddle before bringing backfill to proper grade.
      b. After planting has been completed, flood pit again so that backfill is thoroughly saturated and settled.
   8. After planting is complete, form a level saucer 3 inches high around each tree extending to limit of plant pit for watering purposes.
   9. Mulch plant pit after saucer has been shaped.
      a. Mulch to limits of pit and uniformly over ground cover beds to a depth of 3 inches.
      b. In mass plantings of shrubs, mulch entire area uniformly among shrubs to a depth of 3 inches.
      c. If mulching is delayed and soil has dried out, water plants thoroughly before spreading mulch.
   10. Staking: Stake trees immediately after planting as detailed on Drawings or in accordance with Nursery Standards.
   11. Wrap deciduous trees 2 inches or more in caliper by neatly overlapping wrapping material between ground line and second branch.
      a. Place ties at top and bottom of wrapping material and not more than 12 inches apart between top and bottom ties.
   12. Remove dead or damaged branches.
      a. Thin deciduous material to about two-thirds of initial branching.
      b. Remove only dead or damaged branches from evergreens.
   13. Water plants during planting operations.
      a. Water each plant a minimum of once each week until final acceptance.
      b. Apply sufficient water to moisten backfill about each plant so that moisture will extend into the surrounding soil.

3.4 MAINTENANCE AND REPLACEMENT

A. General:
   1. Begin maintenance of planted areas immediately after each portion is planted and continue until final acceptance or for a specific time period as stated below, whichever is the longer.
   2. Provide and maintain temporary piping, hoses, and watering equipment as required to convey water from water sources and to keep planted areas uniformly moist as required for proper growth.
   3. Protection of new materials:
      a. Provide barricades, coverings or other types of protection necessary to prevent damage to existing improvements indicated to remain.
      b. Repair and pay for all damaged items.
   4. Replace unacceptable materials with materials and methods identical to the original specifications unless otherwise approved by the Engineer.

B. Seeded or Sodded Lawns:
   1. Maintain seeded lawns: 90 days, minimum, after installation and review of entire project area to be planted.
   2. Maintenance period begins at completion of planting or installation of entire area to be seeded or sodded.
   3. Engineer will review seeded or sodded lawn area after installation for initial acceptance.
   4. Maintain lawns by watering, fertilizing, weeding, mowing, trimming, and other operations such as rolling, regrading, and replanting as required to establish a smooth, uniform lawn, free of weeds and eroded or bare areas.
   5. Lay out temporary lawn watering system and arrange watering schedule to avoid walking over muddy and newly seeded areas.
      a. Use equipment and water to prevent puddling and water erosion and displacement of seed or mulch.
   6. Mow lawns as soon as there is enough top growth to cut with mower set at recommended height for principal species planted.
      a. Repeat mowing as required to maintain height.
      b. Do not delay mowing until grass blades bend over and become matted.
      c. Do not mow when grass is wet.
      d. Time initial and subsequent mowings as required to maintain a height of 1-1/2 to 2 inches.
      e. Do not mow lower than 1-1/2 inches.
   7. Remulch with new mulch in areas where mulch has been disturbed by wind or maintenance operations sufficiently to nullify its purpose.
      a. Anchor as required to prevent displacement.
   8. Unacceptable plantings are those areas that do not meet the quality of the specified material, produce the specified results, or were not installed to the specified methods.
   9. Replant bare areas using same materials specified.
   10. Engineer will review final acceptability of installed areas at end of maintenance period.
   11. Maintain repaired areas until remainder of maintenance period or approved by Engineer, whichever is the longer period.

END OF SECTION

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SECTION 33 05 07.13
UTILITY DIRECTIONAL DRILLING

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish all supervision, labor, professional and technical services, equipment, materials, surveying, transportation, and supplies to perform the work necessary to install pipe by horizontal directional drilling (HDD) in accordance with the Contract Documents and this specification.
   1. Requirement for Contractor to subcontract the HDD portion of the Work to a HDD subcontractor.

B. Related Requirements: Include but are not necessarily limited to:
   1. Section 31 23 05 - Excavation and Fill
   2. Section 40 05 00 – Pipe and Pipe Fittings – Basic Requirements

C. Completely coordinate with work of all subcontractors, suppliers, vendors, other parties, and other trades.

1.2 GENERAL

A. Utilization of HDD subcontractor:
   1. Retain an HDD subcontractor to provide HDD services.
      a. The HDD subcontractor shall be responsible for all work in this Section.

B. For the purposes of this specification, Contractor shall provide all subcontractors, suppliers, vendors, or other parties the information required to complete work as defined in the Contract Documents and described in this specification.

C. The Owner has or will secure temporary construction easements for workspace and access for drilling sites, as shown on the drawings. Work activities shall remain within the provided easements unless otherwise approved by the Owner and the property owners.

D. All work associated with the preparation of the drilling sites (entry/exit points) and carrier pipe stringing/pullback area, will be at Contractor's expense, unless otherwise stated in the Contract Documents.

E. Contractor shall be responsible for constructing, maintaining, clean up, and restoration for all means of temporary access to the designated work sites and shall include all costs in the bid price and shall be liable for all damages to property within the designated workspaces and easements.

F. Comply with all requirements of permits obtained by the Owner for construction of the pipeline and drilling operations.

G. Contractor is responsible for maintaining a clean and sanitary work site. Transport all waste off-site to an Owner-approved disposal site. Provide the preferred disposal site(s) for Owner's review and approval.

H. Provide and maintain all necessary sanitation facilities (portable toilets, garbage cans, dumpsters, etc.).

I. Adhere to the approved Traffic Control Plans established for the Project.

J. Positively locate and mark existing lines, cables or other underground facilities, including exposing any facilities located within 10 feet of the designed drill path prior to commencing drilling operations. Modify drilling practices and down-hole assemblies to prevent damage to existing facilities, if necessary.

K. Verify civil survey, confirming workspace and temporary workspace boundaries and pertinent survey points and elevations (entry, exit, abrupt changes along the alignment, obstacles being crossed, etc.) at the crossing location.

L. Review and evaluate the subsurface conditions at the crossing location(s) provided in the Contract Documents in preparation for development of execution plans and risk assessments. If, in the opinion of the Contractor, the information in the Contract Documents is insufficient to execute the scope of work, additional subsurface investigations or engineering assessments can be performed by Contractor at no charge to the Owner.

M. Minimize construction delays, when possible, without compromising safety or other project requirements in doing so. Sufficient spare parts for HDD equipment and equipment/tooling necessary for implementing mitigation measures shall be readily available such that equipment failure does not extend construction delays.

1.3 REFERENCES

A. Terminology:

1. Annular Pressure: The drilling fluid pressure acting on the formation measured in the space between the drill pipe and the wall of the drilled hole.
2. Annulus: The space that surrounds either the drill pipe or the carrier pipe and is enclosed by the wall of the drilled hole.
3. Bentonite: Refers to a colloidal clay, composed primarily of montmorillonite that swells when wet. Because of its gel-forming properties, bentonite is a major component of drilling fluids.
4. Bits: Replaceable cutting tools on the front of the bottom hole assembly that is associated with a jetting assembly or positive displacement mud motor. Penetrates the formation to create a hole.
5. Bore or Borehole: The small diameter tunnel created by the initial pilot drilling operation, and subsequent reaming or expanding operations.
6. Bottom Hole Assembly: A pilot hole assembly, including everything in front of the first joint of steel.
7. Carrier Pipe: The pipe that carries the transported product for operational use.
8. Cover: The vertical depth from finish grade (top of pavement, top of railroad ties, natural ground surface, riverbed, etc.) to the top of the casing, carrier pipe, or drill path.
9. Crossing: A pipe reach installed using a trenchless method of construction in which the primary purpose is to provide a passage beneath a surface obstruction.
10. Drill Pipe (Stem): Tubular steel conduit fitted with special threaded ends called tool joints. The drill pipe connects the horizontal drilling rig with the downhole tools and facilitates both pumping drilling fluid and advancing or retracting the downhole tools. Drill Pipe String: One or more connected lengths of drill pipe downhole, behind the Bottom Hole Assembly, in front of the reaming assembly, or behind the reaming assembly, etc.; It can also reference the section of drill pipes downhole extending from entry to exit without a reaming assembly downhole; or the section of drill pipes in front of the pullback assembly used during the pipe pull process.
11. Drilling Fluid (commonly referenced in the field application as Mud): Typically, a mixture of water, bentonite, and/or additive(s) continuously pumped to the cutting head to facilitate the removal of cuttings through suspension of excavated material in the mixture, and stabilization of the drilled hole. In directional drilling, the fluid also cools the head and lubricates the installation of the product pipe.
12. Down-hole: Inside the drilled hole.
13. Entry/Exit Angle: The angle relative to the horizontal plane at which the drill string enters and exits the ground in forming the pilot bore.
14. Grout: A material such as cement slurry, sand or pea gravel that is pumped into voids.
15. Grouting: Filling of the annular space between the casing and carrier pipe; filling of voids and fissures in the surrounding soil or rock strata.

16. Gyroscope Guidance Tool: Refers to a tool used during the pilot hole operation for relaying data from downhole. The gyroscope provides its relative location by referencing the Northing and Easting coordinates that are physically identified and entered into the software for the HDD crossing's entry and exit points. A gyroscopic guidance tool is placed at the leading edge of the drill string (in the bottom hole assembly) and provides data that the steering technician and driller use to steer the pilot hole.
17. Magnetic Steering Tool: Refers to a device, commonly referred to as a "probe," containing instruments that measure inclination, azimuth, and tool face. A magnetic steering tool is placed at the leading edge of the drill string (in the bottom hole assembly) and provides data that the steering technician and driller use to steer the pilot hole.
18. Marsh Funnel: An instrument used to determine viscosity. For trenchless applications, used to determine slurry viscosity. The Marsh funnel test is performed by pouring a slurry sample through a screen at the top of the funnel to trap large particulates. After the funnel is filled, the bottom of the funnel is opened, and the slurry is allowed to flow. The flow rate is calculated as the time period counted in seconds for a quart of slurry to drain out of the funnel.
19. Mud: Often used in reference to the Drilling Fluid defined above.
20. Ovality: The difference between the maximum diameter divided by the mean diameter at any one cross section of a pipe, generally expressed as a percentage.
21. Pipe String: The assembled sections of carrier pipe whose total length is at least equal to or greater than the length of the drilled hole.
22. Product Pipe: Same as carrier pipe.
23. Pullback: That part of the guided drilling and reaming operations of the horizontal directional drilling process in which the pipe string is pulled back through the bore to the launch pit, in some cases simultaneously installing the carrier pipe to its final position.
24. Pull Back Force: The tensile load applied to a drill string during the pullback operation. Guided drilling and directional drilling rigs are generally rated by their maximum pullback force.
25. Roller Cone Reamer: A reamer in which the teeth rotate on separate conical shaped cutting assemblies mounted on internal shafts that are usually aligned perpendicular to line to develop a hole diameter larger than the pilot hole diameter; used for enlarging a hole in relatively rock.
26. Sonde: An instrument used in a bottom hole assembly for transmitting data to a locator, most often used for determining depth and orientation for smaller diameter pilot hole installations.
27. Sonde Housing: Integral unit in the bottom hole assembly that houses the sonde radio sending unit.
28. Trenchless Technology: Refers to a family of methods, materials, and equipment that can be used for installation of new, or replacement or rehabilitation of existing underground utilities with minimal or no disruption to the ground surface along the utility alignment, thereby causing no disruption to traffic, commerce, and other activities, as opposed to excavating open cut pipe trenches and the associated major disruptions to surface activities.

B. Referenced Standards:
   1. American Petroleum Institute (API):
      a. Standard 1104, Welding of Pipelines and Related Facilities.
      b. RP7G, Recommended Practice for Drill Stem Design and Operating Limits.
      c. RP7G-2, Recommended Practice for Inspection and Classification of Used Drill Stem Elements.
      d. RP 13A, Drilling-Fluid Materials.
      e. RP 13B-1, Recommended Practice Standard Procedure for Field Testing Water-Based Drilling Fluids.
   2. Pipeline Research Council International (PRCI) Installation of Pipelines by Horizontal Directional Drilling – An Engineering Design Guide.
   3. American Railway Engineering and Maintenance-of-Way Association Manual (AREMA).
   4. TH Hill Standards DS-1.

5. ISO 13500 – Drilling Fluids Materials — Specifications and Tests.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Product Data:
      a. Description of Equipment: Submit manufacturer's cut sheets or detailed descriptions of planned equipment to be used for the pipeline installation, including drill rig capacity. All texts, drawings, figures and photographs shall be clear and legible.
      b. Product data including specifications describing planned materials to be used for the pipeline installation.
      c. Safety Data Sheets (SDS) for materials, as applicable.
   2. List of Key Personnel and Subcontractors per 3.2.B.
   3. Drilling Schedule per 3.2.C.
   4. Drilling Plan that includes individual plans as listed in 3.2.E.

B. Informational Submittals: Submit the following:
   1. Daily drilling status reports per 3.2.F.
   2. Pilot hole survey report per 3.8.F.
   3. Hydrostatic Testing Plan per 3.11A.
   4. Final Project Report per 3.11.D.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:
   1. Verify field conditions at each launching and receiving location of utility directional drilling prior to commencing utility directional drilling Work.
   2. Comply with requirements of Section 31 23 05 - Excavation and Fill, regarding field conditions and examination.

B. Installing the Work constitutes Contractor's approval of underlying work, subsurface conditions, and other field conditions prevailing at the time of the Work.

3.2 MOBILIZATION

A. Do not proceed with work until the Engineer approves its supervisor, personnel, subcontractors, vendors, Drilling Plan, and schedule. Provide all required documentation, as requested herein, at the specified time identified in the Contract Documents, or 90 days, whichever is sooner.

B. Do not mobilize to site and/or execute any on-site construction activities without Engineer's approval. Additional civil survey work and/or geotechnical investigations carried out by Contractor may be permitted prior to construction, if agreed to by the Owner.

C. All HDD equipment and support equipment shall be in good working condition, in compliance with all laws and regulations, and of suitable capacity to perform the anticipated work.

D. All equipment used throughout construction shall have, and display, valid certificates to comply with the applicable laws and regulations of the regulating agencies. Make copies of such certificates available to Engineer upon request.

E. Install secondary spill containment beneath the HDD rig(s) and power unit(s) so any oil or hydrocarbon leaks can be contained and cleaned.

3.3 DRILLING OPERATIONS

A. Access to Equipment Instruments and Support to Owner's representatives and Engineer:

1. Authorized Representatives and Engineer shall have access inside the drill cab and to all instruments and their readings at all times.

B. Contractor's Key Personnel and Subcontractors:
   1. Provide resumes of key personnel and a list of subcontractors that will be on the project. Provide any update(s) to the list should it change either prior to or during construction.
   2. Provide adequate personnel to supervise all aspects of the directional drilling process and provide all means and methods for crew changes throughout construction.
   3. Owner or Engineer has the right to reject any supervisory personnel changes during construction. Submit 72-hour advance notification of any proposed supervisory personnel changes during construction to Engineer for approval.

C. Drilling Schedule:
   1. Submit a drilling schedule. The schedule shall be job specific and comply with the project schedule specified in the Contract Documents. Update the schedule weekly during drilling operations and resubmit to the Engineer every week during the drilling operations period. The schedule shall address continuity of supervision, quality management, and communication between shifts to address completion of tasks and processes begun in previous shifts or undertaken in subsequent shifts.
   2. At a minimum, the following shall be included in the schedule:
      a. Dates drilling equipment will be prepared for mobilization to site.
      b. Dates for mobilization on site, pilot hole start up, subsequent reaming passes, pullback completion, de-mobilization.
      c. Dates for fabrication (identify if completed prior to commencing drilling) and hydrostatic pre-testing of pullback pipe.
      d. Site preparations (including any casing installations).
      e. Mobilization and rig-up/set-up durations.
      f. Pilot hole drill duration.
      g. Reaming steps with size and duration for each ream pass.
      h. Final hole (swab pass) preparation and pullback duration.
      i. Dates for final hydrostatic testing and internal inspection.
      j. Clean up, restoration, and de-mobilization duration.
      k. Any other site-specific activities required for the particular crossing(s).
      l. Daily work schedule for all phases of the project (i.e. 12- or 24-hour work days and number of shifts); and
      m. Personnel (supervisor and work crews) schedule for the various work shifts and phases.
   3. Submit a 72-hour advance notification prior to any proposed changes in schedule or shutdowns (including holidays) to Engineer for approval. The schedule change or shutdown will not occur without Engineer's approval.

D. Noise Mitigation:
   1. Supply and install noise mitigation mechanisms to meet any and/or all requirements of applicable permits for the Project, if any.
   2. Ensure the equipment used throughout construction meets noise level requirements of the applicable permits, if any.

E. Drilling Plan:
   1. Submit a Drilling Plan within 45 days after receiving Notice to Proceed of the construction contract. Submit any proposed changes to the Drilling Plan after submittal of the initial Drilling Plan. Prior to beginning any work, the Drilling Plan must be approved by Owner.
   2. Approval of the Drilling Plan by Engineer does not relieve Contractor of any responsibility or liability for safety, damages, compliance with permits and regulations, accuracy, or adequacy of the plan for execution of the project. Any operational deviation from the submitted plan, including, but not limited to, change in downhole tooling types/sizes, construction methods, etc. shall be submitted to the Engineer. Engineer shall review and approve any deviations to the Drilling Plan prior to implementation by the Contractor.

3. The Drilling Plan shall be site specific and updated during drilling operations. The Drilling Plan shall not override or change requirements of the Contract Documents without an approved Change Order. The individual plans to be included in the Drilling Plan are listed below. If requested by Engineer, provide supporting data, calculations, and/or other information for each item:
    a. Workspace Layout Plan identifying:
        1) Workspace required to perform the work, if proposing additional to what has been identified in the Contract Documents.
        2) Anticipated layout of all equipment.
        3) Description of secondary containment measures for the drill rig.
        4) Rig anchoring plan and drawings: The drill rig anchoring system shall be sufficient to anchor the rig such that the reported or intended rig capacities can be achieved. When the anchoring system is not part of and/or attached to the drilling rig for demobilization, completely remove it from the site upon completion of drilling.
    b. Equipment Plan identifying:
        1) The size and type of the drilling rig(s), including torque and pulling capacities, and ancillary equipment required for both sides of the HDD crossing.
        2) Size, type, quantities, and purpose of all support equipment and structures that will be used to execute the work.
        3) Drill pipe specifications (grade, size, last inspection date, inspection reports, etc.). Drill pipe, crossover subs, bits, reamers, mud motors, Monel collars, Hevi-Wate, swivels, hole openers and any down-hole tools shall be of suitable size and grade for the work to be performed and be free of defect or damage that may result in a failure. For any tools proposed for the project that may have had prior use and are associated with specified life cycles (i.e. hole openers with roller cones, roller cone bits, etc.), the previously used number of hours and condition(s) for which it/they were used shall be identified to Engineer for review and approval prior to use. Confirm that the equipment is designed in accordance with API RP7G, and inspected in accordance with API RP7G-2 or Standard DS-1 Inspection Category 1, 2, 3, 4, or 5. All tool inspections must be coordinated to allow for Engineer to witness/observe each of the processes, if requested by Engineer. Provide inspection reports to the Engineer prior to the start of construction.
        4) Equipment (pumps, etc.) required to obtain water from the approved sources.
        5) On-site equipment required to continuously monitor sensitive natural areas (as determined by Engineer) during drilling operations.
        6) Storage for pipe, drilling fluid, fresh water, and all other consumables and equipment; and
        7) Spare equipment and parts inventory.
    c. Plan for drilling fluid system (refer to Part 3.3).
    d. Plan for drilling fluid composition (refer to Part 3.4).
    e. Plan for disposal of drilling fluids and cuttings (refer to Part 3.5).
    f. Contingency plan for inadvertent drilling fluid migration and release (refer to Part 3.6).
    g. Noise mitigation plan (if required by a Project permit).
    h. Casing plan, including size and type, length, installation, removal, and grouting plans (refer to Part 3.7, if required).
    i. Pilot Hole execution plan (refer to Part 3.8).
    j. Reaming execution plan (refer to Part 3.9).
    k. Pullback plan with contingency plan for pullback assistance (refer to Part 3.10).
    l. Hydrostatic testing plan (refer to Part 3.11).
    m. Daily Drilling Status Report (refer to Part 3.2.F).
    n. Sample Drilling Fluid Reports (refer to Part 3.4.D).
    o. Drilling fluid and cuttings disposal reports (refer to Part 3.5.C).

F. Reporting of Drilling Status:

1. Submit daily reports to Engineer at end of each work shift. The reports shall include the following information, as applicable to the relevant phases of construction:
    a. Supervisor on site, crew members on site, shifts and time worked.
    b. Description of work, phase of operation, downhole tools in use, and footage completed.
    c. Pilot hole deviations and corrections made.
    d. Maximum and average annular pressure for each joint completed during pilot hole. If required, and as determined necessary by the Engineer, annular pressure for each reamed joint shall be recorded and reported as well.
    e. Maximum torque values on each pilot or reaming joint.
    f. Maximum push/pull force for each pilot or reaming joint.
    g. Penetration rates for each pilot or reaming joint.
    h. Downhole drilling fluid discharge rates, pressures, and pump times for each pilot or reaming joint.
    i. Copy of directional survey report and report from secondary pilot tracking system(s).
    j. Provide X, Y, Z location data from the secondary tracking and directional survey for each joint as compared to the design drill path.
    k. Provide data to calculate minimum vertical, horizontal, and combination radius of each three joint segment of pilot hole.
    l. Provide annotated record documents (e.g. – AutoCAD and printed to PDF "as-built") to represent pilot hole progress to date, any abandoned holes, tools, strings of drill pipe, etc., overlaid on the COMPANY approved Plan and Profile Design drawing.
    m. Water acquisition volumes and daily consumption from each permitted source.
    n. Daily total of Bentonite used and total to date.
    o. Drilling fluid additives in use, including quantities of each.
    p. Loss of drilling fluid circulation and duration.
    q. Quantity of drilling fluid lost or released, and disposition of the fluid released in regard to clean-up.
    r. Disposal quantities of drilling fluid and cuttings.
    s. Disposal bill of lading/trip ticket and lab sample results.
    t. Drilling schedule updates.
    u. Drilling Plan updates.
    v. Drilling fluid system (i.e. product/additive changes, etc.) updates.
    w. Drilling fluid properties report.
    x. List of any submitted and/or approved changes to the Drilling Plan during that shift.
2. When Electronic Data Acquisition System is required by Engineer, it must be used to monitor and record specific operational parameters inclusive of those identified above. An Engineer approved, calibrated system with real-time access to the collected data shall be provided to Engineer at the Contractor's expense.

3.4 DRILLING FLUID MANAGEMENT

A. General:
    1. Obtain, test, report (per shift of operation) volumes used, transport, and store any water required for drilling fluids. Engineer must review and approve water source(s) identified by Contractor prior to use.
    2. Drilling fluid management, including generation, storage, and disposal, shall be in accordance with the applicable state requirements and guidance for drilling fluids disposal, as identified in the Contract Documents.
    3. Monitor facilities and other sensitive areas within 500 feet of the drill path or as specified by the Engineer for drilling fluid migration and release. Perform inspection at least three times per shift or more often if any fluid migration is detected and/or slowed or loss of circulation is observed. Engineer may designate certain facilities/features/areas for full-time monitoring by Contractor during drilling operations.

B. Instrumentation:

1. Provide and maintain instrumentation that will accurately measure drilling fluid discharge rate and pressure. Engineer shall have access to these instruments and their readings at all times.

C. Drilling Fluid Pressures and Circulation:
   1. Take necessary precautions to ensure the drilling fluid pressure in the drilled hole does not exceed what can be contained by the formation to reduce the potential for migration into water bodies, wetlands, utilities, foundations, structures, road and railroad rights of way, or other facilities.
   2. Make every effort to maintain full annular circulation of drilling fluid and recycle the drilling fluid throughout the drilling process. Where recycling of drilling fluid is not practical, make every effort to direct drilling fluid dispersed to designated excavations such as the returns pits at the crossing endpoints. All drilling fluid and cuttings directed to these alternative locations must be gathered and collected within the designated excavations, or as otherwise approved by the Engineer.
   3. Utilize a downhole annular pressure tool for recording and reporting maximum and average annular pressure on each joint completed during pilot hole. When annular pressure(s) are observed that may compromise and/or exceed formation limit pressures, make every effort to reduce downhole annular pressures and to maintain full annular circulation without inducing a hydraulic fracture and/or inadvertent returns.
   4. If annular circulation is lost and drilling fluid returns are not flowing to designated excavations, take steps to restore circulation. If inadvertent surface returns of drilling fluids occur, they shall be immediately handled per the agreed upon contingency plan for inadvertent drilling fluid migration and release. If the amount of surface return exceeds what can be handled per the pre-approved contingency plan, suspend drilling operations until surface return volumes can be controlled, or an alternative plan can be implemented.

D. Drilling Fluid Containment:
   1. Provide suitable containment for all drilling fluids resulting from the drilling operation. Ensure all drilling fluids are contained within the drilled hole, the endpoint excavations, or any fluid tanks used for recirculating fluid.

E. Plan for Drilling Fluid System:
   1. Submit a job specific plan of the proposed drilling fluid mixing system, cleaning system, and drilling fluid pumping capabilities in its Drilling Plan. At a minimum, the plan shall include the following information:
      a. Total volume of mixing tank – (BBLS).
      b. Total volume of cleaning tank – (BBLS).
      c. Scalping shakers – quantity.
      d. Scalping shakers – mesh size.
      e. Desander cones – quantity.
      f. Desander cleaning ability – GPM.
      g. Desander shakers – mesh size.
      h. Desilter cones – quantity.
      i. Desilter cleaning ability – GPM.
      j. Desilter shakers – mesh size.
      k. Centrifuge(s) – quantity.
      l. Centrifuge(s) cleaning ability – GPM.
      m. Drilling fluid pump(s) capabilities (for both entry and exit sides): name brand, liner size, maximum pressure, maximum flow rate (GPM), and gallons per stroke.
      n. Anticipated drilling fluid pump volumes (GPM) to be maintained on each reaming pass, per subsurface conditions identified for project.
      o. Size(s) and type(s) of centrifugal pit pumps or submersible pit pumps.
      p. Anticipated quantity of water required for drilling operations with estimated maximum daily rate to be consumed.
      q. Drilling fluid containment sites and volumes.

3.5 DRILLING FLUID PROPERTIES

A. General:
   1. Composition of drilling fluids and products utilized shall be in accordance with the applicable state and site-specific requirements and guidance for drilling fluids disposal, as identified in the Contract Documents.

B. Drilling Fluid Engineer:
   1. Provide a certified Drilling Fluid Engineer on-site (one Engineer per shift of operation) during all phases of the drilling process.

C. Plan for Drilling Fluid Composition:
   1. Provide, as a component of the Drilling Plan, a description of the drilling fluid composition to be used. The drilling fluid composition shall be determined by the Contractor's drilling fluid engineer(s). The Engineer reserves the right to prohibit the use of materials it deems unsuitable for proper performance of the work or when considered noncompliant with project permits.
   2. The drilling fluid composition plan shall include the following information:
      a. Anticipated drilling fluid composition with SDS sheets, including all proposed additives.
      b. Minimum and maximum viscosities that will be maintained in the anticipated formation(s) to be encountered.
      c. Proposed ideal and maximum percentage of solids (including sand content) to be maintained during all phases of the drilling process. Describe the process that will be implemented should the percentage of solids exceed the proposed maximum.
      d. Proposed ideal and maximum drilling fluid density to be maintained during the drilling process. A description of the process that will be implemented should the drilling fluid density exceed the proposed maximum.
   3. Submit for Engineer's approval SDS sheets for any changes to the drilling fluid composition or use of additives during construction. Engineer must review proposed alternatives and gain permit approval for any changes prior to use of the new product(s) and/or drilling fluid additive(s).
   4. Any additives not included in the plan shall NOT be allowed on-site or used without Engineer's approval and/or clearance with permits.

D. Reporting of Drilling Fluid Properties:
   1. Check drilling fluid properties at least every 2 hours during all phases of drilling operations. The results of these tests shall be recorded during each shift and a copy of the report shall be given to Engineer at the end of each shift. The report shall include the following or as otherwise approved by Engineer:
      a. Daily total of Bentonite used and total to date.
      b. Drilling fluid additives in use.
      c. Density ('mud weight', per API RP 13B-1).
      d. Rheology (including apparent viscosity, plastic viscosity and yield point per API RP 13B-1).
      e. Funnel Viscosity (using Marsh funnel, per API RP 13B-1).
      f. Gel Strength (per API RP 13B-1).
      g. Solids and Sand Content (per API RP 13B-1).
      h. Water loss (filtration, per API RP 13B-1).
      i. Chemical quality of make-up water and drilling fluid (e.g., pH, chlorides, hardness, per API RP 13B-1).

3.6 DISPOSAL OF DRILLING FLUID AND CUTTINGS

A. General:
   1. Promptly remove all waste drilling fluids and associated cuttings collected from job site and haul to an Owner approved facility for proper disposal. Disposal costs shall be borne by the Contractor. Contractor is responsible for all work necessary for disposal and/or containment

within the designated area, including any improvements to the property and including improvements necessary for ingress and egress to the site, and is responsible for all work necessary to clean up and restore property used for beneficial reuse. Bear all costs to clear additional disposal sites requested by the Contractor and approved by Owner.

2. Obtain and maintain current permits for disposal of all solid and liquid wastes at each Owner-approved disposal location.
3. Maintain a steady supply of equipment to keep up with the volume of drilling fluid disposal (drilling fluid, soil, and cuttings) requirements.
4. At any designated location for which containment and disposal of drilling fluid and cuttings has been approved, ensure drilling fluid and/or cuttings do not escape the designated area. Means and methods for directing drilling fluid into, or out of, the prescribed locations is the Contractor's responsibility.

B. Plan for Disposal of Drilling Fluids and Cuttings:
   1. For any drilling fluid and cuttings requiring disposal, include in the Drilling Plan a disposal management plan for excess drilling fluid and cuttings. Notify Engineer of any proposed changes to the plan for approval prior to work starting and throughout construction. At a minimum, the disposal plan shall include:
      a. Description of plans for disposal of the drilling fluid and cuttings.
      b. Drilling fluid disposal and/or containment sites.
      c. Names, addresses, and telephone numbers of subcontractors to be performing any portion of the disposal activities.
      d. Disposal location (to comply with applicable Owner's permits and/or an Owner's authorized location) for disposing drilling fluid and cuttings or other project wastes.
      e. Travel corridors (including alternative routes) to and from the workspace and disposal locations.
      f. Anticipated intervals for disposing of the drilling fluid (duration between loads and volume per load).
      g. Disposal hauling vehicle(s) and vessel(s).
      h. Estimated quantities of drilling fluid and cuttings to be disposed of.
      i. Estimated quantities to be contained in designated containment sites.
      j. Remediation plan for restoration of the containment sites.

C. Disposal Reporting:
   1. Submit daily reports to Engineer, including the following:
      a. Quantity of liquids and solids hauled or transferred away from drill sites.
      b. Physical description of the solids and liquids (drilling fluid, cuttings, hazardous waste, etc.)
      c. Bill(s) of lading/trip ticket(s) for each load hauled off and/or disposed of.
      d. Lab sample results in accordance with Owner disposal permits, if applicable.
   2. Total solids and liquids disposal quantities shall be reported for each disposal site used throughout construction.

3.7 INADVERTENT DRILLING FLUID MIGRATION AND RELEASE

A. General:
   1. Immediately cease drilling and notify Engineer upon detection of drilling fluid-release to the ground surface, water body, or any other sensitive site. Operations shall not resume without Engineer's approval.
   2. Have adequate spill containment measures and collection equipment on site at all times to properly execute the approved contingency plan for inadvertent drilling fluid release.
   3. All areas contaminated by drilling fluid shall be cleaned up and restored to the original condition, meet and/or exceed agency requirements, or as accepted by the Engineer, at Contractor's expense.
   4. Contractor is responsible for damages to structures, foundations, pavements, utilities and/or other facilities affected by drilling fluid migration. Owner's approval shall be required before any remediation efforts are considered complete and acceptable.

B. Contingency Plan for Drilling Fluid Migration and Release:
   1. Submit a site-specific plan for containing, collecting, and cleaning up after inadvertent drilling fluid migration and release as part of the Drilling Plan. At a minimum, the contingency plan shall include:
      a. Monitoring procedure for detecting and/or identifying loss of circulation indicators.
      b. Procedures for monitoring fluid pressure and ranges for acceptable annular pressure.
      c. Decision points and procedures for suspending drilling operations.
      d. Detailed descriptions of all equipment to be used for monitoring, such as the downhole annular pressure tool.
      e. Materials to be utilized for drill continuance such as plugging agents, lost circulation materials, etc.
      f. A list of any pre-identified sensitive areas near the alignment where access and/or methods for containment and cleanup may be limited with proposed plans for addressing the limitations.
      g. An inventory of equipment and materials to be on site for containment/cleanup.
      h. Containment methods.

C. Reporting of Drilling Fluid Migration and Releases:
   1. Submit a report (for each instance) of quantity of drilling fluid released, specific location, phase of operation at which time the event occurred, description of operational conditions, and clean up activity.

3.8 CASING

A. If a casing is required or determined necessary, the following shall apply:
   1. Casing shall be installed into a competent formation that will enable the drilling operations to proceed with minimal loss of drilling fluid at this interface.
   2. Large diameter casing shall be sized adequately to ensure the planned reaming passes can be completed with the casing in-place.
   3. Casing centralizers shall be included in large diameter casing to facilitate the reaming tools and assemblies for entering into the casing.
   4. For large diameter casing, the planned timing and techniques for removal of the casing must be approved by Engineer prior to pullback. Removal prior to pullback and/or post pullback may be approved but is at the discretion of the Engineer.
   5. All concerns associated with the casing(s) presence shall be addressed prior to demobilization and all casings must be removed, unless otherwise approved by the Engineer.
   6. Provide qualified welders to complete welds on the casing.
   7. Engineer reserves the right to require approved non-destructive testing (NDT) completed on all casing welds at the expense of the Contractor.
   8. Grout the annulus between the extracted casing and the installed carrier pipe.
   9. Prepare a Casing Plan and submit to Engineer as part of the Drilling Plan. At a minimum, the Casing Plan shall include:
      a. Location for casing installation.
      b. Anticipated schedule for casing installation.
      c. Length, diameter, wall thickness, and tensile strength.
      d. Methods of installation, anchoring, grouting, and removal; and
      e. Details of centralizers and plan for loading and unloading relative to each phase of drilling operation.

3.9 PILOT HOLE DRILLING, TRACKING, AND SURVEY

A. Magnetic Survey:
   1. At all times, provide and maintain instrumentation to document and accurately locate the pilot hole, to measure drill-string axial and torsional loads, and to measure drilling fluid discharge rate and pressure. Engineer shall have access to these documents and instruments, along with their readings at all times.

2. The pilot hole shall be drilled within the specified tolerances along the path shown on the plan and profile drawing. The position of the drill string shall be monitored with precise magnetic downhole survey instruments and verified with secondary survey location equipment (i.e. TruTracker, ParaTrack, or equal).
3. Provide a description of its downhole survey instruments and surface location equipment and provide a sketch of the coil layout (as applicable) with its Drilling Plan for Engineer approval. Where practical, there shall be no gap in tracking coverage for the entire length of drill path. If a surface tracking system is used, install coils over or under obstacles.
4. The following information shall be recorded prior to commencing the pilot hole operations:
    a. Surveyed elevation and location of the actual ground surface at the endpoints and comparison to the design drawing.
    b. Distance from the drill bit to the down-hole steering tool sensors.
    c. Distance from the rig's pipe break-out point to the entry point.
    d. Length and description of the complete bottom hole assembly including motor, bit, orienting sub and non-magnetic pipe, etc.
5. Compute the position in the X, Y, and Z-axes relative to ground surface from down-hole survey data a minimum of once per length of each joint drilled or jetted (approximately 30-foot interval). Upon exit of the pilot hole bit, take the final survey with the steering tool at the ground elevation. This survey shall be tied-in to the existing exit survey stake.
6. Where surface location equipment is not practical, a gyroscopic steering tool (i.e. Drillguide GST, or equal) or alternative Engineer-approved technology shall be used for the primary and/or secondary survey. See Gyroscopic Survey requirements.

B. Gyroscopic Survey:
1. At all times, provide and maintain instrumentation to document and accurately locate the pilot hole, to measure drill-string axial and torsional loads, and to measure drilling fluid discharge rate and pressure. Engineer shall have access to these documents and instruments, along with their readings at all times.
    a. The pilot hole shall be drilled within the specified tolerances along the path shown on the plan and profile drawing. The position of the drill string shall be monitored with precise gyroscopic downhole survey instruments and, if required, verified with secondary survey location equipment (i.e. Drillguide GST and Drillguide GPS Tracker, or equal).
    b. The Survey & Tracking instruments shall be pre-approved by the Engineer. Provide a description of all Gyroscopic Steering Tool (GST) and Tracking System with the manufacturers specifications. The GST Technology shall only be TRUE North Seeking with a minimum published accuracy of (+/-0.04-degrees Lateral and +/-0.02-degrees Depth). The GST must be a stand-alone system used as the primary survey and reporting system. The tracking technology shall only be used to provide periodic confirmation of the GST position.
    c. The GST shall utilize pre-determined GPS coordinates to establish the Line Azimuth Heading, as well as any points of horizontal turns, based on True North calculations. Provide a sketch of the tracker layout (as applicable) with its Drilling Plan for Engineer approval. There shall be no gap in GST survey coverage for the entire length of drill path.
    d. The following information shall be recorded prior to commencing the pilot hole operations:
        1) Confirmation of surveyed elevations, PI's, PT's, and PC's, and Entry and Exit locations as specified on the drawings.
        2) Stated GPS survey method of Coordinates (State Plane, UTM, WGS84, and etc.)
        3) Distance from the drill bit to the down-hole steering tool sensors;
        4) Distance from the rig's pipe break-out point to the entry point;
        5) Length and description of the complete bottom hole assembly including; motor, bit, orienting sub and non-magnetic pipe, etc.
        6) Compute the position in the X, Y, and Z-axis relative to ground surface, and lateral displacements from down-hole survey data a minimum of once per length of each

joint drilled or jetted (approximately 30-foot interval). The relative survey data is to be reported based on actual Gyroscopic Surveyed Points, where the lateral displacements are based on True North calculations. To assist in accuracies, North Seek operations are to be completed at a minimum in accordance to the individual tools manufactures specifications. Upon exit of the pilot hole bit, take the final survey with the Gyro Steering Tool sensor at the ground elevation. This survey shall be tied-in to the existing exit survey stake.

C. Plan for Pilot Hole Execution:
   1. Submit a plan for the execution of the pilot hole as part of the Drilling Plan. At a minimum, the following information shall be provided:
      a. Confirmation of, and agreement to, HDD design(s) including route, profiles, depth of cover, penetration angles and Engineer-approved minimum radius of curvature, or proposed alternatives. If modifications are proposed, submit detailed plan and profile designs depicting the proposed changes for Engineer's review and approval. An approved Change Order must be obtained for any modifications to the design in the Contract Documents to be executed.
      b. Anticipated and maximum penetration rates and drilling fluid pump volumes to be maintained for the geotechnical formation expected for the crossing.
      c. Type of pilot hole bits (include diameter, type, and historical usage time) and serial numbers for each bit.
      d. Type of pilot hole survey equipment to be utilized and its stated accuracy; and
      e. A sketch of surface tracking system layout (as applicable) and/or alternative tracking devices and their locations proposed for completing the pilot hole.
      f. Submit documentation showing steering tool calibration has been implemented prior to pilot hole operations and subsequent roll test(s) shall be completed during pilot hole operations if the steering tool is tripped out for any reason.

D. Entry/Exit Angle, Horizontal Alignment, and Depth:
   1. The entry and exit points will be staked on the ground or identified as shown on the plan and profile drawing and shall be located by the Contractor using traditional and/or GPS survey methods. Engineer will work with Contractor to determine the impact and assess the need for providing new coordinates for the entry or exit point, assuming site grading is required at entry or exit.
   2. Prior to construction, perform a survey evaluation of the proposed crossing at the specified location to verify the locations shown on the Contract Documents drawings. The survey shall include verification that the location of the HDD entry point(s), the azimuth along the alignment, and the drill exit location(s) are in accordance with the drawings. If the Contractor detects any discrepancies, they shall notify the Engineer immediately. All benchmarks, survey monuments, and other positioning stations shall be maintained.
   3. Pilot hole drill path shall follow the path shown on the drawings and as listed in the table below:

Item	Tolerance
Pilot entry angle	Increase angle up to 1° (steeper) or decrease up to 1° (flatter).
Pilot entry location	As defined on the drawings. No change without Engineer's approval.
Pilot exit angle	Increase angle up to 1° (steeper) or decrease up to 2° (flatter).
Pilot exit location	Up to 20 feet longer or 10 feet shorter than the exit point at the bottom of exit excavation. Between 2 feet left and 2 feet right of HDD centerline shown on the drawings.
Pilot depth	Up to two (2) feet above the designed drill profile or up to 10 feet below the designed drill profile.

Pilot alignment	Shall remain within 2 feet left or right of the HDD centerline shown on the drawings.

E. Pilot Hole Radius:
   1. The pilot hole shall be drilled at a radius equal to that shown on the plan and profile drawing. Deviations and corrections made along the drill path shall not exceed the absolute minimum vertical, horizontal, and combination radius over a three-joint range as shown on drawings.
   2. Calculate the vertical, horizontal, and combination drilled radius over all consecutive three-joint segments using the following formula (assuming range 2 drill pipe):

$$\mathbf{R}_{drilled} = (\mathbf{L}_{drilled}/\boldsymbol{\theta}_3) * \mathbf{180}/\boldsymbol{\pi}$$

Where:

$\mathbf{R}_{drilled}$ = radius of curvature in feet over $\mathbf{L}_{drilled}$
$\mathbf{L}_{drilled}$ = length in feet over any three joints of drill pipe
$\boldsymbol{\theta}_3$ = change in angle over $\mathbf{L}_{drilled}$ in degrees
$\mathbf{180}/\boldsymbol{\pi}$ = unit conversion from radians to degrees = 57.2957795139

Combined radius values shall be calculated as follows:

$$\mathbf{R}_{combined} = \sqrt{(\mathbf{R}_{vertical}^2 * \mathbf{R}_{horizontal}^2)/(\mathbf{R}_{vertical}^2 + \mathbf{R}_{horizontal}^2)}$$

Where:

$\mathbf{R}_{combined}$ = combined three-joint radius
$\mathbf{R}_{vertical}$ = vertical three-joint radius
$\mathbf{R}_{horizontal}$ = horizontal three-joint radius

F. Pilot Hole Survey Reporting:
   1. Deviations between the recorded position of the drill string and the plan and profile drawing, resulting in out-of-project-tolerance and/or radius violations shall be documented and immediately brought to the attention of Engineer. Correction of any deviations shall be at Contractor's sole expense.
   2. Provide in the daily report (i.e. per each shift of operation) to Engineer the computer printout of the directional survey; TruTracker, ParaTrack, Drillguide or equivalent; and data verification reports generated by the downhole survey tool's software. Report data shall be in a format (Excel, CSV, or similar) suitable for independent evaluation of the pilot hole profile. Vertical and horizontal deviations from the designed drill path shall be reported at each surveyed location to ensure the drilled path is within the specified pilot hole tolerances. Provide this information with no additional cost to Owner, even should the pilot hole drilling operation be halted to provide this information.
   3. Also provide the following to Engineer in the daily report:
      a. Maximum torque and push/pull values observed and recorded on each joint drilled. Note reasons for any excessive torque or push force value beyond normal operating conditions.
      b. Penetration rates for each joint drilled/jetted.
      c. Surveyed position of the steering tool on each joint, including azimuth, inclination, elevation, and right/left position relative to the design centerline.
      d. Calculated vertical, horizontal, and combination radius of each three-joint segment of the pilot hole.
   4. At the completion of the pilot hole drilling and prior to initiating the reaming phase of operation, provide a complete tabulation of horizontal and vertical coordinates referenced to the drilled entry point, which accurately describe the location of the pilot hole drill path.

G. Pilot Hole Corrections:
   1. Re-drill or pullback and correct the pilot hole to maintain a drill path within the project tolerances. Provide documentation for verifying the pilot hole is within the specifications.
   2. Contractor is responsible for all costs associated with re-drilling of any portion of the pilot hole, including grouting of abandoned pilot hole(s), or alternative Engineer--approved practice.

3.10 HOLE REAMING

A. General:
   1. Meet with the Engineer and review pilot hole data before the hole-opening process begins. Do not proceed with reaming the hole until the Engineer has approved the pilot hole.

B. Reaming Plan:
   1. Submit a reaming plan as part of the Drilling Plan, which shall include but is not limited to:
      a. Size and type of hole opening tools (provide historical usage time and serial numbers).
         1) All tooling condition must be documented prior to and post hole entry and exit.
      b. Number of reaming and swab passes (include size, direction, and any additional relevant information for each pass).
      c. Anticipated and maximum penetration rates and pump volumes to be maintained for the geology anticipated for the project, as well as, in clay, sand, silt, rock, and gravel; and
      d. Final hole size.
   2. Any proposed changes to Engineer-approved reaming plan resulting from operational observations during construction shall be submitted to Engineer for review and approval prior to implementation.

C. Lost or Lodged Tools:
   1. Any tools or other metal object(s) lost or lodged downhole shall be reported to the Engineer as soon as possible. All metal objects shall be fully recovered prior to the pipe pullback operation, unless specifically approved by Engineer. Fishing tools shall be of adequate size and ability to capture lost tooling. Failure to recover metal objects lost or lodged downhole within a reasonable time period may constitute just cause for rejection of the drilled hole.

3.11 CARRIER PIPE PREPARATION AND PULLBACK

A. Pullback Preparation and Execution Plan:
   1. Submit a plan for the preparation and execution of pulling the carrier pipe into the final reamed hole as part of the Drilling Plan. At a minimum, the following information shall be provided:
      a. Procedural outline, including timeline of events.
      b. Expected pulling loads (include out-of-hole, in-hole, and maximum overall pull loads).
         1) Capabilities and capacity of the rig used to pull the pipe.
         2) Lift equipment and HDD rig anticipated pullback forces to be exerted; and
         3) Anchoring procedures as required.
      c. Equipment and tooling capacities and configurations to be utilized for the pullback assembly and pullhead.
         1) Barrel reamer(s), hole openers, rock shields, swivel, u-joints, shackles, pullhead, etc.; and
         2) Condition of equipment and loading certificates.
      d. Casing removal and pull-through plan (if applicable).
      e. Drilling Fluid Management Plan.
      f. Pullback assembly/pullhead connection including equipment type, size, and positioning for execution. A support plan for pulling the carrier pipe string up to the drilled hole prior to installation shall be included.
      g. Types of equipment anticipated for use and support for handling the carrier pipe during pullback. Plan for carrier pipe fabrication, testing, and pullback support. Number and sizes(s) of pullback equipment (i.e. number of side booms, cranes, and other support equipment).

1) Lifting plan including bending radius calculations for the above-ground pull string accounting for the as-drilled exit angle and actual ground surface behind exit at the time of construction.
2) Pipe supports and roller spacing; and
3) Buoyancy control plan (if to be applied), including control volumes, fill rates, filling methods, etc.

h. Plan for making any mid-pullback fuses, including locations behind exit where the connections will be made.
i. Pullback rates.
j. Contingency Plans.
1) Methods and equipment used in the event the carrier pipe becomes stuck during pullback; and
2) Pipe abandonment.

B. Pipe Preparation Prior to Pullback:
1. The pipe and fuses shall be inspected during fabrication, and immediately prior to setting the pull string in its pre-designated location.
2. Provide a pullhead of suitable condition, strength, and durability to withstand the anticipated external loads during pullback. The pullhead shall be readily available onsite for installation onto the carrier pipe so there are no delays in the pipe preparation process.
3. To minimize torsional stress imposed on the pull section, use a swivel assembly with sufficient capacity for overcoming all potential pull loads that may be exerted for connecting to the pull section. The swivel shall be recently greased prior to pullback and in acceptable working condition.
4. In addition to inspection requirements for all carrier pipe pullback string fuses, Engineer may require inspection on the fused connection between the pullhead and leading end of the carrier pipe.

C. Pipe Pullback:
1. During pullback, the carrier pipe above ground shall be supported in accordance with the approved pullback plan. Ensure the carrier pipe string moves freely on the support equipment cradles and rollers.
2. Provide and maintain instrumentation that will accurately measure drill string axial and torsional loads. Engineer shall have access to these instruments and their readings at all times. The maximum permissible tensile load imposed on the pull section shall be less than the safe pull load reported by the carrier pipe manufacturer or as specified in the contract documents when accounting for axial stress limits (tensile and bending included).
3. Ensure pulling forces do not exceed what the anchored rig can safely withstand. If higher pulling forces are anticipated, implement supplemental support systems for anchoring the equipment with Engineer approval prior to installation.
4. Do not use any hammering or ramming device to aid in the installation of the pipeline. If any pneumatic hammering or ramming devices are used to progress or extract pipe, the entire portion of pipe exposed to the process shall not ever be utilized for product pipe. It shall be removed and replaced without pneumatic means.
5. Install the pipeline in one continuous string with no mid-pullback fuses, unless stated otherwise in the approved Drilling Plan. Make every effort to minimize time between the final ream pass and pullback while ensuring the hole is conditioned and suitable to receive the HDD carrier pipe through one or more successful swab passes. Pullback shall commence immediately after the final (successful) swab pass has been completed. Once the pullback operation begins, installation shall not cease until pullback operations are completed unless otherwise approved by the Engineer.
6. Unless otherwise approved, the section of carrier pipe shall be flooded with water as it is pulled into the prepared hole. Implement buoyancy control during pullback to reduce uplift forces, reduce chances of buckling and decrease pulling loads. Contractor's proposed buoyancy control plan shall be submitted to the Engineer for approval. No plan shall be

used which has not been approved by Engineer. Repair any damage to the pull section resulting from failure to execute the approved buoyancy plan.

7. Modifications to the buoyancy control plan approved for the project shall be used at Contractor's discretion. Any buoyancy control modification procedures proposed for use shall be submitted to Engineer for approval prior to any modifications being started. No procedure may be used that Engineer has not approved. Contractor is responsible for any damage to the pipeline resulting from buoyancy control modification(s).
8. Utilize equipment necessary to lift the pullback section up to match the as-drilled exit angle as the carrier pipe enters the reamed hole, and safely support the pipeline in the break over area.
9. If the carrier pipe pull section becomes lodged in the drilled hole during pullback and cannot be recovered, seal the pipe and existing drilled hole.
10. In the event of failed pullback with abandoned carrier pipe downhole, redesign the crossing. Do not initiate any repeat efforts to install carrier pipe by HDD until Engineer approves the revised design. Bear all costs of re-design, re-drilling, pipe fabrication, and hydrostatic testing to replace any pipe that is not retrieved from an unsuccessful pullback.
11. The pull section shall be installed in the enlarged hole so that pipe stresses are minimized. Any damage to pipe resulting from external forces during installation shall be Contractor's responsibility.
12. The leading end of the HDD carrier pipe shall be pulled out beyond the entry point a sufficient length so that the pipe does not recede back into the hole once the tension is released from the rig and to be cleaned and visually inspected by the Engineer prior to disconnecting the pullhead from the pullback assembly.

3.12 FIELD QUALITY CONTROL

A. Hydrostatic Testing of Installed Pipe:
   1. Prepare for and perform a pre- and/or post-installation hydrostatic test(s) of the carrier pipe per the requirements in Section 40 05 00.
   2. Water source for the pre- and/or post-installation hydrostatic test(s) shall be from Owner-approved locations. Contractor is responsible for all costs (labor, equipment, and material) associated with recording and reporting volume consumed, hauling, filling, and dewatering of pipe section(s) for pre- and/or post-installation hydrotest(s).
   3. Perform any required hydrotests in accordance with the following requirements:
      a. The test section shall be the entire length of pipe installed by HDD.
      b. Test medium shall be water.
      c. The minimum and maximum test pressures shall be per Section 40 05 00 or as directed by the Engineer.
      d. Each support shall have a weight capacity to hold up the water-filled pipe with an appropriate safety factor.

B. Internal Inspection and Geometry of Installed Pipe:
   1. Arrange for internal inspection of the installed pipe unless otherwise specified. Allow the Engineer adequate time to analyze the relevant inspection tool data.
   2. Run a sizing tool through the installed pipe. The gauging pig survey will be considered acceptable if the following results are achieved:
      a. Anomalies can be no larger than 2 percent of the nominal pipe diameter. The depth of a dent shall be measured as the gap between the lowest point of the dent and the original contour of the pipe. Pipe ovality will be considered unacceptable if results indicate ovality greater than 2.5 percent of the nominal pipe diameter. Pipe ovality shall be measured as the percent difference between the maximum and minimum pipe diameters within a span of 5 feet.
   3. Engineer may choose to run a post-installation geometry tool through the HDD segment to evaluate as-installed geometry. The radii of curvature and X, Y, Z positioning of the pipe will be evaluated against project tolerances. The geometry will be considered acceptable if the pipe segment will not be overstressed under the expected operating conditions as determined by Engineer.

C. Acceptance of Installation:
   1. Engineer will review results of the pilot hole survey information, post-installation hydrostatic test data, sizing plate run data, internal pipeline inspection report, and any material inspection data and then determine the acceptability of the installed HDD crossing. Engineer shall notify the Contractor of the final results.

D. Final Reporting:
   1. Compile all daily reports, project documentation, and record documents into a Final Project Report that shall be submitted to the Engineer within 10 days after completion of construction.
   2. Furnish to Engineer a copy of the complete computer printout of the directional survey; TruTracker, ParaTrack, or equivalent; and data verification reports made during the drilling operation. Also provide a plan and profile map of the horizontally drilled section showing the X, Y, and Z coordinates of the final pipeline location. The maximum spacing between coordinate points shall be every joint of drill pipe (approximately every 30 feet).
   3. Furnish record documents within 10 days after the completion of the pilot hole. The annotated record documents must be submitted in both AutoCAD and printed to PDF, representing final approved pilot hole data, any abandoned holes, tools, strings of drill pipe, etc. overlaid on the plan and profile drawing in the Contract Documents.
   4. All data reports and record documents shall be included as part of a comprehensive Final Project Report as required.

3.13 DEMOBILIZATION

A. Do not demobilize equipment from the job site until approved by the Engineer.

3.14 SITE CLEANUP AND RESTORATION

A. Grouting and Sealing of Annulus and Abandoned Holes:
   1. Furnish and inject cement grout into the annulus at entry and exit of completed HDD. The minimum extent of the grouting will be to completely seal and fill the upper 30 linear feet of hole (immediately below tie-in elevation) entirely with grout and a minimum of the top 5 vertical feet filled with backfill material to match surrounding soil conditions. More extensive grouting may be required to prevent ground subsidence or comply with permit requirements, as defined by the Engineer—all of which shall be the responsibility of the Contractor.

B. Backfill of Endpoint Excavations:
   1. Backfill of excavations shall not commence until approved by the Engineer.

C. Remediation of Ground Subsidence and Voids:
   1. Check for voids along all attempted drill paths and the final HDD corridor that are within dry land (not within the river). Fill voids and compact subsoil along installed pipeline and along any abandoned drill path. Restore ground above HDD corridor to original contours and condition including furnishing and installing Engineer-approved fill materials at no additional cost to Owner.

D. Clean Up and Restoration:
   1. Remove all equipment, materials, debris, temporary markers, and other remnants of construction, including trash, and then perform final clean up to restore all work areas to their original (or better) condition in accordance with Contract Documents. Restoration shall include backfilling, compacting, and re-surfacing any excavations at the entry and exit pits, temporary and permanent re-vegetation as applicable and/or as specified in the drawings and Contract Documents.

END OF SECTION

SECTION 33 05 61
CONCRETE MANHOLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Precast concrete round manhole structures and appurtenant items.
      a. Drain manholes and appurtenances.

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 01 33 00 – Submittal Procedures

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. A48/A48M, Standard Specification for Gray Iron Castings.
      b. C150/C150M, Standard Specification for Portland Cement.
      c. C478, Standard Specification for Precast Reinforced Concrete Manhole Sections.
      d. C923, Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals.
      e. D1227, Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing.
      f. D4586, Standard Specification for Asphalt Roof Cement, Asbestos-Free.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
   2. Fabrication and/or layout drawings:
      a. Include detailed diagrams of manholes showing typical components and dimensions, reinforcements and other details.
      b. Itemize, on separate schedule, sectional breakdown of each manhole structure with all components and refer to drawing identification number or notation.
      c. Indicate knockout elevations for all piping entering each manhole.
   3. Buoyancy uplift and structural calculations.
   4. Drawings shall be signed and sealed by a Professional Engineer registered in state corresponding to the project location.

B. Unless approved prior to submittal, submit all products from this Specification Section in one complete submittal package. Include all products and accessories together.

1.4 SITE CONDITIONS

A. For this project, the established high groundwater elevation is 460.00 feet MSL (Mean Sea Level).

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Manhole rings, covers and frames:

a. Neenah Foundry and Neenah Enterprises, Inc.
b. Deeter Foundry.

2. Black mastic joint compound:
   a. Kalktite 340.
   b. Tufflex.
   c. Plastico.
3. Premolded joint compound:
   a. RAM-NEK.
   b. Kent Seal.
4. Emulsified fibrated asphalt compound:
   a. Somebom Hydrocide 700B.

2.2 SANITARY SEWER, STORM AND DRAIN MANHOLE STRUCTURE COMPONENTS

A. Manhole Components:
   1. Reinforcement: ASTM C478.
   2. Minimum wall thickness: 5 inches.
   3. Minimum base thickness: 12 inches.
   4. Provide the following components for each manhole structure:
      a. Base (precast) with integral bottom section or (cast-in-place).
      b. Precast bottom section(s).
      c. Precast barrel section(s).
      d. Precast eccentric transition section.
      e. Precast adjuster ring(s).
      f. Precast concrete transition section.
      g. Precast flat top.
   5. Unless dimensioned or specifically noted on Drawings, provide manhole section with minimum 48 inches inside dimensions.

B. Nonpressure Type Frames and Cover:
   1. Cast iron frame and covers: ASTM A48/A48M, Class 35 (minimum).
   2. Use only cast ductile iron of best quality, free from imperfections and blow holes.
   3. Furnish frame and cover of heavy-duty construction a minimum total weight of 450 pounds.
   4. Machine all horizontal surfaces.
   5. Furnish unit with solid nonventilated lid with concealed pickholes.
   6. Ensure minimum clear opening of 24 inches diameter.

C. Pressure Type Frame and Cover:
   1. Provide covers meeting the requirements of the Nonpressure Type Frames and Cover paragraph above and as modified below.
   2. Furnish frame and bolted cover of heavy-duty construction.
      a. Equip unit with six stainless steel countersunk 3/8 inches diameter by 1-1/2 inches long bolts with stainless steel washers.
   3. Provide solid lid and minimum 1/8 inches thick x 1/2 inches wide continuous strip neoprene gasket.
   4. Furnish unit with a minimum of six anchorage holes and six, 6 inches long x 3/4 inches diameter stainless steel anchor bolts.

D. Special Coatings and Joint Treatment:
   1. Joints of precast sections:
      a. Black mastic compound: ASTM D4586.
   2. Vertical wall surfaces:
      a. Emulsified fibrated asphalt compound meeting ASTM D1227 Type II for all exterior and interior vertical wall surfaces.

E. Sanitary Sewer Manhole Concrete:
   1. Provide all sanitary manholes constructed with Portland ASTM C150/C150M, Type I or II cement with a tricalcium aluminate content not to exceed 8%.

2. Mix aggregate shall be a minimum of 50% crushed limestone.
3. Provide 3000 psi nonshrink grout.

PART 3 - EXECUTION

3.1 MANHOLE CONSTRUCTION

A. General:
   1. Construct cast-in-place concrete base slabs.
   2. Make inverts with a semi-circular bottom conforming to the inside contour of the adjacent sewer sections.
   3. On all straight runs, lay pipe through manhole and cut out top half of pipe.
      a. See detail on Drawings.
      b. If pipes deflect at manhole, shape as specified in Paragraphs 2 and 4 inches this General Paragraph.
   4. Shape inverts accurately and steel trowel finish.
      a. For changes in direction of the sewer and entering branches into the manhole, make a circular curve in the manhole invert using as large a radius as manhole inside diameter will permit.
      b. Pour base slab integral with bottom barrel section.

B. Build each manhole to dimensions shown on plans and at such elevation that pipe sections built into wall of manhole will be true extensions of line of pipe.

C. For all horizontal mating surfaces between concrete and concrete or concrete and metal, above established high groundwater elevation shown trowel apply to clean surface black mastic joint compound to a minimum wet thickness of 1/4 inches immediately prior to mating the surfaces.

D. For horizontal joints that fall below established high groundwater elevation shown, install a resilient O-ring type gasket or pre-molded joint compound.

E. Seal all pipe penetrations in manhole.
   1. Form pipe openings smooth and well shaped.
   2. After installation, seal cracks with, non shrink grout.
   3. After grout cures, wire brush smooth and apply two coats emulsified fibrated asphalt compound to minimum wet thickness of 1/8 inches to ensure complete seal.

F. Set and adjust frame and cover final 6 inches (minimum) to 18 inches (maximum) to match finished pavement or finished grade elevation using precast adjuster rings.

END OF SECTION

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SECTION 33 14 19
FIRE HYDRANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Dry-barrel fire hydrant.

B. Related Sections include but are not necessarily limited to:
   1. Section 01 33 00 – Submittal Procedures
   2. Section 09 96 00 - High Performance Industrial Coatings.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Water Works Association (AWWA):
      a. C502, Standard for Dry-Barrel Fire Hydrants.
      b. M17, Installation, Operation and Maintenance of Fire Hydrants.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Product technical data:
      a. Acknowledgement that products submitted meet the requirements of the standards referenced.
      b. Manufacturer's installation instructions.
      c. Acknowledge and verify dimensions and provide list of integral parts and materials.
   2. Prior to submission of shop drawings, submit one copy of complete submittal information direct to City of Lewisville Fire Department, Attn: Fire Chief, and request and secure written approval of hydrant selection.
      a. Incorporate copies of written approval letter with submittals.

B. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Mueller.
   2. American Flow Control.
   3. Waterous.

2.2 FIRE HYDRANT

A. Design and Fabrication:
   1. Conform to AWWA C502.
   2. Provide with either compression or gate design.
   3. Provide with a 5 inches valve opening, nozzle section consisting of two, 2-1/2 inches hose nozzles and one, 4-1/2 inches steamer.
   4. Provide with water passages to permit full flow of water to minimize friction loss.

5. Furnish with multiple weep holes for positive draining to allow water to escape readily from standpipe when hydrant valve is closed.
6. Designed to throttle flow when partially opened.
7. Designed to allow removal of valve and valve stem without digging up hydrant.
8. Suitable for 5 feet of bury.
9. Furnish with mechanical (gland type) joint inlet connections.
10. Design to break off at ground line when struck by a vehicle.
11. Furnish with O-ring packing only.
12. Furnish hose and steamer nozzles with threads conforming to standard threads used by local Fire Department.
13. Furnish with direction of opening as required by local Fire Department with direction of opening cast on dome.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install hydrants at locations indicated in accordance with AWWA M17 and the following:
   1. Remove foreign material from barrel of hydrant before placement.
   2. Install plumb and at same elevation as connecting pipe and main.
   3. Place each hydrant on a slab of concrete not less than 6 inches thick and 18 inches SQ.
   4. Block backside of hydrant, opposite pipe connection, with concrete firmly wedged between hydrant and vertical face of undisturbed trench.
   5. Place granular bedding material around base of hydrant to the dimensions shown in the Drawings.
   6. Firmly tamp carefully compacted backfill around hydrant to surface of ground and to a distance of 5 feet in front of hydrant.

3.2 COATINGS AND FINISHES

A. Provide hydrant with below grade and above grade coatings as per Section 09 96 00.
   1. Above grade paint color:
      a. Non-potable water service: Purple
      b. Potable water service: Silver

END OF SECTION

SECTION 40 05 00
PIPE AND PIPE FITTINGS - BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Process piping systems.
2. Utility piping systems.
3. Plumbing piping systems.

B. Related Specification Sections include but are not necessarily limited to:
1. Section 09 96 00 - High Performance Industrial Coatings.
2. Section 10 14 00 - Identification Devices.
3. Section 31 23 05 – Excavation and Fill.
4. Section 40 05 07 - Pipe Support Systems.
5. Section 40 05 19 - Ductile Iron Pipe and Fittings
6. Section 40 05 23 - Stainless Steel Process Pipe And Tubing
7. Section 40 05 31 - Plastic Pipe and Fittings
8. Section 40 05 33 – Polyethylene Process Pipe.
9. Section 40 05 37 - Fiberglass Reinforced Polymer Mortar Pipe
10. Section 40 05 51 - Common Requirements for Process and Utility Valves.
11. Section 40 41 13 - Heat Tracing Cable.
12. Section 40 42 00 - Pipe, Duct and Equipment Insulation.
13. Section 40 73 00 - Pressure Instrumentation.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
1. American Association of State Highway and Transportation Officials (AASHTO):
   a. M36, Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains (Equivalent ASTM A760).
   b. M190, Standard Specification for Bituminous Coated Corrugated Metal Culvert Pipe and Pipe Arches.
   c. M252, Standard Specification for Corrugated Polyethylene Drainage Tubing.
   d. M294, Interim Specification for Corrugated Polyethylene Pipe 12 to 24 Inch Diameter.
2. American Iron and Steel Institute (AISI).
3. American Society of Mechanical Engineers (ASME):
   a. B16.3, Malleable Iron Threaded Fittings.
   b. B16.5, Pipe Flanges and Flanged Fittings.
   c. B16.9, Factory-Made Wrought Steel Butt-Welding Fittings.
   d. B16.22, Wrought Copper and Bronze Solder - Joint Pressure Fittings.
   e. B16.26, Cast Copper Alloy Fittings for Flared Copper Tubes.
   f. B36.19, Stainless Steel Pipe.
   g. B40.100, Pressure Gauges and Gauge Attachments.
4. ASTM International (ASTM):
   a. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
   b. A74, Standard Specification for Cast Iron Soil Pipe and Fittings.
   c. A106, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
   d. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
   e. A182, Standard Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.

f. A197, Standard Specification for Cupola Malleable Iron.
g. A234, Standard Specification for Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
h. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
i. A312, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
j. A518, Standard Specification for Corrosion-Resistant High-Silicon Iron Castings.
k. A536, Standard Specification for Ductile Iron Castings.
l. A587, Standard Specification for Electric-Resistance-Welded Low-Carbon Steel Pipe for the Chemical Industry.
m. A760, Standard Specification for Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains.
n. A774, Standard Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures.
o. A778, Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products.
p. B88, Standard Specification for Seamless Copper Water Tube.
q. C14, Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.
r. C76, Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
s. C425, Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings.
t. C443, Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
u. C564, Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
v. C700, Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength and Perforated.
w. D1785, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
x. D2466, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
y. D2467, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
z. D3261, Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
aa. D4101, Standard Specification for Polypropylene Plastic Injection and Extrusion Materials.
bb. F439, Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
cc. F441, Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.

5. American Water Works Association (AWWA):
   a. C207, Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 inches through 144 inches.
   b. C208, Standard for Dimensions for Fabricated Steel Water Pipe Fittings.
   c. C606, Standard for Grooved and Shouldered Joints.
   d. C651, Standard for Disinfecting Water Mains.
   e. C800, Standard for Underground Service Line Valves and Fittings.
6. American Water Works Association/American National Standards Institute (AWWA/ANSI):
   a. C110/A21.10, Standard for Ductile-Iron and Gray-Iron Fittings.
   b. C111/A21.11, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

c. C115/A21.15, Standard for Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
d. C151/A21.51, Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.
e. C153/A21.53, Standard for Ductile-Iron Compact Fittings for Water Service.

7. Cast Iron Soil Pipe Institute (CISPI):
   a. 301, Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
8. International Plumbing Code (IPC).
9. National Fire Protection Association (NFPA):
   a. 69, Standard on Explosion Prevention Systems.
10. Underwriters Laboratories, Inc. (UL).

B. Coordinate flange dimensions and drillings between piping, valves, and equipment.

1.3 DEFINITIONS

A. Hazardous Gas Systems: chlorine gas, sulfur dioxide gas.

B. HDPE: High density polyethylene

C. HPIC: High performance industrial coating.

D. PVDF: Polyvinylidene fluoride.

1.4 SYSTEM DESCRIPTION

A. Piping Systems Organization and Definition:
   1. Piping services are grouped into designated systems according to the chemical and physical properties of the fluid conveyed, system pressure, piping size and system materials of construction.
   2. See PIPING SYSTEMS SCHEDULE in PART 3.

1.5 SUBMITTALS

A. Shop Drawings:
   1. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Copies of manufacturer's written directions regarding material handling, delivery, storage and installation.
      c. Separate schedule sheet for each piping system scheduled in this Specification Section showing compliance of all system components.
         1) Attach technical product data on gaskets, pipe, fittings, and other components.
   2. Fabrication and/or Layout Drawings:
      a. Exterior yard piping drawings (minimum scale 1 inch equals 10 feet) with information including:
         1) Dimensions of piping lengths.
         2) Invert or centerline elevations of piping crossings.
         3) Acknowledgement of bury depth requirements.
         4) Details of fittings, tapping locations, thrust blocks, restrained joint segments, harnessed joint segments, hydrants, and related appurtenances.
         5) Acknowledge designated valve or gate tag numbers, manhole numbers, instrument tag numbers, pipe and line numbers.
         6) Line slopes and vents.
      b. Interior piping drawings (minimum scale 1/8 inches equals 1 foot) with information including:
         1) Dimensions of piping from column lines or wall surfaces.
         2) Centerline dimensions of piping.
         3) Centerline elevation and size of intersecting ductwork, conduit/conduit racks, or other potential interferences requiring coordination.
         4) Location and type of pipe supports and anchors.

5) Locations of valves and valve actuator type.
6) Details of fittings, tapping locations, equipment connections, flexible expansion joints, connections to equipment, and related appurtenances.
7) Acknowledgement of valve, equipment and instrument tag numbers.
8) Provisions for expansion and contraction.
9) Line slopes and air release vents.
10) Rough-in data for plumbing fixtures.

c. Schedule of interconnections to existing piping and method of connection.

B. Contract Closeout Information:
1. Operation and Maintenance Data:
a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

C. Informational Submittals:
1. Qualifications of lab performing disinfection analysis on water systems.
2. Test reports:
a. Copies of pressure test results on all piping systems.
b. Reports defining results of dielectric testing and corrective action taken.
c. Disinfection test report.
d. Notification of time and date of piping pressure tests.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect pipe coating during handling using methods recommended by manufacturer.
1. Use of bare cables, chains, hooks, metal bars or narrow skids in contact with coated pipe is not permitted.

B. Prevent damage to pipe during transit.
1. Repair abrasions, scars, and blemishes.
2. If repair of satisfactory quality cannot be achieved, replace damaged material immediately.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Insulating unions:
a. "Dielectric" by Epco.
2. Strainers (Y type):
a. Mueller (#351).
b. Sarco.
c. Armstrong.
3. Chemical strainers (Y type):
a. Chemtrol.
b. Asahi.
4. Dry disconnect couplings:
a. Kamlock.
5. Dielectric flange kit:
a. PSI.
b. Maloney.
c. Central Plastics.
6. Pipe saddles (for gage installation):
a. Dresser Style 91 (steel and ductile iron systems).
b. Dresser Style 194 (nonmetallic systems).
7. Elastomeric bellows type expansion joints for liquids service:
a. Garlock, Guardian 200/204.

b. PROCO, equivalent model.
c. Red Valve, equivalent model.
d. Or equal.

2.2 PIPING SYSTEMS SCHEDULE

A. Piping system materials, fittings and appurtenances are subject to requirements of specific piping systems schedule located at the end of PART 3 of this Specification Section.

2.3 COMPONENTS AND ACCESSORIES

A. Insulating Components:
   1. Dielectric flange kits:
      a. See Section 40 05 05.20.
   2. Dielectric unions:
      a. Screwed end connections.
      b. Rated at 175 psi, 210 degrees F.
      c. Provide dielectric gaskets suitable for continuous operation at union rated temperature and pressure.

B. Strainers:
   1. Y-type.
   2. Composition bronze.
   3. Rated for test pressure and temperature of system in which they are installed.
   4. 20 mesh Monel screen.
   5. Threaded bronze plug in the blowoff outlet.
   6. Threaded NPT end connections.

C. Reducers:
   1. Furnish appropriate size reducers and reducing fittings to mate pipe to equipment connections.
   2. Connection size requirements may change from those shown on Drawings depending on equipment furnished.

D. Protective Coating and Lining:
   1. Include pipe, fittings, and appurtenances where coatings, linings, coating, tests and other items are specified.
   2. Piping systems scheduled in the PIPING SYSTEM SCHEDULES Article of this Section that are indicated to receive HPIC per Specification Section 09 96 00 shall receive surface preparation and primer applied in the fabrication facility, at the coating applicator's shop, or other off-site location acceptable to the Engineer. Intermediate and topcoats are to be field applied unless noted otherwise.

E. Underground Warning Tape:
   1. See Specification Section 10 14 00.

F. Pressure Gages:
   1. See Specification Section 01 61 03 and Specification Section 40 73 00.

G. Quick-Disconnect Couplings:
   1. Furnish cam and groove style couplings with NPT connections in 304 SST materials unless otherwise specified elsewhere. Furnish cap or plug in same materials at each fitting. 150 psig minimum pressure rating.

H. Valves:
   1. See schematics and details for definition of manual valves used in each system under 4 inches in size.
      a. See Specification Section 40 05 51 schedule for valve types 4 inches and above and for automatic valves used in each system.
   2. See Specification Section 40 05 51.

I. Elastomeric Bellows Type Expansion Joints for liquids service:
   1. Air piping: Refer to stainless steel Specification 40 05 23.
   2. Flanges: ANSI 125/150.
   3. Materials:
      a. Bellows:
         1) Sludge service: Natural rubber.
         2) Hot Water (over 100 degrees F): EPDM.
         3) All other: Compatible with fluid.
      b. Restraint:
         1) Provide restraint limit bolts (control rods) and nuts to restrain joint at test pressure of piping.
         2) Control rod material: 316 stainless steel.
      c. Working pressure: Equal to or greater than test pressure of connecting piping.
      d. Minimum axial movement: 3/8 inches.
   4. Arches:
      a. Sludge service: Provide single filled arches unless otherwise stated on the Drawings.
      b. All other service: Provide double open arches unless otherwise stated on the Drawings.

PART 3 - EXECUTION

3.1 EXTERIOR BURIED PIPING INSTALLATION

A. Unless otherwise shown on the Drawings, provide a minimum of 4 feet and maximum of 8 feet earth cover over exterior buried piping systems and appurtenances conveying water, fluids, or solutions subject to freezing.

B. Enter and exit through structure walls, floors, and ceilings by using penetrations and seals specified in Specification Section 01 73 20 and as shown on Drawings.

C. When entering or leaving structures or passing beneath the vertical projection of a structure wall use restrained flexible joint piping with first joint installed within 1 - 2 feet of point where pipe enters or leaves structure.
   1. Install second joint not more than 6 feet nor less than 4 feet from first joint.

D. When entering or leaving structures with buried mechanical joint piping, install joint within 1 - 2 feet of point where pipe enters or leaves structure.
   1. Install second joint not more than 6 feet nor less than 4 feet from first joint.

E. Install expansion devices as necessary to allow expansion and contraction movement.

F. Laying Pipe In Trench:
   1. Excavate and backfill trench in accordance with Specification Section 31 23 05.
   2. Clean each pipe length thoroughly and inspect for compliance to specifications.
   3. Grade trench bottom and excavate for pipe bell and lay pipe on trench bottom.
   4. Install gasket or joint material according to manufacturer's directions after joints have been thoroughly cleaned and examined.
   5. Except for first two joints, before making final connections of joints, install two full sections of pipe with earth tamped alongside of pipe or final with bedding material placed.
   6. Lay pipe in only suitable weather with good trench conditions.
      a. Never lay pipe in water except where approved by Engineer.
   7. Seal open end of line with watertight plug if pipe laying stopped.
   8. Remove water in trench before removal of plug.

G. Lining Up Push-On Joint Piping:
   1. Lay piping on route lines shown on Drawings.
   2. Deflect from straight alignments or grades by vertical or horizontal curves or offsets.
   3. Observe maximum deflection values stated in manufacturer's written literature.

4. Provide special bends when specified or where required alignment exceeds allowable deflections stipulated.
5. Install shorter lengths of pipe in such length and number that angular deflection of any joint, as represented by specified maximum deflection, is not exceeded.

H. Anchorage and Blocking:
1. Provide reaction blocking, thrust collars, anchors, joint harnesses, or other acceptable means for preventing movement of piping caused by forces in or on buried piping tees, wye branches, plugs, or bends.
2. Place concrete blocking so that it extends from fitting into solid undisturbed earth wall.
   a. Concrete blocks shall not cover pipe joints.
3. Provide thrust collars or concrete blocking at all connections to existing piping for the purpose of providing restraint along existing alignments.

I. Install underground hazard warning tape per Specification Section 10 14 00.

J. Install insulating components where dissimilar metals are joined together.

3.2 INTERIOR AND EXPOSED EXTERIOR PIPING INSTALLATION

A. Install piping in vertical and horizontal alignment as shown on Drawings.

B. Alignment of piping smaller than 4 inches may not be shown; however, install according to Drawing intent and with clearance and allowance for:
1. Expansion and contraction.
2. Operation and access to equipment, doors, windows, hoists, moving equipment.
3. Headroom and walking space for working areas and aisles.
4. System drainage and air removal.

C. Enter and exit through structure walls, floor and ceilings using penetrations and seals specified in Specification Section 01 73 20 and as shown on the Drawings.

D. Install vertical piping runs plumb and horizontal piping runs parallel with structure walls.

E. Pipe Support:
1. Use methods of piping support as shown on Drawings and as required in Specification Section 40 05 07.
2. Where pipes run parallel and at same elevation or grade, they may be grouped and supported from common trapeze-type hanger, provided hanger rods are increased in size as specified for total supported weight.
   a. The pipe in the group requiring the least maximum distance between supports shall set the distance between trapeze hangers.
3. Size pipe supports with consideration to specific gravity of liquid being piped.

F. Locate and size sleeves and castings required for piping system.
1. Arrange for chases, recesses, inserts or anchors at proper elevation and location.

G. Use reducing fittings throughout piping systems.
1. Bushings will not be allowed unless specifically approved.

H. Equipment Drainage and Miscellaneous Piping:
1. Provide drip pans and piping at equipment where condensation may occur.
2. Hard pipe stuffing box leakage to nearest floor drain.
3. Avoid piping over electrical components such as motor control centers, panelboards, etc.
   a. If piping must be so routed, utilize 16 GA, 316 stainless steel drip pan under piping and over full length of electrical equipment.
   b. Hard pipe drainage to nearest floor drain or clearwell.
4. Collect system condensate at drip pockets, traps and blowoff valves.
5. Provide drainage for process piping at locations shown on Drawings in accordance with Drawing details.

6. For applications defined above and for other miscellaneous piping which is not addressed by a specific piping service category in PART 1, provide 304 stainless steel piping and fittings.
    a. Size to handle application with 3/4 inches being minimum size provided.

I. Unions:
1. Install in position which will permit valve or equipment to be removed without dismantling adjacent piping.
2. Mechanical type couplings may serve as unions.
3. Additional flange unions are not required at flanged connections.

J. Install expansion devices as necessary to allow expansion/contraction movement.

K. Provide full face gaskets on all systems.

L. Anchorage and Blocking:
1. Block, anchor, or harness exposed piping subjected to forces in which joints are installed to prevent separation of joints and transmission of stress into equipment or structural components not designed to resist those stresses.

M. Equipment Pipe Connections:
1. Equipment - General:
    a. Exercise care in bolting flanged joints so that there is no restraint on the opposite end of pipe or fitting which would prevent uniform gasket pressure at connection or would cause unnecessary stresses to be transmitted to equipment flanges.
    b. Where push-on joints are used in conjunction with flanged joints, final positioning of push-on joints shall not be made until flange joints have been tightened without strain.
    c. Tighten flange bolts at uniform rate which will result in uniform gasket compression over entire area of joint.
        1) Provide tightening torque in accordance with manufacturer's recommendations.
    d. Support and match flange faces to uniform contact over their entire face area prior to installation of any bolt between the piping flange and equipment connecting flange.
    e. Permit piping connected to equipment to freely move in directions parallel to longitudinal centerline when and while bolts in connection flange are tightened.
    f. Align, level, and wedge equipment into place during fitting and alignment of connecting piping.
    g. Grout equipment into place prior to final bolting of piping but not before initial fitting and alignment.
    h. To provide maximum flexibility and ease of alignment, assemble connecting piping with gaskets in place and minimum of four bolts per joint installed and tightened.
        1) Test alignment by loosening flange bolts to see if there is any change in relationship of piping flange with equipment connecting flange.
        2) Realign as necessary, install flange bolts and make equipment connection.
    i. Provide utility connections to equipment shown on Drawings, scheduled or specified.
2. Plumbing and HVAC equipment:
    a. Make piping connections to plumbing and HVAC equipment, including but not limited to installation of fittings, strainers, pressure reducing valves, flow control valves and relief valves provided with or as integral part of equipment.
    b. Furnish and install sinks, fittings, strainers, pressure reducing valves, flow control valves, pressure relief valves, and shock absorbers which are not specified to be provided with or as integral part of equipment.
    c. For each water supply piping connection to equipment, furnish and install union and gate or angle valve.
        1) Provide wheel handle stop valve at each laboratory sink water supply.
        2) Minimum size: 1/2 inches.
    d. Furnish and install "P" trap for each waste piping connection to equipment if waste is connected directly to building sewer system.
        1) Size trap as required by IPC.

e. Stub piping for equipment, sinks, lavatories, supply and drain fittings, key stops, "P" traps, miscellaneous traps and miscellaneous brass through wall or floor and cap and protect until such time when later installation is performed.

N. Provide insulating components where dissimilar metals are joined together.

O. Instrument Connections:
1. See drawing details.

3.3 CONNECTIONS WITH EXISTING PIPING

A. Where connection between new work and existing work is made, use suitable and proper fittings to suit conditions encountered.

B. Perform connections with existing piping at time and under conditions which will least interfere with service to customers affected by such operation.

C. Undertake connections in fashion which will disturb system as little as possible.

D. Provide suitable equipment and facilities to dewater, drain, and dispose of liquid removed without damage to adjacent property.

E. Where connections to existing systems necessitate employment of past installation methods not currently part of trade practice, utilize necessary special piping components.

F. Where connection involves potable water systems, provide disinfection methods as prescribed in this Specification Section.

G. Once tie-in to each existing system is initiated, continue work continuously until tie-in is made and tested.

3.4 HEAT TRACING AND INSULATION

A. See Specification Section 40 41 13 (Heat Tracing Cable) and Section 40 42 00 (Pipe, Duct, and Equipment Insulation).

3.5 PRESSURE GAGES

A. Provide at locations shown on the Drawings and specified.

B. See Specification Section 01 61 03.

3.6 FIELD QUALITY CONTROL

A. Pipe Testing - General:
1. Test piping systems as follows:
a. Test exposed, non-insulated piping systems upon completion of system.
b. Test exposed, insulated piping systems upon completion of system but prior to application of insulation.
c. Test concealed interior piping systems prior to concealment and, if system is insulated, prior to application of insulation.
d. Test buried piping (insulated and non-insulated) prior to backfilling and, if insulated, prior to application of insulation.
e. Provide complete retesting of buried systems after backfilling has been completed.
2. Isolate equipment which may be damaged by the specified pressure test conditions.
a. Isolate Blowers and blower-manufacturer-furnished appurtenances on suction piping from pressure testing.
3. Perform pressure test using calibrated pressure gages and calibrated volumetric measuring equipment to determine leakage rates.
a. Select each gage so that the specified test pressure falls within the upper half of the gage's range.
b. Notify the Owner's representative 24 hours prior to each test.
4. Completely assemble and test new piping systems prior to connection to existing pipe systems.

5. Acknowledge satisfactory performance of tests and inspections in writing to Engineer prior to final acceptance.
6. Bear the cost of all testing and inspecting, locating and remedying of leaks and any necessary retesting and re-examination.

B. Pressure Testing:
1. Testing medium: Unless otherwise specified in the PIPING SYSTEMS SCHEDULE, utilize the following test media.
   a. Process systems: Water
   b. Laboratory gases and natural gas systems: Cylinder nitrogen.
   c. Plant Drain: Water or Air
   d. Liquid systems:

PIPE LINE SIZE (DIA)	GRAVITY OR PUMPED	SPECIFIED TEST PRESSURE	TESTING MEDIUM
Up to and including 48 inches	Gravity	25 psig or less	Water
Above 48 inches	Gravity	25 psig or less	Water
All sizes	Pumped	250 psig or less	Water

2. Allowable leakage rates:
   a. Hazardous gas systems, all exposed piping systems, all pressure piping systems and all buried, insulated piping systems which are hydrostatically pressure tested shall have zero leakage goal at the specified test pressure throughout the duration of the test.
   b. Hydrostatic exfiltration and infiltration for sanitary and stormwater sewers (groundwater level is below the top of pipe):
      1) Leakage rate: 200 GAL per inch diameter per mile of pipe per day at average head on test section of 3 feet.
      2) Average head is defined from groundwater elevation to average pipe crown.
      3) Acceptable test head leakage rate for heads greater than 3 feet: Acceptable leakage rate (gallons per inch diameter per mile per day) equals 115 by (actual test head to the 1/2 power).
   c. Hydrostatic infiltration test for sanitary and stormwater sewers (groundwater level is above the top of pipe):
      1) Allowable leakage rate: 200 GAL per inch diameter per mile of pipe per day when depth of groundwater over top of pipe is 2 to 6 feet.
      2) Leakage rate at heads greater than 6 feet: Allowable leakage rate (gallons per inch diameter per mile of pipe per day) equals 82 by (actual head to the 1/2 power).
   d. Large diameter (above 48 inches) gravity plant piping systems shall have a maximum exfiltration of 25 GPD per inch-mile.
   e. Non-hazardous gas and air systems which are tested with air shall have a maximum pressure drop of 5% of the specified test pressure throughout the duration of the test.
   f. For low pressure (less than 25 psig) air testing, the acceptable time for loss of 1 psig of air pressure shall be:

PIPE SIZE (IN DIA)	TIME, MINUTES/100 feet
4	0.3
6	0.7
8	1.2
10	1.5
12	1.8

PIPE SIZE (IN DIA)	TIME, MINUTES/100 feet
15	2.1
18	2.4
21	3.0
24	3.6
27	4.2
30	4.8
33	5.4
36	6.0
42	7.3
48	7.6

3. Hydrostatic pressure testing methodology:
   a. General:
      1) All joints, including welds, are to be left exposed for examination during the test.
      2) Provide additional temporary supports for piping systems designed for vapor or gas to support the weight of the test water.
      3) Provide temporary restraints for expansion joints for additional pressure load under test.
      4) Isolate equipment in piping system with rated pressure lower than pipe test pressure.
      5) Do not coat or insulate exposed piping until successful performance of pressure test.
   b. Soil, waste, drain and vent systems:
      1) Test at completion of installation of each stack or section of piping by filling system with water and checking joints and fittings for leaks.
      2) Eliminate leaks before proceeding with work or concealing piping.
      3) Minimum test heights shall be 10 feet above highest stack inlet.
   c. Larger diameter (above 36 inches) gravity plant piping:
      1) Plug downstream end of segment to be tested.
         a) Provide bracing as required.
      2) Fill segment and upstream structure to normal operating level as per hydraulic profile.
      3) Allow 24 hours for absorption losses.
         a) Refill to original level.
      4) Provide reservoir to maintain constant head over duration of test.
      5) Record reservoir water volume at beginning and end of test.
4. Air testing methodology:
   a. General:
      1) Assure air is ambient temperature.
   b. Low pressure air testing:
      1) Place plugs in line and inflate to manufacturer's designated seal pressure.
      2) Check plugs for proper sealing.
      3) Introduce low pressure air into sealed line segment until air pressure reaches 4 psig greater than ground water or allowable limits of ASTM F1417.
         a) Use test gage conforming to ASME B40.100 with 0 to 15 psi scale and accuracy of 1% of full range.
      4) Allow 2 minutes for air pressure to stabilize.
      5) After stabilization period (3.5 psig minimum pressure in pipe) discontinue air supply to line segment.

6) Record pressure at beginning and end of test.

C. Dielectric Testing Methods and Criteria:
   1. Provide electrical check between metallic non-ferrous pipe or appurtenances and ferrous elements of construction to assure discontinuity has been maintained.
   2. Wherever electrical contact is demonstrated by such test, locate the point or points of continuity and correct the condition.

3.7 CLEANING, DISINFECTION AND PURGING

A. Cleaning:
   1. Clean interior of piping systems thoroughly before installing.
   2. Maintain pipe in clean condition during installation.
   3. Before joining piping, thoroughly clean and wipe joint contact surfaces and then properly dress and make joint.
      a. Pig high pressure air piping before connecting to valves or instruments.
   4. At completion of work and prior to Final Acceptance, thoroughly clean work installed under these Specifications.
      a. Clean equipment, fixtures, pipe, valves, and fittings of grease, metal cuttings, and sludge which may have accumulated by operation of system, from testing, or from other causes.
      b. Repair any stoppage or discoloration or other damage to parts of building, its finish, or furnishings, due to failure to properly clean piping system, without cost to Owner.
   5. After erection of piping and tubing, but prior to installation of service outlet valves, blow systems clear of free moisture and foreign matter by means of air, nitrogen or carbon dioxide.
      a. Oxygen shall never be used.

B. Disinfection of Potable Water Systems:
   1. After favorable performance of pressure test and prior to Final Acceptance, thoroughly flush entire potable water piping system including supply, source and any appurtenant devices and perform disinfection as prescribed.
   2. Perform work, including preventative measures during construction, in full compliance with AWWA C651.
   3. Perform disinfection using sodium hypochlorite complying with AWWA B300.
   4. Flush each segment of system to provide flushing velocity of not less than 2.5 feet per second.
   5. Drain flushing water to sanitary sewer.
      a. Do not drain flushing water to receiving stream.
   6. Use continuous feed method of application.
      a. Tag system during disinfection procedure to prevent use.
   7. After required contact period, flush system to remove traces of heavily chlorinated water.
   8. After final flushing and before placing water in service, obtain an independent laboratory approved by the Owner to collect samples and test for bacteriological quality.
      a. Repeat entire disinfection procedures until satisfactory results are obtained.
   9. Secure and deliver to Owner, satisfactory bacteriological reports on samples taken from system.
      a. Ensure sampling and testing procedures are in full compliance to AWWA C651, local water purveyor and applicable requirements of State of Texas.

3.8 LOCATION OF BURIED OBSTACLES

A. Furnish exact location and description of buried utilities encountered and thrust block placement.

B. Reference items to definitive reference point locations such as found property corners, entrances to buildings, existing structure lines, fire hydrants and related fixed structures.

C. Include such information as location, elevation, coverage, supports and additional pertinent information.

D. Incorporate information on "As-Recorded" Drawings.

3.9 PIPE INSULATION

A. Insulate pipe and pipe fittings in accordance with Specification Section 40 42 00.

3.10 PIPING SYSTEM SCHEDULES

A. Piping System 2 – Buried and Exposed, Ductile Iron and Polyethylene, Gravity and Low-Head, Process Piping within a Facility (up to 60-inch diameter).
   1. General:
      a. Piping symbol and service:
         1) ABI-DIP – Aeration Basin Influent.
         2) ABI-HDPE – Aeration Basin Influent.
         3) DR – Drain
         4) MLR-DIP – Mixed Liquor Recycle (only where specifically noted on Drawings as DIP)
         5) RS-HDPE – Raw Sewage
         6) RS-DIP – Raw Sewage
         7) SCE – Secondary Clarifier Effluent
         8) SCI – Secondary Clarifier Influent
      b. Test requirements:
         1) Test medium: Water.
         2) Pressure: 25 psiG.
         3) Duration: 6 hours.
      c. Gaskets:
         1) Push-on, and mechanical joints (ductile iron): Rubber, AWWA/ANSI C111/A21.11.
         2) Flange gaskets: Bulb ring SBR per Section 40 05 05.20.
      d. Flange hardware: Type 316 stainless steel per Section 40 05 05.20.
   2. System Components:
      a. Pipe size up to 60 inches:
         1) Exposed service:
            a) Material: Ductile iron, Class 53.
            b) Reference: AWWA/ANSI C115/A21.15.
            c) Lining: Ceramic Epoxy.
            d) Coating: HPIC; See Specification Section 09 96 00.
            e) Fittings: Either AWWA/ANSI C110/A21.10 ductile or gray iron.
            f) Joints: AWWA/ANSI C115/A21.15 flanged.
         2) Buried service:
            a) Ductile iron piping for all indicated services other than indicated below in Item b.
               (1) Materials: Ductile iron, Class 150.
               (2) Reference: AWWA/ANSI C151/A21.51.
               (3) Lining: Ceramic Epoxy.
               (4) Coating: Bituminous.
               (5) Fittings:
                  (a) Either AWWA/ANSI C110/A21.10 ductile or gray iron.
                  (b) Optional: AWWA/ANSI C153/A21.53 ductile iron compact fittings for sizes 3 inches to 16 inches.
               (6) Joints: restrained joints or lug-style restrained mechanical joint glands as specified in Section 40 05 19.
            b) RS-HDPE and ABI-HDPE services, HDPE piping in locations indicated on the Drawings.
               (1) Materials: Polyethylene, PE4710, DR21.
               (2) Reference: AWWA C906.
               (3) Lining: None.

(4) Coating: None.
(5) Fittings:
(a) Either molded or fabricated HDPE fittings shall be used per 40 05 33, unless indicated otherwise on the drawings.
(b) Either AWWA/ANSI C110/A21.10 ductile or gray iron.
(6) Joints:
(a) Butt fusion per Section 40 05 33 unless indicated otherwise on the drawings.
(b) Restrained joints or lug-style restrained mechanical joint glands in accordance with Section 40 05 33.

B. Piping System 3 – Buried and Exposed, Ductile Iron, Process Piping Operating Under Pressure at up to 100 psig.
1. General:
a. Piping symbol and service:
1) WAS – Waste Activated Sludge
2) RAS-DIP – Return Activated Sludge
3) RAS-HDPE – Return Activated Sludge
b. Test requirements:
1) Test medium: Water.
2) Pressure: 1.25 x working pressure.
3) Duration: 6 hours.
c. Gaskets:
1) Push-on and mechanical joints (ductile iron): Rubber, AWWA/ANSI C111/A21.11.
2) Flange gaskets: Bulb ring SBR per Section 40 05 05.20.
d. Flange hardware: Type 316 stainless steel per Section 40 05 05.20.
2. System components:
a. Pipe Size - All:
1) Exposed service:
a) Material: Ductile iron, Class 53
b) Reference: AWWA/ANSI C115/A21.15.
c) Lining: Ceramic Epoxy. See Section 40 05 19.
d) Coating: HPIC; See Specification Section 09 96 00.
e) Fittings: Either AWWA/ANSI C110/A21.10 ductile or gray iron.
f) Joints:
(1) Flanged.
(2) Provide screwed-on flanges at equipment, valves and structure penetrations.
2) Buried service for WAS and RAS-DIP:
a) Materials: Ductile iron, Class 150.
b) Reference: AWWA/ANSI C151/A21.51.
c) Lining: Ceramic Epoxy.
d) Coating: Zinc with bituminous.
e) Fittings:
(1) Either AWWA/ANSI C110/A21.10 ductile or gray iron.
(2) Optional: AWWA/ANSI C153/A21.53 ductile iron compact fittings for sizes 3 inches to 16 IN.
f) Joints: restrained joints or lug-style restrained mechanical joint glands as specified in Section 40 05 19.
3) Buried service for RAS-HDPE:
a) Materials: HDPE, DR21
b) Reference: Polyethylene, PE4710.
c) Lining: None.
d) Coating: None.
e) Fittings:

(1) Either molded or fabricated HDPE fittings shall be used per 40 05 33, unless indicated otherwise on the drawings.
(2) Either AWWA/ANSI C110/A21.10 ductile or gray iron.

f) Joints:
(1) Butt fusion per Section 40 05 33 unless indicated otherwise on the drawings.
(2) Restrained joints or lug-style restrained mechanical joint glands in accordance with Section 40 05 33.
(3) Factory assembled transition fittings may be used but must be submitted and approved by Engineer.

C. Piping System 7 – Exposed Process Piping, PVC and CPVC, for Liquid Chemical and Gaseous Service.
1. General:
a. Piping symbol and service:
1) CS - Chlorine Solution.
b. Test requirements pressure lines:
1) Test medium: Water.
2) Pressure: 1.25 x working pressure.
3) Duration: 6 hours.
c. Gaskets and O-rings:
1) Viton for CS.
2. System components:
a. Pipe size 12 inches and smaller:
1) Exposed service:
a) Material: PVC, Type 1, Grade 1, Schedule 80.
b) Reference: ASTM D1785.
c) Lining: None.
d) Coating: HPIC; See Specification Section 09 96 00.
e) Fittings: Solvent welded socket type complying with ASTM D2467.
f) Joints: Solvent welded with unions at valves, penetrations through structures and equipment connections for pipe 2 inches and less and flanges at those locations for pipe above 2 inches.
2) Buried service:
a) Material: PVC, Type 1, Grade 1, Schedule 80.
b) Reference: ASTM D1785.
c) Lining: None.
d) Coating: None.
e) Fittings: Solvent welded socket type complying with ASTM D2466.
f) Joints: Solvent welded with unions at valves, penetrations through structures and equipment connections for pipe 2 inches and less and flanges at those locations for pipe above 2 inches.

D. Piping System 9 – Buried and Exposed Process Piping for Non-Potable Water, Seal Water, and Similar Applications.
1. General:
a. Piping symbol and service:
1) NPW - Nonpotable Water.
2) NPW - Seal Water.
b. Test requirements:
1) Test medium: Water.
2) Pressure: 1.25 x working pressure.
3) Duration: 6 hours.
c. Gaskets and O-rings:
1) O-rings: Neoprene or rubber.

2) Push-on and mechanical joints (ductile iron): Rubber, AWWA/ANSI C111/A21.11.
3) Flange gaskets: Bulb ring SBR per Section 40 05 05.20.

d. Flange hardware: Type 316 stainless steel per Section 40 05 05.20.

2. System components:

a. Pipe size to 1 inch:

1) Exposed service:

a) Materials: Stainless steel tubing, TP-304L.
b) Reference: ASTM A269.
c) Lining: None.
d) Coating: None.
e) Fittings: Stainless steel 304L compression type tube fittings.
f) Joints: Compression type couplings, unions at equipment and valves.
g) Minimum wall thickness:
(1) 1/16 inches OD: 0.010 inches.
(2) 1/8 to 1/4 inches OD: 0.028 inches.
(3) 5/16 to 1/2 inches OD: 0.049 inches.
(4) 5/8 to 1 inch OD: 0.065 inches.

b. Pipe size 1 inch to 3 inches:

1) Exposed service:

a) Materials: PVC, Type 1, Grade 1, Schedule 80.
b) Reference: ASTM D1785.
c) Lining: None.
d) Coating: HPIC; See Specification Section 09 96 00.
e) Fittings: Solvent welded socket type complying with ASTM D2467.
f) Joints: Solvent welded with unions at valves, penetrations through structures and equipment connections for pipe 2 inches and less and flanges at those locations for pipe above 2 inches.

2) Buried service:

a) Materials: PVC, Type 1, Grade 1, Schedule 80.
b) Reference: ASTM D1785.
c) Lining: None.
d) Coating: None.
e) Fittings: Solvent welded socket type complying with ASTM D2467.
f) Joints: Solvent welded with unions at valves, penetrations through structures and equipment connections for pipe 2 inches and less and flanges at those locations for pipe above 2 inches.

c. Pipe size 1 inch to 3 inches where specifically called out as SST on the Drawings:

1) Exposed service:

a) Materials: 304 SST, Schedule 80.
b) Fittings and Joints: NPT.

d. Pipe size greater than 3 inches:

1) Exposed service:

a) Materials: Ductile iron, Class 53.
b) Reference: AWWA/ANSI C115/A21.15.
c) Lining: Cement.
d) Coating: HPIC; See Specification Section 09 96 00.
e) Fittings: Either AWWA/ANSI C110/A21.10 ductile or gray iron.
f) Joints: AWWA/ANSI C115/A21.15 flanged.

2) Buried service:

a) Materials: Ductile iron, Class 150.
b) Reference: AWWA/ANSI C151/A21.51.
c) Lining: Cement.
d) Coating: Bituminous.
e) Fittings:

(1) Either AWWA/ANSI C110/A21.10 ductile or gray iron.
(2) Optional: AWWA/ANSI C153/A21.53 ductile iron compact fittings for sizes 3 inches to 16 inches.

f) Joints: restrained joints or lug-style restrained mechanical joint glands as specified in Section 40 05 19.

E. Piping System 10 – Buried and Exposed Potable Water Piping.
1. General:
a. Piping symbol and service:
1) PW – Potable Water
b. Test requirements:
1) Test medium: Water.
2) Pressure: 1.25 x working pressure.
3) Duration: 6 hours.
c. Gaskets and O-rings:
1) O-rings: Neoprene or rubber.
2) Flanged, push-on and mechanical joints (ductile iron): Rubber, AWWA/ANSI C111/A21.11.
3) Flanged joints (steel): Rubber, AWWA C207.
4) Grooved coupling joints (ductile and steel): Rubber, AWWA C606.
2. System components:
a. Pipe size to 3 inches:
1) Exposed service:
a) Material: Copper tubing, Type K.
b) Solder: Cadmium-free and lead-free solder compatible with tubing and fittings materials.
c) Reference: ASTM B88.
d) Lining: None.
e) Coating: None.
f) Fittings: Wrought copper or bronze fittings meeting ASME B16.22.
g) Joints: Soldered or brazed with unions at valves and equipment.
2) Buried service:
a) Material: Copper tubing, Type K.
b) Reference: ASTM B88.
c) Lining: None.
d) Coating: None.
e) Fittings: AWWA C800.
f) Joints: Flared.
b. Pipe size 3 inches through 16 inches:
1) Exposed service:
a) Materials:
(1) Flanged: Ductile iron, Class 53.
(2) Grooved type joint system: Use pipe thickness per AWWA C606.
(3) With both systems, provide screwed on flanges at equipment, valves and structural penetrations.
b) Reference: AWWA/ANSI C115/A21.15.
c) Lining: Cement.
d) Coating: None.
e) Fittings: Either AWWA/ANSI C110/A21.10 ductile or gray iron.
f) Joints:
(1) Flanged or grooved type mechanical coupling (AWWA C606) joints.
(2) With both systems, provide screwed-on flanges at valves, equipment, and structure penetration.
2) Buried service:
a) Materials: PVC, DR18, PR 165.
b) Reference: 40 05 31.

c) Lining: None.
d) Coating: None.
e) Fittings:
(1) Either AWWA/ANSI C110/A21.10 ductile or gray iron.
(2) Optional: AWWA/ANSI C153/A21.53 ductile iron compact fittings for sizes 3 to 16 inches.
f) Joints: Push-on with mechanical (stuffing box type) joints at fittings and valves.

3. Install drain tees with capped nipples of IPS brass 3 inches long at low points.
   a. If low point occurs in concealed piping, provide approved flush access panel.
   b. These drains are not shown on Drawings.
4. Slope water lines down to drain points not less than 1 inch in 60 feet.
5. Install all threaded piping with clean-cut tapered threads and with ends thoroughly reamed after cutting to remove burrs.
   a. Pipe joint cement permitted only on external threads.
6. For screwed nipples for connections to flush valves, lavatory supplies, and other equipment with threaded connections use iron, copper, or brass pipe.
7. Install ball, butterfly and plug valves where indicated or required to adequately service all parts of system and equipment.
   a. Install valves on each branch serving restroom.
   b. Install valves on inlet and outlet connections of heat exchangers and on other equipment connected to water lines.
8. Install unions between valves and connections to each piece of equipment and install enough unions throughout piping system to facilitate installation and servicing.
   a. On copper pipelines, install wrought, solder-joint, copper to copper unions for lines 2 IN and smaller and, for lines 2-1/2 inches and over install brass flange unions.
9. Construct and equip plumbing fixtures and equipment with anti-siphon devices as to eliminate any danger of siphoning waste material into potable water supply system.
10. Where exposed pipes 6 inches in size and smaller pass-through floors, finished walls, or finished ceilings, fit with nickel or chrome-plated plates large enough to completely close hole around pipes.
    a. Secure plates to pipe by set screw in approved manner.
11. Size supply branches to individual fixtures as scheduled or indicated on Drawings.
12. Install piping to be free to expand with proper loops, anchors and joints without injury to system or structure.
13. Provide branches to wall hydrants or hose bibbs in exterior locations with interior shutoff and drain valves.
14. Provide approved type vacuum breaker and backflow preventer installations indicated or as required by Code.
15. Install concealed in finished structures such as administration and office facilities and at locations shown on Drawings.

F. Piping System 12 – Exposed Process Piping for Low-Pressure Air Service up to 25 psiG.
   1. General:
      a. Piping symbol and service:
         1) AA - Aeration Air.
      b. Test requirements:
         1) Test medium: Air.
         2) Pressure: 20 psiG.
         3) Duration: 6 hours.
      c. Gaskets and O-rings:
         1) O-rings and flanged joints: FKM (Viton), 300 degrees F, per Section 40 05 05.20..
      d. Flange hardware: Type 316 stainless steel per Section 40 05 05.20.
      e. Temperature:
         1) Normal: 200 DEGF.

2) Maximum: 270 DEGF.

2. System components:
   1) Pipe size through 2 inches:
      a) Material: Stainless steel 304L, Schedule 40.
      b) Reference: ASTM A312.
      c) Lining: None.
      d) Coating: None.
      e) Fittings: Seamless steel 304L meeting ASTM A403.
         (1) Butt welded with unions at equipment and valves.
   2) Pipe size above 2 inches:
      a) Material: Stainless steel 304L, Schedule 10; 3/8" wall thickness for pipe size larger than 30 inches.
      b) Reference: ASTM A312 up to 24 inches, ASTM A358 above 24 inches.
      c) Lining: None.
      d) Coating: None.
      e) Fittings: Seamless steel 304L meeting ASTM A403.
         (1) Butt welded with flanges at equipment and valves.

G. Piping System 17 – Fiberglass Reinforced Polymer Mortar Pipe.
   1. General:
      a. Piping symbol and service:
         1) MLR - Mixed Liquor Recycle.
      b. Test requirements:
         1) Test medium: Water.
         2) Pressure: 10psig
         3) Duration: 6 hours.
   2. System components:
      a. Pipe size above 24 inches:
         1) Immersion service:
            a) Material: FRPM per Section 40 05 37.
            b) Reference: ASTM D3262.
            c) Lining: per Section 40 05 37.
            d) Coatings: None.
            e) Fittings: mitered.
            f) Joints: fiberglass sleeve couplings with elastomeric sealing gaskets.

H. Piping System 18 – Equipment Condensate Piping
   1. General:
      a. Piping symbol and service:
         1) CD – Condensate Drain.
      b. Test requirements:
         1) Test medium: Water.
         2) Pressure: Minimum test heights shall be 10 ft above highest stack inlet.
         3) Duration: 30 minutes.
   2. System components:
      a. All pipe sizes:
         1) Above ground service:
            a) Material: Schedule 40 DWV grade PVC with UV inhibitors.
            b) Reference: ASTM D 2665
            c) Lining: None.
            d) Coatings: None.
            e) Fittings: Schedule 40 DWV grade PVC with UV inhibitors.
            f) Joints: Solvent weld.

3.11 SERVICE SYSTEM SUMMARY

A. Service System is defined in Table B:

TABLE B - SERVICE SYSTEM SUMMARY						
SYMBOL	**SERVICE**	**SYSTEM NO.**	**LOCATION**	**SIZE (IN)**	**PIPE MATERIAL**	**TEST PRESSURE (PSIG)**
AA	Aeration Air	12	Exposed and Submerged	All	Stainless steel	20 (2 psig for blower suction piping)
ABI-DIP	Aeration Basin Influent	2	Exposed and Buried	All	Ductile iron	25
ABI-HDPE	Aeration Basin Influent	2	Buried	All	HDPE	25
CLS	Chlorine Solution	7	Exposed and Buried	All	PVC	125
DR, DRN	Drain	2	Exposed and Buried	All	Ductile iron	25
MLR	Mixed Liquor Recycle	17	Submerged	All	FRPM	15
MLR-DIP	Mixed Liquor Recycle	2	Submerged	All	Ductile iron	15
NPW	Nonpotable Water	9	Exposed and Buried	Less than 1, larger where specifically called out on the Drawings	Stainless steel	125
				1-3	PVC	125
			Exposed and Buried	Greater than 3	Ductile iron	125
PW	Potable Water	10	Exposed and Buried	Less than 3	Copper	125
			Exposed	3 and larger	DIP	125
			Buried	3 and larger	PVC	125
RAS-DIP	Return Activated Sludge	3	Exposed and Buried	3-24	Ductile iron	50
RAS-HDPE	Return Activated Sludge	3	Buried	3-24	HDPE	
RS-DIP	Raw Sewage	2	Exposed and Buried	All	Ductile iron	25
RS-HDPE	Raw Sewage	2	Buried	All	HDPE	
SCI	Secondary Clarifier Influent	2	Exposed and Buried	All	Ductile iron	25
SCE	Secondary Clarifier Effluent	2	Exposed and Buried	All	Ductile iron	
WAS	Waste Activated Sludge	3	Exposed and Buried	All	Ductile iron	50

END OF SECTION

SECTION 40 05 05.20
PIPING FLANGE GASKETS AND ASSEMBLY HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Flange gaskets and hardware for water, wastewater, air, and select chemical services.

B. Related Requirements: Include, but are not necessarily limited to, the following:
   1. Section 01 61 03 – Equipment – Basic Requirements.
   2. Section 40 05 00 – Pipe and Pipe Fittings – Basic Requirements
   3. Section 40 05 07 – Pipe Support Systems.
   4. Division 40 – Process Interconnections.

1.2 REFERENCES

A. Referenced Standards:
   1. American Society of Mechanical Engineers (ASME):
      a. B1.1 – Unified Inch Screw Threads (UN and UNR form)
      b. B16.5 – Pipe Flanges and Flanged Fittings
      c. B16.21 – Nonmetallic Flat Gaskets for Pipe Flanges
      d. B16.47 – Large Diameter Steel Flanges NPS 26 through NPS 60
      e. B18.2.1 – Square and Hex Bolts and Screws: Inch Series
      f. B18.2.2 – Square and Hex Nuts
      g. B46.1 – Surface Texture (Surface Roughness, Waviness, and Lay)
      h. PCC-1 – Guidelines for Pressure Boundary Bolted Flange Bolt Assembly
   2. ASTM International (ASTM):
      a. A153, - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
      b. A193 – Standard Specification for Alloy Steel and Stainless Steel Bolting Materials for High-Temperature Service
      c. A194 – Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both
      d. A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
      e. A320 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service
      f. A967 - Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts
      g. B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
      h. D2000 - Standard Classification System for Rubber Products in Automotive Applications
      i. F104 – Standard Classification System for Nonmetallic Gasket Materials
      j. F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
      k. F606 – Standard Test Method for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, Direct Tension Indicators, and Rivets
      l. F1941 – Standard Specifications for Electrodeposited Coatings on Mechanical Fasteners, Inch and Metric
      m. F2329 – Standard Specifications for Zinc Coating, Hot Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts and Special Threaded Fasteners
   3. American Water Works Association (AWWA):
      a. C207 – Steel Pipe Flanges for Waterworks Service, Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm).
      b. C228 – Stainless Steel Pipe Flanges for Water Service – Sizes 2 inch through 72 in

4. NSF International (NSF), formerly National Sanitation Foundation:
   a. NSF/ANSI 61 – Drinking Water System Components – Health Effects.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Materials:
      a. Coordinate materials of gaskets and hardware for process piping with constituents of the process liquid or gas flow stream.
   2. Location:
      a. Flanged piping connections shall be provided for above grade process piping as shown on the Drawings and as specified in the Pipe Schedule in Section 40 05 00. Flanged connections may be provided for buried service connections were shown on the Drawings and/or specifically allowed by the Engineer.

1.4 QUALITY ASSURANCE

A. Qualifications:
   1. The suppliers shall utilize factories, foundries, and machine shops, holding a current ISO 9001 Certificate of Quality System Registration, and furnish all documentation necessary to verify the Supplier's certification and registration, upon the request of the Owner and Engineer.

1.5 SUBMTTALS.

A. Action Submittal: Submit the following:
   1. Product Data:
      a. Supplier gasket, hardware, and product data, cut-sheets, and test reports.
   2. Calculations:
      a. Bolting calculations including clamping forces and target bolt torque values for assembly of flanged joints in each piping system.
      b. Bolting calculations shall be sealed and signed by a professional engineer, in accordance with the Laws and Regulations of codifying agencies having jurisdiction at the Site.
   3. Material Test Reports (MTRs):
      a. The Contractor shall submit to the Engineer, four copies of all certified MTRs for chemical analysis, mechanical properties including tensile, impact, and bend test results for all materials used in the manufacture of the Work specified herein. MTRs shall identify the Work, for which the material will be used, and all information necessary to verify compliance with the requirements specified herein.

B. Informational Submittals: Submit the following:
   1. Manufacturer's Instructions:
      a. Manufacturer's written instructions for handling, storage, and installation.
   2. Qualifications Statements:
      a. Manufacturer, when requested by Engineer.

C. Closeout Submittals: Submit the following:
   1. Flange bolting worksheets.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT – GENERAL

A. Flange gaskets used in long-term contact with raw and potable drinking water shall be constructed of materials that comply with NSF-61.

B. Gasket and flange hardware materials required for each piping system are listed in the Pipe Schedule in Section 40 05 00.

C. No field-cut or field-modified gaskets shall be allowed.

D. All flange assembly hardware (bolts, nuts, and washers) shall be marked and stamped as specified herein.

2.2 FLANGE GASKETS

A. Bulb Ring Styrene Butadiene (SBR) Rubber Gaskets (Non-NSF-61 Certified)
   1. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
      a. RING FLANGE-TYTE®, manufactured by U.S. Pipe, Birmingham, Alabama.
      b. Toruseal, manufactured by American Cast Iron Pipe Company, Birmingham, Alabama.
   2. Materials, Fabrication and Performance Criteria
      a. Gaskets shall be ring type SBR elastomer per ANSI/AWWA C111/A21.11.
      b. Gaskets shall be cut from 1/8 inch (+/-0.02 inch) thick calendared sheet stock.
      c. Gaskets shall have three bulb-type rings molded into both faces of the gasket.

B. Flat Aramid-Fiber Nitrile Gaskets (Non-NSF-61 Certified)
   1. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
      a. Durlon® 8500, manufactured by Gasket Resources, Exton, Pennsylvania.
      b. Blue-Gard® 3000, manufactured by Garlock Sealing Technologies, Palmyra, New York.
      c. SF3300® manufactured by Flexitallic, Deer Park, Texas
      d. NA1001 manufactured by Teadit North America, Pasadena, Texas
      e. L-441® manufactured by Lamons Gasket Company, Houston, Texas.
      f. Klingersil® 4401 manufactured by Thermoseal, Sidney, Ohio.
   2. Materials, Fabrication and Performance Criteria
      a. Compressed aramid-fiber-reinforced nitrile rubber (CAF) flat sheet stock, used for raised face and flat faced ASME flange gaskets, shall be cut in the type "F" or "ring pattern" (not metal RTJ) with inside and outside dimensions as specified in ASME B16.21 and the drilling of the flange noted in the Pipe Schedule.
      b. CAF gaskets shall be cut from 1/8 inch (+/-0.02 inch) thick calendared sheet stock.
      c. CAF gasket stock shall have a minimum tensile strength of 2000 psi; an operating temperature range of -60 degrees F to 500 degrees F, or greater; and a maximum operating pressure of 1000 psi or greater. Gasket properties shall be in conformance with ASTM F104.

C. Flat Aramid-Fiber Nitrile Gaskets (NSF-61 Certified)
   1. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
      a. Durlon® 7910, manufactured by Gasket Resources, Exton, Pennsylvania.
      b. Multi-Swell™ 3760-U, manufactured by Garlock Sealing Technologies, Palmyra, New York.
      c. NA1082SAN manufactured by Teadit North America, Pasadena, Texas.
   2. Materials, Fabrication and Performance Criteria
      a. CAF gaskets used for raised face and flat faced ASME flange gaskets, shall be cut in the type "F" or "ring pattern" (not metal RTJ) with inside and outside dimensions as specified in ASME B16.21 and the drilling of the flange noted in the Pipe Schedule.
      b. Cut from sheet stock by a qualified gasket Supplier. Gasket properties shall be in conformance with ASTM F104 or equivalent.

D. Flat Polytetrafluoroethylene (PTFE) Gaskets for Metallic Piping (Non-NSF-61 Certified)
   1. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
      a. Gylon® 3500, manufactured by Garlock Sealing Technologies, Palmyra, New York.
      b. Durlon 9000, manufactured by Gasket Resources, Exton, Pennsylvania.
      c. Sigma 500, manufactured by Flexitallic®, Deer Park, Texas.

d. 24SH, manufactured by Teadit North America, Pasadena, Texas.

2. Materials, Fabrication and Performance Criteria
   a. PTFE flat gasket stock, used for raised-face and flat-faced stainless steel ASME forged flanges, shall be cut in the type "F" or "ring pattern" (not metal RTJ) with inside and outside dimensions as specified in ASME B16.21.
   b. Flange gaskets shall be cut from 1/8 inch (+/-0.02 inch) thick calendared sheet stock by the gasket Supplier at the factory.
   c. PTFE flange gaskets shall be cut from sheet stock by a qualified gasket distributor. Gasket welding shall be performed by the gasket manufacturer in the gasket manufacturer's factory.

E. PTFE Gaskets for Metallic Piping (NSF-61 Certified)
   1. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
      a. Gylon® 3505, manufactured by Garlock Sealing Technologies, Palmyra, New York.
      b. Gylon EPiX ® 3505, manufactured by Garlock Sealing Technologies, Palmyra, New York.
      c. Approved equal.
   2. Materials, Fabrication and Performance Criteria
      a. PTFE flat gasket stock, used for raised-face and flat-faced stainless steel ASME forged flanges, shall be cut in the type "F" or "ring pattern" (not metal RTJ) with inside and outside dimensions as specified in ASME B16.21.
      b. Flange gaskets shall be cut from 1/8 inch (+/-0.02 inch) thick calendared sheet stock by the gasket Supplier at the factory.
      c. PTFE flange gaskets shall be cut from sheet stock by a qualified gasket distributor. Gasket welding shall be performed by the gasket manufacturer in the gasket manufacturer's factory.

F. Low Torque Gaskets for Plastic Piping (Non-NSF-61 Certified)
   1. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
      a. EPDM with PTFE Film
         1) Stress Saver® 370, manufactured by Garlock Sealing Technologies, Palmyra, New York.
         2) Series 9013-ET, manufactured by PROCO Products, Inc., Stockton, California.
         3) Panacea ® PT70M, manufactured by Prince Rubber and Plastics, Co. Inc., Buffalo, New York.
      b. Peroxide Cure EPDM
         1) Series 9013-EP, manufactured by PROCO Products, Inc., Stockton, California.
         2) Approved equal.
      c. Materials, Fabrication and Performance Criteria
         1) Full faced, EPDM gasket with bonded PTFE film or peroxide cure; provide as schedule in the Pipe Schedule.
         2) Dual concentric, convex sealing rings.
         3) Dimensions shall comply with ANSI B16.5 drilling.

G. Low Torque Gaskets for Plastic Piping (NSF-61 Certified)
   1. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
      a. Stress Saver® XP, manufactured by Garlock Sealing Technologies, Palmyra, New York.
      b. Approved equal.
   2. Materials, Fabrication and Performance Criteria
      a. Full-faced, Fluoroelastomer (FKM) with raised ribs designed for use with PVC, CPVC, FRP and other non-metallic flanges up to 24 IN diameter.
      b. Suitable for maximum pressure of 250 psig.
      c. Durometer hardness of 70 Shore A (+/- 5 percent).

d. Dimensions shall comply with ANSI B16.5 drilling.

H. Flat Peroxide-Cured EPDM-P Gaskets (NSF-61 Certified)
1. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
a. WARCO® Compound 0044224678 manufactured by West America Rubber Company, LLC, Orange, California
b. Panacea® 6962 manufactured by Prince Rubber and Plastics, Co. Inc., Buffalo, New York
2. Materials, Fabrication and Performance Criteria
a. Flat EPDM-P gasket stock, used for raised face and flat faced ASME flange gaskets, shall be cut in the type "F" or "ring pattern" (not metal RTJ) with inside and outside dimensions as specified in ASME B16.21.
b. Flange gaskets shall be cut from 1/8 inch (+/-0.02 inch) thick calendared sheet stock by the gasket Supplier at the factory. All large diameter flat flange gaskets, used with flat-faced large diameter ring flanges, shall be Type "F" with inside and outside dimensions specified in AWWA C228 and shown on the Drawings.
c. Product compounding shall enhance aging, heat stability, modulus and compression set properties by peroxide crosslinking. The finished gasket shall be resistant to degradation during extended exposure to potable water treated with chloramines under the specified pressure and temperature conditions shown on the Drawings.
d. EPDM gasket stock shall be black in color and have a talc-treated smooth finish, free of blooming and other surface defects. Gasket stock shall have a minimum tensile strength of 1450 psi; Durometer hardness of 70 Shore A (+/- 5percent); and, an operating temperature range of -60 degrees F to 300 degrees F. Gasket properties shall be in conformance with ASTM D2000.

I. Flat FKM Gaskets
1. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
a. FKM:
1) Style 9520, manufactured by Garlock Sealing Technologies, Palmyra, New York.
2) Equal product manufactured by Gasket Resources, Exton, Pennsylvania.
3) Approved equal.
2. Materials, Fabrication and Performance Criteria
a. FKM, Type A flat gasket stock, used for raised-face and flat-faced stainless steel ASME forged flanges, shall be cut in the type "F" or "ring pattern" (not metal RTJ) with inside and outside dimensions as specified in ASME B16.21.
b. Suitable for maximum temperature of 500 deg F
c. Minimum durometer hardness of 50-60 Shore A (+/- 5 percent).
d. Flange gaskets shall be cut from 1/8 inch (+/-0.02 inch) thick calendared sheet stock by the gasket supplier at the factory.

2.3 FLANGE HARDWARE

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Birmingham Fasteners, Birmingham, Alabama
2. Portland Bolt and Manufacturing, Portland, Oregon
3. Sigma Fasteners, Houston, Texas
4. Lamons Gasket Company Inc., Houston, Texas
5. Texas Bolt and Nut, Houston, Texas
6. Fluid Sealing Products, Houston, Texas

B. General Requirements
1. Heavy hex head flange bolts and stud-bolts
a. Dimensions as specified in ASME B18.2.1.
b. Thread dimensions per ASME B1.1 UNC, Class 2A fit.

c. For ASME flanges, flange bolting materials used for a specific process or pipeline application shall be selected based on the limits published in ASME B16.5, Table 1B and ASME B16.47, Table 2.
d. Custom designed bolts and stud-bolts shall be manufactured in accordance with the details shown on the Drawings.
e. Nuts shall meet the dimensions of ASME B18.2.2 and have ASME B1.1, UNC threads, Class 2B fit; or manufacturer's preferred or proprietary design. Threads may be machine cut or rolled.

2. Hex-head bolt, stud-bolt and nut markings
   a. Hardware shall have grade markings stamped on a non-load bearing surface, machine-struck using character dies.
   b. Character size for all markings shall be suitable for on-site visual inspection during and following installation. Hex head flange bolts shall be furnished with material grade markings on the top surface of the head in raised characters. Stud-bolts shall be furnished with recessed material grade markings on the plain metal face at the tip of each threaded end. Nuts shall be furnished with material markings on the face, transverse to the points and flats.
   c. All character markings shall be formed or struck prior to the application of finishes.
3. Finishes for bolts, stud-bolts and nuts shall be as shown in the Pipe Schedule in Section 40 05 00. Finishes for ferritic steel bolts, stud-bolts and nuts shall meet the following requirements:
   a. Hot black oxide
      1) In accordance with ASTM D769, or equivalent.
   b. Electro-plated zinc finish
      1) Type III supplemental clear chromate satin finish, Class SC3 thickness, in accordance with ASTM B633 and ASTM F1941.
   c. Hot-dipped galvanized zinc
      1) The surfaces of all fasteners shall be cleaned in a hot caustic bath, rinsed in water, and pickled in an acid bath. After a second water rinse fasteners shall be fluxed to remove oxides and prevent further oxidation prior to hot dipping in molten zinc. Hot-dip galvanizing that be performed in accordance with ASTM A153 and ASTM F2329.
      2) The galvanized zinc finish shall have a final average thickness of 1.7 to 3.4 mils, depending on nominal fastener size.
   d. Baked-on ceramic-filled fluorocarbon resin
      1) Dry film thickness of 0.0008 inches to 0.002 inches.
      2) The coating shall have a static coefficient of friction of 0.15 to 0.35.
      3) Fluoropolymer tee-head bolt coatings shall be:
         a) Xylan® 1424 manufactured by Witford Corporation, Elverson, Pennsylvania.
         b) FlouroKote#1® manufactured by Metal Coatings Corp., Houston, Texas.
         c) Cor-Blu® manufactured by Birmingham Fastener, Birmingham, Alabama.
   e. Stainless steel
      1) Scale free bright finish by chemical passivation using the Nitric 1 or Nitric 2 process in accordance with ASTM A967.
      2) Surface finish shall be 70 µinch Ra all over, in accordance with ASME B46.1, or finer.

C. Carbon Steel Flange Bolts, Nuts, and Washers
   1. Bolts
      a. ASTM A193, Grade B7 chromium-molybdenum steel, carbide solution treated. Bolts shall be marked "B7".
      b. Mechanical properties:
         1) Bolts up to 2.5 inch nominal size shall have minimum yield strength of 105,000 psi; minimum tensile strength of 125,000 psi; and maximum Brinell hardness of 321 BHN (35 HRC).

2) Bolts 2.5 inch to 4.0 inch nominal size shall have minimum yield strength of 95,000 psi; minimum tensile strength of 115,000 psi; and maximum Brinell hardness of 321 BHN (35 HRC).
3) Bolts 4.0 inch to 7.0 inch nominal size shall have minimum yield strength of 75,000 psi; minimum tensile strength of 100,000 psi; and maximum Brinell hardness of 321 BHN (35 HRC).

2. Nuts
   a. Nuts shall meet the dimensions of ASME B18.2.2 and have ASME B1.1, UNC threads, Class 2B fit; or manufacturer's proprietary design, where applicable.
   b. ASTM A194, Grade 2H.
   c. Properties:
      1) Quenched and tempered medium carbon steel.
      2) Hot forged or cold punched ferritic steel, carbide solution treated.
      3) Proof load tension capacity based on a proof load stress of 175,000 psi.
      4) Brinell hardness of 248 to 327 BHN.
   d. Hex nuts shall be marked "2H" on a non-load bearing surface, with engraved or mechanically stamped characters.
3. Washers
   a. Type A STL plain carbon steel washers shall be manufactured to the dimension included in ASME B18.22.1, Type A, Tables 1A and Tables 1B. SAE J924 washer configurations shall also be allowed.
   b. Carbon steel washers shall meet the requirements included in ASTM F844 and be fabricated from high strength and low-alloy carbon steel sheet stock conforming with the requirements of ASTM A568.
   c. Type A carbon steel washers shall be furnished with a plain descaled unless noted in the Pipe Schedule. Where noted, washers shall be furnished with one of the following factory-applied finishes:
      1) Zinc-plated by electroplating process with a Type II supplemental yellow chromate satin finish, Class SC3 thickness, in accordance with ASTM B633.
      2) Hot-dipped galvanized in accordance with ASTM A153 and F2329.

D. Stainless Steel Flange Bolts, Nuts, and Washers
1. Bolts
   a. ASTM A193, Grade B8M (Type 316), Class 2, carbide solution treated, and strain hardened, in accordance with supplementary requirement S1.
   b. Properties:
      1) Minimum yield strength of 50,000 psi.
      2) Minimum tensile strength of 90,000 psi.
      3) Maximum finished Brinell hardness of 321 BHN.
   c. Bolts shall be marked "B8M". Stud bolts shall be marked "B8M" machine-struck on the plain metal face at the tip of each threaded end in recessed characters.
2. Nuts
   a. ASTM A194, Grade 8M (Type 316).
   b. Properties:
      1) Hot forged or cold punched.
      2) Proof load strength of 80,000 psi.
      3) Brinell finished hardness of 126 to 300 BHN.
   c. Hex nuts shall be marked "8M" on a non-load bearing surface, with engraved or mechanically stamped characters.
3. Washers
   a. Type 316 stainless steel.

2.4 COMPOSITE DIELECTRIC INSULATING GASKETS FOR DRINKING WATER

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Trojan® system manufactured by Advanced Product Systems, Houston, Texas.

2. PSI GasketSeal® manufactured by GPT Division of EnPro Industries, Charlotte, North Carolina.
3. IsoGuard™ manufactured by Lamons Gasket Company Inc., Houston, Texas.

B. General
1. Composite flange isolation kits for use with drinking water and other aqueous applications shall be installed where dissimilar metallic piping flanges are joined; where metallic pipe flanges mate with valve connecting flanges and other equipment of dissimilar metallic construction; where exposed piping makes a vertical transition to buried piping; and where otherwise shown on the Drawings.
2. Pipe flange materials applicable to this section include ductile iron, cast iron, cast copper alloy, forged stainless steel alloys, forged copper-nickel alloy, and forged nickel alloy (Monel, Hastelloy, etc.), all of which having an adequate difference in potential to steel for internal electro-chemical corrosion. Gasket materials shall be NSF-61 certified.
3. Insulating flange gaskets shall be comprised of a composite retainer constructed of G-10, FR-4 glass-reinforced epoxy sheet stock in accordance with NEMA LI-1, having a dielectric strength of 400 to 500-volts/mil in accordance with UL 94. The retainer shall have a full-faced Type "E" configuration, 1/8 IN thick, with bolt holes cut to match the drilling shown on the Drawings. The retainer shall contain a precision tapered groove designed to accommodate the controlled compression of an extruded elastomer sealing element. The quad-ring seal shall be pressure energized. The glass-reinforced epoxy retainer shall have 550-volts/mil dielectric strength and a minimum 50,000-psi compressive strength.
4. The sealing element shall be constructed on one of the following materials shown on the Drawings:
   a. BUNA-N rubber shall be used with standard couplings and fittings and have a working temperature range of -20 to 180 degrees F. This elastomer shall not be used for hot water service above 150 degrees F or hot dry air over 140 degrees F.
   b. Peroxide-cured EPDM rubber having a working temperature of -30 to 250 degrees F. This elastomer shall be NSF 61 certified for cold and hot potable water service.
   c. Silicone having a working temperature of 20 to 300 degrees F. This elastomer shall not be used for hot water service. This elastomer shall be NSF 61 certified for potable water service.
5. Insulating bolt sleeves shall be manufactured of Mylar or G-10 composite material having a dielectric strength of not less than 4000-volts/mil. Insulating washers shall be manufactured of the same G-10 FR-4 epoxy fiberglass materials as the gasket. Insulating washers shall be installed with metallic follower washers specified below to prevent damage to the insulating washer during field assembly.
6. The Contractor shall be allowed to use molded sleeve washers as an alternate to separate washers and sleeves, provided the material of construction has equivalent properties to those specified herein.

2.5 ANTI-SEIZE THREAD LUBRICANT FOR FLANGE BOLTING

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Never-Seez® Pure Nickel Special Lubricant manufactured by Bostik, Wauwatosa, Wisconsin.
2. Loctite® Heavy Duty Anti-Seize Lubricant Manufactured by Henkel Technologies, Rocky Hill, Connecticut.
3. Chesterton 772® Premium Nickel Anti-Seize Compound manufactured by Chesterton Technical Products, Stoneham, Massachusetts.

B. General
1. Flange bolts shall be installed using a nickel anti-seize lubricant capable of achieving the required bolt torque and sealing stress and permitting future disassembly with minimal manual input.

2. Excess anti-seize compound shall be removed by degreasing solvent prior to finish painting the piping.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Bolting Procedure for Flanged Joints

1. The Contractor shall perform flanged joint assembly in accordance with the gasket Supplier's instructions and as specified herein. The Contractor shall utilize calibrated bolting equipment capable of applying the necessary bolt tension to flange bolts during assembly. Flange bolting shall achieve the proper bolt tension (clamping force) necessary to maintain a drip tight seal during the service life of the piping system.
2. All Shop Drawings, field reports and relevant documents submitted in accordance with this Section, and all verbal communications at the Site regarding flange assembly procedures shall be described in terms of "Range-of -Bolt-Tension (RBT)."
3. RBT shall be calculated by the Contractor or their bolting consultant. Regardless of who performed the calculations, the Contractor shall bear all responsibility for joint performance. The Contractor's calculations shall take into consideration the pipe diameter, gasket Supplier's recommended assembly stress; bolt material tensile and yield stress; gasket Supplier's recommended bolt stress; pipe service, design, and test pressures. Calculations shall be stamped by a professional engineer.
4. RBT calculation shall be based on the minimum sealing stress required to maintain a lasting seal under the service conditions entered into the General Notes shown on the Civil Drawings, and/or Pipe Schedule shown on the Process Mechanical Drawings; and, the maximum sealing stress above which the flange gasket will be crushed and leak. Both gasket stress values shall be provided by the Supplier of the flange gaskets included in the relevant approved Shop Drawings. Flange assembly shall be performed within this range.
5. Determination and application of target assembly torque at the Site, required to meet the RBT, shall be the responsibility of the Contractor. The bolt-tension calibrator shall have documented calibration by the OEM, within two weeks of performance of the Work at the Site. Calibration certifications shall be submitted to Engineer prior to performance of the Work.
6. Bolt tension compliance shall be demonstrated for joint assembly tools and systems to the Resident Project Representative, Engineer and Owner by the Contractor, by performance of the approved assembly procedures on a portable bolt-tension calibrator. The preferred device for calibration shall be the Model W portable tool calibrator manufactured by Skidmore Wilhelm, Solon, Ohio.
7. Bolting tools and systems shall be adjusted to meet the RBT on the calibrator in the presence of the Engineer prior to the commencement of the Work each workday and documented by the Contractor on the form included at the end of this Section.
8. If the contractor uses a manual adjustable torque wrench, adjustment of the torque setting shall be performed on the bolt tension calibrator by the Contractor. The torque required to achieve the RBT shall be recorded on the attached form by the Contractor.
9. Bolting application patterns shall be as shown on the Drawings, but compliance shall also be confirmed by their inclusion in the Shop Drawings submitted to the Engineer prior to piping installation. If a bolting pattern table is not shown on the Drawings, the contractor shall refer to tables included in the latest revision of ASME PCC-1. Leaking joints, regardless of whether the joint leaks are discovered during execution of the Work or Warranty period, and whether detected during the hydrostatic or leakage testing, or not, shall be considered defective Work and shall be rejected.
10. Under no circumstances shall flange nuts be reused during the repair of defective Work. Used nuts from defective joints shall be removed from the Site and disposed of by the Contractor. Bolts may be reused provided there is no indication of damaged threads or permanent elongation, due to excessive bolt tension resulting in the bolt stress exceeding the elastic limit of the bolt material, during the previous joint assembly. The Work required to

remove and replace damaged gaskets shall be performed by the Contractor at no increase in Contract Time or Contract Cost.

11. The Contractor shall use hydraulic cassette wrenches for assembly of flanged pipe joints requiring greater than 600 ft-lbs of assembly torque. The Contractor shall document each flanged joint assembly procedure performed at the site. The Work shall be documented on the "Flange Bolting Worksheet" located at the end of this Section.
12. Contractor shall visually inspect and clean flange bolts, stud-bolts, nuts, and washers prior to bolting. The Contractor shall lubricate bolts and nuts; if hardened washers are not used, lubricate the flange surface around the bolt holes. Excess lubricant on surfaces to receive protective coatings shall be removed by cleaning and degreasing solvent prior to applying a coating system.
13. The Contractor shall hand-tighten all nuts and bolts, then tighten them to 10 to 20 percent of the target torque. The initial torque shall not exceed 20 percent of the target torque. The bolts shall be tightened according to the pattern recommended by the gasket Supplier.
14. The Contractor shall perform three rounds of bolt tightening on flanges having 4 to 8 bolts following hand tightening, first to 30 percent; then 60 percent; and finally, 100 percent of the target torque calculated by the Contractor.
15. The Contractor shall perform four rounds of bolt tightening for flanges having 12 bolts or more, following hand tightening, first to 20 percent; then 40 percent; then 80 percent, and then 100 percent of target torque calculated by the Contractor.
16. The Contractor shall measure the gap between flanges following application of 100 percent of the target at every other bolt to confirm uniformity. The Contractor shall perform a final re-tightening to 100 percent of the target torque 24-hours after 100 percent tightening at the end of the initial bolting sequence. Every bolt and stud-bolt shall have a minimum of three full threads exposed beyond the nut following the final tightening.
17. The Contractor shall be responsible for filling out the "Flange Bolting Worksheet", located at the end of this Section, for all flanged joints on the project. The joints shall be identified in accordance with the designation included in the approved laying schedule. The form shall be submitted to the Engineer and Owner at the end of each workday, after the 24-hour re-tightening sequence, for filing in the project records.

B. See Section 40 05 00 for additional information and requirements.

FLANGE BOLTING WORKSHEET

Basic Information					
Joint No.:		Date:		Filled Out By:	
Program / Project:					
Facility:					
Owner:					

Table 1: Basic Joint Data

Basic Data	Parameters
Nominal Bolt Size:	
Bolt Material:	
Number of Bolts:	
Lubricant:	
Gasket Sealing Surface Finish:	
Calculated Target Torque:	
Calculated By:	
Bolt Tightening Method:	
Calibration Date:	

Table 2: Calculated Field Assembly Target Torque Values

Bolting Sequence	Target Torque (ft-lbs)
Round 1 (20percent of Target):	
Round 2 (40percent of Target):	
Round 3 (80percent of Target):	
Round 4 (100percent of Target, flanges w/12 bolts or greater):	

END OF SECTION

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SECTION 40 05 06
COUPLINGS ADAPTERS AND SPECIAL FOR PROCESS PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Flanged coupling adapters.
   2. Bolted sleeve couplings.
   3. Dismantling joints.
   4. Clamp style couplings.
   5. Flexible expansion joints for process piping.
   6. Metal, bellows-type expansion compensators for process piping.

B. Related Requirements: Include, but are not necessarily limited to, the following:
   1. Section 01 61 03 – Equipment – Basic Requirements.
   2. Section 40 05 00 – Pipe and Pipe Fittings – Basic Requirements
   3. Section 40 05 07 – Pipe Support Systems.

1.2 REFERENCES

A. Referenced Standards:
   1. American Society of Mechanical Engineers (ASME):
      a. ASME/ANSI B16 – Standard for Pipe and Pipe Fittings.
   2. ASTM International (ASTM):
      a. A36/A36M, Standard Specification for Carbon Structural Steel.
      b. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
      c. A58, Standard Specification for Carbon Steel Bars for Vehicles and General Purpose Springs.
      d. A193, Standard Specification for Alloy Steel and Stainless Steel Bolting Materials for High-Temperature Service
      e. A194, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both
      f. A283, Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
      g. A325, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minium Tensile Strength.
      h. D2000, Standard Classification System for Rubber Products in Automotive Applications
      i. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
      j. F594, Standard Specification for Stainless Steel Nuts.
   3. American Water Works Association (AWWA):
      a. AWWA-C219-17, Bolted-Sleeve-Type-Couplings-for-Plain-End-Pipe
      b. AWWA C221, Fabricated Steel Mechanical Slip-Type Expansion Joints.
      c. AWWA C227, Bolted Pipe Couplings.
      d. AWWA C606, Grooved and Shouldered Joints.
   4. Hydraulic Institute (HI):
      a. ANSI/HI 9.6.2, Centrifugal and Vertical Pumps for Allowable Nozzle Loads.
   5. US Military Specifications (MIL):
      a. MIL-DTL-17813:H – Expansion Joints, Pipe, Metallic Bellows, General Specifications for
   6. NSF International (NSF), formerly National Sanitation Foundation:
      a. NSF/ANSI 61 – Drinking Water System Components – Health Effects.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Materials:

a. Coordinate materials of couplings, specials, and adapters for process piping with constituents of the process liquid or gas flow stream.
b. Where specified materials or the associated couplings, specials, or adapters for process piping are not compatible with long-term service life of the associated couplings, specials, and adapters in the application intended, Supplier of the associated couplings, specials, and adapters shall submit to Engineer, through Contractor, request for interpretation or clarification setting forth Supplier's recommendations for appropriate materials for each coupling, special, and adapter required.
c. Should Engineer determine couplings, specials, or adapters materials other than those specified are necessary, Engineer will issue a Field Order or Proposal Request and, if necessary, an appropriate Contract modification will be issued.

2. Location:
a. Coordinate locations of couplings, specials, and adapters with associated process piping, valves, equipment, and related items. Final, installed location of couplings, specials, and adapters shall not conflict with valves, equipment, or other items in associated process piping.
b. Should Engineer determine that coupling, special, or adapter location, other than shown on the Drawings, is necessary, Engineer will issue a Field Order or Proposal Request and, if necessary, an appropriate Contract modification will be issued.

3. Piping Joints:
a. Coordinate joints connecting couplings, specials, and adapters to associated piping. Provide compatible joints to connect piping and couplings, specials, and adapters.

1.4 QUALITY ASSURANCE

A. Qualifications:
1. Manufacturer:
a. Manufacturer of each type of coupling, special, or adapter, as applicable, shall be a business regularly engaged in manufacturing and furnishing couplings, special, or adapters (as applicable), for piping systems.
b. Manufacturer shall be able to document having furnished not less than 50 couplings, specials, or adapters required, of size equal to or larger than those required for the Work, during the past five years.
c. When requested by Engineer, submit qualifications statement indicating manufacturer's record of manufacturing and furnishing herein specified adapters and couplings and furnish documentation of compliance with qualifications requirements of this Article.

1.5 SUBMITTALS.

A. Action Submittals: Submit the following:
1. Shop Drawings:
a. Schedule (table) indicating each individual coupling, special, and adapter required by this Section. Indicate for each:
1) Tag number (if any) and location in the Work.
2) Type of coupling, special, or adapter.
3) Manufacturer and model number.
4) Size.
5) Material.
6) Whether installed location is buried, exposed (dry)), exposed (exposed to wet conditions), or exposed (submerged or intermittently submerged).
7) Other pertinent data, as necessary.

Submit one schedule for all required couplings, specials, and adapters required for process piping.
b. For buried or submerged couplings and adapters, submit manufacturer's design of harnessing
c. Submit manufacturer's allowable limit for deflection and confirmation that the installed condition will limit the deflection to 50% of manufacturer's allowable limit.
d. Product Data:

1) Manufacturer's standard drawings for each type and size of coupling, special, and adapter required. Such drawings shall indicate item's layout, size, dimensions, materials, type of connections to adjacent piping, and other pertinent information.
2) Manufacturer's published performance data (based on previously performed testing on identical unit), including, for each type and size of coupling, special, and adapter:
   a) Maximum pressure rating.
   b) Maximum temperature rating.
   c) Range of acceptable movement of the coupling in compression, expansion, and angular deflection.
   d) Bolting system and torque requirements
   e) Elastomeric seals and gaskets type(s)
3) Manufacturer's standard published catalog data and specifications for each size and type of ping coupling, special, and adapter required.
4) Indicate third-party reference standards with which materials and equipment comply.

e. Samples:
   1) Color Samples of available, factory-applied finish coat. Clearly indicate: (1) manufacturers standard colors and optional, special colors; and 2) whether certain colors are available only for certain sizes or types of equipment.

B. Informational Submittals: Submit the following:
   1. Manufacturer's Instructions:
      a. Manufacturer's written instructions for handling, storage, installation, and removal.
   2. Qualifications Statements:
      a. Manufacturer, when requested by Engineer.

C. Closeout Submittals: Submit the following:
   1. Operation and Maintenance Data:
      a. Submit in accordance with Section 01 78 23 – Operations and Maintenance.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT – GENERAL

A. For service in potable water applications or water that will be treated to become potable, materials and equipment shall be in conformance with NSF/ANSI 61.

2.2 FLANGED COUPLING ADAPTERS

A. Manufacturers:
   1. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
      a. Smith Blair Style 912 for DI pipe, 3 to 12-inch diameter.
      b. ROMAC Industries, Inc., FCA-501 for DI pipe, 3 to 12-inch diameter.
      c. Baker Coupling Style 604.
      d. Dresser Style 227.
      e. Smith Blair, Style 913 for DI and steel pipe, 12 to 96-inch diameter.
      f. ROMAC Industries Inc., FC400 for DI and steel pipe, 12 to 96-inch diameter.
      g. Dresser Style 128.

B. Description:
   1. Provide, at each location shown on the Drawings or otherwise indicated in the Contract Documents, flanged coupling adapters in process piping.
   2. One end of flanged coupling adapter shall be flanged and opposite end shall have sleeve-type flexible coupling.
   3. Provide harnessing (tie-rods) for flanged coupling adapters in all piping systems.

C. Performance Criteria:
   1. Service: Same as connected piping.
   2. Pressure: Not less than that of connected piping, including required testing pressure.
   3. Flange rating: Same as adjacent flanges.

4. Capable of deflection during assembly or permit a minimum of 0.6-IN gap between the end of a field-cut pipe and the mating flange without affecting the integrity of the follower seal.
5. Minimum safety factor of 2.

D. Materials, Assembly, Fabrication:
1. Flange adapter body:
   a. ASTM A536 ductile iron.
   b. ASTM A53, A513 or A283C carbon steel.
2. Follower:
   a. ASTM A536 ductile iron.
   b. ASTM A576, A36 or A283C carbon steel.
3. Flanges:
   a. Fabricated and drilled in accordance with ASME B16.
   b. Flange class for steel joints (AWWA D, E, or F) to match connecting piping.
4. Gasket:
   a. Acrylonitrile butadiene rubber (BUNA-N), NSF-61 certified for potable water use.
   b. Peroxide-cured ethylene propylene diene monomer (EPDM), NSF-61 certified for potable water use. Product compounding shall enhance aging, heat stability, modulus, and compression set properties by peroxide crosslinking.
5. Bolts and Nuts:
   a. ASTM F593/F594, AISI Type 316 stainless steel.
6. Harnessing:
   a. Harness flanged coupling adapters to restrain pressure piping. For pressure piping, test pressures are included in piping schedules in Section 40 05 00 – Pipe and Pipe Fittings – Basic Requirements.
   b. For flanged coupling adapters 12-inch diameter and smaller, provide 0.5-inch diameter (minimum) Type 316 stainless steel anchor studs installed in pressure-tight anchor boss. For buried or submerged applications, provide external bolting and other hardware of Type 316 stainless steel, including tie bolts, bolt plates, lugs, nuts, and washers. Provide quantity of studs necessary to restrain test pressure and service conditions. Harness shall be as designed and recommended by flanged coupling adapter manufacturer. Provide not less than the following anchor studs unless otherwise approved by Engineer:
      1) Studs indicated below are suitable for 175 PSIG.
      2) 6-inch diameter and smaller: 2.
      3) 8-inch diameter and smaller: 4.
      4) 10-inch diameter and smaller: 6.
      5) 12-inch diameter and smaller: Eight.
   c. For flanged coupling adapters larger than 12-inch diameter, provide split ring harness clamps with not less than four corrosion resistant alloy steel bolts. For buried or submerged applications, provide external bolting and other hardware of Type 316 stainless steel, including tie bolts, bolt plates, lugs, nuts, and washers. Harness assembly shall be as designed and recommended by flanged coupling adapter manufacturer. Dimensions, sizes, spacing, and materials shall be suitable for service and conditions encountered and shall be approved by Engineer.
7. Harnessing:
   a. Harness flanged coupling adapters to restrain pressure piping. For pressure piping, test pressures are included in piping schedules in Section 40 05 00 – Pipe and Pipe Fittings – Basic Requirements.
   b. Harnessing shall comply with details on the Drawings. For buried or submerged applications, provide external bolting and other hardware of Type 316 stainless steel, including tie bolts, bolt plates, lugs, nuts, and washers.
8. Factory Coating:
   a. Fusion epoxy, 3M Skotchkote 206N FBG, or equal, conforming to NSF/ANSI 61.

2.3 BOLTED SLEEVE COUPLINGS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. ROMAC Industries Inc., Style 400.
2. Smith Blair, Style 411.
3. Approved equal.

B. Description:
1. Bolted sleeve coupling is a non-restrained coupling used to connect two plain end pipes.
2. Meets the applicable requirements of AWWA C219.
3. Provide, at each location shown on the Drawings or otherwise indicated in the Contract Documents, bolted sleeve couplings in process piping. Provide restraint harnesses where indicated on the Drawings. Harness design shall be provided by the sleeve coupling manufacturer using the design criteria provided in the Pipe Schedule.

C. Performance Criteria:
1. Service application: Same as connected piping.
2. Pressure rating: Not less than as required for connected piping.

D. Materials, Assembly, Fabrication:
1. End Rings and Center Ring:
a. ASTM A53, ASTM A283 Grade C, or ASTM A36 carbon steel with minimum yield strength of 30 KSI.
2. Bolts and Nuts:
a. ASTM F593/F594, AISI Type 316 stainless steel.
3. Tie Rods and Nuts:
a. ASTM F593/F594, AISI Type 316 stainless steel
1. Gasket:
a. Acrylonitrile butadiene rubber (BUNA-N), NSF-61 certified for potable water use.
2. Factory Coating:
a. Fusion epoxy, 3M Skotchkote 206N FBG, or equal, conforming to NSF/ANSI 61.

2.4 DISMANTLING JOINTS

A. Manufacturers:
1. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
a. ROMAC Industries Inc., Style DJ400.
b. Smith Blair, Style 975.
c. Dresser, Style 131.

B. Description:
1. Provide, at each location shown on the Drawings or otherwise indicated in the Contract Documents, dismantling joints in process piping.
2. Dismantling joint is a telescoping, flanged spool pieces with tie rods that facilitate future disassembly of the piping at and adjacent to the dismantling joint.
3. Inherently restrained.
4. Meets the applicable requirements of AWWA C219.

C. Performance Criteria:
1. Service application: Same as connected piping.
2. Pressure rating: Same as item's flanges. Not less than as required for connected piping.
3. Longitudinal adjustment: Not less than two inches.

D. Materials, Assembly, Fabrication:
1. Flanged Spigot Spool:
a. 14 IN diameter and larger: ASTM A53, ASTM A283 Grade C, or ASTM A36 carbon steel with minimum yield strength of 30 KSI.
2. Flange Adapter Body and End Ring:
a. 14 IN diameter and larger: ASTM A53, ASTM A283 Grade C; or ASTM A36 carbon steel with minimum yield strength of 30 KSI.
b. 3 to 12 IN diameter: Carbon steel as specified above or ASTM A536 65-45-12 ductile iron.
3. Flanges:
a. Fabricated and drilled in accordance with ASME B16.

b. Flange class for steel joints (AWWA D, E, or F) to match connecting piping.

4. Tie Rods and Nuts:
   a. ASTM F593/F594, AISI Type 316 stainless steel.
5. Bolts and Nuts:
   a. ASTM F593/F594, AISI Type 316 stainless steel.
6. Gasket:
   a. Acrylonitrile butadiene rubber (BUNA-N), NSF-61 certified for potable water use.
7. Factory Coating:
   a. Fusion epoxy, 3M Skotchkote 206N FBG, or equal, conforming to NSF/ANSI 61.

2.5 CLAMP STYLE COUPLINGS

A. Manufacturers:
   1. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
      a. Straub-Grip (restrained).
      b. Straub-Flex (non-restrained).
      c. Approved equal.

B. Description:
   1. Provide, at each location shown on the Drawings or otherwise indicated in the Contract Documents, clamp style couplings in process piping.
   2. Couplings are sleeve style with clamping bolts.
   3. Restrained or non-restrained as noted on the Drawings.

C. Performance Criteria:
   1. Service application: Same as connected piping.
   2. Pressure rating: Same as connected piping.

D. Materials, Assembly, Fabrication:
   1. Body: Type 316 stainless steel.
   2. Bolts and Nuts: Type 316 stainless steel, ASTM F593/F594.
   3. Gasket: EPDM.

2.6 FLEXIBLE EXPANSION JOINTS FOR PROCESS PIPING

A. Manufacturers:
   1. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
      a. Process Liquid Service (1-inch to 24-inch diameter), Multiple Arch:
         1) Holz Rubber Company, Series 320HP.
         2) Flexicraft, Rubber Expansion Joint – Ultraspool Double and Triple.
         3) Garlock.
      b. Process Liquid Service (8-inch diameter and less), Single Arch:
         1) Holz Rubber Company, Perflex SF 1000.
         2) Flexicraft, Rubber Expansion Joint – Ultraspool Sginle.
         3) Garlock.
      c. Liquid Chemical Service:
         1) Solid PTFE Joints
            a) PROCO Products, Series 440.
            b) Or equal.
         2) PTFE Lined Joints
            a) PROCO Series 231/ET
            b) Or equal.

B. Description:
   1. Provide, at each location shown on the Drawings or otherwise indicated in the Contract Documents, flexible expansion joints for process piping.
   2. Provide as required for: (a) water service up through 16-inch diameter, and (b) chemical service, as indicated in this Article.

C. Performance Criteria:

1. Process Liquid Piping Service (16-inch diameter and smaller):
    a. Pressure Rating:
        1) 10- through 14-inch diameter: 250 PSIG at 180 degrees F.
        2) Less than 10-inch diameter: 227 PSIG at 180 degrees F.
    b. Allow for the following non-concurrent movements:
        1) Elongation: Single arch - 0.9-inch. Double arch – two inches.
        2) Compression: Single arch - 1.5 inches. Double arch - 3.5 inches.
        3) Lateral Offset: Single arch - 0.75 inch. Double arch - two inches.
        4) Angular: 25 degrees for six-inch diameter, 20 degrees for eight-inch diameter, 30.6 degrees for 10-inch diameter, 25.8 degrees for 12-inch diameter.
2. Liquid Chemical Service:
    a. Pressure Rating: 70 PSIG at 70 degrees F.
    b. Allow for the following non-concurrent movements:
        1) Allowable Axial Movement: Not less than 3/8-inch.
        2) Axial Compression: Nor less than 1.5 inches.
        3) Axial Extension: Not less than 0.625-inch
        4) Lateral Deflection: Not less than 0.75-inch
        5) Angular Deflection: Not less than 14 degress
        6) Torsional Rotation: Not less than four degrees

D. Materials, Assembly, Fabrication:
1. Process Liquid Piping Service (24-inch diameter and smaller):
    a. Type: Reinforced rubber expansion joints with full rubber flanges and retainer rings.
    b. Materials:
        1) Tube: EPDM.
        2) Body/Carcass: Chlorobutyl with polyester fabric and metal reinforcing rings.
        3) Cover: EPDM, Hypalon, or chlorobutyl coated with Hypalon.
        4) Control Rods, Retainer Ring, and Bolts: Galvanized steel.
    c. Restraint:
        1) Provide appropriate quantities of ASTM A325, high-strength galvanized steel control rod-compression sleeve assemblies for each flexible expansion joint.
        2) Quantity and size of control rods shall be for not less than 50 PSIG.
    d. Arches: Provide multiple-arch for piping 10-inch diameter and larger. Provide single-arch type for piping eight-inch diameter and less.
2. Liquid Chemical Service
    a. Solid PTFE Joints
        1) Materials:
            a) Bellows: PTFE.
            b) Flanges: Type 316 stainless steel.
            c) Limit rods and hardware: Type 316 stainless steel.
            d) Reinforcing rings: Type 316 stainless steel.
    b. PTFE Lined Joints
        1) Materials:
            a) Bellows: EDPM exterior cover with PTFE liner.
            b) Retaining rings: Type 316 stainless steel.
            c) Limit rods and hardware: Type 316 stainless steel.
    c. Restraint: Provide appropriate quantities of limit rods for each liquid chemical service expansion joint. Quantity and size of control rods shall be for not less than 50 PSIG.

2.7 SOURCE QUALITY CONTROL

A. Factory Tests and Inspections:
1. Perform manufacturer's standard factory tests and inspections on materials and equipment furnished. Correct defects prior to shipment to the Site.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation – General:
   1. Provide couplings, specials, and adapters in process piping at locations shown and indicated in the Contract Documents.
   2. Install in accordance with the Contract Documents, Submittals approved by Engineer, and manufacturer's written instructions. In event of conflict between the Contract Documents and manufacturer's written instructions, obtain written interpretation or clarification from Engineer.
   3. Comply with:
      a. Section 01 61 03 - Equipment - Basic Requirements.
      b. Section 40 05 00 – Pipe and Pipe Fittings – Basic Requirements.
   4. Before installing, ensure each coupling, special, adapter, and accessory is clean and free of dirt and debris.

3.2 FIELD QUALITY CONTROL

A. Field Tests and Inspections:
   1. Test couplings, specials, and adapters together with associated process piping system.
   2. Where couplings, specials, or adapters are installed in piping conveying potable water or water that will be treated to become potable, disinfect couplings, specials, and adapters together with associated process piping. Obtain successful bacteriological test results before placing the system into service.

END OF SECTION

SECTION 40 05 07
PIPE SUPPORT SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Pipe support systems.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 03 15 19 - Anchorage to Concrete.
   4. Section 05 50 00 - Metal Fabrications.
   5. Section 09 96 00 - High Performance Industrial Coatings.
   6. Section 40 42 00 - Pipe, Duct and Equipment Insulation.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society of Mechanical Engineers (ASME):
      a. B31.1, Power Piping.
      b. B31.3, Process Piping.
   2. ANVIL International (ANVIL).
   3. ASTM International (ASTM):
      a. A36, Standard Specification for Carbon Structural Steel.
      b. A276, Standard Specification for Stainless Steel Bars and Shapes.
      c. A510, Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel.
      d. A575, Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades.
      e. A576, Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality.
      f. A917, Standard Specification for Steel Sheet, Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface (General Requirements).
      g. A918, Standard Specification for Steel Sheet, Zinc-Nickel Alloy Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface.
      h. B633, Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
   4. American Welding Society (AWS):
      a. D1.1, Structural Welding Code - Steel.
   5. Manufacturers Standardization Society of the Valve and Fittings Industry Inc. (MSS):
      a. SP-58, Pipe Hangers and Supports - Materials, Design and Manufacture.
      b. SP-69, Pipe Hangers and Supports - Selection and Application.

B. Responsibility:
   1. Support systems for piping greater than 12 IN DIA with internal pressure over 100 psi and piping with product temperatures over 200 Deg F are shown on the Drawings.
   2. Contractor shall design support systems for 12 IN DIA piping and smaller.
   3. Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified and required to design, furnish and install the system of hangers, supports, guidance, anchorage and appurtenances.
   4. General piping support details may be indicated on the Drawings in certain locations for pipe smaller than 12 IN DIA.
   5. Contractor shall incorporate those details with requirements of this Specification Section to provide the piping support system.

C. Each type of pipe hanger or support shall be the product of one manufacturer.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Itemized list of wall sleeves, anchors, support devices and all other items related to pipe support system.
      d. Scaled drawings showing location, installation, material, loads and forces, and deflection of all hangers and supports.
      e. Analyze each pipe system for all loads and forces on hangers and supports and their reaction forces to the structure to which they are fastened.
      f. Support systems for piping systems designed by the Contractor. Submit detail design calculations and scaled drawings prepared and signed by a registered Professional Engineer in the State of Texas.
      g. Acknowledgement of materials used below water level in tankage.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the manufacturers listed below are acceptable:
   1. Pipe supports and accessories:
      a. B-Line/Eaton.
      b. ANVIL (ASC Engineered Solutions).
      c. Tolco.
      d. PHD Supports.
      e. Approved equal.
   2. Channel framing strut and accessories:
      a. Stainless steel and steel
         1) Unistrut P1000.
         2) Equal product by Power-Strut.
         3) Equal product by Flexstrut.
      b. Fiberglass reinforced plastic (FRP).
         1) DuroStrut by Enduro Composites.
         2) Approved equal.
   3. Insulation accessories:
      a. Advance Products and Systems, Inc.
      b. Approved equal.

2.2 MANUFACTURED UNITS

A. General
   1. Materials:
      a. Unless noted otherwise on the Drawings, all pipe supports shall be Type 304 stainless steel with Type 316 stainless steel hardware.
      b. For stainless steel and galvanized supports, anchor bolts and hardware shall match the support and accessory materials. For FRP supports, anchor bolts and hardware shall be Type 316 stainless steel.
      c. Galvanized components:
         1) Electro-galvanized:
            a) Bar, forged, or cast fabrications: ASTM B633, SC4.
            b) Rolled sheet fabrications: ASTM A917 and ASTM A918, 50N50NU.

2) Hot-dipped galvanized:
a) See Section 05 50 00.

d. The ANVIL models noted below are used to establish a basis of and standard of design. Equal models by the listed manufacturers may be provided.

B. Hangers and Accessories
1. Rods:
a. Continuously loaded.
b. Load limits:

NOMINAL ROD DIAMETER	MAXIMUM SAFE LOAD, (LBS)
3/8 IN DIA (min)	610
1/2 IN DIA	1,130
5/8 IN DIA	1,810
3/4 IN DIA	2,710
7/8 IN DIA	3,770
1 IN DIA	4,960

2. Hangers:
a. Clevis type.
b. ANVIL Figure 260 or 590.
3. Concrete Inserts for Hanger Rods:
a. Continuous slots: Unistrut #P1000.
b. Individual inserts: ANVIL Figure 281.
c. See Specification Section 03 15 19, mechanical anchors.
d. ANVIL Figure 52 attachment plate for precast or existing concrete.
4. Beam Clamps for Hanger Rods:
a. Heavy duty.
b. ANVIL Figure 134.
5. Trapeze Hangers for Suspended Piping:
a. Angles, channels, or other structural shapes.
b. Curved roller surfaces at support point corresponding with type of hanger required.

C. Adjustable Stanchion Supports
1. General
a. For pipe located 3 FT or less from floor elevation, except as otherwise indicated on the Drawings.
2. Pipe support saddle:
a. ANVIL Figure 264 or 265 as shown on Drawings.
3. Pipe support baseplate and riser:
a. Schedule 40 pipe.
b. ANVIL Figure 63.

D. Pipe Covering Protection Saddle
1. For insulated pipe at point of support.
2. ANVIL Figure 167, Type B.

E. Wall Brackets
1. For pipe located near walls and 8 FT or more above floor elevation or as otherwise indicated on the Drawings.
2. PVC Pipe: ANVIL Figure 194.
3. Metal pipe: ANVIL Figure 195 or 199 (as required).
4. When used with pipe hangers: Fig. 195 or 199 (as required).

F. U-Bolts

1. Double nuts and lock-washers.
2. ANVIL Figure 137.

G. Channel Framing Strut Supports and Accessories
1. 12 Gauge.
2. 1 5/8 IN nominal size.
3. Provide post bases, clamps, and other standard manufacturer items as required or as shown on Drawings.
4. Approved manufacturers:
a. Unistrut P1000.
b. Equal product by Power-Strut.
c. Equal product by Flexstrut.

H. Pipe Clamps
1. Offset style.
2. ANVIL Figure 103.

2.3 DESIGN REQUIREMENTS

A. Supports capable of supporting the pipe for all service and testing conditions.
1. Provide 5 to 1 safety factor.

B. Allow free expansion and contraction of the piping to prevent excessive stress resulting from service and testing conditions or from weight transferred from the piping or attached equipment.

C. Design supports and hangers to allow for proper pitch of pipes.

D. For chemical and waste piping, design, materials of construction and installation of pipe hangers, supports, guides, restraints, and anchors:
1. ASME B31.3.
2. MSS SP-58 and MSS SP-69.
3. Except where modified by this Specification.

E. For steam and hot and cold water piping, design, materials of construction and installation of pipe hangers, supports, guides, restraints, and anchors:
1. ASME B31.1.
2. MSS SP-58 and MSS SP-69.

F. Check all physical clearances between piping, support system and structure.
1. Provide for vertical adjustment after erection.

G. Support vertical pipe runs in pipe chases at base of riser.
1. Support pipes for lateral movement with clamps or brackets.

H. Place hangers are to be installed on outside of pipe insulation.
1. Use a pipe covering protection saddle for insulated pipe at support point.
2. Insulated piping 1-1/2 IN and less:
a. Provide a 9 IN length of high-density perlite or high-density calcium silicate at saddle.
b. See Specification Section 40 42 00.
3. Insulated piping over 1-1/2 IN: Provide a 12 IN length of high-density perlite or high density calcium silicate at saddle.

I. Provide 20 GA stainless steel pipe saddle for fiberglass and plastic support points to ensure minimum contact width of 4 IN.

J. Pipe Support Spacing:
1. General:
a. Factor loads by specific weight of liquid conveyed if specific weight is greater than water.
b. Locate pipe supports at maximum spacing scheduled unless indicated otherwise on the Drawings.

c. Provide at least one (1) support for each length of pipe at each change of direction and at each valve.

2. Steel, stainless steel, ductile and cast-iron pipe support schedule:

PIPE SIZES - IN	MAXIMUM SPAN - FT
1-1/2 and less	5
2 thru 4	10
5 thru 8	15
10 and greater	20

3. Copper pipe support schedule:

PIPE SIZES - IN	MAXIMUM SPAN - FT
2-1/2 and less	5
3 thru 6	10
8 and greater	15

4. PVC pipe support schedule:

PIPE SIZES - IN	MAXIMUM SPAN - FT
1-1/4 and less	3
1-1/2 thru 3	4
4 and greater	5

* Maximum fluid temperature of 120 DegF.

5. Support each length and every fitting:
   a. Bell and spigot piping:
      1) At least one (1) hanger.
      2) Applied at bell.
   b. Mechanical coupling joints:
      1) Place hanger within 2 FT of each side of fittings to keep pipes in alignment.
6. Space supports for soil and waste pipe and other piping systems not included above every 5 FT.
7. Provide continuous support for nylon tubing.
8. For PVC, FRP and copper piping provide cushion wrap of pipe at each support.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide piping systems exhibiting pulsation, vibration, swaying, or impact with suitable constraints to correct the condition.
   1. Included in this requirement are movements from:
      a. Trap discharge.
      b. Water hammer.
      c. Similar internal forces.

B. Weld Supports:
   1. AWS D1.1.
   2. Weld anchors to pipe in accordance with ASME B31.3.

C. Locate piping and pipe supports as to not interfere with open accesses, walkways, platforms, and with maintenance or disassembly of equipment.

D. Inspect hangers for:
   1. Design offset.
   2. Adequacy of clearance for piping and supports in the hot and cold positions.
   3. Guides to permit movement without binding.
   4. Adequacy of anchors.

E. Inspect hangers after erection of piping systems and prior to pipe testing and flushing.

F. Install individual or continuous slot concrete inserts for use with hangers for piping and equipment.
   1. Install concrete inserts as concrete forms are installed.

G. Welding:
   1. Welding rods: ASTM and AWS standards.
   2. Integral attachments:
      a. Include welded-on ears, shoes, plates and angle clips.
      b. Ensure material for integral attachments is of good weldable quality.
   3. Preheating, welding and post heat treating: ASME B31.3, Chapter V.

H. Field Painting:
   1. Comply with Specification Section 09 96 00.

END OF SECTION

SECTION 40 05 19
DUCTILE IRON PIPE AND FITTINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Ductile iron piping, fittings, and appurtenances for process-mechanical and buried service.

B. Related Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 09 96 00 – High Performance Industrial Coatings (HPIC)
   4. Section 40 05 00 - Pipe and Pipe Fittings: Basic Requirements.
   5. Section 40 05 05.20 – Piping Flange Gaskets and Assembly Hardware.
   6. Section 40 05 06 – Coupling Adapters and Specials for Process Piping.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society of Mechanical Engineers (ASME):
      a. B1.1, Unified Inch Screw Threads (UN and UNR Thread Form).
      b. B16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
   2. ASTM International (ASTM):
      a. A36, Standard Specification for Carbon Structural Steel
      b. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
      c. A247, Standard Test Method for Evaluating the Microstructure of Graphite in Iron Castings.
      d. A307, Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
      e. A536, Standard Specification for Ductile Iron Castings.
      f. A588, Standard Specification for High-Strength Low-Alloy Structural Steel, up to 50 ksi Minimum Yield Point, with Atmospheric Corrosion Resistance.
      g. F104, Standard Classification System for Nonmetallic Gasket Materials.
      h. ASTM D2000, Standard Classification System for Rubber Products in Automotive Applications.
   3. American Society of Mechanical Engineers (ASME):
      a. ASME B16.1 Cast Iron Pipe Flanges and Flanged Fittings.
      b. ASME B1.1 - Unified Inch Screw Threads (UN and UNR form)
      c. ASME B18.2.1 - Square and Hex Bolts and Screws: Inch Series
      d. ASME B18.2.2 – Square and Hex Nuts
   4. American Water Works Association (AWWA):
      a. C203, Standard for Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied.
      b. C217, Microcrystalline Wax and Petrolatum Tape Coating Systems for Steel Water Pipe.
   5. American Water Works Association/American National Standards Institute (AWWA/ANSI):
      a. C104, Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
      b. C105/A21.5, Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
      c. C110/A21.10, Standard for Ductile-Iron and Gray-Iron Fittings.
      d. C111/A21.11, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

e. C115/A21.15, Standard for Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
f. C150/A21.50, Standard for Thickness Design of Ductile-Iron Pipe.
g. C151/A21.51, Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.
h. C153, Ductile-Iron Compact Fittings for Water Service.
i. C606, Grooved and Shouldered Joints.

6. American Welding Society (AWS)
   a. AWS A5.15 – Specification for Welding Electrodes and Rods for cast iron
7. International Organization for Standardization
   a. ISO 9001 – Quality management systems—Requirements
8. NSF International
   a. NSF 61 – Drinking Water System Components

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. See Specification Section 40 05 00 for Pipe Schedule.
   3. Certification of factory hydrostatic testing.
   4. Samples and Operation and Maintenance Manuals are defined separately from Shop Drawings in HDR's Specification Sections. Therefore, they are addressed as different categories of the SUBMITTALS Article.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Ductile iron pipe and fittings:
      a. American Cast Iron Pipe Company, Birmingham, Alabama.
      b. U.S. Pipe Fabrication, Birmingham, Alabama.
      c. McWane Group, Birmingham, Alabama.
   2. Ceramic epoxy lining:
      a. Protecto 401™ by Induron Coatings, Birmingham, Alabama.
      b. Novacoat SP2000W by Ergon Armor, Jackson, Mississippi.
      c. Permox CTF by D&M Coatings, Ocala, Florida.
   3. Polyethylene wrap
      a. V-Bio® Enhanced Polywrap.
   4. Polyethylene encasement tape:
      a. Chase (Chasekote 750).
      b. Kendall (Polyken 900).
      c. 3M (Scotchrap 50).
   5. Restrained joints:
      a. ACIPCO (Flex-Ring or Lok-Ring)
      b. U.S. Pipe (TR-Flex) - 4 IN to 36 IN.
      c. U.S. Pipe (HP LOK) – 30 IN to 54 IN.
      d. U.S. Pipe HDSS® - 12 IN to 48 IN.
   6. Lug-Style restrained mechanical joint glands:
      a. Mega-Lug® Series 1100 manufactured by EBAA Iron, Inc., Eastland, Texas
      b. Approved equal.
   7. Fluoropolymer tee-head bolt coatings:
      a. Xylan® 1424 manufactured by Witford Corporation, Elverson, Pennsylvania.
      b. FlouroKote#1® manufactured by Metal Coatings Corp., Houston, Texas.
      c. Cor-Blu® manufactured by Birmingham Fastener, Birmingham, Alabama.

d. R-Blue manufactured by Romac Industries, Bothell, Washington.

8. Urethane primer:
   a. MC-FerroClad Primer manufactured by Wasser High-Tech Coatings, Inc., Auburn, Washington.
   b. Approved equal.

2.2 MATERIALS AND FABRICATION

A. Ductile Iron Pipe

1. General
   a. Ductile iron pipe and fittings shall be manufactured of desulfurized ductile iron having a fine homogeneous microstructure and a corrosion resistant oxide finish in the annealed condition. The carbide (cementite) rating for all castings shall be no greater than 5 percent. This shall be accomplished by use of high-quality charge containing pig iron and automotive or other industry scrap materials having predictable chemistry (i.e. brake rotors, brake drums, scrap automobiles, plate scrap, recycled tramp metals, etc.); and improved inoculation processes and/or heat treatment.
   b. The nodularity of all castings shall be no less than 90 percent Type I spheroidal graphite, in accordance with ASTM A247. Ductile iron shall have a minimum 100x nodule count of 200/mm2 as documented by photo metallography at the pipe mill. The Supplier shall control the nodularity at the pipe mill by addition of graphite controlling inoculants, and addition of magnesium and cerium when necessary. The phosphorus content shall not exceed 0.08 percent. Ductile iron pipe shall be constructed of ASTM A536, Grade 60-42-10 ferritic ductile iron, centrifugally cast in metal molds by the deLavaud or equivalent process.
2. Pipe
   a. Ductile iron pipe shall have the configuration, dimensions and tolerances specified AWWA C151/A21.51. Pipe shall be permanently marked with the following information:
      1) Manufacturer's mark
      2) The letters "DUCTILE" or "DI"
      3) Country of manufacture
      4) Date of manufacture
      5) Size, class, or wall thickness
      6) Heat or Lot numbers matching the laying schedule.
   b. Process mechanical ductile iron piping shall be flanged as shown on the Drawings and as scheduled in Section 40 05 00. Flanged ductile iron pipe shall be threaded, and have flanges installed in the pipe mill or fabricator's shop. Flanged pipe shall be Class 53, minimum, per AWWA C115 and AWWA 606.
   c. All buried ductile iron piping shall be restrained bell and spigot type. Pipe shall have wall thickness (Class 150, 250, 350) noted in the Pipe Schedule in Section 40 05 00 per AWWA C115.
3. Fittings and Flanges
   a. Fittings and companion flanges shall be constructed of ASTM A536, Grade 70-50-05 ferritic-pearlitic ductile iron, cast in sand molds. Gray cast iron flanges shall not be allowed. Hollow-back flanges shall not be allowed. Only solid ductile iron flanges shall be allowed.
   b. Ductile iron companion flanges shall be designed and manufactured in accordance with the AWWA C115 and the requirements of this Section. Flanged joints with mating flanges of dissimilar metals shall be installed with composite dielectric flange gaskets, hardware and accessories where required.
   c. AWWA flanged ductile iron pipe fittings for mechanical piping applications shall have a minimum pressure rating of 250 psi. Fittings shall meet all requirements of AWWA C110. Fittings shall have the same pressure rating, as a minimum, of the connecting pipe and flanges.

d. Buried ductile iron fittings shall have joints as specified herein and dimensions in accordance with AWWA/ANSI C110/A21.10 and/or AWWA C153.

B. Flange Hardware
   1. As scheduled in Section 40 05 00.
   2. Material as specified in Section 40 05 05.20.

C. Mechanical Joint Hardware:
   1. T-Bolts: ASTM A307, low alloy steel with fluoropolymer or thermoset epoxy coating.
   2. Nuts: low alloy steel with fluoropolymer or thermoset epoxy coating.

D. Flange and Mechanical Joint Gaskets
   1. Flange Gaskets
      a. As scheduled in Section 40 05 00.
      b. Material as specified in Section 40 05 05.20.
   2. Mechanical Joint Gaskets
      a. Ethylene propylene diene monomer rubber (EPDM) shall have a working temperature range of -30 to 230 degrees F; 40 to 80 durometer hardness shore A, smooth finish up to 200°F. ASTM D2000, Type B, Class A. Pipelines conveying potable water having chloramines require peroxide-cured ethylene propylene diene monomer rubber elastomers.

E. End Treatments/Joint Types for Buried Pipe
   1. Proprietary Restrained Joint Systems
      a. Positive locking joints manufactured by the pipe and fitting manufacturer that utilize restraint independent of the joint gasket. Joint system may be field adjustable type.
      b. Joints shall have a minimum allowable joint deflection after installation of 5 degrees up to 12 IN diameter and 2.5 degrees up to 48 IN diameter.
   2. Lug-Style Restrained Mechanical Joint Retainer Glands
      a. For piping diameters up to 36 IN, a restraint device utilizing a follower gland and numerous individually activated gripping surfaces with torque limiting twist-off nuts. Restraint device shall have a working pressure of at least 250 psi and a safety factor of 2:1.
      b. Glands and wedges shall be ASTM A536 ductile iron. Wedges and glands shall be factory coated with manufacturer's standard fluoropolymer or thermoset epoxy coating. Alternative restraint devices not allowing deflection shall not be used on pipe joints within 10 FT of a structure.
      c. Joints shall be bonded as shown on the Drawings and where scheduled in Section 40 05 00.

F. Coatings, Linings, and Encasement
   1. See Pipe Schedule in Section 40 05 00 for required exterior coatings and interior linings for each pipe service.
   2. Exterior Coatings
      a. Exposed Pipe and Fittings
         1) Surface preparation shall be per SSPC-SP12.
         2) Factory applied, single component, moisture cured urethane primer.
         3) Field coat per Section 09 96 00.
      b. Buried Pipe and Fittings
         1) Bituminous Coating.
   3. Interior Linings
      a. Ceramic Epoxy
         1) Two component, amine cured novolac epoxy.
         2) Twenty percent by volume ceramic pigmentation.
         3) Minimum finished thickness of 40 mils.
      b. Cement Mortar
         1) Single thickness cement mortar and asphaltic seal coat per AWWA C104.
      c. Glass Lining

1) Minimum two-coat process.
    a) Base coat heated to solidly fuse glass to pipe surface.
    b) Subsequent coat(s) heated to form integral bond with preceding coat.
2) Final finish parameters:
    a) Thickness: 8-12 mils.
    b) Hardness: Above 5 on MOHS scale.
    c) Density: 2.5-3.0 grams per cubic centimeter.
    d) Metal to lining bonding: Capable of withstanding strain of 0.0001 IN/IN without damage to lining.
3) Complete compatibility between fittings and piping.

4. Polyethylene Encasement:
    a. Encasement shall be a three-layer system consisting of a linear low density polyethylene (LLDPE) UV resistant outer layer and a LLDPE inner layer with corrosion inhibitor and biocide.
    b. Encasement and be in accordance with AWWA/ANSI C105/A21.5.
    c. Encase all buried pipe and fittings.

G. External wall penetrations 48-IN diameter and less shall be made by ASTM A536 Grade 70-50-5 ductile iron sleeve capable of being bolted directly to the formwork. The seals shall be capable of withstanding the adjoining piping system pressure. Sleeve shall have an integrally cast water stop of ½-in minimum thickness and 2½-in minimum height.

2.3 MANUFACTURED UNITS

A. Couplings, including dismantling joints, shall be as specified in Section 40 05 00.

B. Flange insulating kits shall be as specified in Section 40 05 05.20.

C. Pipe tapping/service saddles shall be as specified in Section 40 05 00.

2.4 SOURCE QUALITY CONTROL

A. Hydrostatic Test
1. The Supplier shall perform hydrostatic testing of each pipe length at the factory following production at 500 psi, for 10 seconds per AWWA C151.
2. The Supplier shall perform hydrostatic testing prior to or following machining the bell and spigot. Acceptance criteria shall be no rupture of the pipe wall at any location along the pipe length. Defective Work shall be rejected and replaced by the Contractor and Supplier at no change in Contract Price or Contract Time. Certified test results shall be furnished in duplicate to the Engineer prior to time of shipment.

B. Physical Testing:
1. The Supplier shall perform physical quality assurance testing of ductile-iron pipe and fittings at the factory. The Contractor shall submit documentation of quality assurance testing results prior to the shipment of pipe. The quality assurance data shall include results for tests for each heat lot:
    a. As per the AWWA C151 the acceptance value for the Charpy test shall be a minimum of 7ft-lb for test conducted at 70°F + 10°F.
    b. Tensile test per the AWWA C151 the acceptance values for the iron tensile test shall be as follows for Grade 65-45-12.
    c. Tensile test per the AWWA C151 the acceptance values for the iron tensile test shall be as follows for Grade 70-50-5.
    d. Chemical analysis.
2. All hydrostatic pressure testing shall be recorded and submitted by the Contractor as a certified MTR that describes the testing procedure, equipment, measured values, and pass/fail status of the test results.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Joining Methods
   1. Push-On Mechanical (Gland-Type) Joints
      a. Install in accordance with AWWA/ANSI C111/A21.11.
      b. Assemble mechanical joints carefully according to manufacturer's recommendations.
      c. If effective sealing is not obtained, disassemble, thoroughly clean, and reassemble the joint.
      d. Do not overstress bolts.
      e. Where piping utilizes mechanical joints with tie rods, align joint holes to permit installation of harness bolts.
   2. Push-On Joints
      a. Install in accordance with AWWA/ANSI C151/A21.51.
      b. Assemble push-on joints in accordance with manufacturer's directions.
      c. Bevel and lubricate spigot end of pipe to facilitate assembly without damage to gasket.
         1) Use lubricant that is non-toxic, does not support the growth of bacteria, has no deteriorating effects on the gasket material, and imparts no taste or odor to water in pipe.
      d. Assure the gasket groove is thoroughly clean.
      e. For cold weather installation, warm gasket prior to placement in bell.
      f. Taper of bevel shall be approximately 30 degrees with centerline of pipe and approximately 1/4 IN back.
   3. Flanged Joints
      a. Install in accordance with AWWA/ANSI C115/A21.15.
      b. Extend pipe completely through screwed-on flanged and machine flange face and pipe in single operation.
      c. Make flange faces flat and perpendicular to pipe centerline.
      d. When bolting flange joints, exercise extreme care to ensure that there is no restraint on opposite end of pipe or fitting which would prevent uniform gasket compression or would cause unnecessary stress, bending or torsional strains to be applied to cast flanges or flanged fittings.
      e. Allow one flange free movement in any direction while bolts are being tightened.
      f. Do not assemble adjoining flexible joints until flanged joints in piping system have been tightened.
      g. Gradually tighten flange bolts uniformly to permit even gasket compression.
      h. Project bolt ends 1/4 to 1/2 IN beyond nuts.
      i. Anti-seize lubricant for flange bolting
         1) Flange bolts shall be installed using a nickel anti-seize lubricant capable of achieving the required bolt torque and sealing stress and permitting future disassembly with minimal manual input.
         2) Excess anti-seize compound shall be removed by degreasing solvent prior to finish painting the piping.

B. Cutting
   1. Do not damage interior lining material during cutting.
   2. Use abrasive wheel cutters or saws.
   3. Make square cuts.
   4. Bevel and free cut ends of sharp edges after cutting.

C. Support exposed pipe in accordance with Section 40 05 07 and as shown on the Drawings.

D. Install buried piping in accordance with Section 40 05 00.

E. Install restrained joint systems where specified in Section 40 05 00 (Pipe Schedule) and as shown on the Drawings.

3.2 CARE AND REPAIR OF CERAMIC EPOXY LINING DURING CONSTRUCTION

A. Ceramic epoxy lined pipe and fittings shall be rigged from the outside of the pipe and fittings. No forks, chains, straps, hooks, etc. shall be placed inside the pipe and fittings for lifting or positioning. The pipe shall not be dropped or unloaded by rolling. Care shall be taken avoid the pipe striking sharp objects while swinging or being off loaded.

B. Field-cut or damaged linings shall be repaired in accordance with the manufacturer's instructions and as specified herein. Prior to repairing the lining, remove burrs caused by field-cutting of ends or handling damage and smooth out the edge of the lining if rough. Remove all traces of oil, grease, asphalt, dust, dirt, etc. Remove any damaged lining caused by field cutting operations or handling and clean any exposed metal by sanding or scraping.

C. Sandblasting or power tool cleaning and roughening shall be acceptable on the interior of the pipe. Remove loose lining material by chiseling, cutting, or scraping into well adhered lined areas. The repair shall overlap at least 1 inch of lining in the area to be repaired.

D. After preparing the area to be repaired apply a coat of ceramic epoxy joint compound using the manufacturer's instructions. Coat the entire freshly cut exposed metal surface of the cut pipe end, or damaged area, to ensure proper sealing, and overlap of at least 1 inch of the lining with the joint compound.

3.3 FIELD QUALITY CONTROL

A. Hydrostatically test piping systems in accordance with Section 40 05 00.

3.4 CLEANING AND DISINFECTION

A. See Section 40 05 00.

END OF SECTION

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SECTION 40 05 23
STAINLESS STEEL PROCESS PIPE AND TUBING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Stainless steel tubing, piping, fittings, and appurtenances.

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 40 05 00 - Pipe and Pipe Fittings - Basic Requirements.

1.2 REFERENCES

A. Referenced Standards:
   1. American Society of Mechanical Engineers (ASME):
      a. B16.1, Gray Iron Pipe Flanges and Flanged Fittings (Classes 25, 125 and 250).
      b. B31.3, Process Piping.
      c. BPVC.IX, Welding, Brazing, and Fusing Qualifications
   2. ASTM International (ASTM):
      a. A182, Standard Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
      b. A193, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
      c. A194, Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
      d. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
      e. A312, Standard Specification for Seamless, Welded, and Heavy Cold Worked Austenitic Stainless Steel Pipes.
      f. A358 Standard Specification for Electric-Fusion-Welded Austenitic Chromium-Nickel Stainless Steel Pipe for High-Temperature Service and General Applications.
      g. A380/A380M, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
      h. ASTM A403, Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings
      i. A530, Standard Specification for General Requirements for Specialized Carbon and Alloy Steel Pipe.
      j. A967, Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts.
   3. American Welding Society:
      a. AWS D10.4M/D10.4, Guide for Welding Austenitic Stainless Steel Piping and Tubing.
   4. Nickel Development Institute (NiDI):
      a. Publication 11 007, Guidelines for the Welded Fabrication of Nickel-Containing Stainless Steels for Corrosion Resistant Services.

1.3 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Product technical data including:
         1) Acknowledgement that products submitted meet requirements of standards referenced.
      b. Free iron contamination test method to be used (to be selected from ASTM A380).

B. Informational Submittals: Submit the following:

a. Fabrication details and welding procedure specifications for all work to be done under this Specification Section.

C. See Specification Section 40 05 00 for additional piping submittal requirements.

1.4 QUALITY ASSURANCE

A. QA/QC Program
1. Fabricator shall have QA/QC program and procedures in place to avoid cross contamination between stainless steel and carbon steel products, materials, and tools. The QA/QC program will be made available to owner for review and comment.
2. Weld personnel shall be qualified for all positions that will be welded, qualified by testing in accordance with applicable welding code ASME BPVC.IX or AWS D1.6 requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Tubing:
1. ASTM A269.
2. Filler material: Extra low carbon (ELC) with 0.03% maximum carbon.

B. Pipe, unless noted otherwise on individual piping system in Specification Section 40 05 00:
1. 8" and less: ASTM A312 TP 304/304L (dual rated), seamless.
2. 10" – 24": ASTM A312 TP 304/304L (dual rated), EFW (Ej = 0.8)
3. 26" and larger: ASTM A358 TP 304/304L (dual rated), CL2, EFW (Ej =0.85)
4. Diameter tolerance and wall thickness tolerance are to conform to ASTM A530.

C. Pipe Fittings:
1. ASTM A403.
2. Fabrication standard and tolerances shall be per ASME B16.9. Stainless type/grade / seamless/welded shall match above piping requirements.
3. Fittings shall be long radius unless otherwise noted on the drawings. Furnish short radius wherever specifically required to furnish the configuration shown on the drawings.

D. Flanges, unless noted otherwise on individual piping system in Specification Section 40 05 00:
1. Flat faced.
2. Slip on type.
3. ASTM A182, Type 304L.

E. Nuts, Bolts and Washers, unless noted otherwise on individual piping system in Specification Section 40 05 00:
1. ASTM A193 Gr. B8M bolts and ASTM A194 Gr. 8M hex nuts, Type 316.
2. Provide two (2) nuts for 1 inch diameter bolt applications and larger.

F. Elastomeric Bellows Type Expansion Joint (for hot air service including Aeration Air):
1. Refer to Section 40 05 00 for expansion joints for liquid service.
2. Manufacturers:
a. General Rubber Series 1101 or equal.
3. Single Arch construction.
4. Material: EPDM (tube and cover)
5. Backer rings and rod tabs: 304 stainless steel, 150# ANSI flange drilling
6. Restraint: Provide control rods sized to restrain joint at test pressure.
a. Materials: 316 stainless steel rods and hardware.
b. Rods: ASTM A193 B8M 316SS
c. Nuts: ASTM A194 8M 316SS

7. Allow for the following minimum joint deflections:

Nominal Diameter	Axial Compression	Axial Extension	Lateral Deflection	Angular Deflection	Torsional Deflection
10"	2"	1"	1.25"	17°	3°
12"	2"	1"	1.25"	14°	2.9°
18"	2.25"	1.125"	1.25"	10°	2.6°
24"	2.5"	1.25"	1.375"	8°	2.4°

1. Manufacturer shall furnish their recommended rod and hardware configuration to achieve the specified deflections under the specified operating conditions.
2. Contractor shall field install expansion joints with all hardware configured to allow extension, compression, and deflection indicated above.
3. Pressure Rating: Working pressure of joint equal or greater than test pressure of connecting piping. Provide minimum 25 psig rating.
4. Temperature Rating: 300°F, minimum.

G. Pressure Balanced Elastomeric Bellows Type Expansion Joint (for hot air service including Aeration Air):
1. Manufacturers:
   a. General Rubber Series 5100P or equal.
2. Material: EPDM (tube and cover), Kevlar reinforcement
3. Thrust rings and rod tabs: 304 stainless steel, 150# ANSI flange drilling
4. Restraint: Provide control rods sized to restrain joint at test pressure.
   a. Materials: 316 stainless steel rods and hardware.
   b. Rods: ASTM A193 B8M 316SS
   c. Nuts: ASTM A194 8M 316SS
   d. Spherical washers

   Allow for the following minimum joint deflections:

Nominal Diameter	Axial Compression	Axial Extension	Lateral Deflection	Angular Deflection	Torsional Deflection
36"	2.5"	1.25"	1.375"	7°	2.3°

5. Manufacturer shall furnish their recommended rod and hardware configuration to achieve the specified deflections under the specified operating conditions.
6. Contractor shall field install expansion joints with all hardware configured to allow extension, compression, and deflection indicated above.
7. Pressure Rating: Working pressure of joint equal or greater than test pressure of connecting piping. Provide minimum 25 psig rating.

H. Temperature Rating: 300°F, minimum.Gasket Material, unless noted otherwise on individual piping system in Specification Section 40 05 00:
1. FKM (Viton).
2. Temperature rating of 300 degrees F.

2.2 FABRICATION

A. Shop Welding:
1. Weld stainless steel in accordance with AWS D10.4-86R and NiDI 11 007.
2. Provide welds sound and free from embedded scale or slag, and tensile strength at weld not less than pipe.
3. Perform butt welds only with an inert gas shielded process.
4. Provide adequate inert gas protection to the top and under or backside of the weld to protect from atmospheric contamination.
5. Provide filler metal appropriate for the base material being welded.
6. Use only inert gas shielded welding processes for spool fabrication.

7. Provide butt welds with 100% penetration to the interior or back side of the weld joint.
8. Weld reinforcement on both sides of the weld is to be smooth, uniform and no more than 1/16 inches in height.

B. Joints:
1. Shop welded circumferential buttweld joints.
2. ASME B16.1, Class 150.

C. Elastomeric Bellows Type Expansion Joints:
1. Ensure aerial travel in expansion joints of 3.1 inches minimum for 15,000 cycles or 5.2 inches for 1000 cycles.
2. Furnish each assembly with a minimum of two control tie rods.
3. Fabricate with 125 pound flanged end connections.

D. Expansion Joints:
1. Fabricate for 25 psi internal pressure and 270 degrees F operation.
2. Ensure aerial travel in expansion joints of 3.1 inches minimum for 15,000 cycles or 5.2 inches for 1000 cycles.
3. Furnish each assembly with minimum four control tie rods.
4. Fabricate with 125 pound flanged end connections.

E. Passivation
1. For components/assemblies to be used only in dry air service environments:
   a. No post-fabrication passivation treatments are required for external corrosion control.
2. For components/assemblies to be used in outdoor atmospheric service environments:
   a. Following the conclusion of fabrication operations, just prior to shipping, pickle/passivate all fabricated components per the requirements of ASTM A380 to remove dirt, weld heat tint, weld slag, free iron contamination, and other surface contaminants suffered during fabrication.
      1) 100% of all completed welds and material shall be pickled/passivated.
      2) Additional methods listed in ASTM A967 or NiDI 11 007 may be used for cleaning/passivation with written approval from the Engineer.
   b. For assemblies containing crevices, joints, flanges, gaskets, pockets, etc. that cannot be completely rinsed to remove passivating acids/chemicals following the passivating process: disassemble prior to passivation, then reassemble after rinsing/drying.
   c. Protect passivated assemblies from additional carbon steel surface contamination or other contaminants during all subsequent packing, shipping, handling, and installation operations as described in ASTM A380.
3. For components/assemblies to be used in corrosive service environments:
   a. Following the conclusion of fabrication operations, just prior to shipping, pickle/passivate all fabricated components per the requirements of ASTM A380 to remove dirt, weld heat tint, weld slag, free iron contamination, and other surface contaminants suffered during fabrication.
      1) 100% of all completed welds and material shall be pickled/passivated.
      2) Additional methods listed in ASTM A967 or NiDI 11 007 may be used for cleaning/passivation with written approval from the Engineer.
   b. For assemblies containing crevices, joints, pockets, etc. that cannot be completely rinsed to remove passivating acids/chemicals following the passivating process disassemble prior to passivation, then reassemble after rinsing/drying.
   c. Demonstrate that all free iron contamination has been removed from all stainless steel surfaces per one of the free iron test methods listed in ASTM A380.
      1) Submit the free iron contamination test method to be used for approval in advance by the Engineer.
      2) Test results must be approved in writing by the Engineer.
   d. Protect passivated assemblies from additional carbon steel surface contamination or other contaminants during all subsequent packing, shipping, handling, and installation operations as described in ASTM A380.

4. Control and dispose solvents and acid cleaning solutions used by the fabricator according to all applicable federal, state, and local pollution control regulations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to installation, inspect and verify condition of piping and appurtenances.
   1. Installation constitutes installer's acceptance of condition for satisfactory installation.

3.2 PREPARATION

A. Correct defects or conditions which may interfere with or prevent a satisfactory installation.

B. Ensure ends of pipe to be fitted with flanges have all protrusions ground flush.

3.3 INSTALLATION

A. Ensure all pipe cutting, threading and jointing conforms to requirements of ASME B31.1.
   1. Lubricate all pipe threads with Teflon tape.

B. Field Welding:
   1. Weld stainless steel in accordance with AWS D10.4-86R and NiDI 11 007.
   2. For welding on existing lines, clean and purge lines prior to welding.
   3. Provide welds sound and free from embedded scale or slag, and tensile strength at weld not less than pipe.
   4. Perform butt welds only with an inert gas shielded process.
   5. Provide adequate inert gas protection to the top and under or backside of the weld to protect from atmospheric contamination.
   6. Apply filler metal for all manually-performed welds appropriate for the base material being welded.
   7. Use only inert gas shielded welding processes for spool fabrication.
   8. Provide butt welds with 100% penetration to the interior or back side of the weld joint.
   9. Weld reinforcement on both sides of the weld is to be smooth, uniform and no more than 1/16 inches in height.
   10. Following completion of field welding, remove all dirt, weld heat tint, weld slag, free iron contamination, and other surface contaminants suffered during field welding.
      a. For external corrosion control, follow the pickling/passivation/cleanliness requirements of Article 2.2, Paragraph F of this specification section.
      b. Additional methods listed in ASTM A967, Section 8 may be used for passivation with engineer approval.

C. Joining Method - Flanges:
   1. Leave 1/8 inches to 3/8 inches flange bolts projection beyond face of nut after tightening.
      a. Coordinate dimensions and drillings of flanges with flanges for valves, equipment, and other systems.
      b. Tighten bolts evenly around pipe until following range of torques is achieved:

BOLT SIZE, IN	RANGES OF TORQUE, FT/LBS
5/8	40 - 60
3/4	60 - 90
1	70 - 100
1-1/4	90 - 120

D. Expansion Joints:

1. Install in accordance with manufacturer's instructions.
2. Apply anti-seize compound to all exposed steel threads.

3.4 FIELD QUALITY CONTROL

A. Test piping systems in accordance with Specification Section 40 05 00.

3.5 CLEANING

A. Clean in accordance with Specification Section 40 05 00.

END OF SECTION

SECTION 40 05 31
PLASTIC PIPE AND FITTINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Single wall plastic pipe and fittings for buried and exposed service.
   2. Drainage and sewage pipe and fittings for buried service.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 31 23 05 – Excavation and Fill.
   4. Section 40 05 00 – Pipe and Pipe Fittings: Basic Requirements.
   5. Section 40 05 05.20 – Piping Flange Gaskets and Assembly Hardware.
   6. Section 40 05 19 – Ductile Iron Pipe and Fittings.
   7. Section 40 05 33 – High Density Polyethylene Process Pipe.

1.2 QUALITY ASSURANCE

A. See Specification Section 40 05 00.

B. Referenced Standards:
   1. ASTM International (ASTM):
      a. PVC (polyvinyl chloride) materials:
         1) D1784, Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
         2) D1785, Standard Specification for Poly (Vinyl Chloride) PVC Plastic Pipe, Schedules 40, 80 and 120.
         3) D2467, Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
         4) D3034, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
         5) D3139, Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
         6) D3212, Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
         7) D3219, Specification for Industrial Filament Yarns, Tire Cords, and Tire Cord Fabrics Made from Man-Made Organic-Base Fibers.
         8) F477, Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
         9) F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws and Studs.
         10) F594, Standard Specification for Stainless Steel Nuts.
         11) F679, Standard Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
         12) F794, Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.
         13) F949, Standard Specification for Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings.
         14) D2321, Standard Practice for Underground Installation of Thermosplastic Pipe for Sewers and Other Gravity-Flow Applications.
      b. Polyethylene (PE) materials:
         1) D-1248, Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.

1. American Water Works Association (AWWA):
   a. PVC (polyvinyl chloride) materials:
      1) C900-16, Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 IN Through 60 IN.
   b. Polyethylene (PE) materials:
      1) C901, Standard for Polyethylene (PE) Pressure Pipe and Tubing, 1/2 IN through 3 IN, for Water Service.
2. NSF International (NSF).

1.3 SUBMITTALS

A. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

B. See Specification Section 40 05 00.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Care shall be taken in loading, transporting, and unloading to prevent injury to the pipe. Under no circumstances shall the pipe be dropped or skidded against each other. Slings, hooks, and pipe tongs shall be padded and used in such a manner as to prevent damage to the exterior surface of the pipe.

B. Materials, if stored, shall be kept safe from damage. The interior of all piping, fittings and other appurtenances shall be always kept free from dirt and foreign matter.

C. Pipe shall not be stacked higher than the limits recommended by its manufacturer. The bottom tier shall be kept off the ground on timbers, rails, or concrete. Stacking shall conform to manufacturer's recommendations.

D. Field cutting of the pipe segments prior to removing them from the stockpile shall not be allowed.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Schedule 80 PVC and CPVC single wall pipe and fittings:
      a. Chemtrol/NIBCO.
      b. George Fisher.
      c. IPEX USA LLC.
      d. Charlotte Pipe and Foundry Company.
   2. PVC primer (water service):
      a. P-70® Primer (clear) manufactured by IPS Corporation.
      b. IPEX 5® Primer (Aqua Blue) Wet/Dry Primer manufactured by IPEX, Inc.
   3. PVC solvent cement (water service):
      a. Weld-On 711® solvent cement manufactured by IPS Corporation.
      b. IPEX 25 (Aqua Blue) Wet/Dry solvent cement, manufactured by IPEX, Inc.
   4. PVC primer (chemical service):
      a. P-70® Primer (clear) manufactured by IPS Corporation.
      b. IPEX Xirtec 7® Primer (Clear) Wet/Dry Primer manufactured by IPEX, Inc.
   5. PVC solvent cement (chemical service):
      a. Weld-On 724® (Orange) Chemical Resistant solvent cement, manufactured by IPS Corporation.
      b. IPEX Xirtec 24® (Orange) chemical resistant solvent cement, manufactured by IPEX, Inc.
   6. AWWA C900 plastic pipe:
      a. JM Eagle™ Loc900.

b. Diamond Lok-21.
c. Approved equal.

7. AWWA C901 plastic pipe:
   a. JM Eagle™.
   b. Diamond Plastics.
   c. Approved equal.
8. Gravity drainage/sewer plastic pipe:
   a. JM Eagle™ Gravity Sewer with Ring-Tite Joints.
   b. Diamond Plastics.
   c. Approved equal.
9. Lug-style restrained joint adapters for fittings:
   a. EBAA Iron, Inc., Series 2000PV.
   b. Approved equal.
10. Mechanical joint hardware:
    a. Birmingham Fastener.
    b. Approved equal.
11. Fluoropolymer tee-head bolt and hardware coatings:
    a. Xylan® 1424 manufactured by Witford Corporation, Elverson, Pennsylvania.
    b. FlouroKote#1® manufactured by Metal Coatings Corp., Houston, Texas.
    c. Cor-Blu® manufactured by Birmingham Fastener, Birmingham, Alabama.
    d. R-Blue manufactured by Romac Industries, Bothell, Washington.

2.2 POLYVINYL CHLORIDE (PVC) PRESSURE PIPING (EXPOSED)

A. General:
   1. Provide Schedule 80 pipe with Schedule 80 fittings and appurtenances as scheduled in Section 40 05 00 and shown on the Drawings.
   2. Furnish materials in full compliance to following material specifications:
      a. Manufacture pipe, fittings, and appurtenances from PVC compound which meets the requirements of Type 1, Grade 1 (12454-B) Polyvinyl Chloride as outlined in ASTM D1784.
      b. Manufacture pipe, fittings and valves from materials that have been tested and approved for conveying potable water by the NSF.

B. Pipe:
   1. Furnish pipe meeting requirements of ASTM D1785.
   2. Pipe 2 IN and less to be solvent welded.
   3. Pipe larger than 2 IN may be either flanged or solvent welded unless shown otherwise on Drawings.

C. Fittings: Provide ASTM D2467 PVC socket type fittings having the same pressure and temperature rating as the pipe.

D. Flanges and Unions:
   1. General
      a. Furnish flanges and unions at locations shown on Drawings.
      b. Provide either flanges or unions at valves, penetrations through structures and equipment connections.
      c. For pipe larger than 2 IN, provide 150 LB socket type PVC flange.
      d. For pipe 2 IN and less, provide socket type PVC union with O-ring material as scheduled in the Pipe Schedule in Section 40 05 00.
   2. Flanged Connections
      a. See Section 40 05 05.20 for flange gaskets and assembly hardware. Gaskets for all PVC flanges shall be low-torque design.

2.3 CHLORINATED POLYVINYL CHLORIDE (CPVC) PRESSURE PIPING (EXPOSED)

A. General:

1. Provide Schedule 80 pipe with Schedule 80 fittings and appurtenances as scheduled in Section 40 05 00 and shown on the Drawings.
2. Furnish materials in full compliance to following material specifications:
   a. Manufacture pipe, fittings, and appurtenances from PVC compound which meets the requirements of Type 1, Grade 1 (12454-B) Polyvinyl Chloride as outlined in ASTM D1784.
   b. Manufacture pipe, fittings and valves from materials that have been tested and approved for conveying potable water by the NSF.

B. Pipe:
1. Furnish pipe meeting requirements of ASTM D1785.
2. Pipe 2 IN and less to be solvent welded.
3. Pipe larger than 2 IN may be either flanged or solvent welded unless shown otherwise on Drawings.

C. Fittings: Provide ASTM D2467 PVC socket type fittings having the same pressure and temperature rating as the pipe.

D. Flanges and Unions:
1. General
   a. Furnish flanges and unions at locations shown on Drawings.
   b. Provide either flanges or unions at valves, penetrations through structures and equipment connections.
   c. For pipe larger than 2 IN, provide 150 LB socket type PVC flange.
   d. For pipe 2 IN and less, provide socket type PVC union with O-ring material as scheduled in the Pipe Schedule in Section 40 05 00.
2. Flanged Connections
   a. See Section 40 05 05.20 for flange gaskets and assembly hardware. Gaskets for all CPVC flanges shall be low-torque design.

2.4 PRESSURE PIPING (BURIED)

A. General
1. Identify each length of pipe clearly at intervals of 5 FT or less.
2. Include manufacturer's name and trademark.
3. Nominal size of pipe, appurtenant information regarding polymer cell classification and critical identifications regarding performance specifications and NSF approvals when applicable.

B. Pipe Materials
1. Furnish materials in full compliance with following requirements:
   a. ½ to 3 IN: AWWA C901 PE with Pressure Class as noted in Section 40 05 00.
   b. 4 to 48 IN: AWWA C900 PVC with Pressure Class/Dimension Ratio (DR) as noted in Section 40 05 00.
2. PVC confirming to ASTM D1784, Cell Class 12454.

C. Fittings
1. Mechanical joint ductile iron conforming to AWWA C110 and C153 (See Section 40 05 19).
2. Mechanical joint hardware shall be ASTM A307, low alloy steel with manufacturer's standard fluoropolymer or thermoset epoxy coating.
3. Restrain all fittings with restraint device utilizing a follower gland and numerous individually activated gripping surfaces with torque limiting twist-off nuts. Restraint device shall have a working pressure of at least 250 psi and a minimum safety factor of 2:1. Glands and wedges shall be ASTM A536 ductile iron. Wedges and glands shall be factory coated with manufacturer's standard fluoropolymer or thermoset epoxy coating.

D. Joints

1. Self-restrained push-on joints with an elastomeric-gasket (ASTM F477) and metallic restraint casing and ring. Bell and spigot joints shall conform to ASTM D3139.

2.5 PVC DRAINAGE AND SEWER PIPING (NON-PRESSURE SERVICE)

A. General
   1. Identify each length of pipe clearly at intervals of 5 FT or less.
   2. Include manufacturer's name and trademark.
   3. Nominal size of pipe, appurtenant information regarding polymer cell classification and critical identifications regarding performance specifications and NSF approvals when applicable.

B. Pipe
   1. Furnish materials in full compliance with following requirements:
      a. 4-24 IN DIA: ASTM D3034 with Standard Dimension Ratio (SDR) as indicated in Section 40 05 00.
   2. PVC confirming to ASTM D1784, Cell Class 12454/12364.

C. Pipe Joints
   1. Joining systems shall consist of an elastomeric gasket joint meeting requirements of ASTM D3212.
   2. Joints shall meet or exceed the requirements of ASTM D3219 for joint tightness.
   3. Gaskets shall conform to ASTM F477, synthetic rubber.

D. Fittings
   1. Furnish fittings in full compliance with following requirements:
      a. 4-24 IN DIA: ASTM D3034 with Standard Dimension Ratio (SDR) as indicated in Section 40 05 00.
   2. Fitting joints shall be solvent-cemented type or push-on gasketed meeting requirements of ASTM D3212 and ASTM F1336.

2.6 SHOP TESTING

A. Pressure piping systems shall undergo burst tests at the manufacturer's facility. PVC and CPVC pipe shall be tested to ASTM D1785. Test pressures for specific diameters are detailed in ASTM D1785 and F441 respectively.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Joining Methods
   1. Solvent Weld Joints
      a. Employ installation and pipe support practices and solvent welding all in compliance to the manufacturer's printed recommendation.
      b. Bevel cut ends of PVC for all joints.
      c. Field threading PVC will not be permitted. Perform required threaded connections or attachments using factory molded socket by threaded adapters. Female adapters are not acceptable.
   2. Push-On Mechanical (Gland-Type) Joints
      a. Install in accordance with AWWA/ANSI C111/A21.11.
      b. Assemble mechanical joints carefully according to manufacturer's recommendations.
      c. If effective sealing is not obtained, disassemble, thoroughly clean, and reassemble the joint.
      d. Do not overstress bolts.
      e. Where piping utilizes mechanical joints with tie rods, align joint holes to permit installation of harness bolts.
   3. Push-On Joints
      a. Install in accordance with AWWA/ANSI C151/A21.51.

b. Assemble push-on joints in accordance with manufacturer's directions.
c. Bevel and lubricate spigot end of pipe to facilitate assembly without damage to gasket.
    1) Use lubricant that is non-toxic, does not support the growth of bacteria, has no deteriorating effects on the gasket material, and imparts no taste or odor to water in pipe.
d. Assure the gasket groove is thoroughly clean.
e. For cold weather installation, warm gasket prior to placement in bell.
f. Taper of bevel shall be approximately 30 degrees with centerline of pipe and approximately 1/4 IN back.

4. Flanged Joints
    a. Install in accordance with AWWA/ANSI C115/A21.15.
    b. Extend pipe completely through screwed-on flanged and machine flange face and pipe in single operation.
    c. Make flange faces flat and perpendicular to pipe centerline.
    d. When bolting flange joints, exercise extreme care to ensure that there is no restraint on opposite end of pipe or fitting which would prevent uniform gasket compression or would cause unnecessary stress, bending or torsional strains to be applied to cast flanges or flanged fittings.
    e. Allow one flange free movement in any direction while bolts are being tightened.
    f. Do not assemble adjoining flexible joints until flanged joints in piping system have been tightened.
    g. Gradually tighten flange bolts uniformly to permit even gasket compression.
    h. Project bolt ends 1/4 to 1/2 IN beyond nuts.
    i. Anti-seize lubricant for flange bolting
        1) Flange bolts shall be installed using a nickel anti-seize lubricant capable of achieving the required bolt torque and sealing stress, and permitting future disassembly with minimal manual input.
        2) Excess anti-seize compound shall be removed by degreasing solvent prior to finish painting the piping.

B. Pipe Supports
1. Continuously support PVC piping at liquid operating temperatures more than 100 DegF.
2. For vertical piping, band the pipe at intervals to rigidly support load of twice vertical load.
3. Support riser clamps on spring hangers. Do not clamp PVC tightly or restrict movement for expansion and contraction.
4. See Section 40 05 07 for additional requirements.

C. Install buried piping in accordance with Section 40 05 00.

D. Install restrained joint systems where specified in Section 40 05 00 under specific piping system and as shown on the Drawings.

3.2 FIELD QUALITY CONTROL AND TESTING

A. Pressure Pipe
1. All pipelines shall remain undisturbed for the minimum curing or cooling time specified for each type of pipe material but no less than 8 hours to develop full curing and complete strength at all joints. All pipe systems shall be flushed clean and then subjected to a hydrostatic pressure test for 12 hours at the test pressures and temperatures specified in Section 40 05 00. Should the temperature not be attainable under hydrostatic conditions, then the test may be performed under hydrodynamic conditions, provided that accurate measurements for loss of the test fluid can be made, or the pressure shall be proportionally increased to simulate the stresses of the higher temperature in relation to the lowest system temperature that is expected during the duration of the test. The proportionally higher test pressures shall be determined in accordance with the accepted temperature versus strength properties as published by the pipe manufacturer, PPI, or other pipe material standards organization.

2. The test shall be performed by slowly filling the piping system, expelling entrapped air from all high points. The fill rate shall be controlled so that the fluid velocity within the pipe system is less than 2 fps. Upon completion of the filling process, the system shall be brought up to the specified test temperature as applicable, holding the system pressure to less than 10 percent of the test pressure. Once the system has been stabilized at the specified test temperature, the pipe should be slowly brought up to the test pressure in such a manner so as to not create shock, surge or water hammer in the pipe system. The test duration time limit shall not begin until the full pressure specified above has been reached and the system has been stabilized to within 5 percent of the test temperature. The system pressure and temperature shall be maintained to within 1/2 percent but no more than 5 percent of the specified value for the temperature and within 5 psi of the specified value for the pressure. These tolerances shall be held for the entire duration of the test. Upon completion of the test, the pressure shall be slowly removed by opening a valve or other pressure relieving device at a location remote to the location of the pressure/temperature monitoring equipment.
3. The pressure test shall be monitored by a recording type pressure gauge for tests not requiring temperature control or a dual pen pressure/temperature recording gauge when temperature control is required. The entire test process shall be recorded, including the initial temperature stabilization and pressurization of the piping system. The record shall be continuous through the system test and shall show the final depressurization of the pipe system.
4. All visible leaks detected during the pressure test shall be repaired and the pressure/ temperature test rerun. A successful test shall be a test in which no visible leaks are detected and the pipe system pressure can be maintained within 1/2 percent but no more than 5 psi of the specified value.
5. Prior to testing, the pipelines shall be supported in an approved manner to prevent movement during the tests.

B. Gravity Flow Pipe
1. Field test per Section 40 05 00.

END OF SECTION

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SECTION 40 05 33
POLYETHYLENE PROCESS PIPE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Polyethylene (PE) pipe, fittings, and appurtenances.
   2. This section applies to yard piping, including buried high density polyethylene pipe. Applicable services are identified in pipe schedules in Section 40 05 00.

B. Related Sections include but are not necessarily limited to:
   1. Section 31 23 05 – Excavation and Fill.
   2. Section 40 05 00 – Pipe and Pipe Fittings – Basic Requirements.

1.2 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer of PE Pipe:
      a. Obtain all PE pipe and fittings from one manufacturer, unless otherwise acceptable to Owner and Engineer.
      b. Manufacturer of pipe required by this Section shall be regularly engaged in the business of manufacturing PE piping of the size and type(s) required for the Work. Upon Engineer's request, submit documentation of manufacturer's prior furnishing of PE pipe of the type(s) required for not less than five other projects, similar in size and complexity to the PE piping Work of this Project, in North America.
      c. Equipment:
         1) Qualify each extrusion line and molding machine to produce pressure rated products by taking representative production samples and performing sustained pressure tests in accordance with ASTM D1598.
      d. QA and QC Program:
         1) PE pipe manufacturer shall have documented quality assurance and quality control programs as part of manufacturer's routine business.
         2) PE piping manufacturer shall maintain permanent Quality Control (QC) and Quality Assurance (QA) records.
   2. Installer:
      a. Use one entity for all PE pipe Work, unless otherwise acceptable to Owner and Engineer.
      b. Installer shall be experienced with PE piping installation work similar in scope and complexity to the Work of this Section. When required by Engineer, submit documentation of successful completion of not less than five similar projects to the PE piping Work completed within the past five years.
      c. Where PE pipe joints are made by fusing, fusion machine operators shall have been trained by fusion machine manufacturer within 12 months of starting to perform joint fusion Work. Submit documentation of such training, acceptable to Engineer, when requested by Engineer.
      d. Installer's training and qualifications shall be as recommended by the PE pipe Supplier retained for the Project.

B. Referenced Standards:
   1. American National Standards Institute (ANSI):
      a. B1.1, Unified Inch Screw Threads (UN and UNR Thread Form).
      b. B16.1, Cast-Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.
      c. B16.21, Nonmetallic Flat Gaskets for Pipe Flanges.
   2. ASTM International (ASTM):

a. A182, Standard Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
b. A194, Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
c. A307, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength
d. A536, Standard Specification for Ductile Iron Castings.
e. B695, Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
f. D638, Standard Test Method for Tensile Properties of Plastics.
g. D1248, Specification for Polyethylene Plastics Molding and Extrusion Materials.
h. D1505, Test Method for Density of Plastics by the Density-Gradient Technique.
i. D1598, Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure.
j. D1599, Test Method for Short-Time Hydraulic Failure Pressure of Plastics Pipe, Tubing and Fittings.
k. D2239, Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter.
l. D2290, Test Method for Apparent Tensile Strength of Ring or Tubular Plastics and Reinforced Plastics by Split Disk Method.
m. D2683, Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.
n. D2737, Standard Specification for Polyethylene (PE) Plastic Tubing.
o. D2774, Standard Practice for Underground Installation of Thermoplastic Pressure Piping.
p. D2837, Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products.
q. D3035, Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
r. D3261, Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
s. D3350, Standard Specification for Polyethylene (PE) Plastics Pipe and Fittings Materials.
t. F714, Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
u. F1055, Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing.
v. F2620, Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings.

3. American Water Works Association (AWWA).
   a. C207, Steel Pipe Flanges for Waterworks Service, Sizes 4 In. through 144 In.
   b. C901, Polyethylene (PE) Pressure Pipe and Tubing, ¾ In. through 3 In. for Water Service.
   c. C906, Polyethylene (PE) Pressure Pipe and Fittings, 4 In. through 65 In. for Waterworks.
4. Plastic Pipe Institute (PPI):
   a. TR-3, Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe Material.
   b. PPI TR-4, Recommended Hydrostatic Strengths and Design Stresses for Thermo-plastic Pipe and Fittings Compounds.
5. Military Specification (Mil Spec):
   a. QQ-P-416F, Plating, Cadmium Electro Deposited.
6. National Sanitation Foundation International (NSF):
   a. 14, Plastic Piping Components and Related Materials.
   b. 61, Drinking Water System Components – Health Effects.

1.3 DEFINITIONS

A. DIOD: Ductile Iron Outside Diameter.

B. CTS: Copper Tube Size.

C. DR: Dimension Ratio, Outside Diameter/Minimum Wall Thickness, both in inches.

D. Diametral Deflection: reduction in diameter caused by earth and surcharge loads acting on the installed pipe.

E. ESCR: Environmental Stress Crack Resistance.

F. HDB: Hydrostatic Design Basis per ASTM D2837.

G. IPS: Iron Pipe Size.

H. SDR: Standard Dimension Ratio.

I. SIDR: Standard Inside Diameter Ratio.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Dimensioned, scaled drawings showing Contractor's proposed deviations from piping alignment shown on the Drawings.
      b. Where necessary, include both plans and profiles and section views in Shop Drawings.
   2. Product Data:
      a. Manufacturer's published catalog information and specifications for each size and type of PE piping required, including pipe, fittings, and jointing materials.
      b. Clearly indicate in product data submittal the reference standards with which pipe and appurtenances comply.
      c. Where couplings are required, submit coupling manufacturer's catalog literature and specifications for the specific couplings proposed.

B. Informational Submittals; Submit the following:
   1. Supplier Instructions:
      a. Submit manufacturer's written instructions for handling, storing, and installing piping furnished.
   2. Source Quality Control:
      a. Submit documentation from manufacturer that piping materials furnished were inspected at the production facility and successfully passed manufacturer's quality control procedures.
      b. Manufacturer's affidavit certifying piping materials furnished comply with AWWA standard C906.
   3. Fusion machines proposed for joining pipe/fittings.
   4. Field Quality Control:
      a. Documentation of temperature and pressure profiles from data logger for each butt fusion joint.
      b. Results of field quality control testing and inspections required in this Section.
      c. Documentation of temperature and pressure profiles from data logger for each butt fusion joint.
   5. Qualifications:
      a. Piping materials manufacturer, when requested by Engineer.
      b. Installer, when requested by Engineer, including documentation of training in use of joint fusion equipment.
      c. Documentation showing fusion machine operators have been trained within 12 months prior to installation.

1.5 DELIVERY, HANDLING, AND STORAGE

A. In addition to requirements elsewhere in the Contract Documents, also comply with the following:
   1. During handling and installation avoid conditions where pipe bends excessively and avoid imparting kinks in the pipe.

PART 2 - PRODUCTS

2.1 MANUFACTURER'S

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. PE Pipe and Fittings:
      a. Chevron Phillips Chemical Company LP - Performance Pipe Division (DriscoPlex).
      b. WL Plastics.
      c. JM Eagle.
      d. Pipeline Plastics.
      e. Or equal.
   2. Restrained Transition Fitting:
      a. Georg Fischer Waga N.V.
   3. Butt Fusion Equipment:
      a. McElroy Manufacturing, Inc.
      b. Or equal.
   4. Adaptor Couplings
      a. Central Plastics Co.
      b. Poly-Cam, Inc.
      c. Or equal.

2.2 MATERIALS

A. Pipe:
   1. AWWA C906.
      a. PE 4710 polyethylene material.
      b. ASTM D3350 cell classification 445574C.
      c. Minimum Hydrostatic Design Basis (HDB) of 1600 psi at 73 degF when tested in accordance with PPI TR-3.

B. Fittings:
   1. Same material and thickness as adjoining pipe.
      a. Fittings may be one DR lower (thicker) than the adjoining pipe.
   2. Molded fittings:
      a. Butt fused: ASTM D3261.
      b. Socket: ASTM D2683.
      c. Electrofusion: ASTM F1055.
   3. Fabricated fittings: Fabricate from same material as pipe.

C. Back-up flanges:
   1. Stainless steel: ASTM A182, dimensions per AWWA C207, Class D.
   2. Ductile iron: ASTM A536 Grade 70-50-5, dimensions per ANSI B16.1, Class 125.

D. Nuts and Bolts:
   1. Buried:
      a. Tee-Head bolts for mechanical joints: Per AWWA/ANSI C111/A21.11.
      b. Other bolts and nuts: ASTM A307.
      c. Wax Tape Coatings per AWWA C217.
   2. Exposed: Mechanical galvanized ASTM B695, Class 40.
   3. Heads and dimensions per ASME B1.1.
   4. Threaded per ASME B1.1.

5. Project ends 1/4 to 1/2 inches beyond nuts.

E. Gaskets: See individual piping systems in Section 40 05 00.

2.3 MANUFACTURED UNITS

A. Adaptor Fittings:
   1. Mechanical joint: Adaptor fitting butt fused to pipe.
      a. Capable of developing same pressure rating as specified for pipe.
      b. Restrained.
      c. Central Plastics MJ Adaptor or equal.

B. Restrained Adapter Fitting:
   1. Restrained coupling for pipe material transition.
   2. Multi/Joint 3000 Plus, Type 3000

C. Butt Fusion Equipment:
   1. Designed to create a joint at least as strong as the adjacent pipe.
   2. Equipment to contain stops to prevent excessive pressure on pipe ends during fusion process.
   3. Equipment to plane pipe ends prior to fusion process.
   4. Provide a data logger to document temperatures and pressures for each butt fusion joint.

2.4 DESIGN CRITERIA

A. DR: See piping systems in specification section 40 05 00.

B. Pipe Outside Diameter (OD):
   1. Minimum allowable pipe outside diameter: Per AWWA C906, Table 4 (DIOD sizing).

C. Stub flanges: Design to develop full pressure specified for pipe with blind flange connected to back up flange.

2.5 FABRICATION

A. Pipe:
   1. Clearly mark pipe and fittings per AWWA C906.
   2. Service Indication:
      a. Provide integral color or longitudinal color banding at 180 degrees apart.
         1) Water: Blue.
         2) Sewer: Green.
         3) Reclaimed Water: Purple.

B. Stub flanges:
   1. Design for use with backing flange.
   2. Fabricate per manufacturers recommendations to develop full pressure specified for pipe with blind flange attached.

2.6 SOURCE QUALITY CONTROL

A. Materials:
   1. Incoming polyethylene materials:
      a. Inspect for density per ASTM D1505, melt rate per ASTM D1248, and carbon and color containment.
      b. Provide certification from material supplier for a minimum of 30% of all incoming polyethylene materials.
      c. PE pipe manufacturer shall verify certifications prior to processing into finished pipe or fittings.
   2. Outgoing materials:
      a. Manufacturer to inspect for diameter, wall thickness, length, straightness, out-of-roundness, concentricity, toe-in, inside and outside surface finish, markings, and end cut.

b. Perform tests to determine density, melt flow rate, carbon content, and carbon dispersion.
c. Test representative samples of the pipe provided to determine hoop tensile strength and ductility by either quick burst per ASTM D1599 or ring tensile per ASTM D2290.

B. Equipment:
1. Qualify each extrusion line and molding machine to produce pressure rated products by taking representative production samples and performing sustained pressure tests in accordance with ASTM D1598.

C. Quality Control Program:
1. Pipe and fitting manufacturer shall maintain permanent Quality Control (QC) and Quality Assurance (QA) records.
2. Certified copies of the quality control data taken during product manufacture shall be supplied to the Owner upon request.

D. Factory Inspection:
1. PE pipe manufacturer's production and quality assurance facilities shall be open and available for inspection by Owner and its authorized representatives.

PART 3 - EXECUTION

3.1 GENERAL

1. Locations: Provide PE piping at the locations shown on the Drawings or as otherwise shown and indicated in the Contract Documents.

3.2 INSTALLATION

A. General:
1. Install PE piping in accordance with:
a. Manufacturer's recommendations.
b. The requirements of this specification.
c. 31 23 05 - Excavation and Fill.
d. 40 05 00 – Pipe and Pipe Fittings – Basic Requirements
e. Other provisions of the Contract Documents.
f. Laws and Regulations.
2. Field repairs of pipe and fittings are not permitted, with the exception that portions of straight pipe which are damaged may be cut off provided this alteration is in accordance with the manufacturer's established procedures.

B. Joining method - Fusion Joints:
1. Joint Fusing – General:
a. Comply with ASTM F2620, the Contract Documents, pipe manufacturer's written instructions, and fusion machine manufacturer's written recommendations. Where any of the foregoing are inconsistent, comply with the more-stringent requirement. When unclear, request and obtain from Engineer written interpretation or clarification.
b. Fusion joiner shall be appropriately qualified and experienced in making the type of fusion joint required (butt fusion, socket fusion or sidewall fusion). Fusion joiner shall perform fusion jointing only for the types of joints for which such person possesses appropriate qualifications and experience.
c. Cost of certifying its workers and performing testing required for fused joints is Contractor's responsibility.
d. Fuse PE pipe joints on the surface prior to installation into the trench.
1) Submit alternative methods of fusing to Engineer for approval.
e. Plane ends of joints in fusion machine prior to heating.
f. Push pipe ends together in fusion machine and visually inspect compatibility and alignment of the two ends.

g. Comply with pipe manufacturer's written procedures and recommended heating time for pipe ends based upon pipe diameter and ambient temperature.
h. Visually inspect joint immediately upon removal of heating element to verify blistering of pipe has not occurred. Blistering of pipe is unacceptable.
i. Do not remove pipe from fusion machine until pipe has cooled in accordance with the pipe manufacturer's written instructions.

2. Electro-Fusion Fittings:
a. Comply with pipe fitting manufacturer's written instructions.
b. Ensure ends of connecting pipe are round when fusing.
c. Couplings: Provide means to place pipe ends in compression when fusion coupler is heated/cooled until connection process is complete.

C. Joining method – Flanged Joints:
1. Slide back up flange on PE pipe.
2. Install stub flange on end of pipe with butt fusion.
3. Make flange faces flat and perpendicular to pipe centerline.
4. Allow one flange free movement in any direction while bolts are being tightened.
5. Do not assemble adjoining flexible joints until flanged joints in piping system have been tightened.
6. Gradually tighten flange bolts uniformly to permit even gasket compression.
7. Check bolt torque after 24 hours to ensure that stress relief has not occurred.

D. Joining method – Mechanical Joint:
1. Use only for joining PE pipe to DIP or PVC (AWWA C900).
2. Install MJ adapter on end of PE pipe with butt fusion.
3. Clean components before installation.
a. Clean bolts and nuts by wire brushing.
b. Lubricate bolts with vegetable-based oil only.
4. Insert nuts and bolts (or studs), finger tighten, and progressively tighten diametrically opposite bolts uniformly around the flange to the proper tension.
a. Use bolts from the kit provided by joint manufacturer.
5. Execute care when tightening joints to prevent undue strain upon adjoining pipe.
6. Test joint for leakage.
a. If joint leaks under pressure testing, loosen or remove nuts and bolts, reset, or replace the gasket, reinstall or retighten bolts and nuts, and retest the joints.
b. Completed joints shall be watertight.
7. Check bolt torque after 24 hours to ensure that stress relief has not occurred.

E. Install buried pipe per Section 40 05 00 and per details shown on Drawings.
1. Allow pipe to stabilize to trench bottom or casing temperature before final tie-in or backfilling.
a. Pipe temperature shall be between 50 and 70 degrees Fahrenheit before making tie-in connections and backfilling.
b. After making final tie-in connections, the contractor shall keep the pipe out of direct sunlight and minimize temperature rise of the pipe.
2. For field sweeps, the minimum cold bending allowable radius:

DR	Minimum Radius
≤9	20 times pipe OD
>9 - 13.5	25 times pipe OD
>13.5 - 21	27 times pipe OD
>21	30 times pipe OD
With flange or fitting inside sweep	100 times pipe OD

3.3 FIELD QUALITY CONTROL

A. Use only fusion machine operators who have been trained by machine manufacturer no more than 12 months prior to installation of first fused joint.

B. Visually inspect all pipe for gouges.
   1. Gouges in excess of 10% of the pipe wall thickness are not acceptable.
   2. In area where excessive gouges are present, cut out affected pipe section and butt fused to remaining pipe to make a continuous section.

C. Check integrity of the heating plate in the fusion equipment a minimum of twice per each 8-hour work shift for temperature uniformity.

D. Butt-fused specimen joint inspection and testing per ASTM F2620, Appendix X4.
   1. Visually inspect all joints during and after joining to ensure that the joint meets the requirements of the butt fusion welding procedure.
   2. On every day that butt fusions are to be made, prepare a trial butt-fused joint specimen.
   3. Allow specimen to cool completely and cut into test straps.
   4. Test straps:
      a. Length: 12 inches (min) or 30 times the wall thickness.
      b. Location of fusion: Center of strap.
      c. Width: 1 inch (min) or 1.5 times the wall thickness.
   5. Visually examine the straps for voids or discontinuities.
   6. Deform the straps by bending, torque, or impact.
   7. If failure of the joint occurs outside of the joint area, the test is acceptable.

E. Diametral Deflection:
   1. After backfilling, check each section of pipe for deflection by pulling a mandrel through the pipe.
   2. Pipe with deflection exceeding 3% of the inside diameter: remove backfill and replace to provide a deflection of less than 3%.
   3. Retest any repaired pipe.

F. Hydrostatically test installed pipe and fittings in accordance with Section 40 05 00.
   1. Provide butt fused stub flanges, back up flanges and blind flanges on both ends of each pipe string for hydrostatic testing prior to and following installation.

END OF SECTION

SECTION 40 05 37
FIBERGLASS REINFORCED POLYMER MORTAR PIPE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Fiberglass Reinforced Polymer Mortar Pipe (FRPM) allowable for pipe diameters 30-inch and greater.

B. Scope of Work:
   1. Design calculations, detailing and fabrication of fiberglass gravity piping for the conveyance of raw sewage.
   2. Design of pipe is to include the determination of design pressures, stresses, external loads, pressure class (PN), and pipe stiffness class (SN).
   3. This specification covers the technical requirements for the installation of the fiberglass pipeline, fittings, and accessories.
      a. The Contractor's Work shall include, but not necessarily be limited to, providing all items of labor, material, and equipment necessary to handle, install, and test the pipe, fittings, and accessories shown on the Drawings.
   4. Other work performed under this section includes: shop testing; fabrication of fittings and appurtenances; handling, storage and protection; and loading and transportation of completed fittings and appurtenances to the construction site.
   5. Manufacture all pipes specifically for this project and furnish no pipe from stock unless approved by the Engineer.

1.2 REFERENCES

A. Definitions:
   1. Diametral Deflection: reduction in diameter caused by earth and surcharge loads acting on the installed pipe.
   2. SN: Pipe Stiffness, PSI.

B. Referenced Standards:
   1. ASTM International (ASTM):
      a. C33 - Specification for Concrete Aggregates.
      b. D2412 - Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
      c. D3262 - Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe.
      d. D3567 - Standard Practice for Determining Dimensions of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe and Fittings.
      e. D3681 - Test Method for Chemical Resistance of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe in a Deflected Condition.
      f. D3839 - Standard Practice for Underground Installation of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.
      g. D4161 - Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals.
      h. F477 - Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
   2. American Water Works Association (AWWA):
      a. AWWA M45 - Fiberglass Pipe Design.

1.3 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:

a. Fabrication drawings showing:
   1) Wall thickness
   2) Pipe joint and gasket details
   3) Design of pipe and fittings.
2. Details of all piping system components confirming that the pipe and fittings conform to the specified requirements.
3. Product Data:
   a. Catalog Data Sheets and source for all materials.
4. Design calculations using the assumption listed in Part 2.2 signed and sealed by a Professional Engineer registered in the State of Texas.
   a. Structural calculations to meet all loadings: In-situ, service, and installation.

B. Informational Submittals:
1. Quality control and quality analysis test methods, schedule and results.
2. Manufacturer's certificate of compliance to these specifications referencing project name and location.
3. Manufacturer's recommendations for embedment, manhole connection details, encasement details, and any field repair details.

1.4 TRANSPORTATION, HANDLING, AND STORAGE OF PRODUCTS

A. Comply with the requirements in Section 01 65 00 - Product Delivery Requirements and Section 01 66 00 - Product Storage and Handling Requirements.

B. Protect pipe during handling using methods recommended by manufacturer.
1. Use of bare cables, chains, hooks, metal bars or narrow skids in contact with pipe is not permitted.

C. Prevent damage to pipe during transit.
1. Repair abrasions, scars, and blemishes.
2. If repair of satisfactory quality cannot be achieved, replace damaged material immediately.

D. Store all products above the ground upon platforms, pallets, skids, or other supports supplied by the Contractor.
1. Keep products free from dirt and other foreign matter.

E. Store all products to permit ready access for identification and inspection by the Engineer.

F. Abide by the required handling techniques specified by the Manufacturer.

G. Provide suitable quantities of all lifting equipment to handle the pipe.
1. Do not utilize any equipment that is not rated to handle the intended loading or conditions of use to which it will be subjected, or which will damage or gouge the pipe.
2. Do not drag or drop the pipe.

H. Repair new pipe and fittings that become damaged before or during installation as recommended by the manufacturer or replace as required by the Owner's project representative at the Contractor's expense, before proceeding further.
1. Deliver, store, and handle other materials as required to prevent theft or damage.

I. Place pipe laid directly on the ground prior to installation on an area free of loose stones or sharp objects.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable and no substitutions will be allowed:
1. Fiberglass Reinforced Polymer Mortar Pipe (Aeration Basin Internal Mixed Liquor Return):
   a. Hobas Pipe USA, Inc. – Centrifugally Cast FRPM only.

b. Flowtite Pipe. – Filament Wound FRPM only.

2. No substitutions.

2.2 DESIGN CRITERIA

A. Final pipe structural design and pipe stiffness shall be determined by the pipe manufacturer in accordance with ASTM D2412, ASTM D3262, ASTM D3567, and AWWA M45 standards based on the following Design Conditions (Gravity Service).

1. Size: Nominal diameter varies as shown on drawings.
2. Pipe Stiffness (SN) specified herein and to be determined by pipe manufacturer: PN25/SN46 minimum.
3. Fluid Temperature: 6C to 31C.

2.3 DEFLECTION MANDREL

1. Furnish a mandrel in each pipe size for testing of installed pipe.

2.4 MATERIALS

A. Pipe and fittings:

1. Manufacture pipe and test in accordance with ASTM D3262.
2. Manufacture pipe to produce a dense, nonporous, corrosion-resistant, consistent composite structure.
   a. Utilize resins, reinforcements, colorants, fillers, and other materials, when combined as a composite structure, to produce a pipe that meets the performance requirements of this specification and all applicable ASTM and AWWA standards.
3. Pipe basic structural wall composition: thermosetting resin, glass-fiber reinforcement, and aggregate filler.
4. Reinforcing glass fibers: highest quality commercial grade E-glass filaments with binder and sizing compatible with impregnating resins.
5. Sand: minimum 98 percent silica with a maximum moisture content of 0.2 percent.
   a. Conform to ASTM C33, except that requirements for gradation shall not apply.
6. Utilize resin additives, such as curing agents, pigments, dyes, fillers, thixotropic agents, etc., that do not detrimentally affect the performance of the product.
7. Pipe shall be rated for exposed service, exposed to UV and weathering. Incorporate UV inhibitors in the outer resin layer to protect the pipe from degradation while installed outside if the pipe is not inherently resistant to UV degradation
8. Resin: STD Standard Thermosetting polyester
   a. Utilize only polyester resin systems with a proven history of performance in this particular application.
      1) Provide historical data from a composite material of similar construction and composition as the proposed product.

2.5 FABRICATION

A. Pipe and fittings:

1. Manufacture pipe by the centrifugal casting or filament wound process to result in a dense, nonporous, corrosion-resistant, consistent composite structure.
2. Pipe Interior:
   a. For centrifugal casting and filament wound pipe, provide interior surface liner with chemical, crack and abrasion resistance.
   b. Minimum 40 mils (0.040") nominal, of non-reinforced, or reinforced thermosetting polyester resin.
3. Pipe Exterior:
   a. For centrifugally cast pipe minimum exterior surface thickness: 20 mils of a silica sand resin mixture over any fiber reinforcement.
   b. For filament wound pipe minimum exterior surface thickness: 5 mils (0.005") of resin over all reinforcement.
4. The outside diameter of the pipe: in accordance with ASTM D3262 (gravity service)

5. Supply pipe in nominal lengths of 20 feet with the exception of special sections.
    a. Furnish at least 90 percent of the total footage of each size and class of pipe, excluding special order lengths, in nominal length sections.
6. Mark each length of pipe in accordance with ASTM D3262 and ASTM D3754.
7. Provide pipe with minimum wall thickness sufficient for design conditions specified.
8. Squareness of pipe ends: All points around each end of pipe unit within ± 1/4 inch or ± 0.5% of the nominal diameter of the pipe, whichever is greater, to a plane perpendicular to the longitudinal axis of the pipe.
9. Pipe tolerances.
    a. Maximum internal diameter variance of any portion of each piece of pipe: plus or minus 1 percent, but in no case greater than 3/8 inch from the nominal diameter.
    b. Maximum wall thickness variation: 5 percent less than that shown in the design, but in no case more than 3/16 inch less.
        1) A wall thickness greater than that required in the design will not be cause for rejection.
10. Provide pipe free from all defects including indentations, delaminations, bubbles, pinholes, cracks, pits, blisters, foreign inclusions, and resin-starved areas that due to their nature, degree, or extent, detrimentally affect the strength and serviceability of the pipe.
11. Furnish pipe as uniform as commercially practicable in color, opacity, density, and other physical properties.
12. The inside surface of each pipe: free of bulges, dents, ridges, or other defects that result in a variation of inside diameter of more than 1/8 IN from that obtained on adjacent unaffected portions of the surface.
    a. Provide pipe with no glass fiber reinforcement penetrating the interior surface of the pipe wall.
13. Minimum pipe deflection when tested per ASTM D3681: per Table 4 of ASTM D3262 when exposed to 1.0 N sulfuric acid, at the 50-year strain level (t/d). Coordinate gasket materials for chemical resistance of atypical chemicals in conveyed fluid.
    a. Supply elastomeric gaskets from qualified gasket manufacturers and suitable for the service intended.
14. Unless otherwise specified, field connect pipe joints with fiberglass sleeve couplings that utilize elastomeric sealing gaskets made of EDPM rubber compound as the sole means to maintain joint water tightness.
    a. Joints: meet the performance requirements of ASTM D4161 and ASTM F477.
    b. Tie-ins, when needed, may utilize stainless steel gasket-sealed mechanical couplings.
    c. Coupling joints: meet the requirements of ASTM D4161 and ASTM F477.
15. Design and furnish tees, wyes, and other fittings of withstanding all operating conditions when installed.
    a. Manufacture from mitered sections of pipe joined by glass-fiber-reinforced overlays.
    b. Fully encase fiberglass tees, wyes, or other similar fittings in reinforced concrete designed to withstand the pressure forces.
    c. Pipe manufacturer shall determine reinforcement of increased stiffness required for fabricated fittings.

2.6 IDENTIFICATION

A. Clearly mark each length of pipe with its Pipe Stiffness (SN).

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. Install in accordance with the requirements of applicable ASTM and AWWA standards, this Specification, and the Manufacturer's instructions.

B. Contractor shall be responsible for correct fitting of all pipeline members and components.

C. Furnish necessary or desirable miscellaneous items, appurtenances, and structures not mentioned or described in accordance with the intent of the Drawings and Specifications and as accepted by the Engineer, as necessary to complete the work.

D. Brace and protect pipe sections to prevent deformation during installation.

E. Install the pipeline complete, including bends, couplings, and other associated work and appurtenances, as shown on the Drawings or as herein specified.
   1. Make all necessary connections shown on the Drawings and in accordance with the Specifications.
   2. Furnish all construction materials and equipment required for installation.

3.2 PIPELINE INSTALLATION

A. Clean interior of the pipe of foreign matter before being lowered into position and keep clean during the laying and jointing operations by plugging or other approved method.

B. Lay pipe to line and grade as shown on the Drawings.
   1. Calculate the required location of each pipe joint.

C. Maintain identifying markings (stamped or painted numberings, tags, etc.) on installed pieces throughout installation.
   1. Place markings at top of pipe.

D. Pipe, fittings, and special pieces will be subject to inspection by the Engineer, prior to installation.
   1. Report all damages not detected by the Engineer and discovered by the Contractor during installation to the Engineer for corrective action or replacement.

E. Conform to the manufacturer's repair procedures, with the concurrence of the Engineer, for repair of pipe damaged during installation

F. Jointing:
   1. Clean ends of pipe and coupling components.
   2. Apply joint lubricant to pipe ends and the elastomeric seals of coupling.
      a. Use only lubricants approved by the pipe manufacturer.
   3. Use suitable equipment and end protection to push or pull the pipes together.
   4. Do not exceed forces recommended by the manufacturer for coupling pipe.
   5. Join pipes in straight alignment and grade.
      a. Where joint deflection is allowed by Engineer or shown on Drawings, do not allow the deflection angle to exceed 50 percent of the deflection permitted by the manufacturer.
      b. When installing joints to be deflected, join pipes in straight alignment then deflect to the required angle.

3.3 FIELD QUALITY CONTROL

A. The Owner, Engineer or other designated representative shall be entitled to inspect pipes or witness the pipe manufacturing.

B. All Work performed will be subject to inspection by the Engineer.
   1. Such inspection shall not relieve the Contractor of his responsibility for performing Work in accordance with the Specifications and the Drawings.
   2. Provide Engineer with free access to all Work.
      a. Approval of the products or tests is not implied by the Owner's decision not to inspect the manufacturing, testing, or finished pipes.

C. Provide reasonable facilities and access for Engineer to inspect, test and obtain such information as required with respect to the materials used and the progress and condition of the Work and the results obtained.
   1. Any Work that is not performed in accordance with the procedure or does not comply with the requirements of the Specifications will be rejected.

D. Satisfactory results obtained from inspection, testing or construction and material review procedures shall not relieve the Contractor from his guarantee of all materials, equipment and work performed.
   1. Should the condition of material be found unsatisfactory, pay for subsequent tests and all related Work in connection with repairing or replacing unsatisfactory material.
   2. Should the installed pipeline fail to meet minimum requirements as specified in this section, pay for all related Work in connection with repairing and/or replacing sections as required to bring the pipeline into conformance with these Specifications and applicable standards.

END OF SECTION

SECTION 40 05 51
COMMON REQUIREMENTS FOR PROCESS AND UTILITY VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Valving and valving appurtenances.
   2. Valve Schedule.

B. Related Sections include but are not necessarily limited to:
   1. Section 01 61 03 - Equipment - Basic Requirements.
   2. Section 09 96 00 - High Performance Industrial Coatings.
   3. Section 40 05 00 - Pipe and Pipe Fittings - Basic Requirements.
   4. Section 40 05 52 - Miscellaneous Valves.
   5. Section 40 05 57 - Actuators for Process Valves and Gates.
   6. Section 40 05 61 - Gate Valves.
   7. Section 40 05 62 - Plug Valves.
   8. Section 40 05 64 - Butterfly Valves.

1.2 REFERENCES

A. Definitions:
   1. The following are definitions of abbreviations used in this Specification Section or one of the individual valve sections:
      a. CWP: Cold water working pressure.
      b. SWP: Steam working pressure.
      c. WOG: Water, oil, gas working pressure.
      d. WWP: Water working pressure.

B. Referenced Standards:
   1. American Society of Mechanical Engineers (ASME):
      a. B1.20.1, Pipe Threads, General Purpose.
      b. B16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
      c. B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
   2. ASTM International (ASTM):
      a. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
      b. D256, Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.
      c. D638, Standard Test Method for Tensile Properties of Plastics.
      d. D648, Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position.
      e. D695, Standard Test Method for Compressive Properties of Rigid Plastics.
      f. D2240, Standard Test Method for Rubber Property-Durometer Hardness.
   3. American Water Works Association (AWWA):
      a. C207, Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 inches through 144 inches.
      b. C500, Standard for Metal-Seated Gate Valves for Water Supply Service.
      c. C504, Standard for Rubber-Seated Butterfly Valves.
      d. C507, Standard for Ball Valves, 6 inches through 48 inches (150 mm through 1200 mm).
      e. C509, Standard for Resilient-Seated Gate Valves for Water Supply Service.
      f. C550, Standard for Protective Coatings for Valves and Hydrants.
      g. C606, Standard for Grooved and Shouldered Joints.

4. American Water Works Association/American National Standards Institute (AWWA/ANSI):
   a. C111/A21.11, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
5. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
   b. MG 1, Motors and Generators.
6. National Fire Protection Association (NFPA):
   a. 70, National Electrical Code (NEC).

1.3 SUBMITTALS

A. Action Submittals:
   1. Shop Drawings:
      a. See Section 40 05 57 - Actuators for Process Valves and Gates.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Valve pressure and temperature rating.
      d. Valve material of construction.
      e. Special linings.
      f. Valve dimensions and weight.
      g. Valve flow coefficient.

B. Informational Submittals:
   1. Test reports if required in the individual valve specification.

C. Closeout Submittals:
   1. Operation and Maintenance Data:
      a. Submit in accordance with Section 01 78 23 - Operation and Maintenance Data.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, refer to individual valve Specification Sections for acceptable manufacturers.

2.2 MATERIALS

A. Refer to individual valve Specification Sections.

2.3 FABRICATION

A. End Connections:
   1. Provide the type of end connections for valves as required in the Valve Schedule or as shown on the Drawings.
   2. Comply with the following standards:
      a. Threaded: ASME B1.20.1.
      b. Flanged: ASME B16.1, Class 125 unless otherwise noted or AWWA C207.
      c. Bell and spigot or mechanical (gland) type: AWWA/ANSI C111/A21.11.
      d. Soldered: ASME B16.18.
      e. Grooved: Rigid joints per Table 5 of AWWA C606.

B. Nuts, Bolts, and Washers:
   1. Wetted or internal: Type 316 stainless steel.
   2. Exposed: Type 316 stainless steel.
   3. Buried:
      a. T-Bolts for mechanical joints: See Section 40 05 19.
      b. Other bolts and nuts: ASTM A193/A194 Grade B8M, Class 1.

4. Heads and dimensions per ASME B1.1.

C. Insulated Piping:
   1. Provide valves with extended stems to permit proper insulation application without interference from handle.

2.4 SURFACE PREPARATION, SHOP PRIME, AND FINISH PAINTING

A. General
   1. See Section 09 96 00 for general surface preparation and coating requirements.
   2. Coating systems to comply with NSF-61 when used with potable water.
   3. Utilize the systems described below unless specified otherwise in the narrow scope valve specifications.

B. Coating Systems for Ferrous Metal Valves
   1. Valve interior surfaces shall be lined with manufacturer's standard two-component liquid epoxy coating system. Coating shall be applied in accordance with AWWA C550. Minium dry film thickness (DFT) shall be 12 mils.
   2. Indoor or non-buried valve exteriors shall be coated with manufacturer's standard metal primer. Minium DFT shall be 3 mils. System shall be suitable for the finish coating system specified in Section 09 96 00.
   3. Buried valve exteriors shall be coated with manufacturer's standard two-component zinc primer followed by application of two-component epoxy system. Minimum total DFT shall be 12 mils. Zinc density shall be 200 g/m^2.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. For field painted valves, comply with Section 09 96 00.

C. Buried Valves
   1. Locate valves installed in pipe trenches where buried pipe indicated on Drawings.
   2. Set valves and valve boxes plumb.
   3. Place valve boxes directly over valves with top of box being brought to surface of finished grade.
   4. Install in closed position.
   5. Place valve on firm footing in trench to prevent settling and excessive strain on connection to pipe.
   6. Wax tape coating system:
      a. After installation, coat all buried nuts and bolts with a wax tape coating system in accordance with:
         1) AWWA C217.
         2) Manufacturer's printed instructions.
      b. Cut strips of wax tape and apply them around all bolts and nuts so that there are no voids or spaces under the tape.
      c. Apply enough tape to completely encapsulate all bare metal.
      d. For valves installed on ductile iron piping that is polyethylene encased per Section 40 05 19, polyethylene encasement of valves is acceptable in lieu of wax tape coating system.
   7. Backfill up to top of box for a minimum distance of 4 feet on each side of box.

D. Exposed Valves
   1. Support exposed valves and piping adjacent to valves independently to eliminate pipe loads being transferred to valve and valve loads being transferred to the piping.
   2. For threaded valves, provide union on one side within 2 feet of valve to allow valve removal.

3. Install valves accessible for operation, inspection, and maintenance.

3.2 FIELD QUALITY CONTROL

A. Wax Tape Coating Testing:
   1. Inspect each wax tape-wrapped component.
      a. Verify primer was applied to substrate surfaces.
      b. Ensure the wax tape has fully encapsulated all portions of the substrate.
      c. Ensure that the wax tape is in intimate contact with the substrate.
      d. Verify that the wax tape has been applied to the specified thickness.
   2. Do not backfill until this inspection is complete and the wax tape application is approved by the Owner's representative.

3.3 ADJUSTMENT

A. See section 40 05 57 for adjustment requirements.

3.4 VALVE SCHEDULE

A. Unless shown otherwise on Drawings, provide valves as follows:

3.1 VALVE SCHEDULE[1]

Location / Description	Valve Tag No(s).	Valve Type	Valve Size (in)	Operator Type[2]	Valve Cycle Time (sec)	Joint Type[3]
Aeration Basin Splitter Structure	MV – 1101	Mud	8	MHW with floor stand	-	FLG
Aeration Basin Nos. 5-8	BFV – 2150 BFV – 2160 BFV – 2170 BFV – 2180	HP BFV	18	MGH	-	LUG
Aeration Basin Nos. 5-8	BFV – 2151 BFV – 2161 BFV – 2171 BFV – 2181	HP BFV	14	MGH	-	LUG
Aeration Basin Nos. 5-8	BFV – 2152 BFV – 2162 BFV – 2172 BFV – 2182	HP BFV	12	MGH	-	LUG
Aeration Basin Nos. 5-8	BFV – 2153 BFV – 2163 BFV – 2173 BFV – 2183	HP BFV	10	MGH	-	LUG
Aeration Basin Nos. 5-8	FCV – 2151 FCV – 2161 FCV – 2171 FCV – 2181	HP BFV	14	EM	-	LUG
Aeration Basin Nos. 5-8	CV-2151 CV-2161 CV-2171 CV-2181	Duckbill Check	30	-	-	FLG
Aeration Basin Nos. 5-8	MV – 2153 MV – 2163 MV – 2173 MV – 2183	Mud	12	MHW with floor stand	-	FLG
Secondary Clarifier Splitter Structure	MV – 2201 MV - 2202	Mud	8	MHW with floor stand	-	FLG
NPW Isolation to Proposed Fire Hydrant	GV – 0001 GV - 0002	Gate	6	MB	-	MJ
NPW Isolation to ABI Splitter	GV - 0003	Gate	4	MB	-	MJ
NPW Isolation to Aeration Basin NO.5-8	GV - 0004	Gate	6	MB	-	MJ

Location / Description	Valve Tag No(s).	Valve Type	Valve Size (in)	Operator Type[2]	Valve Cycle Time (sec)	Joint Type[3]
NPW Isolation to SC Splitter Structure	GV - 0005	Gate	4	MB	-	MJ
SC Splitter Structure Drain	CV - 0001	Duckbill Check	8	-	-	-
Plant II Blower Building	BFV – 3105* BFV – 3106* BFV – 3107* BFV – 3108* *Furnished under Division 43	HP BFV	20	MCW	-	LUG
Plant II Blower Building	CV – 3105* CV – 3106* CV – 3107* CV – 3108* *Furnished under Division 43	Dual Disk Check	20 or 16 per Spec 43 11 23	-	-	WAF
Secondary Clarifier Splitter Structure	FCV-2201 FCV-2202 FCV-2203 FCV-2204	Plug	36	EMR	120	FLG
Secondary Clarifier Splitter Structure	ARV-2201 ARV-2202 ARV-2203 ARV-2204	Sewage Type Air Release	2	-	-	NPT
RAS/WAS Pump Station	KGV-4001A KGV-4001B KGV-4011 KGV-4012 KGV-4021 KGV-4022 KGV-4002A KGV-4002B KGV-4031 KGV-4032 KGV-4041 KGV-4042	Knife Gate	10	MHW	-	LUG

Location / Description	Valve Tag No(s).	Valve Type	Valve Size (in)	Operator Type[2]	Valve Cycle Time (sec)	Joint Type[3]
RAS/WAS Pump Station	CV-4001 CV-4011 CV-4012 CV-4021 CV-4022 CV-4002 CV-4031 CV-4032 CV-4041 CV-4042	Swing Check	12	-	-	FLG
RAS/WAS Pump Station	FCV-4059 FCV-4060	Plug	4	EM	10	FLG
RAS/WAS Pump Station	PV-4060 PV-4061	Plug	4	MGH	-	FLG
RAS/WAS Pump Station	PV-4001 PV-4011 PV-4012 PV-4021 PV-4022 PV-4002 PV-4031 PV-4032 PV-4041 PV-4042	Plug	12	MGH	-	FLG
RAS/WAS Pump Station	PV-4051 PV-4054 PV-4055 PV-4058	Plug	12	MCW	-	FLG
RAS/WAS Pump Station	PV-4052 PV-4053 PV-4056 PV-4057	Plug	16	MCW	-	FLG
RAS/WAS Pump Station	SV-4001 SV-4011 SV-4012 SV-4021 SV-4022 SV-4002 SV-4031 SV-4032 SV-4041 SV-4042	Solenoid	1	Solenoid	-	NPT

Location / Description	Valve Tag No(s).	Valve Type	Valve Size (in)	Operator Type[2]	Valve Cycle Time (sec)	Joint Type[3]
RAS/WAS Pump Station	PRV-4001 PRV-4011 PRV-4012 PRV-4021 PRV-4022 PRV-4002 PRV-4031 PRV-4032 PRV-4041 PRV-4042	Pressure Reducing	1	-	-	NPT
Yard Piping WAS Line Isolation	PV-4063 PV-4064 PV-4065 PV-4066	Plug	8	MGB	-	MJ
Fire Hydrants and Yard Hydrants	See Yard Piping Drawings for all required hydrants					

Notes:

1. Schedule includes all valves 4-IN diameter and larger including those with electric, hydraulic, or pneumatic operators, miscellaneous air and vacuum valves, specialty flow control valves with manual operators, and solenoid valves.
2. Valve operator types:
   a. MQ = Manual, quarter turn lever
   b. MGH = Manual, gear operator with handwheel
   c. MHW = Manual, hand wheel
   d. MCW = Manual, chain wheel (with chain)
   e. MTB = Manual, gear operator and torque tube
   f. MGB = Manual, buried gear operator
   g. EOC = Electric open/close service
   h. EOCR = Electric open/close service with remote control station
   i. EM = Electric modulating service
   j. EMR = Electric modulating service with remote control station
   k. MB = Manual, buried (direct actuated with 2 IN operating nut)
3. Joint Types (general), see narrow scope valve specification for exact requirements).
   a. MJ = Mechanical Joint
   b. FLG = Flange
   c. LUG = Lug body
   d. WAF = Wafer body
   e. NPT = Threaded

END OF SECTION

SECTION 40 05 52
MISCELLANEOUS VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Air release and vacuum relief valves.
   2. Mud valves.
   3. Pressure-reducing valves (2 inches and smaller).
   4. Solenoid valves.

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 01 61 03 - Equipment - Basic Requirements.
   2. Section 40 05 51 - Common Requirements for Process and Utility Valves.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society of Mechanical Engineers (ASME):
      a. B16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
   2. American Water Works Association (AWWA):
      a. C512, Standard for Air-Release, Air-Vacuum, and Combination Air Valves for Waterworks Service.
      b. C550, Standard for Protective Interior Coatings for Valves and Hydrants.
   3. Canadian Standards Association (CSA).
   4. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 40 05 51.

B. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the manufacturers listed in the applicable Articles below are acceptable.

2.2 AIR RELEASE AND VACUUM RELIEF VALVES

A. Wastewater Service
   1. General: Conform to AWWA C512.
   2. Acceptable manufacturers:
      a. A.R.I. D-040 LP.
      b. Approved equal.
   3. Materials:
      a. Cover assembly: Type 316 stainless steel shell with nylon body and polypropylene discharge outlet.
      b. Float: Polypropylene.

c. Extension assembly and base: Type 316 stainless steel.
d. O-rings: EPDM/Viton.

4. Design requirements:
   a. Suitable for use with raw sewage and municipal sludge with up to 5,000 mg/L suspended solids.
   b. Size: As shown in the Valve Schedule.
   c. Minimum operating pressure: 0.75 PSI.
   d. Maximum operating pressure: 15 PSI.
   e. Combination type valve suitable pipeline air and vacuum relief and automatic, accumulated air release.
   f. End connection:
      1) 2 inches and smaller: Threaded.
      2) 3 inches and larger: Flanged.
   g. Provide isolation valve, type as shown on the Drawings.

2.3 SOLENOID VALVES (1 INCHES AND SMALLER)

A. General Service (Air and Water):
   1. Acceptable manufacturer:
      a. ASCO.
   2. Materials:
      a. Body: Brass.
      b. Seat: Buna-N.
      c. Insulation: Class F.
   3. Design requirements:
      a. 110 VAC.
      b. Two-way, normally closed.
      c. Enclosure: Compatible with area classifications indicated on Drawings.
      d. Working pressure, air and water: 125 psig.
   4. Accessories: Provide strainer on supply.

2.4 PRESSURE-REDUCING VALVES (2 INCHES AND SMALLER)

A. Water Pressure Regulators:
   1. Acceptable manufacturers:
      a. Fisher, Type 75A.
      b. Watts Series 25AUB-Z3.
   2. Materials:
      a. Body: Bronze.
      b. Strainer body: Bronze.
      c. Strainer screen: Stainless steel.
   3. Design requirements:
      a. Self-contained diaphragm operated.
         1) Spring loaded.
         2) Field adjustable.
      b. Strainer: Y-type on supply.
      c. Size as shown in Process Drawings or size equal to connecting line size with 125 psi inlet and 50 psi outlet pressure.

2.5 MUD VALVES

A. Manufacturers:
   1. Trumbull.
   2. Troy Valve.
   3. Clow.
   4. M&H.

B. Materials:

1. Yoke: Stainless steel Type 304 or 316.
2. Frame: Stainless steel Type 304 or 316.
3. Stem: Stainless steel Type 304 or 316.
4. Thrust nut: Stainless steel Type 304 or 316.
5. Operating nut: Stainless steel Type 304 or 316.
6. Plug: Stainless steel Type 304 or 316.
7. Seat: SBR or Buna N.
8. Seat ring: Stainless steel Type 304 or 316.
9. Floor stand: Stainless steel Type 304 or 316.
10. Extension stem: Stainless steel Type 304 or 316, maximum L/R or 360.
11. Stem guides: Stainless steel Type 304 or 316.
12. Floor stand mounting bracket: Stainless steel Type 304 or 316.

C. The mud valve shall be of the flanged type and designed to provide a positive seal under both seating and unseating head conditions.
   1. Provide with rising stem, 1.5 in stem diameter, solid construction.
   2. Floorstand height 32 in.
   3. Seats shall be mechanically fastened, resilient type.

D. Accessories:
   1. Provide position indicating floor stand operator assembly for all mud valves.
   2. Provide floor stand mounting bracket for attachment to wall of hydraulic structure where floor stand is shown over a grated area.
   3. Provide extension stems, floor stands, and stem guides as indicated on the Drawings.

2.6 ACCESSORIES

A. Furnish any accessories required to provide a completely operable valve.

2.7 FABRICATION

A. Completely shop assemble unit including any interconnecting piping, speed control valves, control isolation valves and electrical components.

B. Provide internal epoxy coating suitable for potable water for all iron body valves in accordance with AWWA C550.

2.8 SOURCE QUALITY CONTROL

A. Shop hydrostatically test to the greater of unit or piping system test pressure.

2.9 MAINTENANCE MATERIALS

A. Provide one set of any special tools or wrenches required for operation or maintenance for each type valve.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: See Specification Section 01 61 03 and Specification Section 40 05 51.

B. Air Release, Vacuum Relief, and Pressure Relief Valves:
   1. Pipe exhaust to a suitable disposal point.
   2. Where exhausted to a trapped floor drain, terminate exhaust line 6 inches minimum above floor.

3.2 FIELD QUALITY CONTROL

A. Clean, inspect, and operate valve to ensure all parts are operable and valve seats properly.

B. Check and adjust valves and accessories in accordance with manufacturer's instructions and place into operation.

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SECTION 40 05 57
ACTUATORS FOR PROCESS VALVES AND GATES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Actuators for valves and gates.
      a. Manual actuators.
      b. Electric actuators.

B. Related Sections include but are not necessarily limited to:
   1. Section 01 61 03 - Equipment - Basic Requirements.
   2. Section 01 81 33 - Cyber Security Requirements.
   3. Section 09 96 00 - High Performance Industrial Coatings.
   4. Section 40 05 51 - Common Requirements for Process and Utility Valves.
   5. Section 40 05 52 - Miscellaneous Valves.
   6. Section 40 05 59 - Fabricated Stainless Steel Slide Gates.
   7. Section 40 05 61 - Gate Valves.
   8. Section 40 05 62 - Plug Valves.
   9. Section 40 05 63 - Ball Valves.
   10. Section 40 05 64 - Butterfly Valves.

1.2 REFERENCES

A. Definitions:
   1. The following are definitions of abbreviations used in this Specification Section:
      a. CPU: Central Processing Unit.
      b. NRTL: Nationally Recognized Testing Laboratory.
      c. OEM: Original Equipment Manufacturer.
      d. OIT: Operator Interface Terminal.

B. Referenced Standards:
   1. American National Standards Institute/Underwriters Laboratory (ANSI/UL):
      a. 429, UL Standard for Safety Electrically Operated Valves.
      b. 50, UL Standard for Safety Enclosures for Electrical Equipment, Non-Environmental Considerations.
      c. 50E, UL Standard for Safety Enclosures for Electrical Equipment, Environmental Considerations.
   2. ASTM International (ASTM):
      a. A266, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
      b. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
      c. A276, Standard Specification for Stainless Steel Bars and Shapes.
      d. A564, Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes.
      e. A693, Standard Specification for Precipitation-Hardening Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
   3. American Water Works Association (AWWA):
      a. C500, Standard for Metal-Seated Gate Valves for Water Supply Valves.
      b. C541, Standard for Hydraulic and Pneumatic Cylinder and Vane-Type Actuators for Valves and Slide Gates.
      c. C542, Standard for Electric Motor Actuators for Valves and Slide Gates.
      d. C550, Standard for Protective Coatings for Valves and Hydrants.

e. C560, Standard for Cast-Iron Slide Gates.
f. C561, Standard for Fabricated Stainless Steel Slide Gates.
g. C562, Standard for Fabricated Aluminum Slide Gates.
h. C563, Standard for Fabricated Composite Slide Gates.

4. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
   b. MG 1, Motors and Generators.
5. National Fire Protection Association (NFPA):
   a. 70, National Electrical Code (NEC).

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer: actuator manufacturers must have at least 100 installations with each type of proposed actuators.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Provide actuators that are fully compatible with valve or gate for which it is intended.
   2. Contractor to coordinate valve/gate manufacturer and actuator manufacturer for proper sizing of actuator.
      a. See below for safety factors.
   3. Mounting hardware by actuator manufacturer.
   4. Install actuators at valve/gate manufacturers facility to allow for testing prior to shipping to site.

1.5 SUBMITTALS

A. Action Submittals:
   1. Shop Drawings.
      a. Layout drawings with dimensions.
         1) Include those dimensions necessary for interfacing with valve/gate.
      b. Include wiring and control diagrams for electric, cylinder actuators, and electro-hydraulic actuators.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Torque or thrust output.
      c. Travel speed.
      d. Input power (voltage, phase, frequency).
      e. Input current draw.
      f. Control methodology.
      g. Control Accessories.
      h. Short Circuit Current Rating (SCCR) nameplate marking in accordance with NFPA 70.
         1) Include any required calculations in accordance with Section 01 61 03.
   3. Samples of the factory finish colors available at no additional cost to Owner for selection by Engineer.
   4. Test reports.

B. Informational Submittals:
   1. Manufacturer's installation instructions.
   2. Acknowledgement that the Manufacturer meets the number of installations criteria.
      a. Submit for each different manufacturer.
      b. Submit detailed installation list if requested by Engineer.
   3. Recommended storage procedures.
   4. Certificate of Proper Installation that includes verification from actuator manufacturer that actuators have been installed properly, that all limit switches and position potentiometers have been properly adjusted, and that the actuator responds correctly to the position command.

5. Test Reports.

C. Closeout Information:
   1. Operation and Maintenance Data:
      a. See Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
      b. Lubrication Guide.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Manual Valve Actuators:
      a. By valve manufacturer.
   2. Manual Gate actuators:
      a. By gate manufacturer.
   3. For other types of actuators, refer to the individual article for that actuator type for acceptable manufacturers.

2.2 MATERIALS

A. Refer to individual Articles for materials.

2.3 VALVE ACTUATORS

A. General:
   1. Refer to Section 01 81 33 - Cyber Security Requirements for cyber security related product requirements.
   2. Provide actuators as shown on Drawings or specified.
   3. Counter-clockwise opening as viewed from the top.
   4. Direction of opening and the word OPEN to be cast in handwheel or valve bonnet.
      a. Paint in a contrasting color such as white.
   5. Size actuator to produce required torque with a maximum pull of 80 pounds at the maximum pressure rating of the valve provided and withstand without damage a pull of 200 pounds on handwheel or chainwheel or 300 foot-pounds torque on the operating nut.
   6. Unless otherwise specified, actuators for valves to be buried, submerged or installed in vaults or manholes shall be sealed to withstand at least 20 FT of submergence.
   7. Valve Lockout Devices:
      a. Device manufactured from same material as valve actuator, preventing access to valve actuator, to accept lock shackle.
   8. Extension stem:
      a. Install where shown or specified.
      b. Solid steel with actuator key and nut, diameter not less than stem of valve actuator shaft.
      c. Pin all stem connections.
      d. Center in valve box or grating opening band with guide bushing.

B. Buried Valve Actuators:
   1. Provide 2 IN standard actuator nuts in accordance with AWWA C500, Section 3.16.
   2. Provide at least one tee handle keys for actuator nuts of each type required, with 5 feet extension between key and handle.
   3. Extension stem:
      a. Provide for buried valves greater than 4 feet below finish grade.
      b. Extend to within 6 inches of finish grade unless specifically shown otherwise on the Drawings.
   4. Cast Iron Valve Box:
      a. Provide screw or slide type adjustable cast iron valve box,

b. 5 IN minimum diameter, 3/16 IN minimum thickness, and identifying cast iron cover rated for traffic load.
c. Valve box cover embossed with the applicable fluid service such as "WATER", "SEWER", "REUSE", "NON-POTABLE", etc.

5. Box base to enclose buried valve gear box or bonnet.
6. Provide concrete pad encasement of valve box as shown on Drawings for all buried valves unless shown otherwise.

C. Exposed Valve Manual Actuators:
1. Provide for all exposed valves not having electric, cylinder or electro-hydraulic actuators.
2. Provide handwheels for gate and globe valves. Size handwheels for valves in accordance with AWWA C500.
3. Provide lever actuators for plug valves, butterfly valves and ball valves 3 inches diameter and smaller.
a. Provide lever actuators for butterfly valves with a minimum of five intermediate lock positions between full open and full close.
b. Provide at least two levers for each type and size of valve furnished.
4. Gear actuators required for plug valves, butterfly valves, and ball valves 4 inches diameter and larger.
5. Provide gearing for gate valves 20 inches and larger in accordance with AWWA C500.
6. Gear actuators to be totally enclosed, permanently lubricated and with sealed bearings.
7. Provide chain actuators for valves 6 feet or higher from finish floor to valve centerline.
a. Stainless steel chain looped to within 3 feet of finish floor.
b. Equip chain wheels with chain guides to permit rapid operation with reasonable side pull without "gagging" the wheel.
c. For smaller valves with lever or handle actuators, provide offset tee handles with attached chain for operation from the operating floor.
d. Provide chain storage device for each chain.
1) Chain-Away Bucket by Chain Away Corporation.
2) Chain-Up by Trumbull Manufacturing.
3) Or equal.
8. Provide cast iron floor stands as required the Valve or Gate Schedule or where shown on Drawings.
a. Stands to be furnished by valve manufacturer with actuator.
b. Stands or actuator to include thrust bearings for valve operation and weight of accessories.

D. Electric Actuators: See Paragraph 2.5 below.

2.4 GATE ACTUATORS AND LIFTS

A. General:
1. Provide lifts in accordance with AWWA C561 as modified in this Specification Section.
2. Limit speed of travel for powered actuators to 10-14 inches/minute.
3. Rising stem lifts:
a. Aluminum pipe.
1) Provide with slotted, openings filled with clear plastic windows to indicate gate position.
4. Gate Lockout Devices:
a. Device manufactured from same material as gate actuator, preventing access to gate actuator, to accept lock shackle.

B. Manual Actuators:
1. Equip the lift mechanism with a pedestal, torque tube, or baseplate, machined and drilled for installing the lift housing and ready for bolting to the operating floor, top wall mounting bracket, or gate yoke, as shown on Drawings or specified.
2. Centerline of crank or handwheel: Approximately 36 inch above operating floor, unless otherwise shown.

3. Crank wheel: Removable and fitted with a corrosion resistant rotating handle.
4. Size mechanism to produce required torque with a maximum pull of 40 pounds, or 50 foot-pounds torque on the lift nut or input shaft at the maximum seating or unseating head, whichever is greater of the gate provided.
    a. Provide mechanism capable of withstand without damage a pull of 200 pounds on handwheel/crank or 300 foot-pounds torque on the operating nut.
5. Maximum handwheel diameter: 30 inches.
6. Maximum crank radius: 15 inches.
7. Direction of opening and the word OPEN to be cast in handwheel or hand crank.

2.5 ELECTRIC ACTUATORS (480 VAC, 3 PHASE)

A. General:
1. Non-intrusive type, conforming to AWWA C542 as modified herein.
2. Provide actuators with a NRTL label.
3. Provide electric motor actuators for valves and gates as shown on the Drawings and in the Valve and Gate Schedules.
4. Size actuators for 125% of required torque to operate valve/gate under design pressure/head unless specified otherwise.
5. Provide equipment or control panels with Short Circuit Current Rating (SCCR) labeling as required by NFPA 70 and other applicable codes. See Section 01 61 03 for information on how to determine the available fault current, such that, the SCCR rating meets or exceeds the available fault current.

B. Housing/enclosure:
1. Provide cast iron gear housing and cast-iron load bearing enclosure.
2. Non load bearing enclosure and housing: Aluminum or cast iron.
3. Watertight to IP66 and NEMA 4, 4X rated.
4. Provide O-ring seals for covers and entries.
5. Terminal and limit switch compartment covers are to be fastened to gear housing by stainless steel fasteners with capture device to prevent loss.
6. Provide space heating elements sized to prevent condensation in both motor and geared limit switch compartment(s). Furnish heating elements rated at 120 Vac with heaters continuously energized.

C. Motors:
1. Provide motors suitable for 480V, 3PH, 60 HZ.
2. Provide motors that are totally enclosed, non-ventilated, high torque design made expressly for valve/gate actuator service and capable of operating the valve/gate under full differential pressure for complete open-close and reverse cycle of travel at least twice in immediate succession without overheating.
3. Provide motors rated for continuous duty for modulating actuators.
4. Provide motors in accordance with NEMA MG 1 standards where applicable, with Class F insulation with a Class B temperature rise, and to operate successfully at any voltage within 10% above or below rated voltage.
5. Provide positive method to ensure motor bearings are permanently lubricated.
6. Provide three thermal switches imbedded in windings:
    a. 120 degrees apart.
    b. Provide motor shutdown at high temperature.
7. Motor housing shall be aluminum or cast iron.
8. Provide motor capable of operating in any position.
9. Provide motor sealed from gearcase to allow any mounting position.
10. Provide shaft with wrench flats through housing for manual operation.

D. Gearing:
1. Provide power gearing consisting of heat-treated steel helical gears, carburized and hardened alloy steel worm, and alloy bronze worm gear, all grease or oil bath lubricated, designed for 100% overload, and effectively sealed against entrance of foreign matter.

2. Provide gearing mechanism constructed to permit field changes of reduction gear ratio.
3. Design actuators so that motor comes up to speed before stem load is encountered in either opening or closing operation.
4. Limit switch gearings and feedback device reduction gearing:
   a. Steel or bronze.
5. Support rotating shafts with anti-friction bearings.
6. Provide separate drive nut/thrust bearing assembly:
   a. Mounted to base of actuator.
   b. High tensile bronze.
   c. Provide 90 degree mounting intervals for quarter turn actuators.
   d. Provide grease fitting on drive assembly.

E. Handwheel:
1. Permanently attached for manual operation.
2. Positive declutch mechanism to engage and disengage handwheel.
3. Design such that handwheel does not rotate during motor operation.
4. Design such that inoperable motor does not prevent manual operation.
5. Direction of opening and the word OPEN to be cast in handwheel.

F. Position measurement:
1. Provide valve position measurement with an 18 bit optical absolute position encoder.
2. Provide a minimum of four contacts which can be selected to indicate any position of the valve or gate. Contacts shall be rated for 5 mA to 5A, 120 VAC, 30 VDC.
3. Actuator display shall include a dedicated numeric/symbol digital position indicated displaying valve position from fully open to fully closed.
4. Provide red, green and yellow LED indicators for valve or gate open/closed status. Yellow LED shall be programmable.

G. Torque measurement:
1. Provide piezo torque sensor to continuously monitor actuator torque.
2. Actuator motor shall be de-energized if the adjustable torque limit is exceeded.

H. Controls
1. Control Stations
   a. Integral Controls
      1) Unless otherwise specified, provide each electric motor actuator with integral control devices for operation, including pushbuttons.
      2) Locate and orient integral control station for ease of reading and use by personnel standing on nearest operating floor.
   b. Remote Control Stations
      1) Actuator manufacturer's standard, remote mount control station.
      2) Locate and orient remotely located control stations as shown on the Drawings.
      3) If location of remotely located operator station is not shown or indicated on the Drawings, obtain Engineer's direction on required location, which will be in reasonable proximity to associated actuator.
      4) Locate each remotely located control station approximately 4 feet above associated operating floor and position for ease of reading and operation.
      5) Furnish and install cabling between actuator and remote station if not provided by the actuator manufacturer.
2. Open-close Actuator Controls:
   a. Provide control assembly with necessary holding relays, reversing starter, control transformers of sufficient capacity to provide control power, space heating element power and valve position transmitter.
   b. Open, close, and stop functionality shall be provided with non-intrusive, magnetically operated control switches. Provide LCD display to indicate valve position and status.
   c. All configured settings shall be stored in non-volatile EEPROM memory.

d. Terminal compartment shall be a separately sealed compartment with segregated power and control terminals.

3. Modulating Service Controls:
   a. Proportional position servo-amplifier mounted integral with the actuator control compartment.
   b. Positioning of valve shall be proportional to a 4-20 mA signal input to the position servo-amplifier when remote control has been selected.
   c. Servo-amplifier adjustments shall include zero, span, gain, and dead-band.
   d. Provide 4-20 mA signal position control as shown on the Drawings that interfaces with the position control/position feedback instrumentation wiring to and from PLC.
4. Communication Protocols
   a. Hard wired.
      1) Dry contacts for discrete input/output.
      2) 4-20 mA for position control/feedback for modulating service.
5. Upon loss of power or loss of signal, modulating and open/close motorized valves shall maintain last position.

I. Acceptable Manufacturers:
   1. Rotork IQ3.
   2. Flowserve Corporation – Limitorque QX or MX.
   3. Equal model by Auma.

2.6 SOURCE QUALITY CONTROL

A. Source Quality Control – General:
   1. Prior to shipping equipment from the production or fabrication facility, perform manufacturer's standard factory tests and inspections and submit documentation of successful completion to Engineer.

B. Standard Duty Electric Actuators:
   1. Proof of Design Test: in conformance with AWWA C542 Section 5.2.
   2. Performance Test: in conformance with AWWA C542 Section 5.3.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Location and Orientation:
   1. Provide actuators and operators as shown on the Drawings.
   2. When not expressly shown on the Drawings, orient valve actuators so valve operator is in a position reasonably convenient for facility personnel.
      a. Unless otherwise shown, install electric or cylinder actuators above or horizontally adjacent to valve and gear box to optimize access to controls and external handwheel.
   3. When orientation of actuator, operator location, or both are unclear, submit to Engineer a request for interpretation and obtain Engineer's response before furnishing the associated Submittal and in no event, later than purchasing the associated valve and actuator.
   4. Contractor is responsible for costs and delays incurred to remedy valve actuators furnished or installed in inconvenient or difficult-to-access positions and locations unless the Contract Documents require otherwise.
   5. Contractor is not responsible for providing permanent platforms, stairs, or other extraordinary, permanent access measures unless so required by the Contract Documents.

C. Touch Up Painting Requirements:
   1. Repair scuffs and scratches on factory-applied finishes using materials furnished by the actuator manufacturer, applied in accordance with the written instructions of both the actuator manufacturer and the Supplier of the touch-up material(s).

D. Install electric or cylinder actuators above or horizontally adjacent to valve and gear box to optimize access to controls and external handwheel.

3.2 FIELD QUALITY CONTROL

A. Demonstrate that all powered valves operate properly after installation.

3.3 ADJUSTMENT

A. Adjust valves/gates, actuators, and appurtenant equipment to comply with Section 01 75 00.
   1. Operate valve, open and close at system pressures.

B. For all electric motor actuators, employ and pay for services of valve actuator manufacturer's field service representative to:
   1. Inspect valve actuators covered by this Specification Section.
   2. Program/configure actuator integral software.
   3. Supervise adjustments and installation checks:
      a. Open and close valves electrically under local manual and demonstrate that all limit switches are properly adjusted and that switch contacts are functioning properly by verifying the inputs are received at the remote input/output (RIO) panels or local control panel as appropriate.
      b. Position powered modulating valves under local manual control and demonstrate that the valve position feedback potentiometer is properly adjusted and that the feedback signal is received at the RIO panels or local control panel as appropriate.
      c. Simulate a valve position command signal at the RIO panel or local control panel as appropriate and demonstrate that the valve is controlled to the desired position without excessive hunting.
   4. Submit to Owner a Certificate of Proper Installation (COPI) from the valve actuator manufacturer that includes:
      a. Verification that the actuators have been installed properly.
      b. Verification that all limit switches and position potentiometers have been properly adjusted.
      c. Verification that the valve actuator responds correctly to the valve position command.

3.4 SCHEDULE

A. See Section 40 05 51 - Common Requirements for Process and Utility Valves for valve schedules.

B. See Section 40 05 59 - Fabricated Stainless Steel Slide Gates for gate schedules.

END OF SECTION

SECTION 40 05 59
FABRICATED STAINLESS STEEL SLIDE GATES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Fabricated stainless steel slide gates.
   2. Fabricated stainless steel stop logs.
   3. Fabricated stainless steel bulkhead gate.
   4. Manual actuators.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 01 61 03 - Equipment: Basic Requirements.
   4. Section 09 96 00 - High Performance Industrial Coatings.
   5. Section 10 14 23 - Signage.
   6. Section 40 05 51 - Valves: Basic Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. A193 – Standard Specification for Alloy Steel and Stainless Steel Bolting Materials for High-Temperature Service
      b. A194 – Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both
      c. F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
   2. American Water Works Association (AWWA):
      a. C561, Fabricated Stainless Steel Slide Gates.
   3. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
   4. National Sanitation Foundation International (NSF):
      a. 61, Drinking Water System Components - Health Effects.
   5. Society for Protective Coatings/NACE International (SSPC/NACE):
      a. SP 5/NACE No. 1, White Metal Blast Cleaning.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. See Specification Section 01 61 03.
   3. Product technical data including:
      a. Acknowledgment that products submitted meet the requirements of standards referenced.
      b. Calculations that demonstrate compliance with the deflections, stress and factor of safety specified.
      c. Certified drawings and material specifications for all components.
      d. Test records.
         1) Performance Test
         2) Leakage Test

B. Operation and Maintenance Manuals:
   1. See Specification Section 01 78 23 for requirements for:
      a. The mechanics and administration of the submittal process.
      b. The content of Operation and Maintenance Manuals.

C. Affidavit of Compliance: See AWWA C561.

1.4 WARRANTY

A. A five year warranty shall be provided by the manufacturer. The warranty date shall start at the time of substantial completion as defined in Division 00. Warranty shall cover full cost of pump failure diagnosis and testing and pump replacement/repair. See Section 01 78 36 for additional requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following slide gate and stop log manufacturers are acceptable:
   1. Slide Gates, Stop Logs, and Bulkhead Gates:
      a. RW Gate Company.
      b. Whipps.
      c. Fontaine Aquanox.

2.2 MATERIALS

A. General:
   1. Provide gates, logs, stems, lifts and other appurtenances of size, type, material and construction shown on the Contract Drawings and as specified herein.
   2. Materials subject to dezincification or dealuminization prohibited.
   3. Stainless steel "L" grades for all welded components.

B. Materials:
   1. Thimble, frame, guides, slide, log, yoke and stem guides: Stainless steel, Type 304 or 316.
   2. Gear housing: Cast iron, steel or ductile iron.
   3. Actuator pedestal: Stainless steel, Type 304 or 316.
   4. Rising stem thrust nuts: Stainless steel, Type 316.
   5. Stem couplings: Stainless steel, Type 316.
   6. Stem guide bushings: Cast or extruded UV stabilized UHMW-PE.
   7. Stems: Stainless steel, Type 316.
   8. Stem cover: UV resistant PVC, aluminum, or Type 316 stainless steel.
   9. Seals and seats: UV stabilized UHMW-PE.
   10. Anchor bolts and fasteners: Stainless steel, Type 316; ASTM A193/A194 and F593/F594.
   11. Flush-bottom sill retainer: Stainless steel, Type 316.
   12. Odor control covers: not used.
   13. Odor control cover retainer strip: not used.

2.3 FABRICATION:

A. Meet all requirements of AWWA C561 as modified per this Specification Section.

B. Gate types:
   1. Provide type as noted in the Gate Schedule.
   2. Self-contained shall consist of gate, extended frame, yoke, lifting stem, lift and lift support, stem, stem guide, and stem block.
   3. Non-self-contained shall consist of gate, limited frame, lifting stem, lift and lift support, stem, stem guide, and stem block.
   4. Stop logs shall consist of logs and limited frame.

C. Frames:
   1. Slide gate frames shall be one-piece, wall mounted.
   2. Stop log and Bulkhead gate frames shall be channel type, surface mounted.
   3. Guides shall have a minimum weight of 11 LBS/FT for face-mounted frames and 6.5 LBS/FT for embedded or in-channel mounted frames. Guide extensions shall be of the C channel shape or similar for rigidity. Angles are not considered acceptable guide extensions.

4. The portion of the frame that the anchor bolts penetrate shall have a minimum thickness of 0.25 IN. Two-piece frames and sandwich type frames are not acceptable.
5. Holes for anchor bolts every 18 inches for face mounted units or embedded keyways for embedded units.

D. Stems and Guides:
1. Solid rod, minimum 1.5 IN diameter.
2. Minimum tensile strength of 60,000 psi.
3. Slenderness ratio less than 200.
4. Provide stem guides as recommended by manufacturer, spacing shall not exceed 10 FT. Adjustable in two directions.
5. Rising or non-rising as indicated in the Gate Schedule.
6. Rolled or machine cut threads, Acme type, double lead.

E. Slide and logs:
1. Reinforced to restrict deflection to 1/720 of the span or 1/16 IN, whichever is less, at the design head.
2. For slide gates: the portion of the slide that engages the frame shall have a minimum thickness of 0.25 IN.
3. For stop logs: minimum material thickness of all members of the slide shall be ¼ IN. Logs shall be 12" or 18" tall.
4. For bulkhead gate: the portion of the slide that engages the frame shall have a minimum width of 3 IN.
5. Logs shall be reversible within the stop log frame. Log lifter compatible with logs shall be furnished of each type required and coordinated with Davit Crane furnished by others.
6. Bulkhead slide shall be furnished with lifting lugs.

F. Seals:
1. Bottom seals shall be flush mounted where required, replaceable without disassembly of the gate, bolted to the invert member.
2. Side and top seals shall be replaceable without removing gate from the wall or wall thimble.

G. Wall thimbles:
1. Provide wall thimble type as shown on the Drawings or as required for the application. Plate thickness shall be ¼ IN minimum.

H. Hardware and Anchors:
1. Bolts and wall thimble studs shall have a minimum diameter of ½ IN, epoxy type as specified in Section 03 15 19.
2. Anchors and hardware shall be sized by the gate manufacturer and provided by the Contractor or gate manufacturer.

I. Passivate all stainless steel after welding.

2.4 SLIDE GATE ACTUATORS AND LIFTS

A. General:
1. Provide lifts in accordance with AWWA C541 and C542, or as modified in this Specification Section.
2. Type as scheduled herein.
3. Provide slotted stem cover with threaded attachment to actuator for rising stem designs.

B. Manual Operators:
1. Equip the lift mechanism with a pedestal, torque tube, or baseplate, machined and drilled for mounting the lift housing and ready for bolting to the operating floor, top wall mounting bracket, or gate yoke, as shown on Drawings or specified.
2. Centerline of crank or handwheel shall be approximately 42 IN above operating floor.

2.5 SOURCE QUALITY CONTROL

A. All gates shall be shop leak tested and functionally tested at the factory to demonstrate compliance with this specification and AWWA C561. Adjustments shall be made to the guides and seals as required to meet the leakage requirements. Shop testing will not be witnessed by the Owner or Engineer.

B. All gates shall also be functionally tested prior to installation to ensure proper gate operation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Ensure products are installed plumb, true, and free of warp or twist.

C. Locate operators to avoid interference with handrails and other Work.

D. For identification and tagging, and for warning or caution signs, comply with Specification Section 10 14 23.

E. Guides:
   1. Surface and flange mounted
      a. Install guides with expansion anchors.
      b. Position guides at elevation as indicated on Drawings.
   2. Recessed
      a. Cut slot in concrete to receive guides.
      b. Position guides at elevation as indicated on Drawings.
      c. Grout guides in place according to manufacturer's instructions.

F. Sealant:
   1. Apply 1/8-IN thick layer of elastomeric sealant to back of frame.
   2. Tighten nuts snug until sealant begins to flow beyond frame.
   3. Remove excess sealant.
   4. Cure sealant for minimum seven days.
   5. Tighten nuts to their final positions.

3.2 FIELD QUALITY CONTROL

A. See Section 01 75 00 for general starting and adjusting requirements.

B. Employ and pay for services of equipment manufacturer's field service representative(s) to:
   1. Inspect equipment covered by this Specification Section.
   2. Supervise adjustments and installation checks.
   3. Provide test equipment, tools, and instruments necessary to accomplish equipment testing.
   4. Conduct initial start-up of equipment, perform operational checks, and supervise acceptance testing.
   5. Provide, through Contractor, a written statement that manufacturer's equipment has been installed properly, started up and is ready for operation by Owner's personnel.
   6. Instruct Owner's personnel on operation and maintenance of furnished equipment.
   7. Perform a field leakage test as specified herein for slide gates to test gate under design seating head and adjust to maximum leakage specified.

C. Provide operations and maintenance training as specified in Section 01 75 00.

D. Contractor to coordinate field service work with the manufacturer's service representative, Owner, and Engineer prior to initiating such work.

E. Field Leakage Test
   1. After installation, field test gates and stop logs ensuring items of equipment are in compliance with Specifications, including leakage requirements.
   2. Allowable leakage rates for gates and stop logs:
      a. Under 20 FT of seating head (or maximum available, if less): 0.05 gpm/ft of seating perimeter.

b. Under 20 FT of unseating head (or maximum available, if less): 0.2 gpm/ft of sealing perimeter. Unseating test does not apply to stop logs.

3. For units failing to meet specified requirements, make necessary change and retest units. If unit remains unable to meet test requirements to Engineer's satisfaction, it will be replaced with a satisfactory unit at no additional cost to Owner.
4. Equipment Acceptance: Adjust, repair, modify, or replace components failing to perform as specified and re-inspect.
5. Make final adjustments to equipment under direction of manufacturer's representative.

3.1 GATE SCHEDULE

GATE EQUIPMENT TAG NO.	SIZE WxH (INCH)	GATE TYPE[a]	DESIGN HEAD (FEET)[b] SEATING/ UNSEATING		OPENING DIRECTION[c]	TYPE OF CLOSURE[d]	TYPE OF LIFT MECHANISM[e]	RISING OR NON-RISING STEM[f]	THIMBLE REQUIRED[g]	ADDITIONAL REQUIREMENTS
SLG-1101	36 x 60	SC; Single Stem	4.5	0	Up Op	FM	Ped, CH	R	No	Note I
SLG-1102	36 x 60	SC; Single Stem	4.5	0	Up Op	FM	Ped, CH	R	No	Note I
SLG-1103	36 x 60	SC; Single Stem	4.5	0	Up Op	FM	Ped, CH	R	No	Note I
SLG-1104	36 x 60	SC; Single Stem	4.5	0	Up Op	FM	Ped, CH	R	No	Note I
SLG-1105	96 x 60	SC; Single Stem	4.5	0	Up Op	FM	Ped, CH	R	No	Note I
SLG-1106	96 x 60	SC; Single Stem	4.5	0	Up Op	FM	Ped, CH	R	No	Note I
SLG-1107	96 x 60	SC; Single Stem	4.5	0	Up Op	FM	Ped, CH	R	No	Note I
SLG-1108	96 x 60	SC; Single Stem	4.5	0	Up Op	FM	Ped, CH	R	No	Note I
SLG-2201	42 x 42	SC; Single Stem	11.5	5	Up Op	FM	Ped, CH	R	No	
SLG-2202	42 x 42	SC; Single Stem	11.5	5	Up Op	FM	Ped, CH	R	No	
SLG-2203	42 x 42	SC; Single Stem	11.5	5	Up Op	FM	Ped, CH	R	No	
SLG-2204	42 x 42	SC; Single Stem	11.5	5	Up Op	FM	Ped, CH	R	No	
SLG-2205	42 x 42	SC; Single Stem	11.5	5	Up Op	FM	Ped, CH	R	No	
SLG-2206	42 x 42	SC; Single Stem	11.5	5	Up Op	FM	Ped, CH	R	No	
SL-2207	60 x 156	Stop Logs	13	0	Up Op	FM	Crane by Contractor	N/A	N/A	
BG-2201	60 X 138	Bulkhead	11.5	0	Up Op		Crane by Contractor	N/A	N/A	

Notes:
[a] Gate type: SC = self-contained, NSC = non-self-contained; number of stems
[b] Design head: Measured from surface of water to centerline of gate, in feet.
[c] Opening direction: Dn Op = downward opening; Up Op = upward opening.
[d] Type of closure: W = weir service; FB = flush bottom (embedded); FM = face mounted.
[e] Type of lift mechanism: Ped = pedestal; Elec = electric; Hdwl = handwheel; CH = crank handle, SQN = square nut.
[f] Rising or nonrising stem: R = rising; NR = nonrising.
[g] Thimble required: Wall Thimble is required = Yes; Wall Thimble is not required = No.

[h] Centerline of guide frame anchors to be located 3.5" minimum from wall opening. Slide gate manufacturer to utilize standard guide frame and increase size of slide to meet anchor location requirements.

[i] Provide channel gate with slide sized as scheduled and reduced opening height of 36" in order to provide actuator handle no more than 4' above top of grating.

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SECTION 40 05 61
GATE VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Gate valves.
   2. Knife gate valves.

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 40 05 51 - Common Requirements for Process and Utility Valves.
   2. Section 40 05 57 – Actuators for Process Valves and Gates.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
   2. American Water Works Association (AWWA):
      a. C500, Standard for Metal-Seated Gate Valves for Water Supply Service.
      b. C504, Standard for Rubber-Seated Butterfly Valves.
      c. C509, Standard for Resilient-Seated Gate Valves for Water Supply Service.
      d. C515, Standards for Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Systems.
      e. C520, Standard for Knife Gate Valves, Sizes 2 In. (50 mm) Through 96 In. (2,400 mm)
      f. C550, Standard for Protective Epoxy Interior Coatings for Valves and Hydrants.
   3. Manufacturers Standardization Society of the Valve and Fittings Industry Inc. (MSS):
      a. SP-9, Spot Facing for Bronze, Iron and Steel Flanges.
      b. SP-70, Cast Iron Gate Valves, Flanged and Threaded Ends.
      c. SP-80, Bronze Gate, Globe, Angle and Check Valves.

1.3 DEFINITIONS

A. NRS: Non-rising Stem.

B. RS: Rising Stem.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 40 05 51.

B. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the manufacturers listed in the applicable Articles below are acceptable.

2.2 VALVES: WATER, STEAM CONDENSATE, STEAM TO 125 PSI, AIR; 2-1/2 INCHES AND SMALLER

A. Class 125 bronze gate valve.

B. Comply with MSS SP-80.

C. Materials:
   1. Body, bonnet, wedge: Bronze.
   2. Stem: Silicon bronze.
   3. Packing: Aramid fibers with graphite (Kevlar®).

D. Design Requirements:
   1. 125 psi steam, 200 psi non-shock WOG.
   2. Screw in bonnet, non-rising stem, solid wedge.

E. Manufacturers:
   1. Nibco.
   2. Stockham.

2.3 VALVES: WATER (HOT, COLD, HEATING, COOLING, SERVICE, PROCESS, POTABLE, NON-POTABLE, AND WASTEWATER)

A. Resilient Wedge Gate Valves, 2 to 48 inches (Water, Wastewater Application):
   1. Comply with AWWA C509.
   2. Materials:
      a. Stem and stem nut: Bronze.
         1) Wetted bronze parts in low zinc bronze.
         2) Aluminum bronze components: Heat treated per AWWA C504.
      b. Body, gate: Cast iron or ductile iron.
      c. Resilient wedge: Fully encapsulated rubber wedge. Styrene Butadiene Rubber (SBR).
   3. Design requirements:
      a. Minimum 150 PSIG working pressure.
      b. Buried: NRS, O-ring stem seal, 2 inches square operating nut.
      c. Exposed: NRS, O-ring, stem seal, handwheel.
      d. Counterclockwise open rotation.
      e. Fusion bonded epoxy coating interior and exterior except stainless steel and bearing surfaces.
         1) Comply with AWWA C550.
         2) Wetted bronze parts in low zinc bronze.
         3) Aluminum bronze components: Heat treated per AWWA C504.
   4. Manufacturers:
      a. Clow.
      b. Mueller.
      c. M & H.

B. Knife Gate Valves, 2 to 36 inches (Wastewater Sludge Application):
   1. Comply with AWWA C520.
   2. Materials:
      a. Heavy duty body design conforming to TAPPI and MSS-SP81 (as applicable).
      b. Body construction: ASTM A439 ductile iron with epoxy coating.
      c. Gate: Type 304 stainless steel.
      d. Seals: NBR.
      e. Stem: Chromed steel 430F.
      f. Stem nut: brass.
      g. Body bolts: Series 300 stainless steel.
      h. Universal bonnet: Carbon steel with epoxy coating.
      i. Handwheel operator: Carbon steel.
      j. Piston rod: Chromed steel 430F.

3. Design requirements:
    a. Working pressure (WOG non-shock): 150 psig.
    b. Bubble-tight shut-off in both directions.
    c. Suitable for dead end service.
    d. Double pitched thread.
    e. Flange drilling per ANSI 150.
    f. Full lug.
    g. Top traverse seal with phenolic live-loaded scraper blades.
    h. Re-packable while in service and under pressure.
    i. Lifting lugs.
    j. Solid steel heavy duty yoke topworks.
    k. Enclosed bonnet design with rising stem.
    l. Actuator: Handwheel operated actuator.
    m. Piston rod: Chromed steel 430F.
4. Manufacturers:
    a. Wey Valve Model WM.
    b. Delta, Series 15 and 30.

2.4 ACCESSORIES

A. Refer to Drawings and valve schedule for type of actuators.
    1. Furnish actuator integral with valve.

B. Refer to Specification Section 40 05 51 for actuator requirements.

2.5 FABRICATION

A. General:
    1. Provide valves with clear waterways the full diameter of the valve.

B. Spot valves in accordance with MSS SP-9.

PART 3 - EXECUTION

3.1 INSTALLATION

A. See Specification Section 40 05 51.

B. Where larger buried valves utilize smaller bypass valves, provide a second valve box installed over the bypass valve operating nut.

C. Do not install gate valves inverted or with the stems sloped more than 45 degrees from the upright unless the valve was ordered and manufactured specifically for this orientation.

END OF SECTION

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SECTION 40 05 62
PLUG VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Plug valves.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 40 05 51 - Valves: Basic Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society of Mechanical Engineers (ASME):
      a. B16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125 and 250.
   2. ASTM International (ASTM):
      a. A126, Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
      b. A536, Standard Specification for Ductile Iron Castings.
      c. D2240, Standard Test Method for Rubber Property-Durometer Hardness.
   3. American Water Works Association (AWWA):
      a. C517 Resilient-Seated Cast-Iron Eccentric Plug Valves

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. See Specification Section 40 05 51.

B. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
   2. See Specification Section 40 05 51.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the manufacturers listed under the specific valve types are acceptable.

2.2 NON-LUBRICATED ECCENTRIC PLUG VALVES

A. Acceptable Manufacturers:
   1. DeZurik Eccentric PEF.
   2. Val-Matic Cam-Centric 5600F-5700F.
   3. Pratt Ballcentric.

A. Materials:
   1. Body:
      a. Cast iron ASTM A126, Class B, or
      b. Ductile iron ASTM A536 65-45-12.

2. Plug:
    a. Cast iron ASTM A126, Class B, or
    b. Ductile iron ASTM A536 65-45-12.
3. Plug facing: NBR or EPDM.
4. Packing: NBR, V-type.
5. Shaft bearings and sleeves:
    a. Up to 36-inch diameter: Type 316 stainless steel, ASTM A743 Grade CF8M.
    b. 42-inch and larger: Type 316 stainless steel, ASTM A240 sleeves; ASTM B30, Alloy C95400 aluminum bronze bearings.
6. Seats: Welded-in overlay of 90% nickel, (minimum 1/8 IN thick).
7. Bonnet hardware: Type 316 or 18-8 stainless steel.

B. Design Requirements
1. Plug: one or two-piece construction.
2. Port area: Equal to or exceed 80% of full pipe area.
3. Valve body: Fitted with bolted bonnet.
4. End connections: See Valve Schedule in Specification Section 40 05 51.
5. Stem seal: Adjustable and replaceable multiple V-ring design with packing gland follower.
6. Designed for seating drip tight in any flow direction.
7. Rating:
    a. 1/2 through 12 IN, 175 PSI working pressure.
    b. 14 through 36 IN, 150 PSI working pressure.
8. Actuator:
    a. Actuator gearing in enclosure suitable for running in oil with seals on shaft to prevent entry of dirt or water.
    b. Positive identification on actuator indicating valve position.
    c. Adjustable stop to set closing torque.
    d. Actuators shall be integral to the valve.

2.3 ACCESSORIES

A. Actuators
1. General
    a. Actuator gearing in enclosure suitable for running in oil with seals on shaft to prevent entry of dirt or water.
    b. Positive identification on actuator indicating valve position.
    c. Adjustable stop to set closing torque.
    d. Furnish actuator integral with valve.
2. Refer to Drawings and Valve Schedule for type of actuator.
3. Refer to Specification Section 40 05 57 for actuator requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

A. See Specification Section 40 05 51.

B. Install valves with valve stem horizontal, plug seat on inlet side and with plug rotating up into the open position for valves in horizontal lines.

C. Install valve with actuator above pipe or plug centerline.

END OF SECTION

SECTION 40 05 63
BALL VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Ball valves.

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 40 05 51 - Common Requirements for Process and Utility Valves.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. A48, Standard Specification for Gray Iron Castings.
      b. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
      c. A276, Standard Specification for Stainless Steel Bars and Shapes.
      d. A351, Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
   2. Manufacturers Standardization Society of the Valve and Fittings Industry Inc. (MSS):
      a. SP-110, Ball Valves; Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

1.3 DEFINITIONS

A. PVDF: Polyvinylidene fluoride.

B. PTFE: Polytetrafluoroethylene.

C. RPTFE: Reinforced PolyTetraFluoroEthylene.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 40 05 51.

B. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the manufacturers listed in the applicable Articles below are acceptable.

2.2 METALLIC BALL VALVES 1/4 TO 3 INCHES DIAMETER

A. Comply with MSS SP-110.

B. Manufacturers:
   1. Apollo.
   2. Jamesbury.
   3. Watts.
   4. Stockham.
   5. Nibco.

C. Materials (All Stainless Steel):
   1. Body: Three-part stainless steel, ASTM A351 CF8M.
   2. Ball: Stainless steel ASTM A276.
   3. Seats: RPTFE.

D. Design Requirements:
   1. Rated for a minimum of:
      a. 500 psi CWP.
      b. 150 psi of saturated steam.
      c. 29 inches vacuum.
   2. Two-position lockable handle.
   3. Stem with blowout-proof design.
   4. Balancing stop for all applications.
   5. Bodies with mounting pad for applications requiring actuators.

2.3 PLASTIC BALL VALVES: 1/2 INCHES TO 4 INCHES DIAMETER

A. Manufacturers:
   1. Chemtrol/NIBCO.
   2. Spears.
   3. ASAHI/America.

B. Materials:
   1. Body, stem, ball, handle, end connectors:
      a. PVC ASTM D1784-12454B unless otherwise specified.
      b. CPVC ASTM D1784-23447-B where specified. Furnish wherever plastic ball valves are heat traced.
   2. Ball Seat: Teflon.
   3. O-rings: Viton.

C. Design Requirements:
   1. Rated at 150 psi at 75 degrees F unless a more stringent requirement is specified elsewhere.
   2. Double or "true union" design.
   3. Blocks both directions, upstream and downstream.
   4. Union nut capable of compensating for seat wear.
   5. Body with mounting pad for actuators where required.
   6. Capable of being disconnected at downstream end under full line pressure.

2.4 ACCESSORIES

A. Refer to Drawings and valve schedule for type of actuators.
   1. Furnish actuator integral with valve.

B. Refer to Specification Section 40 05 51 for actuator requirements.

2.5 SOURCE QUALITY CONTROL

A. Product Testing: MSS SP-110.

PART 3 - EXECUTION

3.1 INSTALLATION

A. See Specification Section 40 05 51.

SECTION 40 05 64
BUTTERFLY VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Butterfly valves.

B. Related Sections include but are not necessarily limited to:
   1. Section 40 05 00 - Pipe and Pipe Fittings - Basic Requirements.
   2. Section 40 05 51 - Common Requirements for Process and Utility Valves.

1.2 REFERENCES

A. Referenced Standards:
   1. American Society of Mechanical Engineers (ASME):
      a. B16.5, Pipe Flanges and Flanged Fittings - NPS 1/2 Through NPS 24.
      b. B16.47, Large Diameter Steel Flanges: NPS 26 through NPS 60.
   2. ASTM International (ASTM):
      a. A48, Standard Specification for Gray Iron Castings.
      b. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
      c. A276, Standard Specification for Stainless Steel Bars and Shapes.
      d. A395, Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
      e. A436, Standard Specification for Austenitic Gray Iron Castings.
      f. A536, Standard Specification for Ductile Iron Castings.
   3. American Water Works Association (AWWA):
      a. C504, Standard for Rubber-Seated Butterfly Valves.
      b. C519, Standard for High-Performance Butterfly Valves – 3 In. through 60 In.

1.3 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. See Specification Section 40 05 51.

B. Informational Submittals: Submit the following:
   1. For valves 8 inches and larger specified to comply with AWWA C504, furnish "Affidavit of Compliance" with Owner in accordance with AWWA C504.

C. Closeout Submittals: Submit the following:
   1. Operation and Maintenance Data:
      a. Submit in accordance with Section 01 78 23 - Operation and Maintenance Data.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. General Use BFVs:
      a. DeZurik.
      b. Mueller/Lineseal.
      c. Pratt, a Mueller Water Company.
      d. Bray.

2. High Performance BFVs:
   a. Pratt.
   b. DeZurik BHP.
   c. Or approved equal.

2.2 GENERAL USE BUTTERFLY VALVES - LIQUID SERVICE

A. For use in all locations, except where high performance butterfly valves are required.

B. Comply with AWWA C504, except as noted in this Specification Section.

C. Materials:
   1. Valve bodies:
      a. ASTM A126, Class B or ASTM A536 Grade 65-45-12 ductile iron.
      b. Wafer valves may be constructed of ASTM A48, Class 40 cast iron.
   2. Valve shafts:
      a. Shaft and pin material: Type 304 stainless steel.
      b. Bushings/Packing/O-rings: EPDM, Nylatron, RTFE or TFE.
      c. Bearings: Nylatron, Reinforced TFE or equal.
   3. Valve discs:
      a. Cast iron with welded 316 stainless edge or Type 304 Stainless Steel disk.
   4. Valve seats:
      a. Water: EPDM or Hycar.
      b. Located in valve body.
   5. Shaft bearing: Bronze, TFE-coated stainless steel or reinforced TFE.
   6. Shaft seal in addition to any sealing provided by seat: Suitable synthetic rubber rings or PTFE V-ring suitable for operating conditions.

D. Design Requirements:
   1. Shaft design
      a. Valves 16-inch and less: One-piece.
      b. Valves greater than 16-inch: one-piece or two-piece (stub shaft).
   2. Seat type: Resilient.
      a. Valves 24 inch and greater: Field adjustable without dismantling actuator, disc or shaft, and without removing valve from line.
   3. Body type (exposed and submerged):
      a. Wafer in sizes up to 20 inch if max working pressure 50 psi and less.
      b. Flanged.
         1) Fully tapped anchor lugs drilled per ASME B16.5.
      c. Valves 24 inch and greater: short body flanged.
   4. Working pressure rating (exposed and submerged): See valve schedule in Specification 40 05 51.
   5. Direct buried valves:
      a. All valves: Working pressure rated for 150 psi (Class 150B per AWWA C504).
      b. End connection: Mechanical joint.
   6. Offset disc design to provide 360-degree sealing.

2.3 HIGH PERFORMANCE BUTTERFLY VALVES - AERATION AIR SERVICE

A. For all butterfly valves in Aeration Air (AA) service, high performance butterfly valves (HP BFV) with an offset disc design shall be used.

B. Design Requirements:
   1. Comply with AWWA C519 except as noted herein.
   2. AWWA Class 150B.
   3. Shaft:
      a. One-piece shaft.
      b. Separate shaft seal.
      c. Minimum shaft diameter to conform to AWWA C519.

4. Seat located in valve body.
5. Valve design tested to 1,000,000 cycles.
6. Bi-directional drip tight seat.
7. Offset disc design to provide 360-degree sealing.
8. Packing: multiple v-ring PTFE or Braided carbon graphite including anti-extrusion ring.

C. Materials of construction:
1. Body: ASTM A351 Type 304 stainless steel, Grade CF8M.
2. Disc: Type 316 stainless steel.
3. Shaft and pins: 17-4PH stainless steel or Type 316 stainless steel.
4. Seals: Graphite rings.
5. Backing ring: Stainless steel.
6. Bushings/bearings: TFE/Glass liner with a Type 316 stainless steel shell.
7. Seat: Two piece with encapsulated RTFE or PTFE.
8. Seat retainer: Titanium or nickel-chromium alloy (for oxidizing service).
9. End connection: Lugged-wafer; valves shall be suitable for dead end service.
10. Working pressure rating: 150 psi.

2.4 ACCESSORIES

A. Refer to Drawings and/or valve schedule for type of actuators.
1. Furnish actuator integral with valve.
2. Provided by valve manufacturer and installed at valve manufacturer's facility.

B. Refer to Section 40 05 57 for actuator requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

A. See Section 40 05 51.

END OF SECTION

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SECTION 40 05 66
CHECK VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Check valves 2.5-inch diameter and smaller.
   2. Rubber flapper swing check valves, two-inch to 24-inch diameter.
   3. Duckbill check valves.

B. Related Requirements: Include but are not necessarily limited to:
   1. Section 40 05 51 - Common Requirements for Process and Utility Valves.

1.2 REFERENCES

A. Referenced Standards:
   1. American Society of Mechanical Engineers (ASME):
      a. B16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
   2. American Water Works Association (AWWA):
      a. C508, Standard for Swing-Check Valves for Waterworks Service, 2 in. through 24 in. NPS.
   3. Manufacturers Standardization Society of the Valve and Fittings Industry Inc. (MSS):
      a. SP-71, Gray Iron Swing Check Valves, Flanged and Threaded Ends.
      b. SP-80, Bronze Gate, Globe, Angle and Check Valves.
   4. NSF International (NSF), formerly National Sanitation Foundation:
      a. NSF/ANSI 61 – Drinking Water System Components– Health Effects.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Valve Manufacturers:
      a. Manufacturer shall be a business regularly engaged in manufacturing and furnishing check valves of the type required and similar equipment.
      b. Manufacturer shall be able to document having furnished not less than 50 check valves, of the type required, of size equal to or larger than those required for the Work, during the past five years.
      c. When requested by Engineer, submit qualifications statement indicating manufacturer's record of manufacturing and furnishing check valves of the types and sizes required and furnish documentation of compliance with qualifications requirements of this Article.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. In accordance with Section 40 05 51.

B. Informational Submittals: Submit the following:
   1. In accordance with Section 40 05 51.
   2. Manufacturer's Instructions:
      a. Manufacturer's written instructions for delivery, handling, storage, installation, and startup.

C. Closeout Submittals: Submit the following:
   1. Operation and Maintenance Data:
      a. Submit in accordance with Section 01 78 23 - Operations and Maintenance Manuals.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT – GENERAL

A. For service in potable water applications or water that will be treated to become potable, materials and equipment shall be in conformance with NSF/ANSI 61.

2.2 CHECK VALVES: 2.5 INCHES AND SMALLER

A. Class 125 Bronze Swing Check Valves (Fuel Oil, Compressed Air, Water, Wastewater):
   1. Comply with MSS SP-80.
   2. Manufacturers:
      a. Nibco T413-V.
      b. Stockham B-319Y.
   3. Materials:
      a. Body, bonnet, disc: Bronze.
   4. Design requirements:
      a. 125 psi steam to 406 degrees F, 200 psi WOG.
      b. Horizontal swing, renewable disc.

2.3 RUBBER FLAPPER SWING CHECK VALVES

A. Acceptable Manufacturers:
   1. Val-Matic Surgebuster Series 7200.
   2. Equal model by Pratt.
   3. Equal model by Dezurik APCO.

B. Materials:
   1. Body and cover: ASTM A536 ductile iron.
   2. Flapper: Buna-N, steel reinforced.
   3. Seat: Manufacturer's standard or welded nickel.
   4. Cover bolts, hardware, T-handle device: Type 316 stainless steel.
   5. Mechanical backflow actuator: Manufacturer's standard materials.

C. Design Requirements:
   1. Mechanical position indicator.
   2. Suitable for working pressure up to 250 psig.
   3. ANSI B16.1 Class 125 psig flanges.
   4. Provide threaded port and mechanical backflow actuator. Provide T-handle device to operate backflow preventer.
   5. Top access port shall allow removal of the disc without removal of valve body from pipeline.
   6. AWWA C508 tested.
   7. Coatings
      a. Provide factory applied fusion body epoxy coating to the valve interior.
      b. Provide factory applied epoxy primer (See Section 09 96 00) compatible with field finish coatings to valve exterior.

2.4 DUCKBILL CHECK VALVES

A. Acceptable Manufacturers:
   1. Mixed liquor recycle service (Aeration Basins):
      a. Red Valve, Tideflex Series 35-1 flanged type.
      b. Proco Products, Series 700 ProFlex Rubber Check Valve.
      c. Onyx Valve Company, Series DBF.
   2. Secondary Clarifier Splitter Structure:
      a. Red Valve, Tideflex Seres TF-1
      b. Or equivalent.

B. Description:

1. Duckbill check valves provided shall be one-piece, elastomeric, one-way flow devices, installed to allow flow only in the intended direction, without a separate seating surface that is part of the valve.
2. Shall not freeze open or closed.
3. Low hydraulic head loss.

C. Performance Criteria:
   1. Service Application:
      a. Mixed liquor recycle service:
         1) Upstream hydrostatic head required for opening: Two inches of water, maximum.
         2) Downstream hydrostatic head: 5 feet, maximum.
      b. Secondary Clarifier Splitter Structure drain:
         1) Upstream hydrostatic head required for opening: 4 feet, maximum.
         2) Downstream hydrostatic head: 17 feet, maximum.

D. Materials, Assembly, and Fabrication:
   1. Duckbill/sleeve: EPDM.
   2. Mounting to pipe:
      a. Mixed liquor recycle service: Elastomeric flanged, ANSI B16.1 Class 125/150 with 304 stainless steel backing rings.
      b. Secondary Clarifier Splitter Structure drain: Mounting clamp, Type 316 stainless steel.
   3. Markings: Permanently bond to valve manufacturer's information including valve model, valve size, and serial number.

2.5 SOURCE QUALITY CONTROL

A. Factory Tests and Inspections:
   1. Perform manufacturer's standard factory tests and inspections on materials and equipment furnished. Correct defects prior to shipment to the Site.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation – General:
   1. Provide check valves at locations shown and indicated in the Contract Documents.
   2. Install in accordance with the Contract Documents and manufacturer's written instructions. In event of conflict between the Contract Documents and manufacturer's written instructions, obtain written interpretation or clarification from Engineer.
   3. Comply with:
      a. Section 01 61 03 - Equipment - Basic Requirements.
      b. Section 40 05 51 - Common Requirements for Process and Utility Valves.
      c. Section 40 05 00 - Pipe and Pipe Fittings - Basic Requirements.
   4. Before installing, ensure each check valve is clean and free of dirt and debris.

3.2 FIELD QUALITY CONTROL

A. Field Tests and Inspections:
   1. Promptly after installing, before installing connecting pipe, verify proper and free operation of check valve.
   2. Hydrostatically test check valves together with associated piping.
   3. To extent practical, prior to Substantial Completion, verify proper operation of each installed check valve.

END OF SECTION

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SECTION 40 41 13
HEAT TRACING CABLE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Heat tracing cable as required for heat tracing of pipes as indicated on the Drawings.

B. Related Sections include but are not necessarily limited to:
   1. Section 26 05 00 - Electrical - Basic Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

1.3 SUBMITTALS

A. Shop Drawings:
   1. Product technical data:
      a. Power requirements for each circuit based upon actual length of heat trace and maintained temperature.
      b. Circuit breaker rating based upon inrush current at minimum expected start-up temperature.
      c. Length of heat tape for each pipe size and run.
      d. Coordinate and verify length and Watts/FT of heat tape required based upon pipe size and insulation thickness.
         1) Include the calculations to support the heat tape output.
      e. See Section 26 05 00 for additional requirements.
   2. Fabrication and/or layout drawings:
      a. Wiring diagrams showing physical locations of thermostats and heat trace power supply.
   3. Installation recommendations and sample startup reports.

B. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

C. Informational Submittals:
   1. Test reports: Megger test results.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Shall be stored such that they are not exposed to sunlight or other UV rays.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
   1. Chemelex Division; Raychem Corp.
   2. Chromalox.
   3. Thermon.

2.2 HEAT TRACING

A. Design Parameters:
   1. Pipe diameter, length and material: See Drawings and relevant piping Specifications.
   2. Flange, valve, pipe support size: See Drawings and relevant piping Specifications.
   3. Pipe insulation type and thickness: See Drawings and relevant piping Specifications.
   4. Temperatures requirements:
      a. Low ambient temperature for the specific location: 0 DEGF.
      b. Start-up temperature (alarm thermostat set point):
         1) Water/wastewater lines: 40 DEGF.
      c. Maintain temperature (power thermostat set point):
         1) Water/wastewater lines: 40 DEGF.
      d. High temperature exposure with power off: 185DEGF.
   5. Wind factor for the specific location: 10MPH.
   6. Electrical requirements:
      a. Voltage: 208 V unless otherwise shown on Electrical Drawings.
      b. Circuit breaker: Field coordinate if other than 20A GFEPCI type.
   7. Safety factor: 10%.

B. Self-regulating parallel circuit construction consisting of an inner core of conductive material between parallel copper bus wires, with inverse temperature - conductivity characteristics with metal overbraid. Heating cable shall be furnished with a fluoropolymer outer jacket outside the overbraid. Cable shall be rated 208V or 120V as indicated in the Electrical Drawings, Panel Schedules.

C. Furnish single and dual circuit heat trace controllers, Chromalox ITC or equal by Raychem or Thermon. Controller shall include NEMA 4X 304SST enclosure, 40 amp capacity per circuit, soft starting feature to reduce inrush, ground fault protection, output control, current monitoring, configurable high / low current alarms, furnish RTD by same manufacturer for each controller and length of connecting cable as required for the installations shown on the Drawings. Controller shall include all controls and input/output signals indicated on the P&IDs. Each circuit shall be 208V/1Ø or 120V/Ø as shown on the Electrical Drawings. Contractor shall furnish sunshades for all RTDs.

D. All necessary or required components and accessories, such as power connection boxes, end seals, straps, tape and fitting brackets.

E. All end-of-line terminations shall be with End-of-Line LED Lights, Chromalox UESL or equal by other named heat trace system manufacturers.

F. Hazardous areas are identified on the Electrical Drawings. All heating cable and accessories installed in areas identified as hazardous shall be rated for the area they are installed.

PART 3 - EXECUTION

3.1 PREPARATION

A. Install materials after piping has been tested and approved.

3.2 INSTALLATION

A. Installation shall conform to all manufacturer requirements and recommendations.

B. Insulate and heat trace wet pipe systems as indicated on Drawings.

C. Install materials in accordance with manufacturer's instructions.
   1. Each circuit shall not exceed the manufacturer's recommended maximum length.

D. For Metallic Piping:
   1. Heat tracing shall be installed completely wired.
   2. Cut heat trace to lengths as required and secure to pipe with glass or polyester fiber tape.

E. For Nonmetallic Piping:
   1. Allow for extra heat trace output because nonmetallic pipe has a lower heat transfer.
      a. Heat tracing shall be installed completely wired.
   2. Cut heat trace to lengths as required and secure to pipe with aluminum tape throughout the length of the trace.

F. Protection and Control Requirements:
   1. Protection by a GFEPCI circuit breaker.
      a. Breaker amperage rating shall be coordinated with Contractor when different than the Contract Drawings.

3.3 TESTING

A. Megger the cables at the manufacturers recommended voltage level three times.
   1. Before installation.
   2. After attachment to pipe but before insulation is installed.
   3. After pipe insulation is installed but before energization.

B. All megger testing shall be logged with spool number / lot number and records included in the Heat Trace System O&M Manuals.

END OF SECTION

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SECTION 40 42 00
PIPE, DUCT AND EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Insulation:
      a. Piping insulation.
      b. Duct insulation.
   2. Adhesives, mastics, sealants, and finishes.

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 40 05 07 - Pipe Support Systems.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. C177, Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of Guarded-Hot-Plate Apparatus.
      b. C411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
      c. C423, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
      d. C553, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
      e. C612, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
      f. C1071, Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
      g. D1056, Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.
      h. E96, Standard Test Methods for Water Vapor Transmission of Materials.
      i. F25, Standard Test Method for Sizing and Counting Airborne Particulate Contamination in Cleanrooms and Other Dust-Controlled Areas.
      j. C518, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
      k. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
      l. E119 Standard Method of Fire Tests of Building Construction, 2 Hour Wall Panel Test, 2 Hour External Total Engulfment Test, hose stream evaluation.
      m. E136, Combustion Characteristics of Building Materials in a Vertical Tube Furnace.
      n. E162, Surface Flammability of Materials.
      o. E814, Through-Penetration, 2-Hour Firestop Test.
   2. ISO 6944-1985, Method of Determining Fire Resistance of Ventilation Ducts.
   3. National Fire Protection Association (NFPA):
      a. 255, Standard Method of Test of Surface Burning Characteristics of Building Materials.
   4. Underwriters Laboratories, Inc. (UL):
      a. 723, Standard for Test for Surface Burning Characteristics of Building Materials.
   5. National Commercial and Industrial Insulation Standards (2013 seventh edition).
      a. Published by Midwest Insulation Contractors Association (MICA).
      b. Endorsed by National Insulation Association (NIA).
      c. MICA plate numbers listed in this specification reference this document.

1.3 SUBMITTALS

A. Shop Drawings:

1. Product technical data including:
   a. Acknowledgement that products submitted meet requirements of standards referenced.
   b. Manufacturer's installation instructions.
   c. Submit complete specification of insulation materials, adhesives, cement, together with manufacturer's recommended methods of application and coverage for coatings and adhesives.
2. Submit itemized schedule by building of proposed insulation systems showing density, thermal conductivity, thickness, adhesive, jackets and vapor barriers.
3. Certifications: Products will meet the requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Elastomeric insulation:
      a. Armacell
      b. K-Flex
      c. Rubatex.
      d. Armstrong.
   2. Fiberglass insulation:
      a. CertainTeed Corporation.
      b. Johns Manville.
      c. Owens Corning.
      d. Knauf.
   3. Ductwork insulation:
      a. CertainTeed.
      b. Johns Manville.
      c. Owens Corning.
   4. High density perlite:
      a. Johns Manville.
      b. Industrial Insulation Group (LIC).
   5. High density calcium silicate:
      a. Industrial Insulation Group (LIC).
   6. Adhesives, mastics, sealants, and finishes:
      a. Foster Products.
      b. Childers.
      c. Dow Corning.
      d. Johns Manville.
      e. Knauf.

2.2 PIPING INSULATION - ELASTOMERIC

A. General:
   1. Insulation fire and smoke hazard ratings for composite (insulation, jacket or facing, and adhesive used to adhere the facing or jacket to the insulation), as tested by procedure ASTM E84, NFPA 255 and UL 723, not exceeding:
      a. Flame spread: 25.
      b. Smoke developed: 50.
   2. Accessories (adhesives, mastics, cements, and tapes: Same component ratings as listed above.
   3. Indicate on product labels or their shipping cartons: Flame and smoke ratings do not exceed above requirements.
   4. Permanent treatment of jackets or facings to impart flame and smoke safety is required.
      a. Water-soluble treatments are prohibited.
   5. Insulated shields at pipe support points.

B. Pipe, Fitting, and Valve Insulation:
   1. Flexible elastomeric closed cell pipe insulation.
      a. Average thermal conductivity not to exceed 0.27 (BTU-IN)/(HR-FT^2-DEGF) at mean temperature of 75 degrees F, temperature range -40 to 220 degrees F; permeability not to exceed 0.20 by ASTM E96; water absorption 3% by ASTM D1056 and ozone resistance.
   2. Provide minimum insulation thickness conforming to schedules or as shown on the Drawings.

2.3 PIPING INSULATION - FIBERGLASS

A. Pipe and Fitting Insulation:
   1. Preformed fiberglass pipe insulation:
      a. Density: 4 pounds/CUFT.
      b. Temperature rated: 650 degrees F.
      c. Average thermal conductivity not to exceed 0.23 (BTU-IN)/(HR-FT^2-DEGF) at mean temperature of 75 degrees F.
      d. Fire hazard rating:
         1) UL 723, ASTM E84, NFPA 255.
         2) Flame spread not exceeding 25 and smoke developed not exceeding 50.
   2. Moisture adsorption:
      a. ASTM C553.
      b. Not greater than 5% moisture by volume when exposed to moisture laden air at 120 degrees F and 96% RH.
   3. Fungi and bacteria resistance:
      a. ASTM C665.
      b. Does not breed or promote growth.
      c. Flame attenuated glass fibers bonded with thermosetting resin.
   4. Piping jackets (general applications):
      a. Aluminum: 16 mil embossed.
   5. Provide minimum insulation thickness conforming to schedules or as shown on the Drawings.

2.4 PIPE INSULATION INSERTS AT HANGERS

A. High Density Perlite:
   1. Pre-formed.
   2. Fire hazard rating:
      a. UL 723, ASTM E84, NFPA 255.
      b. Flame spread: Zero.
      c. Smoke developed: Zero.
   3. Average density: 13 pounds/CUFT.
   4. Compressive strength: 80 psi to produce 5% compression.
   5. Maximum surface temperature: 1,200 degrees F.

B. High Density Calcium Silicate:
   1. Pre-formed.
   2. Fire hazard rating:
      a. UL 723, ASTM E84, NFPA 255.
      b. Flame spread: Zero.
      c. Smoke developed: Zero.
   3. Average density: 14 pounds/CUFT.
   4. Compressive strength: 100 psi to produce 5% compression.
   5. Maximum surface temperature: 1,200 degrees F.

2.5 DUCTWORK INSULATION: FIBERGLASS

A. Flexible Insulation:
   1. Material: Commercial-grade fiberglass thermal insulation, formaldehyde free.

2. Scheduled thickness and installed R-value. Installed R-value when compressed to a maximum of 25% following recommended duct wrap stretch outs.
3. Factory-applied foil scrim vapor barrier facing.
4. Average thermal conductivity not to exceed 0.27 (BTU-IN)/(HR-FT^2-DEGF) at a mean temperature of 75 degrees F (installed).
5. Rated for a maximum temperature of 250 degrees F.
6. Fungi and bacteria resistance:
   a. ASTM C1338.
   b. Does not breed or promote growth.
7. Fire hazard classification:
   a. UL 723, ASTM E84, NFPA 255.
   b. Flame spread not exceeding 25 and smoke developed not exceeding 50.
8. Basis of design: Johns Manville Microlite fiberglass duct wrap insulation.

B. Semi-Rigid Insulation for Indoor Installation:
1. Scheduled thickness and R-value.
2. Factory applied vapor barrier facing-white scrim foil.
3. Average thermal conductivity not to exceed 0.23 (BTU-IN)/(HR-FT^2-DEGF) at a mean temperature of 75 degrees F.
4. Rated for a maximum temperature of 450 degrees F.
5. Fungi and bacteria resistance:
   a. ASTM C1338.
   b. Does not breed or promote growth.
6. Moisture adsorption:
   a. ASTM C553.
   b. Not greater than 0.5% moisture by volume when exposed to moisture laden air at 120 degrees F and 96% RH.

C. Semi-Rigid Insulation for Outdoor Installation:
1. Scheduled thickness and R-value.
2. Factory-applied foil scrim vapor barrier facing.
3. Average thermal conductivity not to exceed 0.23 (Btu-IN)/(HR-FT^2-DegF) at mean temperature of 75 degrees F.
4. Rated for a maximum temperature of 450 degrees F.
5. Minimum density: 3 pounds/CUFT.
6. Fungi and bacteria resistance:
   a. ASTM C1338.
   b. Does not breed or promote growth.
7. Basis of Design: Johns Manville #815 SPIN-GLASS fiberglass duct insulation.

D. Ductwork Jackets
1. Aluminum: 16 mil embossed.
2. 316 Stainless Steel: 16 mil embossed.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. General:
1. Provide release for insulation application after installation and testing is complete.
   a. Apply insulation on clean, dry surfaces after inspection.
2. Provide insulation continuous through wall, roof and ceiling openings, pipe hangers, supports and sleeves.
3. Provide insulation with vapor barrier for piping, ductwork and equipment where surfaces may be cooler than surrounding air temperatures.

a. Provide vapor barrier (0.17 perm-IN; ASTM C553) continuous and unbroken.
b. Hangers, supports, anchors, and related items that are secured directly to cold surfaces must be adequately insulated and vapor-sealed to prevent condensation.

4. Apply specified adhesives, mastics and coatings at the manufacturer's recommended coverage per unit volume.

C. Piping Insulation - Elastomeric:
1. Do not insulate until satisfactory completion of required pressure testing.
2. Apply insulation to clean, dry surfaces.
3. Slip insulation on pipe prior to connection.
a. Whenever the slip-on technique is not possible provide insulation neatly slit and snapped over the pipe.
4. Fabricate and install fitting cover insulation according to manufacturer's recommendations.
5. Seal joints, slits, miter-cuts and other exposed edges of insulation with adhesive, recommended by the insulation manufacturer, to ensure complete vapor barrier.

D. Piping Insulation - Fiberglass:
1. Apply over clean dry pipe.
a. Butt all joints together firmly.
2. Seal joints, slits, miter-cuts and other exposed edges of insulation as recommended by the insulation manufacturer.
3. Insulate fittings, valves, and flanges with insulation thickness equal to adjacent pipe.
4. For Aeration Air service, fiberglass insulation shall be rated for at least 300°F pipe temperature.
5. Aluminum pipe jacket:
a. Field-applied aluminum jacket with vapor-sealed longitudinal and butt joints.
b. Provide smooth and straight joint with a minimum 2 inches overlap.
c. Secure joints with corrosion-resistant screws spaced 0.25 to 0.50 inches back from edge.
d. Center spacing of screws 5 inches maximum or as required to provide smooth tight-fitted joints.
e. Place joints on least exposed side of piping to obtain neat appearance.

E. Ductwork Insulation - Fiberglass:
1. Flexible insulation:
a. Butt edges tightly.
1) Secure insulation with Benjamin Foster 85-20 adhesive applied in 6 inches strips on 12 IN centers and/or pins, applied on not more than 18 inches centers so that the insulation conforms to the duct surfaces uniformly and firmly.
b. Seal joints with facing overlap or 4 inches wide strips of like facing material adhered and stapled in place.
c. Properly seal any penetration in vapor barrier facing with Benjamin Foster 85-20.
d. Cut insulation slightly longer than the perimeter of the duct to ensure full thickness at corners.
2. Semi-rigid insulation and duct interior lining board:
a. Impaling over pins.
1) Apply insulation with edges tightly butted.
2) Apply insulation with mechanically welded fasteners to the duct and secured with speed clips.
3) Clip pins off close to clip.
4) Space pins as required to hold insulation firmly against duct surface but not less than one pin per 1.5 square feet.
5) Seal joints and speed clips with 3 inches wide strip of facing adhered with Benjamin Foster 85-20 adhesive.
b. If the welded pin method is impossible, secure insulation to the duct with Benjamin Foster 85-20 adhesive.
1) Cover the entire surface of duct with adhesive.

2) Use corner metal angle to protect edge of insulation.
3) Protect edge of insulation.
4) Seal joints as above.

c. For outdoor application finish with Benjamin Foster #4610 weatherproof mastic with white glass fabric membrane.

3.2 REPAIR

A. Whenever any factory applied insulation or job-applied insulation is removed or damaged, replace with the same quality of material and workmanship.

3.3 SCHEDULES

A. Refrigeration Lines (35-60 degrees F):
1. Elastomeric.
2. 1/2 inches thickness for lines 1 inch and smaller.

B. Pipe, Fittings and Valves:
1. Fiberglass.

APPLICATION	PIPE SIZE	THICKNESS	JACKET
Aeration Air (AA) where specifically indicated as insulated on the drawings.	ALL	2 inches	Aluminum

2. Elastomeric:

APPLICATION	PIPE SIZE	THICKNESS	JACKET
Fluid containing pipes not otherwise specified and shown on the drawings to be insulated.	ALL	2 inches	Aluminum
Exterior NPW	ALL	2 inches	Aluminum
Exterior Air Release Valves and associated vent lines, isolation valves, and flushing valves	ALL	2 inches	Aluminum

C. Ductwork:
1. Fiberglass.

DUCT SERVICE	INSULATION AND THICKNESS	MINIMUM R-VALUE $(HR\text{-}FT^2\text{-}DEGF)/BTU$
Outside air ducts, inside building	2-1/2 inches semi-rigid with vapor barrier	12.0
Supply and return air ducts inside building	2 inches flexible with vapor barrier	6.0
Supply and return air ducts outside building and where exposed to atmospheric air	2-1/2 inches semi-rigid for outdoor installation. Provide with stainless steel or aluminum jacket.	12.0

DUCT SERVICE	INSULATION AND THICKNESS	MINIMUM R-VALUE ($HR\text{-}FT^2\text{-}DEGF)/BTU$
Exhaust air ducts serving blower control and motor cabinets, inside building	2-1/2 inches semi-rigid for indoor installation. Provide with stainless steel or aluminum jacket.	12.0
All other ductwork	Uninsulated	N/A

END OF SECTION

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SECTION 40 61 13
PROCESS CONTROL SYSTEM GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Basic requirements for complete instrumentation system for process control.
   2. Requirement for Contractor to subcontract the Process Control System portion of the Work to a "Systems Integrator".

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 10 14 00 - Identification Devices.
   2. Section 40 67 00 - Control System Equipment Panels and Racks.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. The International Society of Automation (ISA):
      a. 7.0.01, Quality Standard for Instrument Air.
      b. S5.1, Instrumentation Symbols and Identification.
      c. S5.3, Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic and Computer Systems.
      d. S5.4, Standard Instrument Loop Diagrams.
      e. S20, Standard Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.
      f. 62443-3-3 Security for Industrial Automation and Control Systems, Part 3-3: System Security Requirements and Security Levels
   2. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
   3. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC).
   4. Underwriters Laboratories, Inc. (UL):
      a. 913, Standard for Safety, Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1, Hazardous (Classified) Locations.
   5. National Institute of Standards and Technology (NIST)
      a. SP 800-82, Guide to Industrial Control Systems (ICS) Security

B. Qualifications:
   1. System Integrator:
      The System Integrator for this project will be

      PRIME CONTROLS
      Contact: Brian Poarch, Water Division Manager
      1725 Lakepointe Drive
      Lewisville, Texas 75057
      Office: (972) 221-4849 (ext.6449)
      Cell: (214) 405-7519

2. Panel Fabricator:
   a. Experience:
      1) Have satisfactorily fabricated control panels for a minimum of five projects of similar magnitude and function.
   b. Certification:
      1) [UL508A] [UL698A] Certification
3. PLC/DCS Programmer:
   a. Experience:
      1) Have satisfactorily provided programming of control systems utilizing the same manufacturers' PLC/DCS for a minimum of five projects of similar magnitude and function.
   b. Certification:
      1) Current certification by PLC/DCS manufacturer specific to PLC/DCS manufacturer equipment and development software used on project.
      2)
4. HMI Programmer:
   a. Experience:
      1) Have satisfactorily provided HMI programming for the type of system specified herein for a minimum of five projects of similar magnitude and function.
   b. Certification:
      1) Current certification by HMI software manufacturer specific to HMI manufacturer equipment and development software used on project.

C. Miscellaneous:
   1. Comply with electrical classifications and NEMA enclosure types shown on Drawings.

1.3 DEFINITIONS

A. Calibrate: To standardize a device so that it provides a specified response to known inputs.

B. Hazardous Areas: Class I, II or III areas as defined in NFPA 70.

C. Highly Corrosive and Corrosive Areas: Rooms or areas identified on the Drawings where there is a varying degree of spillage or splashing of corrosive materials such as water, wastewater or chemical solutions; or chronic exposure to corrosive, caustic or acidic agents, chemicals, chemical fumes or chemical mixtures.

D. Intrinsically Safe Circuit: A circuit in which any spark or thermal effect is incapable of causing ignition of a mixture of flammable or combustible material in air under test conditions as prescribed in UL 913.

E. System Integrator: A Contractor/Subcontractor who combines instrumentation, control devices, hardware, software, and networking products from multiple vendors to provide a fully functioning control system.

1.4 SYSTEM DESCRIPTION

A. Control System Requirements:
   1. This Specification Section provides the general requirements for the control system.
   2. The control system consists of all primary elements, transmitters, switches, controllers, computers, communication devices, recorders, indicators, panels, signal converters, signal boosters, amplifiers, special power supplies, special or shielded cable, special grounding or isolation, auxiliaries, software, wiring, and other devices required to provide complete control of the plant as specified in the Contract Documents.

B. Utilization of System Integrator:
   1. Retain a System Integrator subcontractor to provide a fully functioning control system.
      a. The System Integrator shall be responsible for the provision of an integrated control system fully functioning in accordance with the requirements of the Contract Documents.

b. As a minimum, the responsibilities of the System Integrator shall include:
    1) Control system performance.
    2) Supervision of installation and final connections.
    3) Controller programming.
    4) HMI configuration.
    5) Computer and network equipment configuration
    6) Preparation of Drawings and Operation and Maintenance Manuals.
    7) System start-up.
    8) Training.
    9) Demonstration of substantial completion and all other aspects of the control system.

2. Provide all required coordination of instrumentation with other work to ensure that necessary wiring, conduits, contacts, relays, converters, and incidentals are provided in order to transmit, receive, and control necessary signals to other control elements, to control panels, and to receiving stations.
3. Prior to Shop Drawing preparation, the Systems Integrator shall inspect the Owner's existing equipment and as-constructed electrical documentation so as to be able to fully coordinate the interface of new and existing instrumentation and controls.
    a. All costs associated with this Work shall be incorporated into the original bid.
    b. Although such Work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure, complete and compatible installation.

1.5 SUBMITTALS

A. Shop Drawings:
1. Submittals shall be original printed material or clear unblemished photocopies of original printed material.
    a. Facsimile information is not acceptable.
2. Limit the scope of each submittal to one Specification Section.
    a. Each submittal must be submitted under the Specification Section containing requirements of submittal contents.
    b. Do not provide any submittals for Specification Section 40 61 13.
3. Product technical data including:
    a. Acknowledgement that products submitted meet requirements of standards referenced.
    b. Equipment catalog cut sheets.
    c. Instrument data sheets:
        1) ISA S20 or approved equal.
        2) Separate data sheet for each instrument type.
    d. Materials of construction.
    e. Minimum and maximum flow ranges.
    f. Pressure loss curves.
    g. Physical limits of components including temperature and pressure limits.
    h. Size and weight.
    i. Electrical power requirements and wiring diagrams.
    j. NEMA rating of housings.
    k. Submittals shall be marked with arrows to show exact features to be provided.
4. Comprehensive asset inventory of all networked components:
    a. Provide in Excel spreadsheet format.
    b. Coordinate with the Owner or Engineer to determine the preferred method of delivery to assure security of information contained in asset inventory.
    c. Include:
        1) Device ID.
        2) Manufacturer.
        3) Model Number.
        4) Serial Number.

5) IP Address.
6) Device Use description.
7) Firmware.

5. Network Diagrams:
   a. Provide in both and PDF formats.
   b. Coordinate with the Owner or Engineer to determine the preferred method of delivery to assure security of information contained in Network Diagrams.
   c. Logical Network Diagram(s):
      1) Depict information flow through network(s), and include:
         a) Major network devices, subnets, and VLANs.
         b) Include all wireless communication devices.
         c) Include the following information for each networked device:
            (1) Device ID.
            (2) Device description.
            (3) Manufacturer/model number.
            (4) IP address.
            (5) Ports and Protocols
   d. Physical Network Diagram(s):
      1) Show all network components, ports, protocols, connections and cables.
         a) Include all wireless communication devices.
6. Comprehensive set of wiring diagrams as specified in Section 40 67 00.
7. Panel fabrication drawings as specified in Section 40 67 00.
8. PLC equipment drawings.
9. graphics.
10. Nameplate layout drawings.
11. Drawings, systems, and other elements are represented schematically in accordance with ISA S5.1 and ISA S5.3.
    a. The nomenclature, tag numbers, equipment numbers, panel numbers, and related series identification contained in the Contract Documents shall be employed exclusively throughout submittals.
12. All panel and wiring drawings shall be provided in both hardcopy and softcopy.
    a. Furnish electronic files on owner's designated electronic media.
    b. Drawings in AUTO CAD format.
13. Provide a parameter setting summary sheet for each field configurable device.
14. Certifications:
    a. Documentation verifying that calibration equipment is certified with NIST traceability.
    b. Approvals from independent testing laboratories or approval agencies, such as UL, FM or CSA.
       1) Certification documentation is required for all equipment for which the specifications require independent agency approval.
15. Testing reports: Source quality control reports.

B. Qualifications Submittal:
   1. Documentation verifying contractor/subcontractor adherence to specified certifications and qualifications

C. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
   2. All Shop Drawings shall be modified with as-built information/corrections.
   3. Instrumentation and Control Equipment Operation and Maintenance Manual Content:
      a. Provide a printed copy of the following sheets following the Equipment Record sheets or ISA Data Sheets.
         1) Loop Check-out Sheet.
         2) Instrument Certification Sheet.

3) Final Control Element Certification Sheet.

b. Provide the following detailed information:
   1) Use equipment tag numbers from the Contract Documents to identify equipment and system components.
   2) As-constructed fabrication or layout drawings and wiring diagrams.
   3) As-constructed network asset inventory, and physical and logical network diagrams.
      a) Coordinate with the Owner or Engineer to determine the preferred method of delivery to assure security of this information.
   4) Software Licenses:
      a) Provide a single Software Licenses submittal with documentation of the software licenses for all software provided.
      b) Spreadsheet including license numbers, registration records, [expirations for service contracts,] [expiration of leased licenses], and name of owner representative to whom each software has been registered with the OEM as the licensee.
   5) Software Recovery and Reconstitution Images:
      a) For each control system component on which software is installed or configured under this project, provide a recovery image of the software or configuration. This image must allow for bare-metal restore such that restoration of the image is sufficient to restore system operation to the imaged state without the need for re-installation of software.

c. Password Summary Report:
   1) Provide a Password Summary Report documenting the administrative password for each device and describing the procedure to change the password for each device. Do not provide the Password Summary Report in electronic format. Provide two hardcopies of the Password Summary Report, each copy in its own sealed envelope.
   2) Provide listing of all temporary Systems Integrator usernames setup for each device.

d. Additional information as required in the associated equipment or system Specification Section.

4. Warranties: Provide copies of warranties and list of factory authorized service agents.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not remove shipping blocks, plugs, caps, and desiccant dryers installed to protect the instrumentation during shipment until the instruments are installed and permanent connections are made.

PART 2 - PRODUCTS

2.1 NEMA TYPE REQUIREMENTS

A. Provide enclosures/housing for control system components in accordance with the area designations provided on the Drawings.
   1. Areas designated as wet: NEMA Type 4.
   2. Areas designated as wet and/or corrosive: NEMA Type 4X.
   3. Areas designated as Class I hazardous, Groups A, B, C, or D as defined in NFPA 70:
      a. NEMA Type 7 unless all electrical components within enclosure utilize intrinsically safe circuitry.
         1) Utilize intrinsically safe circuits to the maximum extent practical and as depicted in the Contract Documents.
   4. Areas designated as Class II hazardous, Groups E, F, or G as defined in NFPA 70:
      a. NEMA Type 9 unless all electrical components within enclosure utilize intrinsically safe circuitry.

1) Utilize intrinsically safe circuits to the maximum extent practical and as depicted in the Contract Documents.

5. Either architecturally or non-architecturally finished areas designated as dry, noncorrosive, and nonhazardous: NEMA Type 12.
6. Areas designated to be subject to temporary submersion: NEMA 6P.

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

A. Unless stated otherwise, system operating criteria are as follows:
1. Stability: After controls have taken corrective action, as result of a change in the controlled variable or a change in setpoint, oscillation of final control element shall not exceed two cycles per minute or a magnitude of movement of 0.5% full travel.
2. Response: Any change in setpoint or change in controlled variable shall produce a corresponding corrective change in position of final control element and become stabilized within 30 seconds.
3. Agreement: Setpoint indication of controlled variable and measured indication of controlled variable shall agree within 3% of full scale over a 6:1 operating range.
4. Repeatability: For any repeated magnitude of control signal, from either an increasing or decreasing direction, the final control element shall take a repeated position within 0.5% of full travel regardless of force required to position final element.
5. Sensitivity: Controls shall respond to setpoint deviations and measured variable deviations within 1.0% of full scale.
6. Performance: All instruments and control devices shall perform in accordance with manufacturer's specifications.

2.3 ACCESSORIES

A. Provide identification devices for instrumentation system components in accordance with Specification Section 10 14 00.

B. Provide corrosion resistant spacers to maintain 1/4 inches separation between equipment and mounting surface in wet areas, on below grade walls and on walls of liquid containment or processing areas such as Clarifiers, Digesters, Reservoirs, etc.

Project Name:		Owner's Project No. (if applicable):	Page of
Project Owner:		Regulatory Agency Project No. (if applicable):	
HDR Project No.:		Date:	

LEAK AND TERMINATION/CONTINUITY CHECKS

DESCRIPTION	FIELD					CONTROL CAB	
	LEAK CHECK[1],			TERM/CONT CHECK[2],		TERM/CONT CHECK[2],	
	Device Tag No.	Process Conn.	Signal Tube	Device Tag No.	Termination Ident.	Device Tag No.	Termination Ident.

1. Leak check for pneumatic signal tubing to be per ISA-PR7.1.
2. Termination/continuity check includes check at terminated equipment for: (a) correct polarity, (b) appropriate signal generation, transmission and reception, and (c) correct shield & ground terminations.

OPERATOR INTERFACE CHECK-OUT

MONITORING POINTS OBSERVED

PARAMETER TYPE	TAG NO.	TAG NO.	TAG NO.	TAG NO.	TAG NO.	TAG NO.
PROCESS VAR						
EQUIP STATUS						
ALARM POINT						

OPERATOR CONTROL FUNCTIONS CHECKED

FUNCTION TYPE	TAG NO.	LOCATION	TAG NO.	LOCATION	TAG NO.	LOCATION

FINAL CONFIGURED SETTINGS

TAG NO.	SWITCH & ALARM SP	CONTROLLERS			
		Gain	Reset, rpm	Deriv. (rate), min	PV Set Point

PART 3 - EXECUTION

3.1 INSTALLATION

A. Wherever feasible, use bottom entry for all conduit entry to instruments and junction boxes.

B. Install electrical components per the requirements of the Electrical design.

3.2 FIELD QUALITY CONTROL

A. See Section 01 75 00 and Section 40 61 21.

Describe all interlocks checked, equipment started/stopped, valves/operators stroked. Describe modes of operation checked, and location of operator interface (local/remote).

_____

_____

_____

I certify that the control loop referenced on this page has been completely checked and functions in accordance with applicable drawings and specifications.

Certified by:_____ Date:_____

(Work Performed By)

Instrument Certification Sheet

Project Name:	Owner's Project No. (if applicable):
Project Owner:	Regulatory Agency Project No. (if applicable):
HDR Project No.	Date:
Control Loop No.:	
Instrument Tag No.	Transmitter/gauge span:
Manufacturer:	Switch set-point:
Model No.	Switch dead band:
Serial No.	Switch range:

TRANSMITTERS AND INDICATORS

	INCREASING INPUT			DECREASING INPUT		
% OF SPAN	INPUT	OUTPUT	ERROR (% of span)	INPUT	OUTPUT	ERROR (% of span)
0%						
25%						
50%						
75%						
100%						
Other (if applicable)						
Other (if applicable)						

SWITCHES

	INCREASING INPUT			DECREASING INPUT		
ACTUATION POINT	INPUT	OUTPUT	ERROR (% of range)	INPUT	OUTPUT	ERROR (% of range)
High (Increasing input)						
Low (Decreasing input)						

Maximum allowable error (per Contract Documents): _____

Remarks: _____

_____

_____

CALIBRATION EQUIPMENT UTILIZED

DEVICE TYPE	MFR/MODEL NO.	ACCURACY	NIST TRACEABILITY?

Certified by:_____ Date Certified:_____

Final Control Element Certification Sheet

Project Name:	Owner's Project No. (if applicable):
Project Owner:	Regulatory Agency Project No. (if applicable):
HDR Project No.	Date:
Control Loop No.:	

Tag No.	Actuator: Pneumatic: _____ Electric: _____
Description:	Positioner: Direct: _____ Reverse: _____
Manufacturer:	Positioner: Input: _____ Output: _____
Model No.	I/P Converter: Input: _____ Output: _____
Serial No.	Valve to _____ on air failure
	Valve to _____ on power failure

I/P CONVERTER

	INCREASING INPUT			DECREASING INPUT		
% OF SPAN	INPUT	OUTPUT	ERROR (% of span)	INPUT	OUTPUT	ERROR (% of span)
0%						
25%						
50%						
75%						
100%						

Specified I/P converter accuracy: _____ % of span.

FINAL CONTROL ELEMENT

	INCREASING INPUT			DECREASING INPUT		
% OF SPAN	INPUT	TRAVEL	ERROR (% of full travel)	INPUT	TRAVEL	ERROR (% of full travel)
0%						
25%						
50%						
75%						
100%						

Remarks: _____

_____

_____

CALIBRATION EQUIPMENT UTILIZED

DEVICE TYPE	MFR/MODEL NO.	ACCURACY	NIST TRACEABILITY?

Certified by: _____ Date Certified: _____

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SECTION 40 61 21
PROCESS CONTROL SYSTEM TESTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Requirements for testing of the Process Control System (PCS) hardware and software prior to shipment to the site for installation.
      a. Inspection.
         1) System hardware operational testing.
         2) System software demonstration.
      b. Test records.
   2. Requirements for field testing of the PCS hardware and software.
      a. Process Control System checkout.
      b. Instrument calibration.
      c. Loop testing/checkout.
      d. Integrated Site Acceptance Test (SAT).
      e. Operational Readiness Demonstration (ORD).

B. Related Sections include but are not necessarily limited to:
   1. Section 40 61 13 - Process Control System General Requirements.
   2. Section 40 61 96 - Process Control Descriptions.
   3. Section 40 63 43 - Programmable Logic Controllers.
   4. Section 40 67 00 - Control System Equipment Panels and Racks.

1.2 SUBMITTALS

A. See Specification Section 40 61 13 - Process Control System General Requirements.

B. Submit factory acceptance test (FAT) procedures not less than 15 calendar days prior to the scheduled start of the FAT. Include the following:
   1. Modular test plans and procedures to allow individual test segments to be repeated if necessary.
   2. Description of individual test segments and steps comprising each segment, particularly the methods and processes to be followed.
   3. Procedures for monitoring, correcting, and retesting variances.
   4. Procedures for controlling and documenting all changes made to the hardware/software after the start of testing.
   5. Descriptions of test equipment.
   6. Expected results for each segment, including pass/fail criteria.
   7. Documentation record forms to be used to certify results of factory testing.
   8. Block diagrams of the hardware test configuration, such as PLC external communication links, and any test or simulation hardware and software.

C. Post factory acceptance test:
   1. Final documentation certifying that all Factory tests have passed with satisfactory results.

D. Field Testing Shop Drawings:
   1. Site Acceptance Test (SAT) Plan.
      a. Divide into separate sections based on process systems.
      b. Each section shall include a sequential step-by-step checkout plan.
   2. Typical Loop Checkout Sheets, if other than the form included within contract documents.
   3. Typical Instrument Certification Sheets, if other than the form included within contract documents.

4. Typical Final Control Element Certification Sheets, if other than the form included within contract documents.

E. Contract Closeout Information:
   1. Site Acceptance Test (SAT) Report.
   2. Completed Loop Checkout Sheets.
   3. Completed Instrument Certification Sheets.
   4. Completed Final Control Element Certification Sheets.
   5. All system startup and checkout records, test records, recommendations and information furnished by Manufacturer's representatives during testing and startup, and amended documentation specified herein.

PART 2 - PRODUCTS

2.1 FACTORY ACCEPTANCE TESTING (FAT) GENERAL:

A. Utilize software-based process control simulation and hardware-based I/O simulation panel when conducting the full system test. Software based process simulation shall provide a real time, virtual environment that interfaces with the PLC system applications software and programming to mimic the behavior of the real process equipment and systems that are monitored and controlled by the PLC system, including the capability to force individual or groups of PLC system I/O.

B. Demonstration of communication between processors and to remote I/O racks shall be included in the Test Procedure, where applicable. Test shall include demonstration that communication performance (speed, error rates, failure and recovery) conforms to specified requirements.

C. Any tested segment or function that does not pass in accordance with agreed upon pass/fail criteria shall be retested until the segment or function passes the test.
   1. Pass/fail criteria shall be in accordance with criteria set forth in an approved shop drawing submittal.
   2. The Contractor shall bear all additional travel/accommodation expenses incurred by the Owner due to extension of test dates for retesting of failed segments or functions.

D. Notify the Engineer in writing a minimum of 15 calendar days prior to the Factory Tests.
   1. Engineer has the option to witness all required tests.

E. Testing Documentation
   1. Make following documentation available at test site during the tests:
      a. Contract Documents.
      b. Factory Demonstration Testing procedures.
      c. List of equipment to be testing including make, model, and serial number.
      d. Shop Drawing submittal data for equipment being tested.
   2. Engineer reserves the right to review all documentation at any time during testing.

2.2 FAT INSPECTION

A. Inspect all panels, operator interface terminals and cabinets prior to conducting the FAT to verify quality of workmanship and conformance to the Contract Documents and approved Shop Drawings. Completed inspection forms shall be available for review at time of FAT. Inspection shall include, but not be limited to, the following:
   1. Nameplates, warning labels, and tags including correct spelling, color and size of labeling and characters and methods of attachment.
   2. Enclosure surfaces flatness, finish, and color.
   3. Proper operation of doors, catches, and locks.
   4. Wire and cable type, sizes, tagging, color coding and tag placement in readily viewable position/orientation.
   5. Wiring runs across hinges properly installed.
   6. Proper wiring routing, layout, practices, and grounding.

7. All electrical circuits checked for continuity.
8. Terminal block contact ratings and numbers.
9. Fuses and circuit breakers are correct size and type.
10. Terminal block, fuse, breaker, and other required installed spares.
11. General arrangement and space allocation, including spare usable space in panel and on panel door.
12. PLC equipment (chassis, power supply, power conditioners, processor, adapters, I/O and specialty modules, installed spares, spare usable space) is appropriate.
13. Proper placement, isolation, and labeling of intrinsic safety devices and associated wiring.
14. Equipment and devices are properly installed and secured to subpanels and doors using appropriate methods and in appropriate orientation.
15. Fans, blowers, heaters, air-conditioning units, and other environmental controls are operational, unobstructed, and installed with sufficient clearances recommended by component manufacturers.

2.3 FAT - SYSTEM HARDWARE OPERATIONAL TESTING

A. Assemble and interconnect the entire PLC system as a network that mimics the network that is designed to be installed at the Plant site.
   1. As a minimum, the test shall include the following major components:
      a. All control panels that interface with the control network and are provided by the System Integrator, including local control panels, remote control panels, hardwired/relay logic and PLC based panels.
      b. Remote I/O Panels.
      c. Operator Interface Terminals (OITs).
      d. Human Machine Interface (HMI) system.
      e. Ethernet Networks.
      f. Uninterruptible Power Supplies.
      g. Network switches, Routers, Firewalls.
      h. Workstations
      i. Other network equipment and appurtenances.

B. Packaged systems not present at FAT shall be simulated; communications interfaces shall be simulated to/from vendor confirmed interface registers.

C. All system hardware components and equipment shall be tested to verify proper operation as standalone units. Tests shall include, but not be limited to, the following:
   1. AC/DC power checks.
   2. Power fail/restart tests.
   3. Verification of UPS power to required components.
   4. Diagnostics checks.
   5. Verification that all equipment is functioning properly.
   6. All electrical circuits energized simultaneously and continuously for 48 hours without failures.
   7. All alarm circuits connected to simulated alarm contacts to verify operation.
   8. All interlock and shutdown circuits checked for operability and proper function by means of simulated contact.
   9. All hardwired input/output devices and components, and all network connected I/O shall be tested to verify operability and basic calibration.
   10. Simulate operation of electronic control and receiving instruments and circuits.
   11. Any other test required to place the PCS equipment in an operating state.
   12. Verify all redundant components fail-over hands-free without interruption of control process.
   13. Verify all servers and networking equipment are in an operating state with no unresolved errors in error logs.
   14. Verify that all components are integrated and communicating for full simulation test including any simulation software if applicable.

15. Compliance with Contract Documents.

D. Develop and execute device failure conditions including PLC failure, HMI Workstation failure, OIT failure, peripheral failures, server failure, etc. Special attention shall be given to creating failures in the middle of operator sequences and control actions such as:
   1. Failure of a major communications component.
   2. Incorrect operator entry in the middle of a multi-step action.
   3. HMI Workstation failure in the middle of a control action.
   4. OIT failure in the middle of a control action.
   5. Demonstration of all redundant functions and components.
   6. Demonstration of all required alarm processing functionality, including audible annunciation.

2.4 FAT - SYSTEM SOFTWARE DEMONSTRATION

A. Operator Interfaces:
   1. Prior to the staging and testing of the system, the display environments (Operator Interface Terminals and Human Machine Interfaces) shall have been configured and loaded into the machines, and database parameters linked to the specified fields. Demonstrate displays, faceplates, password/security capabilities, navigation methods, diagnostic/troubleshooting displays, etc.

B. Demonstrate all system software during the FAT (e.g. process monitoring and control, HMI, OIT, historian, alarming, simulation, modeling, utility and security programs) incorporated into the system to implement the various functions and capabilities specified. Demonstrations shall include:
   1. All required historical data capture, storage, retrieval and reporting functions.
   2. All required data management, logging, and trending functions.
   3. All required network, communication and interface functions.
   4. All required device control functions.
   5. All required database management functionality.
   6. All required software support utilities.
   7. All Control System diagnostics, both on-line and off-line.
   8. Correct operation of computations and calculated quantities including totalized values.
   9. Proper operation of all changes to the originally specified Control System that have been negotiated and approved during the implementation period.

C. Demonstrate the proper operation, configuration and programming of all software based on simulation of all the analog inputs/outputs and all of the discrete inputs and outputs, as indicated on the I/O list. In addition to testing allocated I/O, all spare I/O points shall also be simulated and tested to the degree possible. Demonstration shall show that the monitoring and control software and configuration and programming associated with the input/output points (hardwired and network connected) performs as intended.
   1. PLC I/O testing shall include, as a minimum, the following:
      a. Simulate a field digital input for each PLC input point at the terminal strip of the control panel and verify PLC response.
      b. Simulate a field analog input for each PLC analog input point at the terminal strip of the control panel and verify PLC response.
      c. Force an output for each PLC digital output point and verify the signal presence at the terminal strip in the control panel.
      d. Simulate an analog output for each PLC analog output point and verify signal presence at the terminal strip in the control panel.

2.5 FAT TEST RECORDS:

A. Maintain records of all factory test results. As a minimum, include the following items:
   1. Name of test procedure.
   2. Date of the test.
   3. Test results for each test segment including a passed/failed indication.

4. Signatures of individual(s) performing the test and witnesses thereof.

PART 3 - EXECUTION

3.1 GENERAL

A. Maintain accurate daily log of all testing activities, calibration functions, and final set point adjustments.

B. All testing may be witnessed by the Owner or Engineer.

3.2 INSTALLATION AND CHECKOUT

A. Provide the following (after successful completion of the Factory Acceptance Test):
   1. Check and approve the installation of all Process Control System (PCS) components (including but not limited to control panels, field instruments, networking equipment and racks, patch panels and all cable and wiring interconnects between various equipment, panels and devices) prior to placing the various processes and equipment into operation. As a minimum, include:
      a. Verification and documentation that all field instruments and pneumatic signals function properly and are properly calibrated.
      b. Testing of all final control actions.

B. Provide services of authorized manufacturer's representatives to check and verify the correctness of the installation and operation of equipment.

3.3 PRE-DEMONSTRATION PERIOD TESTING

A. Pneumatic Signal Tubing Testing:
   1. In the event that instrument air is not available during calibration and testing, supply either filtered, dry, instrument quality air from a portable compressor or bottled, dry, instrument quality air.
      a. Do not, under any circumstances, apply hydrostatic test to any part of the air supply system or pneumatic control system.
   2. Before the leak test is begun, blow clean with dry air.
   3. Test signal tubing per ISA 7.0.01, except for tubing runs of less than 10 feet where simple soap bubble testing will suffice.
   4. If a leak is detected, repair the leak and repeat the leak test.
   5. After completion of the leak test, check each signal line for obstructions.
      a. If any are indicated, remove and retest.

B. Instrumentation Calibration:
   1. Verify and document that all instruments and control devices are calibrated to provide the performance required by the Contract Documents.
   2. Factory furnished calibration certifications are acceptable for the following:
      a. Flow meters.
      b. Pressure sensors utilized with annular sleeve.
      c. Temperature sensors.
   3. On-site calibration verification is required for all other instruments, including "smart" transmitters that have been factory calibrated.
      a. Provide calibration checks at 0, 25, 50, 75, and 100 percent of span for pressure transmitters and gages.
         1) Check for both increasing and decreasing input signals to detect hysteresis.
      b. In addition to factory calibration certification, temperature sensors and gages shall be checked at a single point for conformance to required accuracy.
      c. Level transducers/transmitters shall be checked at two points in addition to zero.
      d. Analytical sensors shall be calibrated in accordance with manufacturer's recommendations.

e. Check operation of all switches to verify actuation occurs in accordance with manufacturer's specified accuracy.
f. Replace any instrument which cannot be properly adjusted.
g. Stroke pneumatic control valves with clean dry air to verify control action, positioner settings, and solenoid functions.

4. Mark range, date, set point and calibrator's initials on each instrument by means of blue or black ink on a waterproof tag affixed to the instrument.
5. Calibration equipment shall be certified by an independent agency with traceability to NIST.
   a. Certification shall be up-to-date.
   b. Use of equipment with expired certifications shall not be permitted.
6. Calibration equipment shall be at least three times more accurate as the device being calibrated.

C. Loop Testing:
1. Utilize the Loop Check-Out Sheet located at the end of Section 40 61 13 (or Engineer approved equivalent) to document on-site calibration checks.
   a. Utilize separate loop checkout form for each loop.
2. Minimum loop checkout requirements:
   a. Use actual signals where available.
   b. Check control signal generation, transmission, reception and response for all inputs and outputs for all control loops under simulated operating conditions by imposing a signal on the loop at the instrument connections.
   c. Closely observe controllers, indicators, transmitters, HMI displays, OIT displays, recorders, alarm and trip units, remote set points, ratio systems, and other components.
      1) Verify that readings at all loop components are in agreement.
      2) Make corrections as required.
      3) Following any corrections, retest the loop.
   d. Stroke all control valves, cylinders, drives and connecting linkages from the local control station and from the control room operator interface.
   e. Check all interlocks for proper functionality.
   f. Record all set point and calibration changes on all affected Contract Documents and turn over to Owner.

D. Integrated Site Acceptance Test (SAT):
1. Following the testing of each individual loop, perform an integrated Site Acceptance Test (SAT) to verify that all equipment and programmed software are operating as described in the Contract Documents and equipment manufacturers recommendations. Checks to include:
   a. The intended monitoring and control functions of the PCS including all vendor-furnished equipment packaged systems, communications, operator interfaces, statuses, alarms, trends and recording of historical tags.
   b. Integrated testing on a system by system basis as described in the submitted Site Acceptance Test (SAT) plan sequential step-by-step checkout plan.
      1) Documentation with initials of the individuals who perform each test.
2. Provide minimum fifteen (15) day notice to the Owner prior to commencing the SAT.
3. Promptly address and re-test any malfunctions, issues and incompletions arising during the SAT.

E. At the successful conclusion of all testing specified in this article, submit the "Instrumentation Supplier's Instrumentation Installation Certificate" required in Section 01 75 00 - Checkout and Start-up Procedures.

3.4 DEMONSTRATION PERIOD

A. Demonstrate the functional integrity of the Process Control System for the entire facility in accordance with the demonstration period requirements in Section 01 75 00 - Checkout and Start-up Procedures as evidence of Substantial Completion.

3.5 OPERATIONAL READINESS DEMONSTRATION (ORD)

A. Operational Readiness Demonstration shall begin at the start of the Demonstration Period Testing and shall continue until a period of time has been achieved wherein the system (both hardware and software) availability meets or exceeds 99.9% for 60 consecutive days and no system failures have occurred which result in starting the ORD over again. Planned outages required for normal operation and maintenance shall not be included as unavailable time in the availability calculations. During the ORD the system shall be available to Owner's operating personnel for use in normal operation of the Owner's site.

B. For the purpose of the ORD the system shall be defined as consisting of the following components including but not limited to: local control panels, local control stations, VFD's, MCC's, field instruments, networking hardware and software, control processors (PLC's, RTUs, etc.), OIT and HMI workstations and servers, and other PCS software and hardware supplied under the contract.

C. The ORD shall be terminated if one or more of the conditions listed below occur. Following correction of the condition, a new [60] consecutive day ORD shall begin. The following conditions are considered critical system failures affecting the operability and maintainability of the system:
   1. Failure to repair a hardware or software problem within 120 consecutive hours from the time of notification of a system failure.
   2. Recurrent hardware or software problems: if the same type of problem occurs three times or more.
   3. Communication failures or chronic communication interruptions.
   4. Software problem causing a non-redundant processor to halt execution.

D. The following conditions shall constitute a system failure in determining the system availability described herein:
   1. Failure or malfunction of any non-redundant processor or operator interface.
   2. Loss of communications on the data acquisition and control network, or on the HMI network.
   3. Failure or malfunction of one or more I/O modules.
   4. Failure or malfunction of any devices or signals that may affect five (5) or more analog and digital I/O points in the system at any given time.
   5. Failure or malfunction of any type of final control element affecting one or more control loops thereby causing a malfunction in the control logic or desired operation.
   6. Failure of any supply power (24V, 120V, or 480V) to PCS equipment, field instruments, control panels, network racks or network switches. Failure of primary power supply shall not constitute a system failure provided the backup power supply properly takes over and maintains supply power.
   7. Failure of a backup power supply (including UPS) to properly activate and maintain power to the affected device(s) shall constitute a system failure.
   8. Failure, malfunction, or unavailability of two or more field instruments at any given time.
   9. Software failure that requires programmer intervention to restore proper operation.

E. The system availability shall be calculated based on the following equation:

$$A = TTO / (TTO + TTR) \times 100\ \%$$

where:

A = system availability %
TTO = total time in operation
TTR = total time to repair

Planned outages for normal operations and maintenance shall not be included in TTR value.

F. Time to repair shall be the period between the time that Contractor is notified of a system failure and the time that the system has been restored to proper operation in terms of hours with an allowance for the following dead times which shall not be counted as part of the time to repair period.

1. Travel time for Contractor/ System Integrator to arrive at the Owner's work site. Travel time shall not exceed 6 hours from the time the Contractor is notified.
2. Time for receipt of spare parts or components needed for the repair at the Owner's work site, not to exceed 24 hours per incident from the time the Contractor is notified.
3. Allowable dead time listed above for travel and receipt of materials shall not be counted in the system availability time. Dead time shall be logged by Contractor and the duration of the ORD shall be extended for an amount equal to the dead time.

G. Completion of a [60] consecutive day period without any restarts of the ORD and with system availability in excess of 99.9 percent will result in acceptance of the PCS by the Owner.

H. Provide all material and labor required to repair the system during the ORD at no additional cost to the Owner. Promptly replace any spare parts or components used to replace malfunctioning parts or components in the spare inventory at no additional cost to the Owner.

I. Log any repairs or correction of malfunctioning parts or components using an ORD repair/malfunction correction form. Format of the form shall be developed in coordination with the Owner.

END OF SECTION

SECTION 40 61 43
SURGE PROTECTION DEVICES FOR INSTRUMENTATION AND CONTROL EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Category IC4 SPD - Analog instrumentation signal, field mounted.
   2. Category IC5 SPD - Analog instrumentation signal, control panel mounted.
   3. Category IC6 SPD - Combination 120 VAC circuit and analog signal, field mounted.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
      a. C62.41.1, Guide on the Surge Environment in Low-Voltage (1000 V and less) AC Power Circuits.
   2. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
   3. Underwriters Laboratories, Inc. (UL):
      a. 497B, Standard for Safety Protectors for Data Communications and Fire-Alarm Circuits.
      b. 1283, Standard for Electromagnetic Interference Filters.
      c. 1363, Standard for Relocatable Power Taps.
      d. 1449, Standard for Surge Protective Devices.

B. Qualifications:
   1. Provide devices for a manufacturer who has been regularly engaged in the development, design, testing, listing and manufacturing of SPDs of the types and ratings required for a period of 10 years or more and whose products have been in satisfactory use in similar service.
   2. Upon request, suppliers or manufacturers shall provide a list of not less than three customer references showing satisfactory operation.

1.3 DEFINITIONS

A. Clamping Voltage: The voltage measured at the end of the 6 inches output leads of the SPD and from the zero voltage reference to the peak of the surge when the applied surge is induced at the 90 degree phase angle of the applied system frequency voltage.

B. Let-Through Voltage: The voltage measured at the end of the 6 inches output leads of the SPD and from the system peak voltage to the peak of the surge when the applied surge is induced at the 90 degree phase angle of the applied system frequency voltage.

C. Maximum Continuous Operating Voltage (MCOV): The maximum steady state voltage at which the SPD device can operate and meet it specification within its rated temperature.

D. Maximum Surge Current:
   1. The maximum 8 x 20 microsecond surge current pulse the SPD device is capable of surviving on a single-impulse basis without suffering either performance degradation or more than 10% deviation of clamping voltage at a specified surge current.
   2. Listed by mode, since number and type of components in any SPD may vary by mode.

E. Protection Modes: This parameter identifies the modes for which the SPD has directly connected protection elements, i.e., line-to-neutral (L-N), line-to-line (L-L), line-to-ground (L-G), neutral-to-ground (N-G).

F. Surge Current per Phase:
   1. The per phase rating is the total surge current capacity connected to a given phase conductor.
   2. For example, a wye system surge current per phase would equal L-N plus L-G; a delta system surge current per phase would equal L-L plus L-G.
      a. The N-G mode is not included in the per phase calculation.

G. System Peak Voltage: The electrical equipment supply voltage sine wave peak (i.e., for a 120 V system the L-N peak voltage is 170 V).

1.4 SUBMITTALS

A. Shop Drawings:
   1. For named products, submit only a catalog cut sheet.
      a. For all other products, submit the data required below.
   2. See Specification Section 40 61 13 for general process control systems requirements.
   3. Product technical data for non-specified models:
      a. Manufacturer's experience.
      b. Standard catalog cut sheet.
      c. Electrical and mechanical drawing showing unit dimensions, weights, mounting provisions, connection details and layout diagram of the unit.
      d. Create a Product Data Sheet for each different model number of SPD provided.
         1) Data in the Product Data Sheet heading:
            a) SPD Type per PART 2 of the Specification.
            b) Manufacturer's Name.
            c) Product model number.
         2) Data in the Product Data Sheet body:
            a) Column one: Specified value/feature of every paragraph of PART 2 of the Specification.
            b) Column two: Manufacturer's certified value confirming the product meets the specified value/feature.
         3) Data in the Product Data Sheet closing:
            a) Signature of the manufacturer's official (printed and signed).
            b) Title of the official.
            c) Date of signature.

B. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

1.5 WARRANTY

A. The manufacturer shall provide a minimum of a five year Limited Warranty from date of shipment against failure when installed in compliance with applicable national/local electrical codes and the manufacturer's installation, operation and maintenance instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the manufacturers model numbers listed in the individual product paragraphs below are acceptable.

2.2 CATEGORY IC4 SPD

A. Approved Products:
   1. Schneider Electric Surgelogic Type SSE.
   2. Eaton Crouse-Hinds MTL TP48-x-N-NDI.
   3. Phoenix Contact SURGETRAB/PIPETRAB Series.

B. Standards: None.

C. Design:
1. General:
a. For protection of field mounted equipment connected to 4-20mA analog signal loops.
b. Mounted directly to an unused conduit entry on a process transmitter housing.
c. Multi-stage hybrid solid state high performance suppression system.
d. Designed for series connection.
e. Enclosure: 1/2 inches to 3/4 inches stainless steel conduit pipe nipple.
2. Operating voltage: 24 VDC or as indicated on the Drawings.
3. Modes of protection: All modes, L-L and L-G.
4. Maximum continuous operating voltage: Less than 130% of system peak voltage.
5. Maximum surge current: 10,000 A.
6. Minimum repetitive surge current capacity:
a. The SPD shall meet one (1) of the following:
1) 1000 occurrences of a 200 A, 10 x 1000 microsecond waveform.
2) 400 occurrences of a 500 A, 10 x 1000 microsecond waveform.
3) 100 occurrences of a 400 A, 10 x 700 microsecond waveform.
4) 100 occurrences of a 2000 A, 8 x 20 microsecond waveform.
5) 10 occurrences of a 10,000 A, 8 x2 0 microsecond waveform.
7. Maximum clamping voltages, L-L:
a. The SPD shall meet one of the following:
1) 400 A, 10 x 700 microsecond waveform: 400% of system voltage.
2) 10,000 A, 8 x 20 microsecond waveform: 400% of system voltage.
3) IEEE B3 combination wave: 250% of system voltage.
8. Maximum clamping voltages, L-G:
a. The SPD shall meet one of the following:
1) 400 A, 10 x 700 microsecond waveform: 200% of system voltage.
2) 10,000 A, 8 x 20 microsecond waveform: 200% of system voltage.
3) IEEE B3 combination wave: 300% of system voltage.

2.3 CATEGORY IC5 SPD

A. Approved Products:
1. Schneider Electric ASCO 175D043S10KLPCN0 with PCB1B base.
2. Eaton Crouse-Hinds MTL SD32 or SD32X.
3. Phoenix Contact TTC Series.

B. Standards: UL 497B.

C. Design:
1. General:
a. Mounted internally to control panels for protection of equipment connected to analog signal loops.
b. Multi-stage hybrid solid state high performance suppression system.
c. Designed for series connection.
d. Enclosure: Metallic or plastic, flange or DIN rail mounting.
e. Field connection: The unit shall have external terminal screws for line and ground conductors.
2. Operating voltage: 24 VDC or as indicated on the Drawings.
3. Modes of protection: All modes, L-L and L-G.
4. Maximum continuous operating voltage: Less than 130% of system peak voltage.
5. Maximum surge current: 10,000 A.
6. Minimum repetitive surge current capacity:
a. The SPD shall meet one of the following:
1) 1000 occurrences of a 200 A, 10 x 1000 microsecond waveform.
2) 400 occurrences of a 500 A, 10 x 1000 microsecond waveform.
3) 100 occurrences of a 400 A, 10 x 700 microsecond waveform.

4) 100 occurrences of a 2000 A, 8 x 20 microsecond waveform.
5) 10 occurrences of a 10,000 A, 8 x 20 microsecond waveform.

7. Maximum clamping voltages, L-L:
   a. The SPD shall meet one of the following:
      1) 400 A, 10 x 700 microsecond waveform: 400% of system voltage.
      2) 10,000 A, 8 x 20 microsecond waveform: 400% of system voltage.
      3) IEEE B3 combination wave: 225% of system voltage.
8. Maximum clamping voltages, L-G:
   a. The SPD shall meet one of the following:
      1) 400 A, 10 x 700 microsecond waveform: 200% of system voltage.
      2) 10,000 A, 8 x 20 microsecond waveform: 200% of system voltage.
      3) IEEE B3 combination wave: 300% of system voltage.

2.4 CATEGORY IC6 SPD

A. Approved Products:
   1. Phoenix Contact BXT-N4X 4-Wire.

B. Product:
   1. Field mounted for protection of field mounted equipment connected to 120 V power and 4 - 20 mA analog signal loops.
   2. Category IC1 and Category IC5 SPDs mounted in a common enclosure.
   3. Enclosure: Metallic or nonmetallic NEMA 4X.

2.5 SOURCE QUALITY CONTROL

A. Performance tests to be performed or independently verified by a certified testing laboratory.

B. The SPD are to be tested as a complete SPD system including: Integral unit level and/or component level fusing.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Category IC4 SPD:
   1. Provide on the following applications:
      a. Loop powered transmitter (flow, level, etc.) where the transmitter is mounted outdoors or in a remote building or structure from the control panel and the signal conductors are routed above grade or underground.
      b. Loop powered transmitter (flow, level, etc.) where both the transmitter and control panel are mounted outdoors and the signal conductors are mounted above grade or underground.
   2. Connect in series with the equipment.
   3. Attach to spare conduit entry of transmitter or inline of conduit at the transmitter.
   4. Bond transmitter to a grounded structure or provide a ground rod.
   5. Ground shield at control panel end.
   6. Verify SPDs series resistance and capacitance does not interfere with the transmitters signal.

C. Category IC5 SPD:
   1. Provide on the following applications:
      a. Incoming 4-20 mA signals into a control panel from transmitters (flow, level, etc.) where the transmitter is mounted outdoors or in a remote building or structure from the control panel and the signal conductors are routed above grade or underground.
      b. Incoming 4-20 mA signals into a control panel from transmitters (flow, level, etc.) where both the transmitter and control panel are mounted outdoors and the signal conductors are routed above grade or underground.
   2. Connect in series with the equipment.

3. Flange mount or DIN rail mount in control panel.
4. Connect all SPDs in the control panel to the same grounding point.
5. Verify SPDs series resistance and capacitance does not interfere with the transmitters signal.

D. Category 1C6 SPD:
   1. Provide on the following applications:
      a. Outdoor field mounted transmitter (flow, level, etc.) that requires 120 V power and provides a 4-20 mA signal to a control panel where the conductors are routed above grace or underground.
   2. Connect in series with the equipment.
   3. Mounted adjacent to equipment.
   4. Bond transmitter to a grounded structure or provide a ground rod.
   5. Ground shield at control panel end.
   6. Verify SPDs series resistance and capacitance does not interfere with the transmitters signal.

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SECTION 40 61 93
PROCESS CONTROL SYSTEM INPUT-OUTPUT LIST

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Process Control System (PCS) PLC Input/Output (I/O) List description.

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 40 61 13 - Process Control System General Requirements.
   2. Section 40 63 43 - Programmable Logic Controllers.
   3. Section 40 61 96 - Process Control Descriptions.
   4.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. The International Society of Automation (ISA):
      a. 5.1, Instrumentation Symbols and Identification.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Any proposed deviations from the I/O List format, content and attributes stipulated in this Section shall be submitted for approval. I/O List development shall not proceed until the deviation has been approved.
   2. Pre-fabrication I/O Lists for approval.

B. Operation and Maintenance Manuals:
   1. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

C. Informational Submittals:
   1. I/O Lists:
      a. Post-Commissioning Final I/O Lists.
      b. Submit I/O Lists in PDF and native format Microsoft Excel indexed by Area, Panel, and Point Description.

PART 2 - PRODUCTS

2.1 I/O LIST

A. The I/O List in the Appendix 40 61 93A to this Section contains I/O point information derived from the Contract drawings and specifications.

B. The I/O List shall be used as the starting point in the development of the final PLC I/O database.
   1. The I/O list does not include internal software points generated by the control system and is used solely within the control system.

C. The I/O List is organized in columns as follows:
   1. I/O TAG describes the point name that will be used throughout the control system to identify the point.
   2. P&ID references the Process and Instrumentation Diagram on which the point is depicted in relation to the process and equipment.
   3. I/O TYPE denotes the signal type such as analog input or output, discrete input or output, pulse, etc.

4. POINT DESCRIPTION is a concise English language description of the point's function in in relation to the process in terms that a user can easily understand.
5. SIGNAL TYPE is the type of electrical signaling used.

D. I/O List:
1. Refer to Appendix 40 61 93A.

I/O TAG	PANEL	P&ID NUMBER	I/O DESCRIPTION		I/O TYPE	POWER SOURCE
I/O TAG	MIN-MAX RANGE	ENGINEERING UNITS	DIGITAL ZERO STATE	DIGITAL ONE STATE	REMARKS	

PART 3 - EXECUTION

3.1 I/O DATABASE DEVELOPMENT

A. The Systems Integrator shall develop the complete I/O List containing all information needed to facilitate panel building, testing and programming, and the fully document the I/O layout and interconnections.

B. The Systems Integrator shall obtain the Owner's existing tag naming conventions, abbreviations, facility codes, standard state descriptors, and other relevant information prior to creating the I/O List.

C. Prior to the start of PLC panel fabrication, the Systems Integrator shall submit an I/O List for review and approval

D. The I/O List shall include for each I/O point, at minimum, all information as listed in Section 2.1.C.

E. Maintain a copy of the complete I/O List with modifications during construction in native file format. I/O List shall be accessible to Owner and Engineer upon request.

F. Following successful project Commissioning, submit an "As Installed" final I/O List, with all fields representing the updated information, including all field updated information.

3.2 I/O HARDWARE CONFIGURATION

A. Partition the signals among I/O modules as described in Section 40 63 43 to provide enhanced process control and monitoring resiliency.

3.3 I/O POINT DATA FIELDS

A. Information in the I/O List data fields may be subject to review and modification by the Owner or Engineer during the Submittal review phase.
1. Incorporate changes as directed by the reviewer through the system and associated documentation, at no additional cost to the Owner, subject to the following limitations:
   a. Requested modifications shall be limited to 20% of the total number of I/O points.
      1) This 20% shall not include changes to the I/O List prior to the Submittal review.
      2) Corrections for errors by the Systems Integrator shall not count toward the 20% modification limit.
   b. Each unique change shall count as one modification.
      1) For example, modifying the description, range, and engineering unit for one analog input counts as three separate modifications.
   c. Analog input alarm limit adjustments shall not count as modifications.

END OF SECTION

10342803 PRAIRIE CREEK WWTP
IO LIST - PLC 3101

QC CHECK			REVISION HISTORY		
DATE	APPROVED	REV	DATE	ISSUE BY	DESCRIPTION
06/03/25	S. HORRAS	0	06/13/25	P. KAPADIA	ISSUED FOR BID

NO.	P&ID	I/O TAG	TAG NO	POINT DESCRIPTION	IO TYPE	SIGNAL TYPE	REMARKS
1	00Y601	LIT-1101	1101	AERATION BASIN #1 (AB1) DISTRIBUTION ULTRASONIC LEVEL	AI	4-20 mA	
2	00Y601	YI	1101	AC POWER NORMAL	DI	DRY CONTACT	
3	00Y601	YA	1101	UPS BATTERY LOW ALLARM	DI	DRY CONTACT	
4	00Y603	HS-2151	2151	A85 FCV-2151 VALVE POSITION	AI	4-20 mA	
5	00Y603	HSC-2151	2151	A85 FCV-2151 VALVE POSITION COMMAND	AO	4-20 mA	
6	00Y603	HS-LR-2151	2151	A85 FCV-2151 VALVE IN REMOTE	DI	DRY CONTACT	
7	00Y603	FIT-2151	2151	A85 AIR SUPPLY	AI	4-20 mA	
8	00Y603	HS-2151D	2151	A85 MX-2151 MIXER MOTOR E-STOP	DI	DRY CONTACT	
9	00Y603	HS-R-2151A	2151	A85 MX-2151 MIXER IN REMOTE (VFD)	DI	DRY CONTACT	
10	00Y603	HS-A-2151E	2151	A85 MX-2151 MIXER IN AUTO (LCS)	DI	DRY CONTACT	
11	00Y603	YI-R-2151	2151	A85 MX-2151 MIXER MOTOR RUNNING	DI	DRY CONTACT	
12	00Y603	YA-2151	2151	A85 MX-2151 MIXER FAULTED	DI	DRY CONTACT	
13	00Y603	YI-2151	2151	A85 MX-2151 MIXER MOTOR RUN COMMAND	DO	DRY CONTACT	
14	00Y603	SC-2151	2151	A85 MX-2151 MIXER MOTOR SPEED COMMAND	AO	4-20 mA	
15	00Y603	SI-2151	2151	A85 MX-2151 MIXER MOTOR SPEED INDICATION	AI	4-20 mA	
16	00Y603	HS-2152D	2152	A85 MX-2152 MIXER MOTOR E-STOP	DI	DRY CONTACT	
17	00Y603	HS-R-2152A	2152	A85 MX-2152 MIXER IN REMOTE (VFD)	DI	DRY CONTACT	
18	00Y603	HS-A-2152E	2152	A85 MX-2152 MIXER IN AUTO (LCS)	DI	DRY CONTACT	
19	00Y603	YI-R-2152	2152	A85 MX-2152 MIXER MOTOR RUNNING	DI	DRY CONTACT	
20	00Y603	YA-2152	2152	A85 MX-2152 MIXER FAULTED	DI	DRY CONTACT	
21	00Y603	YI-2152	2152	A85 MX-2152 MIXER MOTOR RUN COMMAND	DO	DRY CONTACT	
22	00Y603	SC-2152	2152	A85 MX-2152 MIXER MOTOR SPEED COMMAND	AO	4-20 mA	
23	00Y603	SI-2152	2152	A85 MX-2152 MIXER MOTOR SPEED INDICATION	AI	4-20 mA	
24	00Y603	AIT-2151A	2151	A85 OXIC DISSOLVED OXYGEN	AI	4-20 mA	
25	00Y603	AIT-2151B	2151	A85 OXIC AMMONIA (FUTURE)	AI	4-20 mA	
26	00Y603	MAH-2153	2153	A85 OXIC PUMP P-2153 MOTOR SEAL LEAK	DI	DRY CONTACT	
27	00Y603	TAH-2153	2153	A85 OXIC PUMP P-2153 MOTOR HIGH TEMP	DI	DRY CONTACT	
28	00Y603	HS-2153B	2152	A85 OXIC PUMP P-2153 MOTOR MOTOR E-STOP	DI	DRY CONTACT	
29	00Y603	HS-R-2153A	2153	A85 OXIC PUMP P-2153 IN REMOTE (VFD)	DI	DRY CONTACT	
30	00Y603	HS-A-2153E	2153	A85 OXIC PUMP P-2153 IN AUTO (LCS)	DI	DRY CONTACT	
31	00Y603	YI-R-2153	2153	A85 OXIC PUMP P-2153 MOTOR RUNNING	DI	DRY CONTACT	
32	00Y603	YA-2153	2153	A85 OXIC PUMP P-2153 FAULTED	DI	DRY CONTACT	
33	00Y603	YI-2153	2153	A85 OXIC PUMP P-2153 MOTOR RUN COMMAND	DO	DRY CONTACT	
34	00Y603	SC-2153	2153	A85 OXIC PUMP P-2153 MOTOR SPEED COMMAND	AO	4-20 mA	
35	00Y603	SI-2153	2153	A85 OXIC PUMP P-2153 MOTOR SPEED INDICATION	AI	4-20 mA	
36	00Y603	HS-2161	2161	A86 FCV-2161 VALVE POSITION	AI	4-20 mA	
37	00Y603	HSC-2161	2161	A86 FCV-2161 VALVE POSITION COMMAND	AO	4-20 mA	
38	00Y603	HS-LR-2161	2161	A86 FCV-2161 VALVE IN REMOTE	DI	DRY CONTACT	
39	00Y603	FIT-2161	2161	A86 AIR SUPPLY	AI	4-20 mA	
40	00Y603	HS-2161D	2161	A86 MX-2161 MIXER MOTOR E-STOP	DI	DRY CONTACT	
41	00Y603	HS-R-2161A	2161	A86 MX-2161 MIXER IN REMOTE (VFD)	DI	DRY CONTACT	
42	00Y603	HS-A-2161E	2161	A86 MX-2161 MIXER IN AUTO (LCS)	DI	DRY CONTACT	
43	00Y603	YI-R-2161	2161	A86 MX-2161 MIXER MOTOR RUNNING	DI	DRY CONTACT	
44	00Y603	YA-2161	2161	A86 MX-2161 MIXER FAULTED	DI	DRY CONTACT	
45	00Y603	YI-2161	2161	A86 MX-2161 MIXER MOTOR RUN COMMAND	DO	DRY CONTACT	
46	00Y603	SC-2161	2161	A86 MX-2161 MIXER MOTOR SPEED COMMAND	AO	4-20 mA	
47	00Y603	SI-2161	2161	A86 MX-2161 MIXER MOTOR SPEED INDICATION	AI	4-20 mA	
48	00Y603	HS-2162D	2162	A86 MX-2162 MIXER MOTOR E-STOP	DI	DRY CONTACT	
49	00Y603	HS-R-2162A	2162	A86 MX-2162 MIXER IN REMOTE (VFD)	DI	DRY CONTACT	
50	00Y603	HS-A-2162E	2162	A86 MX-2162 MIXER IN AUTO (LCS)	DI	DRY CONTACT	
51	00Y603	YI-R-2162	2162	A86 MX-2162 MIXER MOTOR RUNNING	DI	DRY CONTACT	
52	00Y603	YA-2162	2162	A86 MX-2162 MIXER FAULTED	DI	DRY CONTACT	
53	00Y603	YI-2162	2162	A86 MX-2162 MIXER MOTOR RUN COMMAND	DO	DRY CONTACT	
54	00Y603	SC-2162	2162	A86 MX-2162 MIXER MOTOR SPEED COMMAND	AO	4-20 mA	
55	00Y603	SI-2162	2162	A86 MX-2162 MIXER MOTOR SPEED INDICATION	AI	4-20 mA	
56	00Y603	AIT-2161A	2161	A86 OXIC DISSOLVED OXYGEN	AI	4-20 mA	
57	00Y603	AIT-2161B	2161	A86 OXIC AMMONIA (FUTURE)	AI	4-20 mA	
58	00Y603	MAH-2163	2163	A86 OXIC PUMP P-2163 MOTOR SEAL LEAK	DI	DRY CONTACT	
59	00Y603	TAH-2163	2163	A86 OXIC PUMP P-2163 MOTOR HIGH TEMP	DI	DRY CONTACT	
60	00Y603	HS-2163B	2162	A86 OXIC PUMP P-2163 MOTOR MOTOR E-STOP	DI	DRY CONTACT	
61	00Y603	HS-R-2163A	2163	A86 OXIC PUMP P-2163 IN REMOTE (VFD)	DI	DRY CONTACT	
62	00Y603	HS-A-2163E	2163	A86 OXIC PUMP P-2163 IN AUTO (LCS)	DI	DRY CONTACT	
63	00Y603	YI-R-2163	2163	A86 OXIC PUMP P-2163 MOTOR RUNNING	DI	DRY CONTACT	
64	00Y603	YA-2163	2163	A86 OXIC PUMP P-2163 FAULTED	DI	DRY CONTACT	
65	00Y603	YI-2163	2163	A86 OXIC PUMP P-2163 MOTOR RUN COMMAND	DO	DRY CONTACT	
66	00Y603	SC-2163	2163	A86 OXIC PUMP P-2163 MOTOR SPEED COMMAND	AO	4-20 mA	
67	00Y603	SI-2163	2163	A86 OXIC PUMP P-2163 MOTOR SPEED INDICATION	AI	4-20 mA	
68	00Y603	HS-2171	2171	A87 FCV-2171 VALVE POSITION	AI	4-20 mA	

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DATE	APPROVED	REV	DATE	ISSUE BY	DESCRIPTION
06/03/25	S. HORRAS	0	06/13/25	P. KAPADIA	ISSUED FOR BID

NO.	P&ID	I/O TAG	TAG NO	POINT DESCRIPTION	IO TYPE	SIGNAL TYPE	REMARKS
69	00Y603	HSC-2171	2171	A87 FCV-2171 VALVE POSITION COMMAND	AO	4-20 mA	
70	00Y603	HS-LR-2171	2171	A87 FCV-2171 VALVE IN REMOTE	DI	DRY CONTACT	
71	00Y603	FIT-2171	2171	A87 AIR SUPPLY	AI	4-20 mA	
72	00Y603	HS-2171D	2171	A87 MX-2171 MIXER MOTOR E-STOP	DI	DRY CONTACT	
73	00Y603	HS-R-2171A	2171	A87 MX-2171 MIXER IN REMOTE (VFD)	DI	DRY CONTACT	
74	00Y603	HS-A-2171E	2171	A87 MX-2171 MIXER IN AUTO (LCS)	DI	DRY CONTACT	
75	00Y603	YI-R-2171	2171	A87 MX-2171 MIXER MOTOR RUNNING	DI	DRY CONTACT	
76	00Y603	YA-2171	2171	A87 MX-2171 MIXER FAULTED	DI	DRY CONTACT	
77	00Y603	YI-2171	2171	A87 MX-2171 MIXER MOTOR RUN COMMAND	DO	DRY CONTACT	
78	00Y603	SC-2171	2171	A87 MX-2171 MIXER MOTOR SPEED COMMAND	AO	4-20 mA	
79	00Y603	SI-2171	2171	A87 MX-2171 MIXER MOTOR SPEED INDICATION	AI	4-20 mA	
80	00Y603	HS-2172D	2172	A87 MX-2172 MIXER MOTOR E-STOP	DI	DRY CONTACT	
81	00Y603	HS-R-2172A	2172	A87 MX-2172 MIXER IN REMOTE (VFD)	DI	DRY CONTACT	
82	00Y603	HS-A-2172E	2172	A87 MX-2172 MIXER IN AUTO (LCS)	DI	DRY CONTACT	
83	00Y603	YI-R-2172	2172	A87 MX-2172 MIXER MOTOR RUNNING	DI	DRY CONTACT	
84	00Y603	YA-2172	2172	A87 MX-2172 MIXER FAULTED	DI	DRY CONTACT	
85	00Y603	YI-2172	2172	A87 MX-2172 MIXER MOTOR RUN COMMAND	DO	DRY CONTACT	
86	00Y603	SC-2172	2172	A87 MX-2172 MIXER MOTOR SPEED COMMAND	AO	4-20 mA	
87	00Y603	SI-2172	2172	A87 MX-2172 MIXER MOTOR SPEED INDICATION	AI	4-20 mA	
88	00Y603	AIT-2171A	2171	A87 OXIC DISSOLVED OXYGEN	AI	4-20 mA	
89	00Y603	AIT-2171B	2171	A87 OXIC AMMONIA (FUTURE)	AI	4-20 mA	
90	00Y603	MAH-2173	2173	A87 OXIC PUMP P-2173 MOTOR SEAL LEAK	DI	DRY CONTACT	
91	00Y603	TAH-2173	2173	A87 OXIC PUMP P-2173 MOTOR HIGH TEMP	DI	DRY CONTACT	
92	00Y603	HS-2173B	2172	A87 OXIC PUMP P-2173 MOTOR MOTOR E-STOP	DI	DRY CONTACT	
93	00Y603	HS-R-2173A	2173	A87 OXIC PUMP P-2173 IN REMOTE (VFD)	DI	DRY CONTACT	
94	00Y603	HS-A-2173E	2173	A87 OXIC PUMP P-2173 IN AUTO (LCS)	DI	DRY CONTACT	
95	00Y603	YI-R-2173	2173	A87 OXIC PUMP P-2173 MOTOR RUNNING	DI	DRY CONTACT	
96	00Y603	YA-2173	2173	A87 OXIC PUMP P-2173 FAULTED	DI	DRY CONTACT	
97	00Y603	YI-2173	2173	A87 OXIC PUMP P-2173 MOTOR RUN COMMAND	DO	DRY CONTACT	
98	00Y603	SC-2173	2173	A87 OXIC PUMP P-2173 MOTOR SPEED COMMAND	AO	4-20 mA	
99	00Y603	SI-2173	2173	A87 OXIC PUMP P-2173 MOTOR SPEED INDICATION	AI	4-20 mA	
100	00Y603	HS-2181	2181	A88 FCV-2181 VALVE POSITION	AI	4-20 mA	
101	00Y603	HSC-2181	2181	A88 FCV-2181 VALVE POSITION COMMAND	AO	4-20 mA	
102	00Y603	HS-LR-2181	2181	A88 FCV-2181 VALVE IN REMOTE	DI	DRY CONTACT	
103	00Y603	FIT-2181	2181	A88 AIR SUPPLY	AI	4-20 mA	
104	00Y603	HS-2181D	2181	A88 MX-2181 MIXER MOTOR E-STOP	DI	DRY CONTACT	
105	00Y603	HS-R-2181A	2181	A88 MX-2181 MIXER IN REMOTE (VFD)	DI	DRY CONTACT	
106	00Y603	HS-A-2181E	2181	A88 MX-2181 MIXER IN AUTO (LCS)	DI	DRY CONTACT	
107	00Y603	YI-R-2181	2181	A88 MX-2181 MIXER MOTOR RUNNING	DI	DRY CONTACT	
108	00Y603	YA-2181	2181	A88 MX-2181 MIXER FAULTED	DI	DRY CONTACT	
109	00Y603	YI-2181	2181	A88 MX-2181 MIXER MOTOR RUN COMMAND	DO	DRY CONTACT	
110	00Y603	SC-2181	2181	A88 MX-2181 MIXER MOTOR SPEED COMMAND	AO	4-20 mA	
111	00Y603	SI-2181	2181	A88 MX-2181 MIXER MOTOR SPEED INDICATION	AI	4-20 mA	
112	00Y603	HS-2182D	2182	A88 MX-2182 MIXER MOTOR E-STOP	DI	DRY CONTACT	
113	00Y603	HS-R-2182A	2182	A88 MX-2182 MIXER IN REMOTE (VFD)	DI	DRY CONTACT	
114	00Y603	HS-A-2182E	2182	A88 MX-2182 MIXER IN AUTO (LCS)	DI	DRY CONTACT	
115	00Y603	YI-R-2182	2182	A88 MX-2182 MIXER MOTOR RUNNING	DI	DRY CONTACT	
116	00Y603	YA-2182	2182	A88 MX-2182 MIXER FAULTED	DI	DRY CONTACT	
117	00Y603	YI-2182	2182	A88 MX-2182 MIXER MOTOR RUN COMMAND	DO	DRY CONTACT	
118	00Y603	SC-2182	2182	A88 MX-2182 MIXER MOTOR SPEED COMMAND	AO	4-20 mA	
119	00Y603	SI-2182	2182	A88 MX-2182 MIXER MOTOR SPEED INDICATION	AI	4-20 mA	
120	00Y603	AIT-2181A	2181	A88 OXIC DISSOLVED OXYGEN	AI	4-20 mA	
121	00Y603	AIT-2181B	2181	A88 OXIC AMMONIA (FUTURE)	AI	4-20 mA	
122	00Y603	MAH-2183	2183	A88 OXIC PUMP P-2183 MOTOR SEAL LEAK	DI	DRY CONTACT	
123	00Y603	TAH-2183	2183	A88 OXIC PUMP P-2183 MOTOR HIGH TEMP	DI	DRY CONTACT	
124	00Y603	HS-2183B	2182	A88 OXIC PUMP P-2183 MOTOR MOTOR E-STOP	DI	DRY CONTACT	
125	00Y603	HS-R-2183A	2183	A88 OXIC PUMP P-2183 IN REMOTE (VFD)	DI	DRY CONTACT	
126	00Y603	HS-A-2183E	2183	A88 OXIC PUMP P-2183 IN AUTO (LCS)	DI	DRY CONTACT	
127	00Y603	YI-R-2183	2183	A88 OXIC PUMP P-2183 MOTOR RUNNING	DI	DRY CONTACT	
128	00Y603	YA-2183	2183	A88 OXIC PUMP P-2183 FAULTED	DI	DRY CONTACT	
129	00Y603	YI-2183	2183	A88 OXIC PUMP P-2183 MOTOR RUN COMMAND	DO	DRY CONTACT	
130	00Y603	SC-2183	2183	A88 OXIC PUMP P-2183 MOTOR SPEED COMMAND	AO	4-20 mA	
131	00Y603	SI-2183	2183	A88 OXIC PUMP P-2183 MOTOR SPEED INDICATION	AI	4-20 mA	
132	00Y604	LIT-2201A	2202A	AERATION BASIN CHANNEL FOR NO. 1 TO 4 LEVEL (HYDROSTATIC PRESSURE)	AI	4-20 mA	
133	00Y604	LIT-2201B	2202B	AERATION BASIN CHANNEL FOR NO. 5 TO 8 LEVEL (HYDROSTATIC PRESSURE)	AI	4-20 mA	
134	00Y604	LIT-2202A	2202A	AERATION BASIN CHANNEL FOR NO. 1 TO 4 LEVEL	AI	4-20 mA	
135	00Y604	LIT-2202B	2202B	AERATION BASIN CHANNEL FOR NO. 5 TO 8 LEVEL	AI	4-20 mA	
136	00Y604	LIT-2201C	2201C	SECONDARY CLARIFIER SPLITTER LEVEL HIGH	DI	DRY CONTACT	

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DATE	APPROVED	REV	DATE	ISSUE BY	DESCRIPTION
06/03/25	S. HORRAS	0	06/13/25	P. KAPADIA	ISSUED FOR BID

NO.	P&ID	I/O TAG	TAG NO	POINT DESCRIPTION	IO TYPE	SIGNAL TYPE	REMARKS
137	00Y604	FIT-2201	2201	SECONDARY CLARIFIER #1 INFLUENT FLOW	AI	4-20 mA	
138	00Y604	FIT-2202	2202	SECONDARY CLARIFIER #2 INFLUENT FLOW	AI	4-20 mA	
139	00Y604	FIT-2203	2203	SECONDARY CLARIFIER #3 INFLUENT FLOW	AI	4-20 mA	
140	00Y604	FIT-2204	2204	SECONDARY CLARIFIER #4 INFLUENT FLOW	AI	4-20 mA	
141	00Y604	HS-2201	2201	SECONDARY CLARIFIER #1 FCV-2201 VALVE POSITION	AI	4-20 mA	
142	00Y604	HSC-2201	2201	SECONDARY CLARIFIER #1 FCV-2201 VALVE POSITION COMMAND	AO	4-20 mA	
143	00Y604	HS-LR-2201	2201	SECONDARY CLARIFIER #1 FCV-2201 VALVE IN REMOTE	DI	DRY CONTACT	
144	00Y604	XI-2201	2201	SECONDARY CLARIFIER #1 FCV-2201 VALVE FAULTED	DI	DRY CONTACT	
145	00Y604	HS-2202	2202	SECONDARY CLARIFIER #2 FCV-2202 VALVE POSITION	AI	4-20 mA	
146	00Y604	HSC-2202	2202	SECONDARY CLARIFIER #2 FCV-2202 VALVE POSITION COMMAND	AO	4-20 mA	
147	00Y604	HS-LR-2202	2202	SECONDARY CLARIFIER #2 FCV-2202 VALVE IN REMOTE	DI	DRY CONTACT	
148	00Y604	XI-2202	2202	SECONDARY CLARIFIER #1 FCV-2202 VALVE FAULTED	DI	DRY CONTACT	
149	00Y604	HS-2203	2203	SECONDARY CLARIFIER #3 FCV-2203 VALVE POSITION	AI	4-20 mA	
150	00Y604	HSC-2203	2203	SECONDARY CLARIFIER #3 FCV-2203 VALVE POSITION COMMAND	AO	4-20 mA	
151	00Y604	HS-LR-2203	2203	SECONDARY CLARIFIER #3 FCV-2203 VALVE IN REMOTE	DI	DRY CONTACT	
152	00Y604	XI-2203	2203	SECONDARY CLARIFIER #1 FCV-2203 VALVE FAULTED	DI	DRY CONTACT	
153	00Y604	HS-2204	2204	SECONDARY CLARIFIER #4 FCV-2204 VALVE POSITION	AI	4-20 mA	
154	00Y604	HSC-2204	2204	SECONDARY CLARIFIER #4 FCV-2204 VALVE POSITION COMMAND	AO	4-20 mA	
155	00Y604	HS-LR-2204	2204	SECONDARY CLARIFIER #4 FCV-2204 VALVE IN REMOTE	DI	DRY CONTACT	
156	00Y604	XI-2204	2204	SECONDARY CLARIFIER #1 FCV-2204 VALVE FAULTED	DI	DRY CONTACT	
157	00Y604	LSHH-2201C	2201	SECONDARY CLARIFIER SPLITTER HIGH HIGH LEVEL	DI	DRY CONTACT	
158	00Y604	LSHH-2201D	2201	SECONDARY CLARIFIER SPLITTER SUMP HIGH HIGH LEVEL	DI	DRY CONTACT	
159	00Y606	VFD-3105	3105	BLOWER #3105 VFD DATA	ETHERNET		TO BE DETERMINED AS PER BLOWER VENDOR SELECTION
160	00Y606	VFD-3106	3106	BLOWER #3106 VFD DATA	ETHERNET		TO BE DETERMINED AS PER BLOWER VENDOR SELECTION
161	00Y606	VFD-3107	3107	BLOWER #3107 VFD DATA	ETHERNET		TO BE DETERMINED AS PER BLOWER VENDOR SELECTION
162	00Y606	VFD-3108	3108	BLOWER #3108 VFD DATA	ETHERNET		TO BE DETERMINED AS PER BLOWER VENDOR SELECTION
163	00Y606	PIT-3120A	3210A	AERATION BASIN #5 TO 8 BLOWER DISCHARGE PRESSURE	AI	4-20 mA	
164	00Y606	PIT-3120B	3120B	AERATION BASIN #5 TO 8 BLOWER DISCHARGE PRESSURE	AI	4-20 mA	
165	00Y606	FIT-3121	3121	AERATION BASIN #5 TO 8 BLOWER DISCHARGE FLOW	AI	4-20 mA	
166	00Y606	TIT-3121	3121	AERATION BASIN #5 TO 8 BLOWER DISCHARGE TEMPERATURE	AI	4-20 mA	
167	00Y606	TT-3120	3120	BLOWER ROOM AMBIENT TEMPERATURE	AI	4-20 mA	SUPPLIED BY HVAC CONTRACTOR
168							
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QC CHECK			REVISION HISTORY		
DATE	APPROVED	REV	DATE	ISSUE BY	DESCRIPTION
06/03/25	S. HORRAS	0	06/13/25	P. KAPADIA	ISSUED FOR BID

NO.	P&ID	I/O TAG	TAG NO	POINT DESCRIPTION	IO TYPE	SIGNAL TYPE	REMARKS
1	007I607	YI	4001	AC POWER NORMAL	DI	DRY CONTACT	
2	007I607	YA	4001	UPS BATTERY LOW ALLARM	DI	DRY CONTACT	
3	007I607	HS-4012B	4012	RAS PUMP P-4012 PUMP E-STOP	DI	DRY CONTACT	
4	007I607	HS-R-4012A	4012	RAS PUMP P-4012 PUMP IN REMOTE (VFD)	DI	DRY CONTACT	
5	007I607	HS-A-4012E	4012	RAS PUMP P-4012 PUMP IN AUTO (LCS)	DI	DRY CONTACT	
6	007I607	YI-R-4012	4012	RAS PUMP P-4012 PUMP RUNNING	DI	DRY CONTACT	
7	007I607	YA-4012	4012	RAS PUMP P-4012 PUMP VFD FAULTED	DI	DRY CONTACT	
8	007I607	HK-4012	4012	RAS PUMP P-4012 PUMP RUN COMMAND	DO	DRY CONTACT	
9	007I607	SC-4012	4012	RAS PUMP P-4012 PUMP SPEED COMMAND	AO	4-20 mA	
10	007I607	SI-4012	4012	RAS PUMP P-4012 PUMP SPEED INDICATION	AI	4-20 mA	
11	007I608	ES-4012	4012	RAS PUMP P-4012 PUMP SEAL WATER VALVE OPEN COMMAND	DO	DRY CONTACT	
12	007I607	YA-4012	4012	RAS PUMP P-4012 MOTOR HIGH TEMP ALARM	DI	DRY CONTACT	
13	007I607	YA-4012	4012	RAS PUMP P-4012 PUMP SEAL LEAK ALARM	DI	DRY CONTACT	
14	007I607	YA-4012	4012	RAS PUMP P-4012 GENERAL PUMP FAULT	DI	DRY CONTACT	
15	007I607	HS-4011B	4011	RAS PUMP P-4011 PUMP E-STOP	DI	DRY CONTACT	
16	007I607	HS-R-4011A	4011	RAS PUMP P-4011 PUMP IN REMOTE (VFD)	DI	DRY CONTACT	
17	007I607	HS-A-4011E	4011	RAS PUMP P-4011 PUMP IN AUTO (LCS)	DI	DRY CONTACT	
18	007I607	YI-R-4011	4011	RAS PUMP P-4011 PUMP RUNNING	DI	DRY CONTACT	
19	007I607	YA-4011	4011	RAS PUMP P-4011 PUMP VFD FAULTED	DI	DRY CONTACT	
20	007I607	HK-4011	4011	RAS PUMP P-4011 PUMP RUN COMMAND	DO	DRY CONTACT	
21	007I607	SC-4011	4011	RAS PUMP P-4011 PUMP SPEED COMMAND	AO	4-20 mA	
22	007I607	SI-4011	4011	RAS PUMP P-4011 PUMP SPEED INDICATION	AI	4-20 mA	
23	007I608	ES-4011	4011	RAS PUMP P-4011 PUMP SEAL WATER VALVE OPEN COMMAND	DO	DRY CONTACT	
24	007I607	YA-4011	4011	RAS PUMP P-4011 MOTOR HIGH TEMP ALARM	DI	DRY CONTACT	
25	007I607	YA-4011	4011	RAS PUMP P-4011 PUMP SEAL LEAK ALARM	DI	DRY CONTACT	
26	007I607	YA-4011	4011	RAS PUMP P-4011 GENERAL PUMP FAULT	DI	DRY CONTACT	
27	007I607	HS-4001B	4001	RAS PUMP P-4001 PUMP E-STOP	DI	DRY CONTACT	
28	007I607	HS-R-4001A	4001	RAS PUMP P-4001 PUMP IN REMOTE (VFD)	DI	DRY CONTACT	
29	007I607	HS-A-4001E	4001	RAS PUMP P-4001 PUMP IN AUTO (LCS)	DI	DRY CONTACT	
30	007I607	YI-R-4001	4001	RAS PUMP P-4001 PUMP RUNNING	DI	DRY CONTACT	
31	007I607	YA-4001	4001	RAS PUMP P-4001 PUMP VFD FAULTED	DI	DRY CONTACT	
32	007I607	HK-4001	4001	RAS PUMP P-4001 PUMP RUN COMMAND	DO	DRY CONTACT	
33	007I607	SC-4001	4001	RAS PUMP P-4001 PUMP SPEED COMMAND	AO	4-20 mA	
34	007I607	SI-4001	4001	RAS PUMP P-4001 PUMP SPEED INDICATION	AI	4-20 mA	
35	007I608	ES-4001	4001	RAS PUMP P-4001 PUMP SEAL WATER VALVE OPEN COMMAND	DO	DRY CONTACT	
36	007I607	YA-4001	4001	RAS PUMP P-4001 MOTOR HIGH TEMP ALARM	DI	DRY CONTACT	
37	007I607	YA-4001	4001	RAS PUMP P-4001 PUMP SEAL LEAK ALARM	DI	DRY CONTACT	
38	007I607	YA-4001	4001	RAS PUMP P-4001 GENERAL PUMP FAULT	DI	DRY CONTACT	
39	007I607	HS-4022B	4022	RAS PUMP P-4022 PUMP E-STOP	DI	DRY CONTACT	
40	007I607	HS-R-4022A	4022	RAS PUMP P-4022 PUMP IN REMOTE (VFD)	DI	DRY CONTACT	
41	007I607	HS-A-4022E	4022	RAS PUMP P-4022 PUMP IN AUTO (LCS)	DI	DRY CONTACT	
42	007I607	YI-R-4022	4022	RAS PUMP P-4022 PUMP RUNNING	DI	DRY CONTACT	
43	007I607	YA-4022	4022	RAS PUMP P-4022 PUMP VFD FAULTED	DI	DRY CONTACT	
44	007I607	HK-4022	4022	RAS PUMP P-4022 PUMP RUN COMMAND	DO	DRY CONTACT	
45	007I607	SC-4022	4022	RAS PUMP P-4022 PUMP SPEED COMMAND	AO	4-20 mA	
46	007I607	SI-4022	4022	RAS PUMP P-4022 PUMP SPEED INDICATION	AI	4-20 mA	
47	007I608	ES-4022	4022	RAS PUMP P-4022 PUMP SEAL WATER VALVE OPEN COMMAND	DO	DRY CONTACT	
48	007I607	YA-4022	4022	RAS PUMP P-4022 MOTOR HIGH TEMP ALARM	DI	DRY CONTACT	
49	007I607	YA-4022	4022	RAS PUMP P-4022 PUMP SEAL LEAK ALARM	DI	DRY CONTACT	
50	007I607	YA-4022	4022	RAS PUMP P-4022 GENERAL PUMP FAULT	DI	DRY CONTACT	
51	007I607	HS-4021B	4021	RAS PUMP P-4021 PUMP E-STOP	DI	DRY CONTACT	
52	007I607	HS-R-4021A	4021	RAS PUMP P-4021 PUMP IN REMOTE (VFD)	DI	DRY CONTACT	
53	007I607	HS-A-4021E	4021	RAS PUMP P-4021 PUMP IN AUTO (LCS)	DI	DRY CONTACT	
54	007I607	YI-R-4021	4021	RAS PUMP P-4021 PUMP RUNNING	DI	DRY CONTACT	
55	007I607	YA-4021	4021	RAS PUMP P-4021 PUMP VFD FAULTED	DI	DRY CONTACT	
56	007I607	HK-4021	4021	RAS PUMP P-4021 PUMP RUN COMMAND	DO	DRY CONTACT	
57	007I607	SC-4021	4021	RAS PUMP P-4021 PUMP SPEED COMMAND	AO	4-20 mA	
58	007I607	SI-4021	4021	RAS PUMP P-4021 PUMP SPEED INDICATION	AI	4-20 mA	
59	007I608	ES-4021	4021	RAS PUMP P-4021 PUMP SEAL WATER VALVE OPEN COMMAND	DO	DRY CONTACT	
60	007I607	YA-4021	4021	RAS PUMP P-4021 MOTOR HIGH TEMP ALARM	DI	DRY CONTACT	
61	007I607	YA-4021	4021	RAS PUMP P-4021 PUMP SEAL LEAK ALARM	DI	DRY CONTACT	
62	007I607	YA-4021	4021	RAS PUMP P-4021 GENERAL PUMP FAULT	DI	DRY CONTACT	
63	007I607	FIT-4051	4051	RAS PUMPS P4001 TO P-4022 PUMP DISCHARGE FLOW	AI	4-20 mA	
64	007I607	FIT-4052	4052	RAS PUMPS P4001 TO P-4022 PUMP DISCHARGE FLOW	AI	4-20 mA	
65	007I609	HS-4032B	4032	RAS PUMP P-4032 PUMP E-STOP	DI	DRY CONTACT	

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DATE	APPROVED	REV	DATE	ISSUE BY	DESCRIPTION
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NO.	P&ID	I/O TAG	TAG NO	POINT DESCRIPTION	IO TYPE	SIGNAL TYPE	REMARKS
66	007I609	HS-R-4032A	4032	RAS PUMP P-4032 PUMP IN REMOTE (VFD)	DI	DRY CONTACT	
67	007I609	HS-A-4032E	4032	RAS PUMP P-4032 PUMP IN AUTO (LCS)	DI	DRY CONTACT	
68	007I609	YI-R-4032	4032	RAS PUMP P-4032 PUMP RUNNING	DI	DRY CONTACT	
69	007I609	YA-4032	4032	RAS PUMP P-4032 PUMP VFD FAULTED	DI	DRY CONTACT	
70	007I609	HK-4032	4032	RAS PUMP P-4032 PUMP RUN COMMAND	DO	DRY CONTACT	
71	007I609	SC-4032	4032	RAS PUMP P-4032 PUMP SPEED COMMAND	AO	4-20 mA	
72	007I609	SI-4032	4032	RAS PUMP P-4032 PUMP SPEED INDICATION	AI	4-20 mA	
73	007I608	ES-4032	4032	RAS PUMP P-4032 PUMP SEAL WATER VALVE OPEN COMMAND	DO	DRY CONTACT	
74	007I609	YA-4032	4032	RAS PUMP P-4032 MOTOR HIGH TEMP ALARM	DI	DRY CONTACT	
75	007I609	YA-4032	4032	RAS PUMP P-4032 PUMP SEAL LEAK ALARM	DI	DRY CONTACT	
76	007I609	YA-4032	4032	RAS PUMP P-4032 GENERAL PUMP FAULT	DI	DRY CONTACT	
77	007I609	HS-4031B	4031	RAS PUMP P-4031 PUMP E-STOP	DI	DRY CONTACT	
78	007I609	HS-R-4031A	4031	RAS PUMP P-4031 PUMP IN REMOTE (VFD)	DI	DRY CONTACT	
79	007I609	HS-A-4031E	4031	RAS PUMP P-4031 PUMP IN AUTO (LCS)	DI	DRY CONTACT	
80	007I609	YI-R-4031	4031	RAS PUMP P-4031 PUMP RUNNING	DI	DRY CONTACT	
81	007I609	YA-4031	4031	RAS PUMP P-4031 PUMP VFD FAULTED	DI	DRY CONTACT	
82	007I609	HK-4031	4031	RAS PUMP P-4031 PUMP RUN COMMAND	DO	DRY CONTACT	
83	007I609	SC-4031	4031	RAS PUMP P-4031 PUMP SPEED COMMAND	AO	4-20 mA	
84	007I609	SI-4031	4031	RAS PUMP P-4031 PUMP SPEED INDICATION	AI	4-20 mA	
85	007I608	ES-4031	4031	RAS PUMP P-4031 PUMP SEAL WATER VALVE OPEN COMMAND	DO	DRY CONTACT	
86	007I609	YA-4031	4031	RAS PUMP P-4031 MOTOR HIGH TEMP ALARM	DI	DRY CONTACT	
87	007I609	YA-4031	4031	RAS PUMP P-4031 PUMP SEAL LEAK ALARM	DI	DRY CONTACT	
88	007I609	YA-4031	4031	RAS PUMP P-4031 GENERAL PUMP FAULT	DI	DRY CONTACT	
89	007I609	HS-4002B	4002	RAS PUMP P-4002 PUMP E-STOP	DI	DRY CONTACT	
90	007I609	HS-R-4002A	4002	RAS PUMP P-4002 PUMP IN REMOTE (VFD)	DI	DRY CONTACT	
91	007I609	HS-A-4002E	4002	RAS PUMP P-4002 PUMP IN AUTO (LCS)	DI	DRY CONTACT	
92	007I609	YI-R-4002	4002	RAS PUMP P-4002 PUMP RUNNING	DI	DRY CONTACT	
93	007I609	YA-4002	4002	RAS PUMP P-4002 PUMP VFD FAULTED	DI	DRY CONTACT	
94	007I609	HK-4002	4002	RAS PUMP P-4002 PUMP RUN COMMAND	DO	DRY CONTACT	
95	007I609	SC-4002	4002	RAS PUMP P-4002 PUMP SPEED COMMAND	AO	4-20 mA	
96	007I609	SI-4002	4002	RAS PUMP P-4002 PUMP SPEED INDICATION	AI	4-20 mA	
97	007I608	ES-4002	4002	RAS PUMP P-4002 PUMP SEAL WATER VALVE OPEN COMMAND	DO	DRY CONTACT	
98	007I609	YA-4002	4002	RAS PUMP P-4002 MOTOR HIGH TEMP ALARM	DI	DRY CONTACT	
99	007I609	YA-4002	4002	RAS PUMP P-4002 PUMP SEAL LEAK ALARM	DI	DRY CONTACT	
100	007I609	YA-4002	4002	RAS PUMP P-4002 GENERAL PUMP FAULT	DI	DRY CONTACT	
101	007I609	HS-4042B	4042	RAS PUMP P-4042 PUMP E-STOP	DI	DRY CONTACT	
102	007I609	HS-R-4042A	4042	RAS PUMP P-4042 PUMP IN REMOTE (VFD)	DI	DRY CONTACT	
103	007I609	HS-A-4042E	4042	RAS PUMP P-4042 PUMP IN AUTO (LCS)	DI	DRY CONTACT	
104	007I609	YI-R-4042	4042	RAS PUMP P-4042 PUMP RUNNING	DI	DRY CONTACT	
105	007I609	YA-4042	4042	RAS PUMP P-4042 PUMP VFD FAULTED	DI	DRY CONTACT	
106	007I609	HK-4042	4042	RAS PUMP P-4042 PUMP RUN COMMAND	DO	DRY CONTACT	
107	007I609	SC-4042	4042	RAS PUMP P-4042 PUMP SPEED COMMAND	AO	4-20 mA	
108	007I609	SI-4042	4042	RAS PUMP P-4042 PUMP SPEED INDICATION	AI	4-20 mA	
109	007I608	ES-4042	4042	RAS PUMP P-4042 PUMP SEAL WATER VALVE OPEN COMMAND	DO	DRY CONTACT	
110	007I609	YA-4042	4042	RAS PUMP P-4042 MOTOR HIGH TEMP ALARM	DI	DRY CONTACT	
111	007I609	YA-4042	4042	RAS PUMP P-4042 PUMP SEAL LEAK ALARM	DI	DRY CONTACT	
112	007I609	YA-4042	4042	RAS PUMP P-4042 GENERAL PUMP FAULT	DI	DRY CONTACT	
113	007I609	HS-5101B	5101	RAS PUMP P-5101 PUMP E-STOP	DI	DRY CONTACT	
114	007I609	HS-R-5101A	5101	RAS PUMP P-5101 PUMP IN REMOTE (VFD)	DI	DRY CONTACT	
115	007I609	HS-A-5101E	5101	RAS PUMP P-5101 PUMP IN AUTO (LCS)	DI	DRY CONTACT	
116	007I609	YI-R-5101	5101	RAS PUMP P-5101 PUMP RUNNING	DI	DRY CONTACT	
117	007I609	YA-5101	5101	RAS PUMP P-5101 PUMP VFD FAULTED	DI	DRY CONTACT	
118	007I609	HK-5101	5101	RAS PUMP P-5101 PUMP RUN COMMAND	DO	DRY CONTACT	
119	007I609	SC-5101	5101	RAS PUMP P-5101 PUMP SPEED COMMAND	AO	4-20 mA	
120	007I609	SI-5101	5101	RAS PUMP P-5101 PUMP SPEED INDICATION	AI	4-20 mA	
121	007I608	ES-5101	5101	RAS PUMP P-5101 PUMP SEAL WATER VALVE OPEN COMMAND	DO	DRY CONTACT	
122	007I609	YA-5101	5101	RAS PUMP P-5101 MOTOR HIGH TEMP ALARM	DI	DRY CONTACT	
123	007I609	YA-5101	5101	RAS PUMP P-5101 PUMP SEAL LEAK ALARM	DI	DRY CONTACT	
124	007I609	YA-5101	5101	RAS PUMP P-5101 GENERAL PUMP FAULT	DI	DRY CONTACT	
125	007I609	FIT-4053	4053	RAS PUMPS P4001 TO P-4042 PUMP DISCHARGE FLOW	AI	4-20 mA	
126	007I609	FIT-4054	4054	RAS PUMPS P4001 TO P-4042 PUMP DISCHARGE FLOW	AI	4-20 mA	
127	007I609	FIT-4059	4059	RAS PUMPS P4002 TO P-4042 PUMP DISCHARGE FLOW TO SOLIDS STORAGE	AI	4-20 mA	
128	007I609	FIT-4060	4060	RAS PUMPS P4002 TO P-4042 PUMP DISCHARGE FLOW TO SOLIDS STORAGE	AI	4-20 mA	
129	007I609	HS-4060	4060	RAS PUMPS PV-4060 VALVE POSITION	AI	4-20 mA	
130	007I609	HSC-4060	4060	RAS PUMPS PV-4060 VALVE POSITION COMMAND	AO	4-20 mA	

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06/03/25	S. HORRAS	0	06/13/25	P. KAPADIA	ISSUED FOR BID

NO.	P&ID	I/O TAG	TAG NO	POINT DESCRIPTION	IO TYPE	SIGNAL TYPE	REMARKS
131	007f609	HS-LR-4060	4060	RAS PUMPS PV-4060 VALVE IN REMOTE	DI	DRY CONTACT	
132	007f609	XI-4060	4060	RAS PUMPS PV-4060 VALVE FAULTED	DI	DRY CONTACT	
133	007f609	HS-4061	4061	RAS PUMPS PV-4061 VALVE POSITION	AI	4-20 mA	
134	007f609	HSC-4061	4061	RAS PUMPS PV-4061 VALVE POSITION COMMAND	AO	4-20 mA	
135	007f609	HS-LR-4061	4061	RAS PUMPS PV-4061 VALVE IN REMOTE	DI	DRY CONTACT	
136	007f609	XI-4061	4061	RAS PUMPS PV-4061 VALVE FAULTED	DI	DRY CONTACT	
137	007f611	HS-A-5101A	5101	CLARIFIER EAST MOTOR M-5101 IN AUTO	DI	DRY CONTACT	
138	007f611	YI-R-5101	5101	CLARIFIER EAST MOTOR M-5101 RUNNING	DI	DRY CONTACT	
139	007f611	YA-5101	5101	CLARIFIER EAST MOTOR M-5101 FAIL	DI	DRY CONTACT	
140	007f611	HS-A-5201A	5201	CLARIFIER 2 MOTOR M-5201 IN AUTO	DI	DRY CONTACT	
141	007f611	YI-R-5201	5201	CLARIFIER 2 MOTOR M-5201 RUNNING	DI	DRY CONTACT	
142	007f611	YA-5201	5201	CLARIFIER 2 MOTOR M-5201 FAIL	DI	DRY CONTACT	
143	007f611	HS-A-5301A	5301	CLARIFIER 3 MOTOR M-5301 IN AUTO	DI	DRY CONTACT	
144	007f611	YI-R-5301	5301	CLARIFIER 3 MOTOR M-5301 RUNNING	DI	DRY CONTACT	
145	007f611	YA-5301	5301	CLARIFIER 3 MOTOR M-5301 FAIL	DI	DRY CONTACT	
146	007f611	HS-A-5401A	5401	CLARIFIER 4 MOTOR M-5401 IN AUTO	DI	DRY CONTACT	
147	007f611	YI-R-5401	5401	CLARIFIER 4 MOTOR M-5401 RUNNING	DI	DRY CONTACT	
148	007f611	YA-5401	5401	CLARIFIER 4 MOTOR M-5401 FAIL	DI	DRY CONTACT	
149	007f611	YI-R-5501	5501	EXHAUST FAN F-5501 RUNNING	DI	DRY CONTACT	
150	007f611	YI-R-5601	5601	EXHAUST FAN F-5601 RUNNING	DI	DRY CONTACT	

SECTION 40 61 96
PROCESS CONTROL DESCRIPTIONS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section is intended to describe the functional and operational requirements of the process being monitored and controlled by the process control system, and to define the Contractor's responsibilities related to the work described herein.

B. Section Includes:
   1. Document Maintenance and Content Requirements.
   2. Process Control Description content and structure.
      a. Process Control Description for each system includes:
         1) Reference Documents.
         2) Major Equipment and Field Instruments.
         3) Overview Description.
         4) Detailed Process Control Descriptions.
         5) Response to Instrument or Equipment Failures.
         6) Displays at HMI/OIT.
         7) Report Descriptions.

C. Related Sections include but are not necessarily limited to:
   1. Section 40 61 13 – Process Control Systems General Requirements.

D. General Requirements:
   1. The Process Control Descriptions describe the operational interface and functional requirements of the Process Control System (PCS) and of the control loops and other PCS functions represented in the Contract Documents.
   2. The Process Control Descriptions do not necessarily address every PCS point or alarm point associated with the process or equipment. Provide and incorporate all hard-wired, networked and internal equipment alarms as shown on the P&IDs, the I/O Lists, the Instrument Lists, or elsewhere within the Contract Documents, as well as other points required to meet the intent of the system control.
   3. The process control descriptions are not intended to be an inclusive listing of all elements and appurtenances required to execute loop functions but are rather intended to supplement and complement the Drawings and other Specification Sections.
   4. The Process Control Descriptions shall not be considered equal to a bill of materials.
   5. Provide instrumentation hardware and software as necessary to perform control functions specified herein and shown on Drawings.
   6. Unless otherwise specified, the following general requirements apply to all process control descriptions.
      a. Analog control loops shall operate based on a standard PID controller, with the controller faceplate incorporated on the PCS HMI graphic display. The PID controller faceplate includes (but is not limited to) the following functions:
         1) Bar graphs for setpoint, process variable and percent output, poke point buttons for Auto/Manual Mode selection, and a numeric entry field with popup keypad for Operator entered values.
            a) Auto/Manual Mode selection: In Auto Mode, the output of the controller is based on the PID controller calculation. In Manual Mode, the output of the controller is operator adjustable. Switching between the PID controller's operational modes shall be configured with setpoint tracking and bump-less transfer.

b) Compound Mode, where applicable: In the Compound Mode, the setpoint is trimmed by a remote setpoint input. This mode is used in applications requiring a cascade control loop such as level/flow.

2) When in the Automatic Mode, PID algorithms shall monitor the margin of error between the setpoint value and the actual process variable. A deviation of +/- 10% between setpoint and process variable generates a Deviation Alarm notifying the operator of the condition. The % of deviation is an adjustable value.

b. All motors (constant and variable speed) must be monitored for the associated Run, Stop, and Fail status. When the PCS initiates a run command output, the PCS logic monitors the running status feedback from the motor (starter or variable speed drive) and produces a "Fail to Run" or "Fail to Stop" alarm (as applicable) if the motor feedback does not correspond with the status of the PCS initiated command output. A PCS internal delay timer with typical preset of 15 seconds (individually adjustable) shall be configured for each logic statement to allow the motor control adequate time to comply with the output command.

1) The PCS output command is de-energized subsequent to the expiration of the alarm delay time period, i.e. a timed-out command.

c. Valves or gates with limit switch functions for position feedback: when the PCS initiates an Open/Close command output, the PCS logic monitors the position feedback and produces a "Failure to Open" or Failure to Close" Alarm (as applicable) if the valve/gate feedback does not correspond with the status of the PCS initiated command output. A PCS internal delay timer preset of 60 seconds (operator adjustable to match actual valve actuator speed) is configured for each logic statement allowing the valve/gate actuator time to comply with the output command. The timer preset requires adjustment at startup depending on the type of valve or gate and the full open to close travel time for each.

1) The PCS output command is de-energized subsequent to the expiration of the alarm delay time period, i.e. a timed-out command.

d. Analog inputs shall have a signal Out Of Range Alarm generated via a PCS internal timer when the PCS input is < 3.8 mADC or > 20.5 mADC. The alarm delay timer preset is initially set at 20 seconds. The delay preset value is operator adjustable.

e. All flow inputs shall be totalized (integrated) and logged on the PCS historian. All totalized values are displayed on the PCS HMI graphic display in the appropriate engineering units as required. Provide daily flow totals for all measured flows.

f. All equipment run times shall be totalized, displayed and logged on the PCS historian. Run times shall have a resolution of one minute and be displayed in hours and tenths of hours on the appropriate PCS HMI graphic display.

g. For each piece of process equipment controllable by the PCS, an equipment "ready" or control mode permissive signal is needed to indicate to the PCS control logic PCS control is allowed. The PCS shall monitor the Local Control Panel mounted L/R mode selector switch and control the equipment that is in the Remote mode.

h. Non-modulating motorized valves or gates shall be controllable via Open-Stop-Close buttons on HMI and OIT faceplates. The valves/gates shall be controlled in the Open and Close directions by separate PCS control signals. The PCS shall stop the Open or Close command to the actuator when the actuator reaches the respective end of travel.

i. I/O points shown on the P&IDs, I/O List or elsewhere within the Contract Documents shall be incorporated into the PCS HMI and OIT graphic displays as indicated by their function.

j. Operator entry of setpoints shall be limited to values within upper and lower operating limits corresponding to the valid operating range of the equipment. An operator-entered setpoint outside the valid range must be rejected by the PCS and the original setpoint shall be maintained until a valid value is entered. When an invalid setpoint is entered into the system, an Invalid Value message shall appear in the setpoint entry faceplate, alerting the operator to the condition. The upper and lower range limits are adjustable.

k. In addition to the requirements specifically stated within each Process Control Description, all control software and hardware shall be provided as required to ensure the safe and reliable operation of all controlled equipment.
l. All "soft" alarms on analog signal shall reside in the PLC logic with de-bounce timers. Provide the capability to modify the soft setpoints through the HMI system with appropriate security.
m. All alarm and trip time delays shall be adjustable from the HMI system by an operator with appropriate security.
n. All process values, ranges, and setpoints described herein shall be considered "Initial values" and may be changed during installation and start-up.
o. All measured analog values shall be logged and available for trending via Operator selection at the HMI.

1.2 DEFINITIONS/ABBREVIATIONS

A. Abbreviations are defined as listed below:

A/M	Auto/Manual
ATS	Automatic Transfer Switch
DPU	Distributed Processing Unit
H/O/R	Hand-Off-Remote
HMI	Human-Machine Interface
L/O/A	Local-Off-Auto
L/R	Local/Remote
LCP	Local Control Panel
LCS	Local Control Station
MCC	Motor Control Center
O/C	Open/Close
OI	Operator Interface (valve actuator, VFD)
OIT	Operator Interface Terminal
P&ID	Process and Instrumentation Diagram
PCS	Process Control System
PID	Proportional-Integral-Derivative
PFD	Process Flow Diagram
PLC	Programmable Logic Controller
RIO	Remote DCS or PLC Input/Output Equipment
~~RTU~~	~~Remote Terminal Unit~~
~~RVSS~~	~~Reduced Voltage Solid-state Starter~~
S/S	Start/Stop
UPS	Uninterruptible Power Supply
VFD	Variable Frequency Drive

1.3 SUBMITTALS

A. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Control Strategy for Record Documents:
   1. Obtain this Specification Section 40 61 96 in electronic format (Microsoft Word) from Engineer at beginning of Project. Provide updated Process Control Descriptions as follows:
      a. As needed or requested following any PCS workshops, working sessions, and/or related submittal reviews.
      b. As needed or requested during the course of programming, start-up and testing to reflect all refinements and changes that occur due to specific operational needs and the characteristics of specific equipment and systems supplied under this Contract.
      c. Show all revisions in 'track change' mode.
      d. Change Specification Section Title to read "Process Control Descriptions - Contractor Record Document."
      e. Reference all changes by Request for Information (RFI) number or Change Proposal Request (CPR) number.
   2. Submit the revised and updated file as a final Process Control description Record Document in the Operation and Maintenance Manual described in Specification Section 01 78 23.
      a. Provide both paper copy and as Electronic Documents (in portable document format, PDF files) by Electronic Means of the Record Document process control descriptions in the Operation and Maintenance Manual described in Specification Section 01 78 23.

B. Coordination with vendor-furnished control packages
   1. Where vendor packages are supplied as part of the Contract, the vendor packages that are supplied with PLC-based controls shall be programmed by the respective vendors. Provide all programming as required to integrate Vendor-furnished controls into the PCS as described in the Contract Documents.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 PROCESS CONTROL DESCRIPTIONS

A. The following Appendices to this Section contain the process control descriptions that define the PCS procedural and operational requirements of the processes included in the Work:
   1. 40 61 96 - Appendix A – Aeration System Process Control Descriptions.
   2. 40 61 96 - Appendix B – Anoxic Zone Mixers Process Control Descriptions.
   3. 40 61 96 - Appendix C – Internal Mixed Liquor Recycle Pumps Process Control Descriptions.
   4. 40 61 96 - Appendix D – Secondary Clarifier Flow Splitter Process Control Descriptions.
   5. 40 61 96 – Appendix E – RAS/WAS Pump Station Process Control Descriptions.

END OF SECTION

APPENDIX A

AERATION SYSTEM
PROCESS CONTROL DESCRIPTIONS

Project: 10342803
Process Areas: 31D – Blower Building

A.1 REFERENCE DOCUMENTS

A. Process & Instrument Diagrams, P&IDs:
   1. 00Y603 Aeration Basin No. 5 (typical for all basins)
   2. 00Y606 Blowers

A.2 MAJOR EQUIPMENT AND FIELD INSTRUMENTS

A. Major Equipment:
   1. Air Flow Control Valve Modulating Actuator FCV-2151
   2. Air Flow Control Valve Modulating Actuator FCV-2161
   3. Air Flow Control Valve Modulating Actuator FCV-2171
   4. Air Flow Control Valve Modulating Actuator FCV-2181
   5. Blower B-3105, associated VFD
   6. Blower B-3106, associated VFD
   7. Blower B-3107, associated VFD
   8. Blower B-3108, associated VFD
   9. Blower Master Control Panel BMCP-3120
   10. PLC-3101 and OIT-3101 at Blower Building.

B. Major Field Instrumentation:
   1. AE/AIT-2151A: Dissolved oxygen concentration transmitter
   2. AE/AIT-2161A: Dissolved oxygen concentration transmitter
   3. AE/AIT-2171A: Dissolved oxygen concentration transmitter
   4. AE/AIT-2181A: Dissolved oxygen concentration transmitter
   5. FE/FIT-2151: Air flowmeter flow transmitter
   6. FE/FIT-2161: Air flowmeter flow transmitter
   7. FE/FIT-2171: Air flowmeter flow transmitter
   8. FE/FIT-2181: Air flowmeter flow transmitter
   9. FE/FIT-3121: Air flowmeter flow transmitter
   10. PIT-3120A: Pressure indicating transmitter
   11. PIT-3120B: Pressure indicating transmitter
   12. TT 3120: Temperature transmitter
   13. TIT 3121: Temperature transmitter

A.3 OVERVIEW DESCRIPTION

A. These blowers will be utilized to supply oxygen to Aeration Basin Nos. 5, 6, 7, and 8.

A.4 DETAILED PROCESS CONTROL DESCRIPTIONS

A. Aeration Air Distribution Control
   1. General:
      a. The Main Air Supply Line modulating valves are operated with an H-O-A switch at the valve and/or controlled through the HMI/OIT. For operation from the HMI/OIT, the H-O-A selector switch must be in the AUTOMATIC position.
      b. Control from the HMI/OIT can be either REMOTE-AUTOMATIC or REMOTE-MANUAL. The REMOTE-AUTOMATIC/MANUAL modes are selected at the HMI/OIT. The REMOTE-AUTOMATIC mode operates the equipment as described

below. The REMOTE-MANUAL mode will provide for manually operating the equipment from the HMI/OIT.

c. There are two REMOTE-AUTOMATIC modes:
   1) Air Flow
   2) DO-Based Aeration Control (DOBAC)
d. REMOTE-AUTO, REMOTE MANUAL, Air Flow, DOBAC, and OFF are independently selectable for each basin.
e. The valve position and HAND-OFF-AUTO status of the valves shall be indicated at the HMI/OIT. Zero percent (zero degrees) shall indicate closed and 100 percent (90 degrees) shall indicate full open.
f. Upon loss of power, the valves shall remain in position at time of power loss until power is restored.
g. For the Aeration Basin Nos. 5-8, one flow control valve and one flow meter are required for each basin to cover the full range of air flows.

2. Normal (REMOTE-AUTO) Operation:
   a. Normal operation of the Main Air Supply Line modulating valves can be achieved by placing the flow control valve H-O-A selector switch in the AUTOMATIC position.
   b. Automatic Air Flow Mode:
      1) The operator will input the desired air flow rate for each basin and the PID control loop will automatically adjust the basin valve positions to maintain the specified, fixed flow rate. The airflow rates are displayed on the HMI/OIT for each.
   c. Automatic DOBAC Mode:
      1) Operator must select which aeration basins are "In Service".
      2) The DO setpoints are operator-defined and are unique for each basin.
      3) DO level is measured separately for each Aerobic Basin Nos. 5-8, at the end of each basin.
      4) The DO reading from the probes will be displayed on the HMI/OIT and used as the process variable for air flow setpoint adjustment.
      5) The PID control loop adjusts the air flow setpoint (SCFM) of the relevant basin to achieve the desired DO setpoint.
      6) DO levels are measured continuously (any sensor dampening is performed at the instrument transmitter).
      7) Deviation from DO setpoint exceeding operator adjustable value (5-25 percent) will initiate an alarm.
      8) Valve movement is restricted when the PID error is less than 5 percent (Operator adjustable).
      9) All basin modulating valves will have an operator-adjustable minimum valve position (0-100%), initially set at 20 percent open.
      10) An option will be available to match flow setpoint to another basin if a DO probe fails.

3. REMOTE MANUAL Operation:
   a. Flow control valve position (% open) is set manually by the operator at the HMI/OIT. All sensor readings are displayed.

4. LOCAL MANUAL Operation:
   a. Local controls are available at each valve actuator for Local operation when the respective H-O-A selector switch is placed in the HAND position.

5. OFF:
   a. The flow control valve is closed (set to 0% open).

6. Blower System Start:
   a. Upon the start of the blower system, all flow control valves in AUTOMATIC mode will be placed in their default position (30% open). Once all valves are at the default position, the blower system will start. The valves will remain at the default position until the header pressure reaches the default header pressure setpoint. After a delay (initially set to 120 seconds), aeration control logic for valve position will commence.

B. Blower System Control
   1. The blower manufacturer will furnish a local control panel (LCP) for each turbo blower and a Blower Master Control Panel (BMCP). The control logic for blower start, stop, capacity control, lead/lag rotation, equipment monitoring systems, equipment protection (including surge protection), shutdowns, alarms and faults are provided in the BMCP and LCPs (vendor controls).
   2. REMOTE AUTO (Normal) Operation:
      a. The vendor controls will control the operation of all blowers and monitor blower performance to prevent units from going into surge.
      b. SCADA will modulate and control the discharge header pressure setpoint by means of a most open valve algorithm which monitors the positions of the aeration header air flow control valves and automatically adjusts the discharge header pressure setpoint.
         1) The Operator will enter a setpoint for the most open valve position for the Aerobic Basin flow control valves.
         2) The OIT finds the maximum of the four Aerobic Basin aeration header air flow valve positions that are in automatic control mode. If a header air flow valve is in manual mode then its position is ignored for the purpose of finding the maximum valve position.
         3) A PID algorithm is used to compare the most open valve target position setpoint with the measured maximum valve position for the Aerobic Basin air flow control valves and the discharge header pressure setpoint. The setpoint will be increased if the maximum valve position is too open or decreased if the maximum valve position is too closed.
   3. REMOTE MANUAL OPERATION:
      a. The operator will enter the discharge header pressure setpoint manually at the HMI/OIT and have START / STOP commands available for the Blower System.
   4. LOCAL Operations:
      a. Local operations are furnished by the blower vendor controls.

C. Hardwired Interlocks
   1. A blower will stop in any mode of operation upon detection of:
      a. High blower vibration
      b. High motor vibration
      c. High blower or motor bearing temperature
      d. High motor temperature
      e. Low blower flow
      f. High filter differential pressure
      g. High inlet nozzle differential pressure
      h. High blower inlet pressure
      i. High blower inlet temperature
      j. High blower discharge temperature
      k. E-stops

A.5 RESPONSE TO INSTRUMENT OR EQUIPMENT FAILURES

A. All PLC outputs related to blower operation (header pressure setpoint, valve positions, and run/stop commands) remain in the last state in the event of either of the following two conditions:
   1. Loss of communication between the local PLC and the Wastewater Treatment Plant Control System.
   2. Upon loss of the dissolved oxygen concentration signal or the air flow meter signal, affected control loops shall remain in their latest state (flow setpoint or valve position will remain as is).
   3. Upon loss of flow control valve feedback signals, operations shall continue.

A.6 DISPLAYS AT HMI/OIT

A. Indications and alarms:

1. Blower System START
2. Blower System STOP
3. Blower IN AUTO (typical for Blowers B-3105, B-3106, B-3107, and B-3108)
4. Blower E-STOP STATUS (typical for Blowers B-3105, B-3106, B-3107, and B-3108)
5. Blower FAULT (typical for Blowers B-3105, B-3106, B-3107, and B-3108)
6. Blower FAIL (typical for Blowers B-3105, B-3106, B-3107, and B-3108)
7. Blower SPEED (typical for Blowers B-3105, B-3106, B-3107, and B-3108)
8. Blower RUNNING STATUS (typical for Blowers B-3105, B-3106, B-3107, and B-3108)
9. Blower Room Ambient Temperature: TT-3120
10. Discharge Header Pressure: PIT 3120B
11. Discharge Header Pressure Setpoint
12. Discharge header pressure HIGH
13. Discharge header pressure LOW
14. Discharge Header Flow: FIT 3121
15. Discharge Header Temperature: TIT 3121
16. Air Flow to Aeration Basin No. 5: FIT-2151
17. Air Flow to Aeration Basin No. 6: FIT-2161
18. Air Flow to Aeration Basin No. 7: FIT-2171
19. Air Flow to Aeration Basin No. 8: FIT-2181
20. Dissolved Oxygen Concentration in Aeration Basin No. 5: AIT-2151A
21. Dissolved Oxygen Concentration in Aeration Basin No. 6: AIT-2161A
22. Dissolved Oxygen Concentration in Aeration Basin No. 7: AIT-2171A
23. Dissolved Oxygen Concentration in Aeration Basin No. 8: AIT-2181A
24. Flow Control Valve Position for Aeration Basin No. 5: ZT-2151
25. Flow Control Valve Position for Aeration Basin No. 6: ZT-2161
26. Flow Control Valve Position for Aeration Basin No. 7: ZT-2171
27. Flow Control Valve Position for Aeration Basin No. 8: ZT-2181
28. Notification alarm for loss of any of the above signals
29. DO level setpoint not attained
30. Air Flow setpoint not attained
31. HMI/OIT AUTOMATIC mode or HMI/OIT MANUAL control setting
32. HMI/OIT DOBAC or HMI/OIT Air Flow mode selection
33. Valve position commands

A.7 REPORT DESCRIPTIONS

A. Provide daily report containing the following:
   1. Volume (SCF) and average flowrate (SCFM) for air supplied to Plant II – at each of (5) flowmeters and Total of (4) flowmeters at Aeration Basin Nos. 5-8.
   2. Average dissolved oxygen concentration (mg/L) in each of Aeration Basin Nos. 5-8.
   3. Graph of average dissolved oxygen concentration (mg/L) and air flow rate (SCFM) over time.

B. Provide monthly report containing the following:
   1. Volume (SCF) and average flowrate (SCFM) for air supplied to Plant II – at each of (5) flowmeters and Total of (4) flowmeters at Aeration Basin Nos. 5-8.
   2. Total run time and number of starts during the month for each blower.
   3. Lifetime cumulative total runtime and number of starts for each blower.

END OF APPENDIX A

APPENDIX B
ANOXIC ZONE MIXERS
PROCESS CONTROL DESCRIPTIONS

Project: 10342803
Process Areas: 21D -- Aeration Basin Nos. 5-8

A.1 REFERENCE DOCUMENTS

A. Process & Instrument Diagrams, P&IDs:
   1. 00Y603 Aeration Basin No. 5 (typical for all basins)

A.2 MAJOR EQUIPMENT AND FIELD INSTRUMENTS

A. Major Equipment:
   1. Anoxic Zone Mixer MX-2151, associated VFD / LCS (Basin No. 5, Zone 1)
   2. Anoxic Zone Mixer MX-2152, associated VFD / LCS (Basin No. 5, Zone 2)
   3. Anoxic Zone Mixer MX-2161, associated VFD / LCS (Basin No. 6, Zone 1)
   4. Anoxic Zone Mixer MX-2162, associated VFD / LCS (Basin No. 6, Zone 2)
   5. Anoxic Zone Mixer MX-2171, associated VFD / LCS (Basin No. 7, Zone 1)
   6. Anoxic Zone Mixer MX-2172, associated VFD / LCS (Basin No. 7, Zone 2)
   7. Anoxic Zone Mixer MX-2181, associated VFD / LCS (Basin No. 8, Zone 1)
   8. Anoxic Zone Mixer MX-2182, associated VFD / LCS (Basin No. 8, Zone 2)
   9. PLC-3101 and OIT-3101 at Blower Building.

B. Major Field Instrumentation:
   1. TSH-2151: Mixer High Temperature Switch
   2. TSH-2152: Mixer High Temperature Switch
   3. TSH-2161: Mixer High Temperature Switch
   4. TSH-2162: Mixer High Temperature Switch
   5. TSH-2171: Mixer High Temperature Switch
   6. TSH-2172: Mixer High Temperature Switch
   7. TSH-2181: Mixer High Temperature Switch
   8. TSH-2182: Mixer High Temperature Switch

A.3 OVERVIEW DESCRIPTION

A. These mixers will be utilized to keep the anoxic zones in Aeration Basin Nos. 5-8 properly mixed.

A.4 DETAILED PROCESS CONTROL DESCRIPTIONS

A. Mixers
   1. The mixers are expected to be operated continuously, and the mixers have identical controls as described below.
   2. AUTO OPERATION: START, STOP, and speed set point commands will be available for each mixer at the HMI/OIT. Speed will initially be set to a default speed after staff set the RUN command. The default speed will be based on the manufacturer's recommendations. A SPEED RESET command will change the speed set point back to the default value.
      a. Remote operation will be disabled for a given mixer when its IN REMOTE or IN AUTO signals are not present.
   3. LOCAL MANUAL OPERATION: Local operations are available for each mixer via LOCAL-OFF-AUTO and HAND-OFF-REMOTE selectors at the VFD and LCS, respectively.
   4. Interlocks
      a. Motor High Temperature

A.5 RESPONSE TO INSTRUMENT OR EQUIPMENT FAILURES

A. All PLC outputs related to mixer operation (both speed control and run/stop commands) remain in the last state in the event of the following condition:

1. Loss of communication between the local PLC and the WWTP Control System (HMI).
2. Loss of communication between the local PLC and mixer VFDs.

A.6 DISPLAYS AT HMI/OIT

A. Indications (all typical of MX-2151, MX-2152, MX-2161, MX-2162, MX-2171, MX-2172, MX-2181, and MX-2182):
   1. Mixer IN AUTO (VFD)
   2. Mixer IN REMOTE (LCS)
   3. Mixer RUNNING STATUS
   4. Mixer SPEED feedback (% or Hz at Owner preference)

B. Alarms (all typical of MX-2151, MX-2152, MX-2161, MX-2162, MX-2171, MX-2172, MX-2181, and MX-2182):
   1. Mixer VFD FAULTED
   2. Mixer NOT IN AUTO (VFD)
   3. Mixer NOT IN REMOTE (LCS)
   4. Mixer E-STOP STATUS

A.7 REPORT DESCRIPTIONS

A. Provide monthly report containing the following:
   1. Total mixer runtime and number of starts during the month.
   2. Lifetime cumulative total mixer runtime and number of starts

END OF APPENDIX B

APPENDIX C
INTERNAL MIXED LIQUOR RECYCLE PUMPS
PROCESS CONTROL DESCRIPTIONS

Project: 10342803
Process Areas: 21D – Aeration Basin Nos. 5-8

A.1 REFERENCE DOCUMENTS

A. Process & Instrument Diagrams, P&IDs:
   1. 00Y603 Aeration Basin No. 5 (typical for all basins and IMLR Pumps)

A.2 MAJOR EQUIPMENT AND FIELD INSTRUMENTS

A. Major Equipment:
   1. Propeller Pump P-2153, associated VFD / LCS (Basin No. 5)
   2. Propeller Pump P-2163, associated VFD / LCS (Basin No. 6)
   3. Propeller Pump P-2173, associated VFD / LCS (Basin No. 7)
   4. Propeller Pump P-2183, associated VFD / LCS (Basin No. 8)
   5. PLC-3101, OIT-3101 at Blower Building

B. Major Field Instrumentation:
   1. MSH-2153: Motor Space Heater
   2. MSH-2163: Motor Space Heater
   3. MSH-2173: Motor Space Heater
   4. MSH-2183: Motor Space Heater
   5. TSH-2153: Motor Temperature Switch
   6. TSH-2163: Motor Temperature Switch
   7. TSH-2173: Motor Temperature Switch
   8. TSH-2183: Motor Temperature Switch

A.3 OVERVIEW DESCRIPTION

A. These pumps will be utilized to recycle aeration basin effluent back to the front of the aeration basin. This recycled effluent will supply nitrate to the anoxic zones, which will allow for denitrification to occur in the anoxic zones and help stabilize nitrification in the aerobic zones.

B. Each pump will assigned solely to one basin.

A.4 DETAILED PROCESS CONTROL DESCRIPTIONS

A. HAND MANUAL Control
   1. In local manual mode, operator shall be able to start, stop, and adjust speed of the pumps at the respective pump VFD control enclosure when the H/O/R selector switch is set to HAND. When the L/O/A at the LCS is set to Local, start / stop controls are available at the LCS.

B. AUTO MANUAL Control
   1. In this mode, the Operator shall be able to start, stop, and adjust pump speed from the HMI when the pump L/O/A and VFD H/O/R are set to AUTO and REMOTE.

C. Hardwired Interlocks
   1. Interlocks to VFD's: A pump will stop in any mode of operation upon detection of:
      a. High motor temperature
      b. Pump motor seal leak
      c. E-stops
   2. Interlock to Motor Protective Relay: Every VFD associated with the pumps will be hardwired interlocked with the Motor Protective Relays associated with the same pumps.

A.5 RESPONSE TO INSTRUMENT OR EQUIPMENT FAILURES

A. All PLC outputs related to pump operation (both speed control and run/stop commands) remain in the last state in the event of either of the following two conditions:
   1. Loss of communication between the local PLC and the WWTP Control System (HMI).
   2. Loss of communication between the local PLC and pump VFDs.

A.6 DISPLAYS AT HMI/OIT

A. Indications and alarms (typical for Pumps P-2153, P-2163, P-2173, and P-2183):
   1. Pump IN AUTO (LCS)
   2. Pump IN REMOTE (VFD)
   3. Pump E-STOP STATUS
   4. Pump RUNNING STATUS
   5. Pump VFD FAULTED
   6. Pump Motor SEAL LEAK
   7. Pump Motor HIGH TEMP
   8. Pump SPEED

A.7 REPORT DESCRIPTIONS

A. Provide monthly report containing the following:
   1. Total pump runtime and number of starts during the month.
   2. Lifetime cumulative total pump runtime and number of starts.

END OF APPENDIX C

APPENDIX D
SECONDARY CLARIFIER FLOW SPLITTER PROCESS CONTROL DESCRIPTIONS

Project: 10342803
Process Areas: 22D -- Secondary Clarifier Splitter Structure

A.1 REFERENCE DOCUMENTS

A. Process & Instrument Diagrams, P&IDs:
   1. 00Y604 Secondary Clarifier Splitter Structure

A.2 MAJOR EQUIPMENT AND FIELD INSTRUMENTS

A. Major Equipment:
   1. Flow Control Valve Modulating Actuator FCV-2201
   2. Flow Control Valve Modulating Actuator FCV-2202
   3. Flow Control Valve Modulating Actuator FCV-2203
   4. Flow Control Valve Modulating Actuator FCV-2204
   5. Flow Control Valve Modulating Actuator FCV-2205 (future)
   6. Flow Control Valve Modulating Actuator FCV-2206 (future)
   7. Remote Control Stations for above modulating valve actuators
   8. PLC-3101, OIT-3101 at Blower Building.

B. Major Field Instrumentation:
   1. LE/LIT-2201A: Level sensor (future).
   2. LE/LIT-2201B: Level sensor.
   3. LE/LIT-2202A: Level sensor (future).
   4. LE/LIT-2202B: Level sensor.
   5. LSH-2201C: High level switch.
   6. FE/FIT-2201: Flowmeter flow transmitter.
   7. FE/FIT-2202: Flowmeter flow transmitter.
   8. FE/FIT-2203: Flowmeter flow transmitter.
   9. FE/FIT-2204: Flowmeter flow transmitter.
   10. FE/FIT-2205: Flowmeter flow transmitter (future).
   11. FE/FIT-2206: Flowmeter flow transmitter (future).

A.3 OVERVIEW DESCRIPTION

A. The flow control valves at the secondary clarifier splitter structure will be used to properly split the aeration basin effluent flow to the Plant II Secondary Clarifiers.

B. The valve positions will be adjusted based on the level in the aeration basin effluent channel, the flow rates measured at the secondary clarifier influent flowmeters, and the flow split ratios set by the City's operations staff.

C. Two additional secondary clarifiers may be constructed in the future at the plant. Two pipe outlets are provided at this splitter structure to accommodate those two clarifiers when they are constructed. Logic to incorporate the valves and flowmeters for these two additional clarifiers shall be included in the program at this time, but not shown on the OIT at this time.

A.4 DETAILED PROCESS CONTROL DESCRIPTIONS

1. The total Plant II Aeration Basins effluent flow rate setpoint will be determined based on an aeration basin effluent channel water level set point and the actual water level measured in the channel by level sensors.The level setpoint will be adjustable at the HMI/OIT and will initially be set to a default level equivalent to a water level elevation of 474.00. At the HMI/OIT, an option will be provided to "Reset" the level set point to the default value.
2. The level set point will be compared to the level measured in the channel by the level sensors (LE/LIT-2201A, LE/LIT-2201B, LE/LIT-2202A, and LE/LIT-2202B).

a. The radar sensor for Clarifiers 1 and 2 (LE/LIT-2201A) will serve as the primary, default sensor. Upon sensor fault, the submersible sensor for Clarifiers 1 and 2 (LE/LIT-2202A) will be used instead.
b. The radar sensor for Clarifiers 3 through 6 (LE/LIT-2201B) will serve as the primary, default sensor. Upon sensor fault, the submersible sensor for Clarifiers 3 through 6 (LE/LIT-2202B) will be used instead.
c. A toggle option will be available on the OIT for operators to set the measured level of Clarifiers 1 and 2 to match that of Clarifiers 3 through 6. If this option is activated, operators may select which sensor to use.

3. When the measured water level does not match the level set point, then the total flow rate set point will be adjusted.
   a. If the measured water level is lower than the set point, than the total flow rate set point will be decreased incrementally.
   b. If the measured water level is higher than the set point, than the total flow rate set point will be increased incrementally.
   c. The total flow rate set point will be adjusted by a PID (proportional integral derivative) algorithm.

B. The flow control valves will be adjusted based on the total flow rate set point. The determined total flow rate will be divided by the number of flow control valves In Auto to get the individual secondary clarifier flow rate set point, which will be the flow rate through each flow meter and flow control valve.
   1. Operators will be able to select which secondary clarifiers are online or offline through the HMI/OIT.
   2. Each flow control valve (FCV-2201, FCV-2202, FCV-2203, FCV-2204, FCV-2205 [future], and FCV-2206 [future]) will be adjusted based on the difference between the flow rate measured by the respective flowmeter (FE/FIT-2201, FE/FIT-2202, FE/FIT-2203, FE/FIT-2204, FE/FIT-2205 [future], and FE/FIT-2206 [future]) and the individual secondary clarifier flow rate set point.
      a. If the measured flow rate is lower than the individual secondary clarifier flow rate set point, than the valve will be opened further incrementally (% open will increase).
      b. If the measured flow rate is higher than the individual secondary clarifier flow rate set point, than the valve will be closed further incrementally (% open will decrease).
      c. The valve positions will be adjusted by a PID (proportional-integral-derivative) algorithm.

C. Interlocks
   1. None

A.5 RESPONSE TO INSTRUMENT OR EQUIPMENT FAILURES

A. All PLC outputs related to valve operation (position commands) remain in the last state in the event of loss of communication between the PLC and the Wastewater Treatment Plant Control System (OIT).

B. Upon loss of flowmeter signal, the position signal to the affected flow control valve shall remain in the last state.

C. Upon loss of valve position feedback signal, the flow control algorithm for the affected flow control valve shall continue.

D. Upon loss of valve In Remote signal, the position signal to the affected flow control valve shall remain in the last state.

A.6 DISPLAYS AT HMI/OIT

A. Indications and alarms:
   1. Secondary Clarifier Splitter Structure to Clarifier No. 1 Flow Rate
   2. Secondary Clarifier Splitter Structure to Clarifier No. 2 Flow Rate
   3. Secondary Clarifier Splitter Structure to Clarifier No. 3 Flow Rate

4. Secondary Clarifier Splitter Structure to Clarifier No. 4 Flow Rate
5. Aeration Basin Effluent Channel HIGH HIGH LEVEL ALARM
6. Aeration Basin No. 1-4 Channel Level
7. Aeration Basin No. 5-8 Channel Level
8. Aeration Basin No. 1-4 Channel Level
9. Aeration Basin No. 5-8 Channel Level
10. Valve IN REMOTE (typical for Valves FCV-2201, FCV-2202, FCV-2203, and FCV-2204)
11. Valve POSITION (typical for Valves FCV-2201, FCV-2202, FCV-2203, and FCV-2204)

A.7 REPORT DESCRIPTIONS

A. Provide daily report containing the following:
   1. Total flow (MG) to each secondary clarifier.

B. Provide monthly report containing the following:
   1. Total flow (MG) to each secondary clarifier.

END OF APPENDIX D

APPENDIX E
RAS/WAS PUMP STATION
PROCESS CONTROL DESCRIPTIONS

Project: 10342803
Process Areas: RAS/WAS Pump Station

A.1 REFERENCE DOCUMENTS

A. Process & Instrument Diagrams, P&IDs:
   1. 00Y607 RAS/WAS Pump Station - Secondary Clarifier Nos. 1 & 2 P&ID
   2. 00Y609 RAS/WAS Pump Station - Secondary Clarifier Nos. 3 & 4 P&ID

A.2 MAJOR EQUIPMENT AND FIELD INSTRUMENTS

A. Major Equipment:
   1. Flow Control Valve FCV-4019
   2. Flow Control Valve FCV-4022
   3. RAS Centrifugal Pump P-4001, associated VFD / LCS (Clarifier Nos. 1 & 2 Swing)
   4. RAS Centrifugal Pump P-4002, associated VFD / LCS (Clarifier Nos. 3 & 4 Swing)
   5. RAS Centrifugal Pump P-4011, associated VFD / LCS (Clarifier No. 1)
   6. RAS Centrifugal Pump P-4012, associated VFD / LCS (Clarifier No. 1)
   7. RAS Centrifugal Pump P-4021, associated VFD / LCS (Clarifier No. 2)
   8. RAS Centrifugal Pump P-4022, associated VFD / LCS (Clarifier No. 2)
   9. RAS Centrifugal Pump P-4031, associated VFD / LCS (Clarifier No. 3)
   10. RAS Centrifugal Pump P-4032, associated VFD / LCS (Clarifier No. 3)
   11. RAS Centrifugal Pump P-4041, associated VFD / LCS (Clarifier No. 4)
   12. RAS Centrifugal Pump P-4042, associated VFD / LCS (Clarifier No. 4)
   13. Local Control Panel(s) and associated PLC
   14. PLC-4001, OIT-4001 at RAS/WAS Pump Station.

B. Major Field Instruments:
   1. Flowmeter Flow Transmitter: FIT-4051
   2. Flowmeter Flow Transmitter: FIT-4052
   3. Flowmeter Flow Transmitter: FIT-4053
   4. Flowmeter Flow Transmitter: FIT-4054
   5. Flowmeter Flow Transmitter: FIT-4059
   6. Flowmeter Flow Transmitter: FIT-4060

A.3 OVERVIEW DESCRIPTION

A. These pumps will be utilized to convey RAS from the secondary clarifiers to the Aeration Basin Splitter Structure and to convey WAS from the secondary clarifiers to Solids Storage.

A.4 DETAILED PROCESS CONTROL DESCRIPTIONS

A. Pumps may be manually controlled via selections made at the VFD. When placed in the REMOTE control mode at the VFD, pumps are controlled by PLC control logic as follows:
   1. The ten VFD driven RAS Pumps are controlled via operator input at the HMI. Pump control is in accordance with selections made at the LOCAL-OFF-AUTO selector, AUTO-MANUAL speed controllers and LEAD1-LAG1, LEAD2-LAG2, LEAD3-LAG3, LEAD4-LAG4 or STANDBY1-STANDBY2 selector function.
   2. City operations staff will set the RAS flow rate setpoints for each of the four (4) flowmeters FIT-4051, FIT-4052, FIT-4053, FIT-4054 and which pumps are online/offline to use for the control of these RAS pumps.

3. The ten VFD drive RAS Pumps will be separated into five (5) groups as below:
   Group 1: P-4011 and P-4012
   Group 2: P-4021 and P-4022
   Group 3: P-4031 and P-4032
   Group 4: P-4041 and P-4042
   Group 5: P-4001 and P-4002
   a. RAS pumps P-4001 and P-4002 will be assigned to one of the four other groups of pumps based on operator input at the HMI.
   b. Selector functions will be set by the PLC control logic based on the total runtime of each pump using the following logic:
      1) The pump with the lowest runtime in each of the four groups will be set as the LEAD pump.
      2) The pump with the second lowest runtime in Group 1 will be set as LAG1.
      3) The pump with the second lowest runtime in Group 2 will be set as LAG2.
      4) The pump with the second lowest runtime in Group 3 will be set as LAG3.
      5) The pump with the second lowest runtime in Group 4 will be set as LAG4.
      6) Of the remaining pumps, the pump with the lowest runtime will be set as STANDBY1.
      7) The remaining pump (with the lowest runtime) will be set as STANDBY2.
4. When operating in an AUTOMATIC control mode, pump control is in accordance with the flow rate set by the operators and in accordance with an AUTO-MANUAL speed controller. AUTOMATIC operation is as follows:
   a. PLC logic commands LEAD1, LEAD2, LEAD3, and LEAD4 to start when the RAS flow set point is set above the flow rate at minimum pump speed (see schedule below). Pump speed will ramp to the minimum set speed at start-up and gradually increase speed up to 100% as listed in the schedule below and in accordance with the flow rate set point. If the LEAD pump in any group fails to operate (after a time delay (adjustable on the HMI), initially set at 10 seconds), then the LAG pump in the same group will be commanded to operate as the LEAD pump.
      1) If the flow rate set point is set below the flow rate at the minimum pump speed (see schedule below), the PLC will automatically adjust the flow rate set point to the flow rate at minimum pump speed and a message will be displayed stating: "Set flow rate below minimum pump speed."
   b. When the LEAD pump in each group has been running at maximum speed for a set period of time ((adjustable on the HMI), initially set at 10 seconds), while not meeting the RAS flow rate set point, the LAG pump in each group will be commanded to operate. The LEAD pump will slow down to minimum speed while the LAG pump starts. Once the LEAD and LAG pumps reach minimum speed, both pumps will operate together at the same speed. Both pumps gradually increase speed up to 100% in accordance with the flow rate set point, as listed in schedule below. If the LAG operating pump fails to operate (after a time delay (adjustable on the HMI), initially set at 10 seconds) and a STANDBY pump is assigned to its group, then that STANDBY pump will be commanded to operate as the LAG pump. IF the LAG pump fails to operate (after a time delay (adjustable on the HMI), initially set at 10 seconds) and no STANDBY pump is assigned to its group, then the LEAD pump will continue to operate, a message will be displayed stating: "LAG pump failure to start", and the LAG pump will be commanded to stop.
   c. PLC logic utilizes a 1-minute time delay (adjustable) prior to commanding an additional RAS pump to start following the start of the previous pump.
   d. If the measured flow rate rises above the set point with the LEAD and LAG pumps for each group running at a minimum set speed for a set period of time (initially set at 15 seconds), the PLC commands the LAG pumps to stop.
   e. If the measured flow rate rises above the set point with only the LEAD pump for each group operating at a minimum speed for a set period of time (initially set at 15 seconds), the PLC commands the LEAD pump to stop.

f. Pump speed is to be controlled by an AUTO-MANUAL speed controller function and level control logic resident with PLC programming.
   1) In MANUAL mode, the speed controller function provides a speed control signal to the pump per the operator's manual speed selection at the HMI.
   2) In AUTO mode, the speed controller function modulates pump speed so as to minimize the number of pump starts and stops. It does this by modulating from a set minimum speed to maximum speed in accordance with the pump control schedule below. Pump speed will increase as tank level falls in order to preclude the need for another pump if possible. Pump speed will decrease as tank level rises in order to keep the pump running as long as possible and thus prevent numerous pump starts and stops.
   3) Pump speed will ramp up at a controlled rate (adjustable on the HMI) during pump start-up.
   4) During a controlled pump shutdown, the pump speed will ramp down

B. WAS Valve Controls
1. The two flow control valves (FCV-4059 and FCV-4060) are controlled via operator input at the HMI.
2. City operations staff will set the WAS flow rate setpoint and which pumps are online/offline to use for the control of these WAS flow control valves.
3. The WAS flow rate will be measured by two flow meters: FIT-4059 and FIT-4060. The flows measured by these two meters will be added together to determine the total WAS flow. These total measured WAS flow will then be compared to the flow rate set point to determine whether the valves need to open or close more.
4. The valves will gradually open or close in accordance with the flow rate set point. When both valves are online, they will be kept open the same amount and will be adjusted simultaneously. Adjustments to the valves will be made at a set rate (change in % open) every set time period.
   a. If RAS pumps P-4021, P-4022, P-4041, and P-4042 are all offline, then FCV-4060 will remain fully closed.
   b. If RAS pumps P-4011, P-4012, P-4031, and P-4032 are all offline, then FCV-4061 will remain fully closed.

C. RAS Pump Station Flow Control Schedule (for Each of Four Groups):

Pumps	Pump Control Action	Total Flow Rate Set Point, gpm	VFD Frequency, Hz
LEAD Pump (Groups 1, 2, 3, 4)	Off	<475	0
	On at Minimum Speed	≥475	25
	100% Speed	≤2025	48
LAG Pump (Groups 1, 2, 3, 4)	On at Minimum Speed	>1015	38
	100% Speed	≤1865	60
Both STANDBY Pumps	On at Minimum Speed	>1240	49
	100% Speed	≤1590	60

D. Pump Interlocks:
1. If the LEAD pump starts and the corresponding flowmeter is still read 0 gpm after a time delay (adjustable), shutdown the pump
2. There will be Adjustable OFF DELAY Timer for avoid short cycling of the pumps. A pump cannot restart immediately after stopping. It has to remain OFF for a certain period before re-starting

A.5 RESPONSE TO INSTRUMENT OR EQUIPMENT FAILURES

A. All PLC outputs related to pump operation (both speed control and run/stop commands) remain in the last state in the event of either of the following two conditions:
   1. Loss of communication between the local PLC and the Wastewater Treatment Plant Control System.
   2. Loss of a flow meter signal.

A.6 DISPLAYS AT HMI/OIT

A. Indications and alarms :
   1. RAS Pumps (typical for Pumps P-4001, P-4002, P-4011, P-4012, P-4021, P-4022, P-4031, P-4032, P-4041, and P-4042):
      a. Pump Motor HIGH TEMP ALARM
      b. Generic Pump FAULT ALARM
      c. Pump E-STOP STATUS
      d. Pump IN AUTO (LCS)
      e. Pump IN REMOTE (VFD)
      f. Pump RUNNING STATUS
      g. Pump VFD FAULTED
      h. Pump SPEED
   2. RAS Flow from Secondary Clarifier No. 1: FIT-4051
   3. RAS Flow from Secondary Clarifier No. 2: FIT-4052
   4. RAS Flow from Secondary Clarifier No. 3: FIT-4053
   5. RAS Flow from Secondary Clarifier No. 4: FIT-4054
   6. WAS Flow from Secondary Clarifier Nos. 1 & 4: FIT-4060
   7. WAS Flow from Secondary Clarifier Nos. 2 & 3: FIT-4059
   8. WAS Flow Control Valve Position: ZT-4060
   9. WAS Flow Control Valve Position: ZT-4059

A.7 REPORT DESCRIPTIONS

A. Provide daily report containing the following:
   1. Volume (MG) of wastewater sludge pumped as RAS – per flowmeter and Plant II total.
   2. Volume (MG) of wastewater sludge pumped as WAS – per flowmeter and Plant II total.

B. Provide monthly report containing the following:
   1. Volume (MG) of wastewater sludge pumped as RAS – per flowmeter and Plant II total.
   2. Volume (MG) of wastewater sludge pumped as WAS – per flowmeter and Plant II total.
   3. Total run time and number of starts during the month for each RAS pump.
   4. Lifetime cumulative total run time and number of starts for each RAS pump

END OF APPENDIX E

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SECTION 40 62 05
COMPUTER SYSTEM HARDWARE AND ANCILLARIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Computer and HMI hardware requirements, which include, but are not necessarily limited to:
      a. Panel Mounted Operator Interface Terminals (OIT).

B. Related Specification Sections include, but are not necessarily limited to:
   1. Section 40 61 13 - Process Control Systems General Requirements.
   2. Section 40 61 21 - Process Control System Testing.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. National Institute of Standards and Technologies (NIST):
      a. 800-82, Guide to Industrial Control Systems (ICS) Security.
      b. 800-53, Security and Privacy Controls for Federal Information Systems and Organizations.
   2. International Society of Automation (ISA):
      a. ISA-62443, Cybersecurity Certificate Programs.

1.3 DEFINITIONS

A. HMI: Human Machine Interface.

B. LCD: Liquid Crystal Display.

C. OIT: Operator Interface Terminal.

D. OPC: "OLE for Process Control", a software standard utilizing a client/server model that makes interoperability possible between automation/control applications and field systems/devices.

E. PC: Personal Computer.

F. RAID: Redundant Array of Independent Disks, a method of storing the same data in different places on multiple hard disks.

G. RAM: Random Access Memory.

H. SCSI: Short for Small Computer System Interface, a parallel interface standard used for attaching peripheral devices to computers.

I. SDRAM: Synchronous Dynamic RAM.

J. SNMP: Simple Network Management Protocol, a set of protocols for managing complex networks.

K. TFT: Thin-Film Transistor, a technology for building LCD screens.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Section 40 61 13 - Process Control System General Requirements.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.

B. Contract Closeout Information:
   1. Operation and Maintenance Data:

a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the manufacturers listed within the following Articles are acceptable.

2.2 PANEL MOUNTED OPERATOR INTERFACE PANELS (OIT)

A. Manufacturers:
   1. Allen Bradley PanelView Plus 7

B. Provide Panel Mounted Operator Interface Panels (OITs) as shown on the Drawings and the Schedule herein.

C. Design and Fabrication:
   1. Display: Color graphics.
   2. Touch screen.
   3. 120 VAC power supply.
   4. Real time battery-backed clock, time stamp data.
   5. Communication ports to support communications methods shown on drawings.
   6. Provide password protection to prevent unauthorized entries for a minimum of two levels:
      a. Authorization to operate.
      b. Authorization to adjust setpoints.
      c. Configure automatic log-out to view-only mode after 15 minutes of inactivity.
   7. Operating temperature: 32 degrees F to 131 degrees F.
   8. Humidity: 10 to 90% RH non-condensing.
   9. Accessories: Install port locks on all unused ports.
   10. Configuration software:
      a. Provide latest version of configuration software licensed to Owner.

D. Configuration:
   1. Remove all unused software and services.
   2. Configure inactivity session lock.
   3. Disable operating system automatic updates..
   4. Change default usernames and passwords.
   5. Secure configuration environment with username and password.

E. Schedule:

EQUIPMENT NO.	LOCATION	SIZE, INCHES
OIT-3101	PLC-3101 CONTROL PANEL	10"
OIT-4001	PLC-4001 CONTROL PANEL	10"

PART 3 - EXECUTION

3.1 DEMONSTRATION

A. Demonstrate system in accordance with Section 01 75 00 - Checkout and Start-Up Procedures.

3.2 INSTALLATION AND CHECKOUT

A. Provide installation and checkout in accordance with Section 40 61 13 - Process Control System General Requirements and Section 40 61 21 - Process Control System Testing.

END OF SECTION

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SECTION 40 63 43
PROGRAMMABLE LOGIC CONTROLLERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Programmable logic controller (PLC) control system(s), including hardware, software, programming, documentation, and training.

B. Related Sections include but are not necessarily limited to:
   1. Section 01 75 00 - Checkout and Start-Up Procedures
   2. Section 26 05 19 - Wire and Cable - 600 Volt and Below.
   3. Section 40 61 13 - Process Control Systems General Requirements.
   4. Section 40 67 00 - Control System Equipment Panels and Racks.
   5. Section 40 61 96 - Process Control Descriptions.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. The Institute of Electrical and Electronics Engineers, Inc. (IEEE):
      a. C37.90.2, Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers.
      b. C62.41.2, Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits.
   2. International Electrotechnical Commission (IEC)
      a. IEC 61131-3 Programmable logic controllers
   3. National Electrical Manufacturers Association (NEMA):
      a. ICS 1, Industrial Control and Systems General Requirements.

B. Qualifications:
   1. Installation supervisor shall have had experience in overseeing installation and startup of at least three similar installations within the last five years.
   2. Programmer(s) shall have had experience in programming PLCs for at least two projects of similar size and complexity.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 40 61 13.
   2. Product technical data including:
      a. Submit annotated copies of complete PLC software programs:
         1) In native-format file including all applicable formats (ladder logic, function block diagram, sequential function chart, instruction list, structured text).
         2) In PDF-format file with fully annotated PLC code that can be read without the native configuration and programming environment on electronic media (DVD or USB drive).
         3) Provide text description completely defining each unique function block used in the program if FBDs are used.
         4) Provide list of all addresses referenced in logic diagram with description of data associated with each address (Tag database).
      b. Results of factory testing or simulation procedures.
      c. Bill of material
      d. Drawings containing the following information to be submitted as part of Specification Section 40 67 00 (control panels) submittals:
         1) Arrangement drawings for PLC system components.

2) Panel and enclosure plans, sections and details.
3) Access opening locations and required clearances for each panel and enclosure.
4) Enclosure internal wiring and terminal blocks.

e. DIP Switch and Jumper Settings, if applicable.
f. I/O Rack and I/O Module Layout.
g. Wiring and Interconnection diagrams.
1) Power Supplies.
2) I/O Points.
3) Communications.
h. Catalog cut sheets containing information on PLC components to be submitted as part of these Specification Section submittals.

3. Certifications:
a. Qualifications of installation supervisor.
b. Qualifications of programmer(s).
4. Software Licenses:
a. Documentation of all software package licenses being assigned to Owner.
5. Manufacturer support proposal [agreement].

B. Operation and Maintenance Data:
1. See Specification Section 01 78 23 for requirements for:
a. The mechanics and administration of the submittal process.
b. The content of Operation and Maintenance Manuals.
2. Program Documentation.
a. Program Overview.
b. Program Listing.
c. I/O Listing.
d. Memory Map.
e. I/O Cross Reference.
3. Maintenance procedures.
a. Include the location and phone numbers of service centers (including 24 hour "hot lines").
b. Provide specific information including operation and maintenance requirements, programming assistance, troubleshooting guide, parts ordering, field service personnel requests, and service contracts.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Rockwell Automation: Allen-Bradley ControlLogix

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

A. See Specification Section 40 61 13.

B. The PLC system shall meet the control requirements of the Section 40 61 96 - Process Control Descriptions, Drawings, and Specifications.

C. PLC programming shall be documented and factory tested.

D. The PLC system be capable of operating in ambient conditions of 32 to 140 degrees F temperatures and 5 to 95% relative humidity without the need for purging or air conditioning.

E. Environmental Controls:
1. Furnish circulation fans in solid state control system enclosures.
2. Over-temperature switches shall be utilized to provide special cooling if required to maintain operating temperatures within the manufacturer's specified range.

3. Air conditioning applications shall include means of preventing moisture condensation.

F. Where the PLC is utilized to control multiple trains of equipment and where the equipment in each train operates as a unit relatively independent of other equipment trains (e.g., facility with multiple boiler units or filter trains), the PLC components (I/O modules, power supplies, etc.) shall be designed so that the failure of any one component does not affect equipment on all trains. The following shall also apply.
   1. I/O modules shall be segregated on a train basis unless required for safety reasons.
   2. Where several equipment units operate in parallel, but are not considered assigned to a particular equipment train (e.g., multiple raw water pumps or chemical feed pumps all discharging into a common header), the PLC I/O modules associated with each equipment unit shall be assigned so that the failure of any one I/O module will not affect the other parallel unit/s.

2.3 PERFORMANCE AND DESIGN REQUIREMENTS

A. Electrical supply voltage to the PLC shall be 120 VAC plus or minus 15 percent, 48-63Hz. PLC system power supplies shall be fused for overload protection.

B. Vibration: 3.5 mm Peak-to-Peak, 5-9 Hz: 1.0G, 9-150\Hz. The method of testing is to be based upon IEC 68-2-6 and JIS C 0911 standards for vibration. The system is to be operational during and after testing. Vibration Rating of 2.0G maximum peak acceleration for 10 to 500Hz. in accordance with at least one of the following:

a. Installed rating: DIN rail mounted PLC: 10-57 Hz, amplitude 0.075 mm, acceleration 25-100 Hz.

b. Panel- or plate-mounted PLC: 2-25 Hz, amplitude 1.6 mm, acceleration 25-200 Hz.

c. In compliance with IEC 60068 and IEC 61131.

C. Shock: 15G, 11 msec. The method of testing is to be based upon IEC 68- 2-27 and JIS C 0912 standards for shock. The system is to be operational during and after testing.

D. Temperature: All PLC hardware shall operate at an ambient temperature of 0 to +55 degrees C (+32 to +140 degrees F), with a storage ambient temperature rating of -25 to +70 degrees C (-40 to +185 degrees F).

E. Relative Humidity: The Programmable Controller hardware shall function continuously in the relative
humidity range of 30 percent to 95 percent non-condensing.

F. Noise Immunity: The Programmable Controller system shall be designed and tested to operate in the high electrical noise environment of an industrial plant as governed by the following regulations: IEEE 472, IEC 801, MILSTD 461B, IEC 255-4, NEMA ICS 2-230.40, and ANSI/IEEE C-37.90A-1978

G. Altitude:

   a. Operation: 0-6,500 feet.
   b. Storage: 0-9,800 feet.

H. Degree of protection: NEMA 1 (IP20).

I. All products shall have corrosion protection.

2.4 HARDWARE

A. Processor shall include diagnostic indicators for power, mode, low battery, communications ports, and memory and I/O errors.

B. Redundant processors, if specified, shall have seamless fail-over capability.

C. I/O modules shall be capable of being replaced while the PLC is on-line and operating.

D. All I/O modules shall have terminal block failure or removal monitoring.

E. Analog output modules shall have a resolution of at least 12 bits.

F. Electrical isolation shall be provided between logical and field device.

G. I/O Module field wiring shall remain undisturbed when removing or replacing an I/O module.

H. Fail-safe state for each I/O channel shall be capable of being defined as on, off or fail-in-place.

I. Power Supply Units:
   a. Electrical service to PLC system shall be 120 VAC, 60 Hz.

J. All PLC control system components shall be capable of meeting or exceeding electromagnetic interference tests per IEEE C37.90.2.

K. Incorporate the following minimum safety measures:
   1. Watchdog function to monitor:
      a. Internal processor clock failure.
      b. Processor memory failure.
      c. Loss of communication between processor and I/O modules.
      d. Processor ceases to execute logic program.
   2. Safety function wiring: Emergency safety switches shall not be wired into the controller.
   3. Safe wiring:
      a. Unless otherwise specified, activation of alarms and stopping of equipment shall be based on de-energization of rather than the energization of control circuits.
   4. Initial safety conditions:
      a. Utilize program module to dictate output states in a known and safe manner prior to running of control program.
      b. Utilize program each time PLC is initialized/re-initiated and the control program activated.
   5. Monitoring of internal faults and display:
      a. Internal PLC system status and faults shall be monitored and displayed.
         1) Monitored items shall include:
            a) Memory ok/loss of memory.
            b) Processor ok/fault.
            c) Scan time overrun.
   6. Control of programs: Protect access to PLC program loading with password protection or with locked, key operated selector switches.
      a. Provide login, passwords, and/or keys to Owner at Substantial Completion.
      b.
   7. Design PLC system with high noise immunity to prevent occurrence of false logic signals resulting from switching transients, relay and circuit breaker noise or conducted and radiated radio frequency interference.
   8. Operator intervention:
      a. Logic system failure shall not preclude proper operator intervention.
      b. Safety shutdown of equipment or a system shall require manual operator intervention before the equipment or system operation may be reestablished.

2.5 SOFTWARE

A. All software will be furnished and licensed to Owner.
   1. At Substantial Completion, transfer all licenses and media to Owner.
   2. At Substantial Completion, all software must be latest edition and licensed to the Owner.
   3. Software shall be lifetime licensed and be OEM supported for at least 10 years from date of license transfer.

B. Programming.
   1. Languages supported: All application programming in IEC 61131-3 compliant language.
   2. Program PLC utilizing ladder diagram, function block, or structured text format.
   3. Protect program via removable key switch or password to prevent unauthorized changes. Provide password and/or programming keys to Owner.
   4. Capable of on-line and off-line programming.

C. PLC program Structure.
   1. Clear, concise, well-annotated logic.

2. Implement a modular design to allow specific functions to be replicated to ensure consistency.
3. Program shall align with the control strategies. Include comments reflecting alignment with control strategies.
4. Include named variables that reflect the actual use of the variable.
5. Annotate program listing to include the following (using the features of the appropriate PLC programming software):
    a. Clearly identified variables, I/O points, contacts, and analog values.
    b. Written description of each functional area.
    c. Written description of each rung's function.
    d. Reference to control loop number for each rung where applicable.
    e. Reference to instrumentation tag number of I/O devices for each rung where applicable.

D. Manufacturer support
1. Submit a written proposal for a manufacturer support agreement for all products specified herein for a minimum of 12 months starting at final completion of the project. The cost of this manufacturer support agreement shall not be included in the Contract Price. The support agreement shall be executed in the name of, and for the benefit of, the Owner. At a minimum, this agreement shall provide the Owner with:
    a. 8 AM to 5 PM, 5 day per week manufacturer telephone support.
    b. Access to the manufacturer's technical support website.
    c. Software updates and patches.

2.6 COMPONENTS

A. PLC System Central Processor Unit (CPU):
1. The PLC shall have the capability of communicating with other commonly specified PLC and control system protocols such as Modbus/RTU, Modbus/TCP, Profibus, Ethernet/TCP and OPC.
2. CPU shall include capability to modify logic via an Ethernet port without taking processor off line.
3. Memory:
    a. Battery-backed RAM.
    b. Non-volatile program storage via flash EEPROM:
        1) Automatically download to RAM in the event RAM is corrupted.
4. Memory battery backup shall be capable of 180 days memory retention with fresh battery.
    a. Provide visual indication of battery status and alarm low battery voltage.
    b. Memory battery backup shall be capable of 28 days memory retention after the "Battery Low" indicating LED is on.
5. Plug-in card designed to allow quick field replacement of faulty devices.
    a. Provide unit designed for field replacement and expansion of memory without requiring rewiring or use of special tools.
6. 20% minimum spare useable memory capacity after all required programming is in place and operating.
7. Capable of executing all control functions required by the Specifications and Drawings.
8. Built-in three-mode (proportional-integral-derivative) control capabilities.
    a. As directly selectable algorithms requiring no user knowledge of programming languages.
9. Lighted status indicators for "RUN" and "FAILURE".
10. Capable of manual or automatic control mode transfer from the operating console stations or from within the control strategy.
    a. Transfer shall be bumpless and balanceless.

B. Input/output (I/O) Modules:
1. Provide plug-in modular-type I/O racks with cables to connect to all other required PLC system components.
2. Provide I/O system with:

a. I/O solid state boards with status lights indicating I/O status.
b. Electric isolation between logic and field device.
c. Capability of withstanding low energy common mode transient to 1000 V without failure.
d. Incorporate noise suppression design.
e. Capable of meeting or exceeding electrical noise tests, NEMA ICS 1-109.60-109.66.
f. Capable of being removed and inserted into the I/O rack under power, without affecting any other I/O modules in the rack.
g. Install 20% spare I/O points for each type.

3. Input/output connection requirements:
   a. Make connections to I/O subsystem by terminating all field wiring on terminal blocks within the I/O enclosure.
   b. Prewire I/O modules to terminal blocks.
   c. Provide terminal blocks with continuous marking strip.
   d. Size terminals to accommodate all active data base points and spares.
   e. Provide terminals for individual termination of each signal shield.
   f. Field wiring shall not be disturbed when removing or replacing an I/O module.
4. Discrete I/O modules:
   a. Interface to ON/OFF devices.
   b. I/O status indicator on module front.
   c. Voltage rating to match circuit voltage.
   d. Output module current rating:
      1) Match maximum circuit current draw.
      2) Minimum 1.0 continuous A/point for 120 VAC applications.
   e. Isolated modules for applications where one module interfaces with devices utilizing different sources of power.
5. Discrete outputs shall be fused:
   a. Provide one fuse per common or per isolated output.
   b. Provide blown fuse indication.
   c. External fusing shall be provided if output module does not possess internal fusing.
   d. Fuses provided external to output model shall:
      1) Be in accordance with module manufacturer's specifications.
      2) Be installed at terminal block.
6. Analog I/O modules:
   a. Input modules to accept signals indicated on Drawings or Specifications.
   b. Minimum 12 bit resolution.
   c. I/O chassis supplied power for powering connected field devices.
   d. Differential inputs and outputs.
   e. User configurable for desired fault-response state.
   f. Provide output signals as indicated on Drawings and Specifications.
   g. Individual D/A converter for each output module.
   h. Individual A/D converter for each input module.
7. Communications Modules:
   a. Provide communications modules as-shown on Drawings.
   b. Provide communications modules for each protocol required for a complete communications system as shown on drawings.
   c. Multi-port Ethernet modules may not be utilized as a network switch or to bridge networks.
   d. [Separate communications modules and networks are required for I/O devices and PLC to HMI communications].

C. Power Supply Units:
1. Provide regulated power units:
   a. Designed to operate with PLC system and shall provide power to:
      1) All components of PLC system.
      2) All two-wire field instruments.

3) Other devices as indicated on Drawings or Specifications.
b. Capable of supplying PLC system when all of the specified spare capacity is utilized.
c. Each power supply shall be sized such that it will carry no more than 75% of capacity under normal loads.
2. Electrical service to PLC system is 120 VAC, 60 Hz.
3. Separate AC circuit breakers shall be provided for each power supply.
4. If the PLC system is field expandable beyond the specified spare capacity, and if such expansion requires power supply modification, note such requirements in the submittals and allow room for power supply modification in the PLC system enclosure.
5. Capable of meeting or exceeding electrical noise tests, NEMA ICS 1-109.60-109.66.
6. Power distribution:
a. Immune to transients and surges resultant from noisy environment.
b. Shall provide constant voltage level DC distribution to all devices.
7. Provide uninterruptible power supply (UPS) to sustain full power to UPS powered loads listed below for a minimum of 30 minutes following loss of primary power and to ensure that the transient power surges and dips do not affect the operation of the PLC system.
a. UPS powered loads:
1) All rack mounted PLC components.
2) Local operator consoles.
3) All power supplies furnished with the PLC and associated loads.
b. Input:
1) 108 to 132 VAC.
2) 57 to 63 Hz.
3) Line fuse protection.
c. Output:
1) 120 VAC nominal.
2) 60 Hz.
3) Short circuit protected.
4) Instantaneous transfer time.
d. IEEE C62.41 Class A voltage surges of 6000 V attenuated to less than 50 V on the output.
e. Battery: Maintenance free lead acid.

D. PLC System Enclosure:
1. In accordance with Specification Section 40 67 00 - Control Panels.
2. Component placement:
a. Mount all controller components vertically within the enclosure to allow maximum convection cooling.
b. Either install power supplies above all other equipment with at least 10 inches of clearance between the power supply and the enclosure top, or adjacent to other components, but with sufficient spacing for circulation of cooling air.
c. Do not place I/O racks directly above the CPU or power supply.
d. Locate incoming line devices (isolation or constant voltage transformers, local power disconnects, surge suppressors, etc.) so as to keep power wire runs within an enclosure as short as possible.
e. If items such as magnetic starters, contactors, relays, and other electromagnetic devices must be located within the same enclosure as the PLC system components, place a barrier with at least 6 inches of separation between the magnetic area and the control area.
f. Place circulating fans close to major heat generating devices.
g. Segregate input/output modules into groups of identical type.
3. Wiring and grounding to be in accordance with Specification Section 40 67 00.
4. Termination requirements:
a. In accordance with Specification Section 40 67 00.
b. Make connections to I/O subsystem by terminating all field wiring on terminal blocks within the enclosure.

c. Prewire I/O modules to terminal blocks.
d. Size terminals to accommodate all active database points and spares.
e. Provide terminals for individual termination of each signal shield.
f. Field wiring shall not be disturbed when removing or replacing an I/O module.

E. PLC System Software and Programming:
1. Provide all hardware and programming required to provide communication between the PLC and the human-machine interface.
2. Coordinate with HMI programmer to allow modification of all setpoint through the HMI utilizing appropriate security considerations. [Configure scaling and setpoint validation within PLC logic].
3. All communications logic shall include a watch-dog timer and alarm for loss of communications. [Logic shall respond to communications failure as shown in drawings and specifications.] [Coordinate communications failure response with Owner].
4. Provide programming to accomplish all control and monitoring requirements of the Drawings and Specifications.
5. Full documentation capability.
6. Online and offline programming.
7. Offline simulation prior to download.
8. Program over network capability.
9. Two-step commands requiring PLC programmer verification prior to modification of any programming.

2.7 ACCESSORIES

A. Provide all accessories required to install and test a complete PLC control system to accomplish the requirements of the Drawings and Specifications.

B. Provide all programming cables required to configure the PLC logic.

2.8 SOURCE QUALITY CONTROL

A. Perform Factory Acceptance Testing in accordance with Specification Section 40 61 21 - Process Control System Testing.

2.9 MAINTENANCE MATERIALS

A. Furnish Owner with the following extra spares:
1. One spare CPU for every [four] field CPUs or fraction thereof installed.
2. One spare communication module by type installed in the Plant.
3. One spare I/O card of each card type for every 10 cards or fraction thereof installed.
4. One spare power supply for every 10 power supplies or fraction thereof installed.
5. A set of spare fuses for all installed types.

B. Include a complete bill of materials itemizing each line item with make and model (part) number.

C. Include a complete set of all special tools required to install, maintain and test the PLCs.

PART 3 - EXECUTION

3.1 FUNCTIONALITY

A. Complete System.
1. Provide all graphics and logic programming, configuration, coordination, integration, and testing required for furnishing a fully functioning system.
2. Provide interface support with all foreign device interfaces (FDI) communicating with the PLC system.

3.2 INSTALLATION

A. Install PLC control system in accordance with manufacturer's written instructions.

3.3 FIELD QUALITY CONTROL

A. Test system in accordance with Specification Section 40 61 21 - Process Control System Testing.

B. Demonstrate system in accordance with Specification Section 01 75 00 - Checkout and Start-Up Procedures.

3.4 TRAINING

A. Employee of the manufacturer or certified representative to provide one week of operation and maintenance training at the Project site after the system has successfully undergone all field testing and acceptance procedures.

B. As a minimum, training shall cover:
   1. Hardware overview.
   2. Software overview.
   3. Documentation.
   4. Maintenance.
   5. Trouble shooting.
   6. Operation, e.g., changing set points, passwords, etc.

3.5 DOCUMENTATION

A. Update O&M manuals to reflect as-built conditions.

3.6 SUPPORT

A. Provide on-call technical support for a period of one year after substantial completion. Include a minimum of two site visits to work with Owner on any final modifications to the logic.

END OF SECTION

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SECTION 40 66 05
NETWORK EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Computer network requirements, which include, but are not necessarily limited to:
      a. Ethernet Switches.
      b. Firewalls.

B. Related Sections include but are not necessarily limited to:
   1. Section 40 61 13 - Process Control Systems General Requirements.
   2. Section 40 61 21 - Process Control System Testing.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
      a. 802.3, Information Technology - Local and Metropolitan Area Networks - Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications.
         1) 802.3u: IEEE Standards for Local and Metropolitan Area Networks: Supplement to Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications Media Access Control (MAC) Parameters, Physical Layer, Medium Attachment Units, and Repeater for 100 Mb/s Operation, Type 100BASE-T.
         2) 802.3x: IEEE Standards for Local and Metropolitan Area Networks: Specification for 802.3 Full Duplex Operation.
   2. National Institute of Standards and Technologies (NIST):
      a. 800-82, Guide to Industrial Control Systems (ICS) Security.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 40 61 13 - Process Control System General Requirements.

B. Product Data:
   1. Acknowledgement that products submitted meet requirements of standards referenced.
   2. Network requirements verification plan.

C. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the manufacturers listed within the following Articles are acceptable.

2.2 ETHERNET SWITCHES

A. Accessories: "Stack Module" as required to create logical switches and reduce network latency.

B. Provide Ethernet switches as shown on the Drawings and the Schedule herein.

C. Layer 2 –Panel Mounted Ethernet Switches:
   1. Manufacturers:
      a. Hirschmann.
      b. N-TRON.
      c. Phoenix Contact.
      d. Allen-Bradley/Cisco.
      e. Moxa.
   2. Design and fabrication:
      a. Support Ethernet 100/1000 Mbps.
      b. Two backbone ports for connection to single mode fiber via type LC connectors (ST not allowed).
      c. 16 100/1000 Mbps twisted pair ports (RJ45) as required for communication with devices as depicted in the Contract Documents. 16 port minimum.
         1) Unless otherwise noted, provide at least two spare 100/1000 MBit/s port (twisted pair) at each Ethernet switch.
      d. Support SNMP v3 and Web based management.
      e. Rapid Spanning Tree Protocol.
      f. IGMP (Internet Group Management Protocol) support for IP multicast filtering to enable switches to automatically route messages only to appropriate ports.
      g. Check all received data for validity.
         1) Discard invalid and defective frames or fragments.
      h. Monitor connected TP/TX line segments for short-circuit or interrupt using regular link test pulses in accordance with IEEE 802.3.
      i. Monitor attached fiber optic lines for open circuit conditions in accordance with IEEE 802.3.
      j. As applicable, meet requirements of IEEE 802.3.
      k. One rack unit (RU) form factor.
      l. Power switch with 120 VAC power input.
      m. Provide dual redundant power supplies.
      n. Provide LED status lights to indicate:
         1) Power: Supply voltage present.
         2) Fault.
         3) Port status.
      o. Environmental rating:
         1) Operating temperature: 32 degrees F to 122 degrees F.
         2) Humidity: 95% relative humidity, non-condensing.
   3. Function in self-healing ring structure.
      a. If one section in the ring fails, the ring structure changes to a line structure within 0.5 seconds.
   4. DIN Rail mounted.

D. Small Form-Factor Pluggable (SFP) Modules:
   1. Provide SFPs as required to support the communication capability shown on the Drawings. Use SFPs instead of media converters. Media converter use is prohibited unless approved in writing.
   2. Hardware Features:
      a. At least two SFP ports per switch supplied with 1 Gbps fiber transceivers for connection to single mode fiber via type LC connectors. Quantity and type as required for communication with devices as depicted in the Contract Documents.
      b. Diagnostic data for the associated media type available through the command line interface of the switch.
      c. 10/100/1000 MBit/s twisted pair ports (RJ45) as required for communication with devices as depicted in the Contract Documents.
         1) Unless otherwise noted, provide at least two spare 10/100/1000 MBit/s port (twisted pair) at each Ethernet switch.
      d. Check all received data for validity.

1) Discard invalid and defective frames or fragments.

e. Monitor connected TP/TX line segments for short-circuit or interrupt using regular link test pulses in accordance with IEEE 802.3.

f. Monitor attached fiber optic lines for open circuit conditions in accordance with IEEE 802.3.

g. As applicable, meet requirements of IEEE 802.3.

h. Power switch with 24 VDC power input.

i. Provide LED status lights to indicate:
   1) Power: Supply voltage present.
   2) Fault.
   3) Port status.

j. Environmental rating:
   1) Operating temperature: 32 degrees F to 122 degrees F.
   2) Humidity: 95% relative humidity, non-condensing.

k. Accessories: Provide port locks for all unused ports.

E. Configuration:
   1. All managed switch unused ports shall be administratively disabled. Sticky MAC or similar port configuration shall be utilized to bind ports to MAC address of connected device per NIST 800-82.
   2. Layer 3 switches shall be configured using static routes per NIST 800-82 best practices. Routes between VLANS shall be restricted except where required to achieve contract required functionality.
   3. Change default usernames and passwords.

F. Schedule:

EQUIPMENT NO.	DESCRIPTION	LOCATION	QUANTITY	SUPPLIED BY
ES-101	Unmanaged Ethernet Switch, 2-Fiber Port, 16 RJ45	PLC-101 Control Panel	1	PLC Control Panel supplier
ES-102	Unmanaged Ethernet Switch, 2-Fiber Port, 16 RJ45	PLC-102 Control Panel	1	PLC Control Panel supplier

2.3 SOURCE QUALITY CONTROL

A. Provide Factory testing if required in section 40 61 21 - Process Control System Testing.

2.4 ACCESSORIES AND MAINTENANCE MATERIALS

A. Provide all accessories required to furnish a complete computer-based network for the control system to accomplish the requirements of the Drawings and Specifications.

B. Furnish Owner with the following extra materials:
   1. One spare Ethernet switch of each type utilized.

PART 3 - EXECUTION

3.1 DEMONSTRATION

A. Demonstrate system in accordance with Section 01 75 00 - Checkout and Start-Up Procedures.

3.2 FIELD QUALITY CONTROL

A. Verify network is configured per requirements herein.

B. Submit verification plan.

3.3 INSTALLATION AND CHECKOUT

A. Provide installation and checkout in accordance with Section 40 61 13 - Process Control System General Requirements and Section 40 61 21 - Process Control System Testing.

END OF SECTION

SECTION 40 67 00
CONTROL SYSTEM EQUIPMENT PANELS AND RACKS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Requirements for control panels and enclosures utilized as follows:
      a. Unless noted otherwise, all control panels and enclosures housing control components that are specified in , Section 40 71 00, Section 40 72 00, Section 40 73 00, Section 40 63 43, Section 40 78 00, or Section 40 61 43.
      b. This Section is only applicable to panels furnished with equipment specified in other specification divisions when so stated in the applicable equipment specification section.

B. Related Sections include but are not necessarily limited to:
   1. Section 10 14 00 - Identification Devices.
   2. Section 26 05 19 - Wire and Cable - 600 Volt and Below.
   3. Section 40 61 13 - Process Controls Systems General Requirements.
   4. Section 40 61 21 - Process Control System Testing.
   5. Section 40 61 43 - Surge Protection Devices for Instrumentation and Control Equipment.
   6. Section 40 63 43 - Programmable Logic Controllers.
   7. Section 40 71 00 - Flow Measurement.
   8. Section 40 72 00 - Level Measurement.
   9. Section 40 73 00 - Pressure Instrumentation.
   10. Section 40 74 00 - Temperature Measurement.
   11. Section 40 75 00 - Process Liquid Analytical Measurement.
   12. Section 40 78 00 - Panel Mounted Instruments.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American National Standards Institute (ANSI).
   2. ASTM International (ASTM):
      a. B75, Standard Specification for Seamless Copper Tube.
   3. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
      b. ICS 4, Industrial Control and Systems: Terminal Blocks.
   4. National Fire Protection Association (NFPA):
      a. 70, National Electrical Code (NEC):
         1) Article 409, Industrial Control Panels.
         2) Article 504, Intrinsically Safe Systems.
   5. Underwriters Laboratories, Inc. (UL):
      a. 508A, Standard for Safety Industrial Control Panels.
      b. 698A, Standard for Industrial Control Panels Relating to Hazardous (Classified) Locations.
      c. 913, Standard for Safety Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1, Hazardous (Classified) Locations.

B. Qualifications:
   1. See Section 40 61 13 - Process Control Systems General Requirements.

C. Miscellaneous:
   1. Approved supplier of Industrial Control Panels under provisions of UL 508A or UL 698A.
      a. Entire assembly shall be affixed with a UL 508A or UL 698A label "Listed Enclosed Industrial Control Panel" prior to shipment to the jobsite.

b. Control panel(s) without an affixed UL 508A or UL 698A label shall be rejected and sent back to the Contractor's factory.

1.3 DEFINITIONS

A. Panel: Control panels or enclosures listed in the schedule included in this Specification Section.

B. Foreign Voltages: Voltages that may be present in circuits when the panel main power is disconnected.

C. Intrinsically Safe:
   1. A device, instrument or component that will not produce sparks or thermal effects under normal or abnormal conditions that will ignite a specified gas mixture.
   2. Designed such that electrical and thermal energy limits inherently are at levels incapable of causing ignition.

D. Intrinsically Safe Circuit: A circuit in which any spark or thermal effect is incapable of causing ignition of a mixture of flammable or combustible material in air under test conditions as prescribed in UL 913.

E. Cable: Multi-conductor, insulated, with outer sheath containing either building wire or instrumentation wire.

F. Instrumentation Cable:
   1. Multiple conductor, insulated, twisted or untwisted, with outer sheath.
   2. Instrumentation cable is typically either TSP (twisted-shielded pair) or TST (twisted-shielded triad) and is used for the transmission of low current or low voltage signals.

G. Ground Fault Circuit Interrupter (GFCI): A type of device (e.g., circuit breaker or receptacle) which detects an abnormal current flow to ground and opens the circuit preventing a hazardous situation.

H. Programmable Logic Controller (PLC): A specialized industrial computer using programmed, custom instructions to provide automated monitoring and control functions by interfacing software control strategies to input/output devices.

I. Remote Terminal Unit (RTU): An industrial data collection device designed for location at a remote site, that communicates data to a host system by using telemetry such as radio, dial-up telephone, or leased lines.

J. Input/Output (I/O): Hardware for the moving of control signals into and/or out of a PLC or RTU.

K. Supervisory Control and Data Acquisition (SCADA): Used in process control applications, where programmable logic controllers (PLCs) perform control functions but are monitored and supervised by computer workstations.

L. Highway Addressable Remote Transducer (HART): a bi-directional communication protocol that provides data access between intelligent field instruments and host systems.

M. Digital Signal Cable: Used for the transmission of digital communication signals between computers, PLCs, RTUs, etc.

N. Uninterruptible Power Supply (UPS): A backup power unit that provides continuous power when the normal power supply is interrupted.

O. Loop Calibrator: Portable testing and measurement tool capable of accurately generating and measuring 4-20mA DC analog signals.

1.4 SUBMITTALS

A. See Section 40 61 13.

B. Shop Drawings:

1. Table of contents sheet(s).
2. Legend and abbreviation sheets.
3. Panel exterior layout drawings.
4. Panel interior layout drawings.
5. Wiring diagrams.
6. Communication network drawing(s).
7. Bill of Material for each panel.
8. Panel door weight calculation.
9. Electrical load calculations for each panel.
10. Climate control calculations for each panel.

C. Product Data:
   1. Manufacturer catalog cut sheets for enclosure, finish, panel devices, control auxiliaries, and accessories.

D. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

E. Informational Submittals:
   1. Unwitnessed Factory Testing confirmation of completion.
   2. Record Drawings:
      a. Updated panel drawings delivered with the panel(s) from the Contractor's factory.
      b. Drawings shall be enclosed in transparent plastic and firmly secured within each panel.

1.5 SUBMITTAL DOCUMENTATION REQUIREMENTS

A. Shop Drawings:
   1. Prepared with computer aided design (CAD) software.
   2. Printed on 11 by 17 inches sheets.
   3. Drawings shall include a title block containing the following:
      a. Plant or facility name where panel(s) are to be installed.
      b. Drawing title.
      c. Drawing number.
      d. Revision list with revision number and date
      e. Drawing date.
      f. Drawing scale.
      g. Manufacturer name, address, and telephone number.
   4. Cover sheet for each drawing set shall indicate the following:
      a. Plant or facility name.
      b. Project name.
      c. Submittal description.
      d. Revision number.
      e. Issue date.
   5. Table of contents sheet(s) shall indicate the following for each drawing in the set:
      a. Drawing number.
      b. Drawing title.
      c. Sheet number.
   6. Legend and abbreviation sheets shall indicate the following:
      a. Description of symbols and abbreviations used.
      b. Panel construction notes including enclosure NEMA rating, finish type and color, wire type, wire color strategy, conductor sizes, and wire labeling strategy.
      c. Confirmation that the panel(s) are to be affixed with a UL 508A or UL 698A label prior to shipment from the factory.
   7. Bill of Material for each panel shall include the following component information:
      a. Instrument tag number.
      b. Quantity.

c. Functional name or description.
d. Manufacturer.
e. Complete model number.
f. Size or rating.

8. Panel exterior layout drawings to scale and shall indicate the following:
   a. Panel materials of construction, dimensions, and total assembled weight.
      1) All dimensions shall be in inches.
   b. Panel access openings.
   c. Conduit access locations.
      1) Ensure conduit entry locations allow for sufficient bend radius of field cables entering enclosure.
      2) Control panel exterior layout shall identify conduit and cable entry locations.
   d. Front view, side views and top view of enclosure.
   e. Front panel device layout.
   f. Nameplate schedule:
      1) Nameplate location.
      2) Nameplate dimensions.
      3) Legend which indicates text, letter height and color, background color and nameplate material.
      4) Include exterior legends as per UL requirements.
      5) Short Circuit Current Rating (SCCR) marking per NFPA 70 or statement of exception. Include any required calculations.
   g. Alarm annunciator window engraving schedule.
   h. Layouts of graphic panels or mosaic displays.
   i. Include a statement on the drawings that indicates that the panel has been built as per UL508A or UL698A standards.
9. Panel interior layout drawings shall be drawn to scale and shall indicate the following:
   a. Sub-panel or mounting pan dimensions.
      1) All dimensions shall be in inches.
   b. Interior device layouts indicating dimensioned location of devices.
   c. PLC/RTU general arrangement layouts.
   d. Wire-way locations, purpose, and dimensions. Include center line dimensions for all DIN rail and wire-way.
   e. Terminal strip designations.
   f. Location of external wiring and/or piping connections.
   g. Location of lighting fixtures, switches and receptacles.
   h. Include interior legends as per UL requirements.
10. Wiring diagrams shall consist of the following:
   a. Panel power distribution diagrams.
   b. Control and instrumentation wiring diagrams.
   c. PLC/RTU I/O information:
      1) Model number of I/O module.
      2) Description of I/O module type and function.
      3) Rack and slot number.
      4) Terminal number on module.
      5) Point or channel number.
      6) Programmed point addresses.
      7) Signal function and type.
   d. Internal network connections diagram
   e. Wiring diagrams shall identify each wire as it is to be labeled.
   f. Wiring diagrams shall include line/ rung references.
   g. Relay coils and their associated contacts shall be cross referenced to each other and clearly identified on the drawings.
   h. Wires leaving the sheet shall clearly indicate the continuation sheet and line/ rung references.

11. Communication network drawing(s) shall include:
    a. Network equipment
    b. Interconnections between all network equipment within the panel.
    c. Connection to the plant network.

B. Verify that panel door mounted equipment will not exceed the maximum allowed weight as per manufacturer's specification.
    1. Submit panel door weight calculation. Include weight of computer if using a laptop shelf.

C. Electrical load calculations for each panel:
    1. Panel current draw based on connected load.
    2. SSCR Calculations.
    3. UPS Run time calculations.
    4. DC power supply load calculations.
    5. Climate control calculations for each panel.
    6. Verify that sufficient dissipation and/or generation of heat is provided to maintain interior panel temperatures within the rated operating temperatures of panel components.
    7. Submit control panel heat release calculations (Watts or BTU/HR). Verify results with cooling/heating software. Submit heating and/or cooling equipment as required. Refer to Section 2.1.
    8. Provide temperature monitoring switch when an air conditioner is required by heat release calculations. High Temperature switch shall be wired to a PLC discrete input for temperature monitoring.
    9. Provide temperature monitoring switch when heater is required by heat release calculations. Low temperature switch shall be wired to a PLC discrete input for temperature monitoring.
    10. Air conditioners shall have built-in temperature display.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
    1. Enclosures:
        a. Hoffman Engineering Co.
        b. Hammond Manufacturing.
        c. Saginaw Control and Engineering.
        d. Rittal
    2. Panel heaters:
        a. Hoffman Enclosures, Inc.
        b. Hammond Manufacturing.
        c. Rittal
    3. Heat exchangers and air conditioners:
        a. Hoffman Engineering Co.
        b. Hammond Manufacturing.
        c. Saginaw Control and Engineering.
        d. Rittal
        e. Pfannenberg.
        f. Kooltronic
    4. Cooling fans and exhaust packages:
        a. Hoffman Enclosures, Inc.
        b. Hammond Manufacturing.
        c. Saginaw Control and Engineering.
        d. Rittal
    5. Internal corrosion inhibitors:
        a. Hoffman Enclosures, Inc.; Model A-HC110E
        b. Northern Technologies International Corporation (NTIC); Model Zerust VC.

c. Cortec Corporation; Model VpCI Emitting Systems.

2.2 ACCESSORIES

A. Panel Nameplates and Identification:
   1. See Section 10 14 00.

B. Free standing enclosures containing a PLC shall be provided with an interior swing out shelf for laptop computers.

C. Enclosures shall be provided with print pocket mounted on the interior of the door. Free standing enclosures shall have a minimum size print pocket of 12 inches.

D. Enclosures containing a PLC shall include door contacts to monitor enclosure door status. Door contacts shall be wired to a PLC input for monitoring status.

E. All field instrument enclosure penetrations shall be plugged using threaded conduit plugs to prevent water or contaminant entry into the enclosure during installation.
   1. Instruments shall maintain manufacturer's rating for the appropriate area designation.
   2. Tape and/or plastic plugs shall not be an acceptable means of preventing water/contaminate intrusion.

2.3 FABRICATION

A. General:
   1. Fabricate panels with instrument arrangements and dimensions identified in the Contract Documents.
   2. Provide panel(s) with the required enclosure rating per NEMA 250 to meet classifications identified in the Contract Documents.
   3. Devices installed in panel openings shall have a NEMA enclosure rating at least equal to the panel enclosure rating.
      a. Devices that cannot be obtained with an adequate NEMA rating shall be installed behind a transparent viewing window.
      b. The window shall maintain the required NEMA rating of the enclosure.
   4. Externally mounted components including but not limited to air conditioners, enclosed transformers, external disconnect switches and external surge protector boxes shall match the NEMA rating and be constructed of the same material as the control panel. As an illustrative example, a NEMA 3/3R external enclosed transformer shall not be mounted on a NEMA 4X stainless steel panel.
   5. Panel(s) shall be completely assembled at the Contractor's factory.
      a. No fabrication other than correction of minor defects or minor transit damage shall be performed on panels at the jobsite.
   6. Painting:
      a. Panels fabricated from steel shall have their internal and external surfaces prepared, cleaned, primed, and painted.
         1) Mechanically abrade all surfaces to remove rust, scale, and surface imperfections.
         2) Provide final surface treatment with 120 grit abrasives or finer, followed by spot putty to fill all voids.
         3) Utilize solvent or chemical methods to clean panel surfaces.
         4) Apply surface conversion of zinc phosphate prior to painting to improve paint adhesion and to increase corrosion resistance.
         5) Electrostatically apply polyester urethane powder coating to all inside and outside surfaces.
         6) Bake powder coating at high temperatures to bond coating to enclosure surface.
            a) Panel interior shall be white with semi-gloss finish.
            b) Panel exterior shall be ANSI #61 gray with flat finish.
         7) Application of alkyd liquid enamel coating shall be allowed in lieu of polyester urethane powder for wall mounted NEMA 1 or NEMA 12 rated panels.
      b. Panels fabricated from stainless steel, aluminum, or fiberglass shall not be painted.

7. Finish opening edges of panel cutouts to smooth and true surface conditions.
    a. Panels fabricated from steel shall have the opening edges finished with the panel exterior paint.
8. Panels shall meet all requirements of UL 508A or UL 698A.
    a. If more than one disconnect switch is required to disconnect all power within a panel or enclosure, provide a cautionary marking with the word "CAUTION" and the following or equivalent, "Risk of Electric Shock-More than one disconnect switch required to de-energize the equipment before servicing."
9. Provide control panel in accordance with NFPA 70, Article 409.
    a. In the event of any conflict between NFPA 70, Article 409 and UL 508A or UL 698A, the more stringent requirement shall apply.
10. Provide equipment or control panels with Short Circuit Current Rating (SCCR) labeling as required by NFPA 70 and other applicable codes.
    a. Determine the SCCR rating by one of the following methods:
        1) Method 1: SCCR rating meets or exceeds the available fault current of the source equipment when indicated on the Drawings.
        2) Method 2: SCCR rating meets or exceeds the source equipment's Amp Interrupting Current (AIC) rating as indicated on the Drawings.
        3) Method 3: SCCR rating meets or exceeds the calculated available short circuit current at the control panel.
    b. The source equipment is the switchboard, panelboard, motor control center or similar equipment where the control panel circuit originates.
    c. For Method 3, provide calculations justifying the SCCR rating. Utilize source equipment available fault current or AIC rating as indicated on the Drawings.

B. Free-Standing Panels:
1. Welded construction.
2. Completely enclosed, self-supporting, and gasketed, dust-tight.
3. Rolled lip around all sides of enclosure door opening.
4. Seams and corners welded and ground smooth to touch and smooth in visual appearance.
5. Full height, fully gasketed flush pan doors.
6. Full length piano hinges rated for 1.5 times door plus instrument weight.
7. Doors with keyed alike locking handles and three-point catch.
8. Appropriate conduit, wiring, and instrument openings shall be provided.
9. Lifting eyebolts to allow simple, safe rigging and lifting of panel during installation.

C. Wall Mounted Panels:
1. Seams continuously welded and ground smooth.
2. Rolled lip around all sides of enclosure door opening.
3. Gasketed dust tight.
4. [Door clamps and hasp/staple for padlocking] [Three-point latching mechanism operated by oil tight key-locking handle].
5. Key doors alike.
6. Continuous heavy GA hinge pin on doors.
    a. Hinges rated for 1.5 times door plus instrument weight.
7. Front full opening door.
8. Brackets for wall mounting.

D. Internal Panel Wiring:
1. Panel wire duct shall be installed between each row of components, and adjacent to each terminal strip.
    a. Route wiring within the panel in wire-duct neatly tied and bundled with tie wraps.
    b. Size wire ducts to include a minimum of 20% spare fill capacity.
    c. Wire-duct shall have removable snap-on covers and perforated walls for easy wire entrance.
    d. Wire-duct shall be constructed of nonmetallic materials with rating in excess of the maximum voltage carried therein.

2. Lay out panel wire-duct on both sides of each terminal strip. Leave one wire-duct empty, so the field wiring has sufficient room for entry into the panel through this wire-way. Designate the other wire-duct for panel wiring.
3. Utilize fiber optic and Ethernet cable management accessories within the panel.
    a. Terminate Ethernet cables from the field to RJ45 punch down blocks. Connect Ethernet patch cords from the RJ45 punch down block to the Ethernet switch.
    b. Terminate Fiber optic cable from field in fiber optic patch panel. Terminate all fibers within the cable. Connect Fiber optic patch cords from the fiber optic patch panel to the fiber optic Ethernet switch.
4. Wiring shall be installed such that if wires are removed from one device, source of power will not be disrupted to other devices.
5. "Daisy-chaining" of ground cables or power neutrals between equipment is not permitted.
6. Terminate all internal wiring with no more than two (2) conductors per terminal block point. For terminal strips designated for field wiring, only one side of the terminal strip shall be used for panel wiring.
7. Splicing and tapping of wires permitted only at terminal blocks.
8. Wire bundles to doors shall be secured at each end so that bending or twisting will be around longitudinal axis of wire.
    a. Protect bend area with sleeve.
9. Arrange wiring neatly, cut to proper length, with surplus wire removed.
    a. Arrange wiring with sufficient clearance.
    b. Provide abrasion protection for wire bundles that pass through openings or across edges of sheet metal.
10. To eliminate noise coupling or interference, AC power and control circuits shall be routed separate from analog signal cables, low voltage control circuits, and communications cables and digital signal cables.
    a. Separate by at least 6 inches, except at unavoidable crossover points and at device terminations.
    b. All wiring shall be bundled and supported by straps.
11. Separation of intrinsically safe circuit conductors and non-intrinsically safe circuit conductors:
    a. Secure conductors so that any intrinsically safe circuit conductor that might come loose from a terminal is unlikely to come into contact with another terminal.
    b. Separate non-intrinsically safe circuit conductors from intrinsically safe circuit conductors by one of the following methods:
        1) Separation of non-intrinsically safe circuit conductors from intrinsically safe circuit conductors by at least 2 inches (50 mm).
        2) Separation of non-intrinsically safe circuit conductors from intrinsically safe circuit conductors by use of a grounded metal partition 0.0359 inches (0.91 mm) or thicker.
        3) Separation of non-intrinsically safe circuit conductors from intrinsically safe circuit conductors by use of an approved insulating partition that extends to within 0.0625 inches (1.5 mm) of the enclosure walls.
        4) Where either (1) all of the intrinsically safe circuit conductors or (2) all of the non-intrinsically safe circuit conductors are in grounded metal-sheathed or metal-clad cables where the sheathing or cladding is capable of carrying fault current to ground.
    c. Blue wire-duct shall be used for wires carrying intrinsically safe circuit conductors.
12. Separate different intrinsically safe circuit conductors from each other by one of the following means:
    a. The conductors of each circuit are within a grounded metal shield.
    b. The conductors of each circuit have insulation with a minimum thickness of 0.01 inches (0.25 mm).

13. Provide minimum clearance of 0.125 inches (3 mm) between uninsulated parts of intrinsically safe field wiring conductors connected to terminals and grounded metal or other conducting parts.
14. Wiring to pilot devices or rotary switches shall be individually bundled and installed with a "flexible loop" of sufficient length to permit the component to be removed from panel for maintenance without removing terminations.
15. Conductors for AC and DC circuits shall be type MTW stranded copper listed for operation with 600 V at 90 degrees C.
    a. Conductor size shall be as required for load and 16 AWG minimum.
    b. Internal panel wiring color code:
        1) AC circuits:
            a) Power wiring: Black.
            b) Control interconnections: Red.
            c) Neutral: White.
            d) Ground: Green.
        2) Low voltage DC circuits:
            a) Power wiring: Dark Blue(+) and White with Blue stripe.
            b) Control interconnections: Dark Blue.
        3) Foreign voltage circuits: Yellow.
        4) Annunciator circuits: Red.
        5) Intrinsically safe circuits: Light Blue.
16. Analog signal cables shall be of 600 V insulation, stranded copper, twisted-shielded pairs.
    a. Conductor size: 18 AWG minimum.
    b. Terminate shield drain conductors to ground only at one end of the cable.
17. High precision 250 ohm resistors with 0.25 % accuracy shall be used where 4 - 20 mA DC analog signals are converted to 1 - 5 VDC signals.
    a. Resistors located at terminal strips.
    b. Resistors terminated using individual terminal blocks and with no other conductors.
    c. Resistor leads shall be un-insulated and of sufficient length to allow test or calibration equipment (e.g., HART communicator, loop calibrator) to be properly attached to the circuit with clamped test leads.
18. Analog signals for devices in separate enclosures shall not be wired in series.
    a. Loop isolators shall be used where analog signals are transmitted between control enclosures.
19. Wire and cable identification:
    a. Wire and cables numbered and tagged at each termination.
    b. Wire tags:
        1) See Section 10 14 00 - Identification Devices.

E. Grounding Requirements:
1. Equipment grounding conductors shall be separated from incoming power conductors at the point of entry.
2. Minimize grounding conductor length within the enclosure by locating the ground reference point as close as practical to the incoming power point of entry.
3. Bond electrical racks, chassis and machine elements to a central ground bus.
    a. Nonconductive materials, such as paint, shall be removed from the area where the equipment contacts the enclosure.
4. Bond the enclosure to the ground bus. Bonded connections shall be free of paint and debris.
5. It is imperative that good electrical connections are made at the point between the ground bus and enclosure.
6. Panel-mounted devices shall be bonded to the panel enclosure or the panel grounding system by means of locknuts or pressure mounting methods.
7. Sub-panels and doors shall be bonded to ground.
8. Associated apparatus (connected to intrinsically safe circuits) and associated cable shields:
    a. Ground in accordance with the associated control drawing (drawing provided for the intrinsically safe circuit and which contains manufacturer's entity parameters).

F. Termination Requirements:
   1. Wiring to circuits external to the panel connected to interposing terminal blocks.
   2. Terminal blocks rigidly mounted on DIN rail mounting channels.
   3. Electrical connections to terminal blocks shall be terminated with a proper torque tool as per manufacturer terminal block instructions. Terminating conductors without a torque tool can result in improper and unsafe installation.
   4. Terminal strips located to provide adequate space for entrance and termination of the field conductors.
   5. One side of each strip of terminal blocks reserved exclusively for the termination of field conductors.
   6. Terminal block markings:
      a. Marking shall be the same as associated wire marking.
      b. Legible, machine-printed markings.
      c. Markings as identified in the shop drawings.
      d. Terminal block markings shall follow a consecutive numbering sequence. Terminal block numbers with a random numbering sequence are not acceptable.
   7. Terminal block mechanical characteristics, and electrical characteristics shall be in accordance with NEMA ICS 4.
   8. Terminal blocks with continuous marking strips.
      a. Each terminal block shall be identified with machine printed labels.
   9. Terminals shall facilitate wire sizes as follows:
      a. 120 VAC applications: Conductor size 12 AWG minimum.
      b. Other: Conductor size 14 AWG minimum.
   10. Analog signal cable shield drain conductors shall be individually terminated.
   11. Install minimum of 20 % spare terminals.
   12. Fused terminal blocks shall be used in the following circuits:
      a. Control voltage is used to energize a solenoid valve.
      b. DC power is connected to 2-wire, loop-powered instruments.
   13. Fused terminal blocks shall be provided with blown fuse indicators.
   14. When control circuits require more than one field conductor connected to a single wiring point, a sufficient number of terminal points shall be connected internally to allow termination of only one field conductor per terminal block.
   15. DIN rail mounting channels shall be installed along full length of the terminal strip areas to facilitate future expansion.
   16. Connections to devices with screw type terminals shall be made using spade-tongue, insulated, compression terminators.
   17. Intrinsically safe circuit termination:
      a. Provide at least 0.25 inches (6 mm) clearance between two terminals for connection of field wiring of different intrinsically safe circuits, unless this clearance is permitted to be reduced by the control drawing this is provided for the intrinsically safe circuit and which contains manufacturer's entity parameters.
      b. Identify intrinsically safe circuits at terminal and junction locations in a manner that is intended to prevent unintentional interference with the circuits during testing and servicing as required by NEC, Article 504.
      c. Terminal blocks used for intrinsically safe wires shall be blue.

G. Component Mounting and Placement:
   1. Components shall be installed per manufacturer instructions.
   2. Mount and wire so removal or replacement may be accomplished without interruption of service to adjacent devices.
   3. Locate all devices mounted inside enclosures so terminals and adjustment devices are readily accessible without use of special tools and with terminal markings clearly visible.
   4. Control relays and other control auxiliaries shall be mounted on DIN rail mounting channels where practical.
   5. Front panel devices shall be mounted within a range of 40 to 70 inches above the finished floor, unless otherwise shown in the Contract Documents.

6. PLC/RTU and I/O rack installation:
    a. Located such that the LED indicators and switches are readily visible with the panel door open.
    b. Located such that repair and/or replacement of component can be accomplished without the need to remove wire terminations or other installed components.
7. Locate power supplies with sufficient spacing for circulation of air.
8. Where components such as magnetic starters, contactors, relays, and other electromagnetic devices are installed within the same enclosure as the PLC/RTU system components, provide a barrier of at least 6 inches of separation between the "power area containing the electromagnetic devices" and the "control area".
9. Components mounted in the panel interior shall be fastened to an interior sub-panel using machine screws.
    a. Fastening devices shall not project through the outer surface of the panel enclosure.
10. Excess mounting space of at least 20 % for component types listed below to facilitate future expansion:
    a. Fuse holders.
    b. Circuit breakers.
    c. Control relays.
    d. Time delay relays.
    e. Intrinsically safe barriers and relays.
11. Components installed on sub-panels shall be provides with a minimum spacing between component and wire duct of 1 inch.
    a. Minimum of 2 inches separation between terminal strips and wire ducts.
12. Pneumatic tubes and appurtenances:
    a. Connect panel air piping and tubing penetrations with bulkhead fittings.
    b. Pneumatic control tubing shall be 1/4 inches OD.
        1) Tubing material: Either soft annealed ASTM B75 copper or flame-resistant polyethylene.
    c. Main headers within panels shall be minimum 1 inch.
    d. Compression-type pressure fittings.
    e. Equip panel instrument leads with ball type isolation valve.
    f. Route tubing neatly and mount securely.
    g. Do not route tubing in front of or in wire ducting.
    h. Code terminal plates.
    i. Pneumatic devices shall be served by a dual function filter regulator.

H. Power Distribution:
1. Control panels powered by voltage greater than 120 VAC (nominal) main incoming power shall be provided with a disconnect switch mounted within the enclosure.
    a. Disconnect switch shall be interlocked with the enclosure door(s).
    b. Disconnect switches that supply motor loads shall comply with NEC Code part IX of article 430.
2. Main incoming power circuits shall be protected with a thermal magnetic circuit breaker.
    a. Limit load to maximum of 80 % of circuit breaker rating.
3. Component types listed below shall be individually fused so that they may be individually de-energized for maintenance:
    a. PLC/RTU power supply modules.
    b. Single-loop controllers.
    c. Operator interface terminals/HMI.
    d. DC power supplies.
    e. Alarm annunciators.
4. Each control panel with PLC/RTU components shall be furnished with power protection in the form of a double conversion UPS.
5. Equip each panel with necessary power supplies with ratings required for installed equipment and with minimum 25 % spare capacity.

6. Constant voltage transformers, balancing potentiometers, and rectifiers as necessary for specific instrument requirements.
7. Circuit breakers and fuses shall be used to protect equipment powered inside and outside enclosure
    a. Circuit breakers shall be UL489.
    b. UL489 circuit breaker shall be finger safe.
    c. Fuses shall be 1/4 x 1-1/4 inches size.

I. Internal Panel Lighting and Service Receptacles:
1. Panels less than or equal to 4 feet wide:
    a. One electrical GFCI duplex receptacle.
    b. One LED light fixture with manual switch(es).
2. Panels or panel faces greater than 4 feet wide:
    a. One duplex electrical GFCI receptacle per 6 feet of length.
    b. Continuous LED lighting strip with manual switches.

J. Security Controls:
1. Provide all control panels and enclosures with door switch monitored by discrete input utilizing normally closed contacts.
2. Configure door switch as an [alarm] [event] at the HMI.

K. Environmental Controls:
1. Indoor panels located in a designated electrical room or control room:
    a. Thermostat controlled cooling fans with exhaust louvers if required to maintain temperature inside panel(s) below the maximum operating temperature rating of the internal components.
    b. Internal corrosion inhibitors.
2. Indoor panels not located within a designated electrical room or control room:
    a. Thermostat controlled heaters to maintain temperature approximately 10 degrees F above ambient for condensation prevention inside the panels.
    b. Automatically controlled, closed-loop heat exchangers or closed-loop air conditioners where required to maintain temperature inside each enclosure below the maximum operating temperature rating of the components inside the panel(s).
    c. Internal corrosion inhibitors.
3. Outdoor panels:
    a. Outdoor temperature range of 0 degrees F through 120 degrees F.
    b. Thermostat controlled heaters to maintain temperature approximately 10 degrees F above ambient dew point for condensation prevention inside the panels.
    c. Thermostat controlled closed-loop heat exchangers or closed-loop air conditioners if required to maintain temperature inside each enclosure below the maximum operating temperature rating of the components inside the panel.
    d. Internal corrosion inhibitors.
4. Environmental control components:
    a. Panel heaters:
        1) Thermostat controlled.
        2) Fan driven.
        3) Components mounted in an anodized aluminum housing.
        4) Designed for sub-panel mounting.
        5) Powered from 120 VAC and protected with a dedicated circuit breaker.
    b. Cooling fans and exhaust packages:
        1) Cooling fan with louver or grill and replaceable filter.
        2) Designed to be mounted within a panel cutout to provide positive airflow through the panel.
        3) Cooling fan and exhaust louvers shall be designed and listed to maintain a NEMA 12 enclosure rating.
        4) Fitted with replaceable, high-density foam or synthetic fiber.

5) Cooling fan controlled with a separately mounted thermostat with bi-metal sensor and adjustable dial for temperature setting.
6) Powered from 120 VAC and protected with a dedicated circuit breaker.

c. Heat exchangers and air conditioners:
1) Dual-loop design to isolate panel interior air from exterior air.
2) Thermostat controlled.
3) Operate from 120 VAC and protected with a dedicated circuit breaker.

d. Internal corrosion inhibitors:
1) Contains chemical which vaporizes and condenses on surfaces in the enclosure.
2) Inhibitor shall be applied in accordance with manufacturer instructions for the enclosure volume.
3) Inhibitor shall be applied in the panel(s) prior to shipment from the Contractor's factory.

2.4 UNWITNESSED FACTORY TESTING

A. Inspect and test entire panel assembly to verify readiness for shipment or readiness for the Engineer and/or Owner to attend factory testing if specified in Section 40 61 21 - Process Control System Testing.

B. Location: Panel fabricator's factory.

C. Tests shall be fully documented and signed by the panel fabricator's factory supervisor.

D. The panel shop shall fully test the control panel for correct wiring.
1. Each I/O point shall be checked by measuring or connecting circuits at the field terminal blocks.

E. Burn-in test: Panel(s) shall be fully energized for a minimum period of 48 hours.

F. A PLC Central Processing Unit (CPU) shall be obtained and connected to the panel(s) if necessary for testing purposes.

G. Testing equipment (such as digital multi-meters, analog loop calibrators, and laptop computers with PLC programming software) shall be used as required for testing.

H. The following functions shall be tested as a minimum:
1. Verify functions of the panel(s) required by the Contract Documents.
2. Correctness of wiring from all panel field terminals to all I/O points and to all panel components.
3. Simulate and test each discrete signal at the field terminal strips.
4. Simulate and test each analog signal using loop calibrators.
5. Correct operation of communications between PLC system Central Processing Units (CPUs) and Remote I/O bases.
6. Correct operation of single-loop controllers (including digital communication to microprocessor based devices).
7. Correct operation of all digital communication devices.
8. Verify online and offline diagnostic tests and procedures.

I. Deficiencies shall be corrected prior to requesting the Engineer and/or Owner to attend factory testing if specified, or prior to shipment from the Contractor's factory.

2.5 FACTORY ACCEPTANCE TESTING

A. Perform Factory Acceptance Testing witnessed by the Owner and/or Engineer if specified in Section 40 61 21 - Process Control System Testing.

2.6 MAINTENANCE MATERIALS

A. Extra Materials:
1. Quantity of 25 % replacement lamps for each type installed (minimum of 12 of each type).
2. Minimum 12 replacement filters for each type installed.

3. 1 QT of exterior finish touch-up paint.
4. One complete set of replacement corrosion inhibitors in sealed packages for each panel.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install freestanding panels on 4 inches high concrete housekeeping pads.

B. Anchor panels in a manner to prevent the enclosure from racking, which may cause the access doors to become misaligned.

C. Obtain approved panel layouts prior to installation of conduits.

D. Install products in accordance with manufacturer's instructions.

END OF SECTION

SECTION 40 67 63
UNINTERRUPTIBLE POWER SUPPLY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Uninterruptible Power Supplies (UPS).

B. Related Sections include but are not necessarily limited to:
   1. Section 40 61 13 - Process Control Systems General Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Federal Communications Commission (FCC):
      a. Code of Federal Regulations, 47 CFR 15, Radio Frequency Devices.
   2. Underwriters Laboratories, Inc. (UL):
      a. 1778, Standard for Uninterruptible Power Supply Equipment.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Section 40 61 13 - Process Control System General Requirements.
   2. Provide load calculations and manufacturer's runtime chart to substantiate UPS sizing.

B. Contract Closeout Information:
   1. Operation and Maintenance Manuals:
      a. See Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the manufacturers listed in the applicable Articles below are acceptable.

B. Provide similar components from the same manufacturer for uniformity of appearance, operations, and maintenance.

2.2 UNINTERRUPTIBLE POWER SUPPLIES (UPS)

A. Manufacturers:
   1. APC Smart-UPS.
   2. Eaton 9PX.
   3. Liebert GXT5.

B. Design and fabrication:
   1. Double conversion, true online type.
   1. Tower type format.
   2. Waveform: Pure sine wave.
   3. Power factor correction.
   4. Minimum 10 minutes power ride through of 100% of connected load without incoming power.
      a. Provide extended battery or batteries as necessary to achieve the specified battery run time.

5. For UPS and related components located within a server rack, install UPS and battery components at bottom of cabinet.
6. Frequency range: 45-65 Hz.
7. Input protection:
   a. Fuse or circuit breaker.
8. Output voltage regulation:
   a. ±1% online.
   b. ±2% on battery mode.
9. Battery: Sealed, lead-acid; maintenance free.
10. Three stage battery charging for prolonged battery life.
11. Battery over discharge protection.
12. Input power cord.
13. Output receptacles.
14. Efficiency:
   a. Normal mode, minimum: 89%.
   b. Efficiency mode, minimum: 95%.
   c. Battery mode, minimum: 83%.
15. Operating temperature: 32 to 104 degrees F.
16. Relative humidity: 5-95% non-condensing.
17. Integral bypass to automatically bypass UPS on selected fault conditions.
18. Front panel indication of UPS status and alarm conditions.
   a. UPS Fault.
   b. UPS on battery.
   c. UPS is online and operating normally.
   d. Battery low.
   e. UPS in bypass.
19. Utilize alarm contacts to enable remote annunciation of the following conditions.
   a. UPS Fault.
   b. UPS on battery.
   c. Low battery.
   d. UPS in bypass.
20. Accessories:
   a. Communications Modules
      1) Provide an Ethernet communications module for network connectivity.
21. Agency Approvals:
   a. Safety: UL 1778.
   b. Emissions: FCC Part 15 (Class A).

C. Schedule:

EQUIPMENT NO.	DESCRIPTION	CAPACITY (VA)	LOCATION	TYPE FORMAT
UPS-3101	Uninterrupted Power Supply	As needed	PLC-3101 Control Panel	Tower
UPS-4001	Uninterrupted Power Supply	As needed	PLC-4001 Control Panel	Tower

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

3.2 FIELD QUALITY CONTROL

A. Test UPS to verify the UPS switches power upon incoming AC power loss correctly while keeping all UPS powered loads online.

B. Perform testing of the UPS to determine if each UPS is sized correctly to maintain the specified run time.

END OF SECTION

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SECTION 40 70 06
SCHEDULE OF INSTRUMENTATION FOR PROCESS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Process Control System (PCS) PLC Schedule of Instrumentation for Process Systems.

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 40 61 13 - Process Control System General Requirements.
   2. Section 40 71 00 - Flow Instrumentation.
   3. Section 40 72 00 - Level Instrumentation.
   4. Section 40 73 00 - Pressure instrumentation.
   5. Section 40 74 00 - Temperature instrumentation.
   6. Section 40 75 00 - Process liquid analytical measurement.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. The International Society of Automation (ISA):
      a. 5.1, Instrumentation Symbols and Identification.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 40 61 13.

B. Operation and Maintenance Manuals:
   1. See Specification Section 01 78 23 for requirements for:
      a. The mechanics and administration of the submittal process.
      b. The content of Operation and Maintenance Manuals.

PART 2 - PRODUCTS

2.1 SCHEDULE OF INSTRUMENTATION

A. The schedule in the Appendix 40 70 06A to this Section contains instrument information derived from the Contract drawings and specifications.

B. The schedule is organized in columns as follows:
   1. TAG NUMBER describes the instrument name that will be used throughout the control system to identify the point.
   2. SERVICE DESCRIPTION is a describes the instrument's function in relation to the process.
   3. INSTRUMENT TYPE denotes the type of measurement the instrument performs.
   4. P&ID DWG. NO. references the Process and Instrumentation Diagram on which the instrument is depicted in relation to the process and equipment.
   5. VOLTAGE (120 VAC, 24 VDC) denotes the supply power source.
   6. POWER CONFIGURATION (4-wire, 2-wire, 3-wire, dry contact) denotes the signal and power writing requirements.
   7. INSTALLATION DETAIL (Drawing and Detail Number) describes which detail the mounting requirements for this instrument are in.
   8. SET POINT denotes the limit that an instrument should change output status.
   9. CALIBRATED RANGE denotes the range the instrument should be calibrated for from its minimum to maximum output.
   10. OUTPUT described the type of output from the instrument to the control system.

C. Schedule:
   1. Refer to Appendix 40 70 06 A.

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

10342803 PRAIRIE CREEK WWTP
SCHEDULE OF INSTRUMENTATION FOR PROCESS SYSTEMS

					QC CHECK			REVISION HISTORY		
					DATE	APPROVED	REV	DATE	ISSUE BY	DESCRIPTION
					6/3/2025	S. HORRAS	0	6/13/2025	P. KAPADIA	ISSUED FOR BID
Tag Number	Service Description	Instrument Type	P&ID Dwg. No.	Area	Signal	Voltage	Power Configuration	Set point	Calibrated Range	Application Notes
LIT-1101	AERATION BASIN #1 (AB1) DISTRIBUTION ULTRASONIC LEVEL	ULTRASONIC LEVEL TRANSMITTER	00Y601	11	AI	24VDC	4-WIRE	12.6 ft	0-16 ft	
AIT-2151A	AERATION BASIN #5 OXIC DISSOLVED OXYGEN	OXYGEN ANALYZER	00Y603	21	AI	120VAC	4-WIRE	N/A	0-10 mg/L	
AIT-2151B	AERATION BASIN #5 OXIC AMMONIA (FUTURE)	AMMONIA NITROGEN METER	00Y603	21	AI	120VAC	4-WIRE	N/A	0.05-20 mg/L	FUTURE
AIT-2161A	AERATION BASIN #6 OXIC DISSOLVED OXYGEN	OXYGEN ANALYZER	00Y603	21	AI	120VAC	4-WIRE	N/A	0-10 mg/L	
AIT-2161B	AERATION BASIN #6 OXIC AMMONIA (FUTURE)	AMMONIA NITROGEN METER	00Y603	21	AI	120VAC	4-WIRE	N/A	0.05-20 mg/L	FUTURE
AIT-2171A	AERATION BASIN #7 OXIC DISSOLVED OXYGEN	OXYGEN ANALYZER	00Y603	21	AI	24VDC	4-WIRE	N/A	0-10 mg/L	
AIT-2171B	AERATION BASIN #7 OXIC AMMONIA (FUTURE)	AMMONIA NITROGEN METER	00Y603	21	AI	120VAC	4-WIRE	N/A	0.05-20 mg/L	FUTURE
AIT-2181A	AERATION BASIN #8 OXIC DISSOLVED OXYGEN	OXYGEN ANALYZER	00Y603	21	AI	120VAC	4-WIRE	N/A	0-10 mg/L	
AIT-2181B	AERATION BASIN #8 OXIC AMMONIA (FUTURE)	AMMONIA NITROGEN METER	00Y603	21	AI	120VAC	4-WIRE	N/A	0.05-20 mg/L	FUTURE
FIT-2151	BLOWER #5 TO #8 DISCHARGE FLOW TO AB #5	THERMAL MASS FLOWMETER	00Y603	21	AI	120VAC	4-WIRE	N/A	0-8600 scfm	
FIT-2161	BLOWER #5 TO #8 DISCHARGE FLOW TO AB #6	THERMAL MASS FLOWMETER	00Y603	21	AI	120VAC	4-WIRE	N/A	0-8600 scfm	
FIT-2171	BLOWER #5 TO #8 DISCHARGE FLOW TO AB #7	THERMAL MASS FLOWMETER	00Y603	21	AI	120VAC	4-WIRE	N/A	0-8600 scfm	
FIT-2181	BLOWER #5 TO #8 DISCHARGE FLOW TO AB #8	THERMAL MASS FLOWMETER	00Y603	21	AI	120VAC	4-WIRE	N/A	0-8600 scfm	
MSH-2153	AERATION BASIN #5 OXIC SUMP PUMP MOTOR SEAL LEAK	MOISTURE SENSOR	00Y603	21	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
MSH-2163	AERATION BASIN #6 OXIC SUMP PUMP MOTOR SEAL LEAK	MOISTURE SENSOR	00Y603	21	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
MSH-2173	AERATION BASIN #7 OXIC SUMP PUMP MOTOR SEAL LEAK	MOISTURE SENSOR	00Y603	21	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
MSH-2183	AERATION BASIN #8 OXIC SUMP PUMP MOTOR SEAL LEAK	MOISTURE SENSOR	00Y603	21	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
TSH-2151	AERATION BASIN #5 AX-1 MIXER HIGH TEMP SWITCH	TEMPERATURE SWITCH	00Y603	21	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
TSH-2152	AERATION BASIN #5 AX-2 MIXER HIGH TEMP SWITCH	TEMPERATURE SWITCH	00Y603	21	DI	24VDC				VENDOR SUPPLIED
TSH-2153	AERATION BASIN #5 OXIC SUMP PUMP HIGH TEMP SWITCH	TEMPERATURE SWITCH	00Y603	21	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
TSH-2161	AERATION BASIN #6 AX-1 MIXER HIGH TEMP SWITCH	TEMPERATURE SWITCH	00Y603	21	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
TSH-2162	AERATION BASIN #6 AX-2 MIXER HIGH TEMP SWITCH	TEMPERATURE SWITCH	00Y603	21	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
TSH-2163	AERATION BASIN #6 OXIC SUMP PUMP HIGH TEMP SWITCH	TEMPERATURE SWITCH	00Y603	21	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
TSH-2171	AERATION BASIN #7 AX-1 MIXER HIGH TEMP SWITCH	TEMPERATURE SWITCH	00Y603	21	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
TSH-2172	AERATION BASIN #7 AX-2 MIXER HIGH TEMP SWITCH	TEMPERATURE SWITCH	00Y603	21	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
TSH-2173	AERATION BASIN #7 OXIC SUMP PUMP HIGH TEMP SWITCH	TEMPERATURE SWITCH	00Y603	21	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
TSH-2181	AERATION BASIN #8 AX-1 MIXER HIGH TEMP SWITCH	TEMPERATURE SWITCH	00Y603	21	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
TSH-2182	AERATION BASIN #8 AX-2 MIXER HIGH TEMP SWITCH	TEMPERATURE SWITCH	00Y603	21	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
TSH-2183	AERATION BASIN #8 OXIC SUMP PUMP HIGH TEMP SWITCH	TEMPERATURE SWITCH	00Y603	21	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
LSHH-2201C	SECONDARY CLARIFIER SPLITTER HI LEVEL ALARM	LEVEL SWITCH	00Y604	22	DI	120VAC	DRY CONTACT		N/A	
LSHH-2201D	SECONDARY CLARIFIER SPLITTER SUMP HI LEVEL ALARM	LEVEL SWITCH	00Y604	22	DI	120VAC	DRY CONTACT		N/A	
FIT-2201	SECONDARY CLARIFIER #1 GST'S INCOMING FLOW	MAGNETIC FLOWMETER	00Y604	22	AI	120VAC	4-WIRE	N/A	0-17,700 gpm	
FIT-2202	SECONDARY CLARIFIER #2 GST'S INCOMING FLOW	MAGNETIC FLOWMETER	00Y604	22	AI	120VAC	4-WIRE	N/A	0-17,700 gpm	
FIT-2203	SECONDARY CLARIFIER #3 GST'S INCOMING FLOW	MAGNETIC FLOWMETER	00Y604	22	AI	120VAC	4-WIRE	N/A	0-17,700 gpm	
FIT-2204	SECONDARY CLARIFIER #4 GST'S INCOMING FLOW	MAGNETIC FLOWMETER	00Y604	22	AI	120VAC	4-WIRE	N/A	0-17,700 gpm	
LIT-2202A	AERATION BASIN CHANNEL FOR NO. 1 TO 4 LEVEL	RADAR LEVEL TRANSMITTER	00Y604	22	AI	24VDC	4-WIRE	8.6 ft	0-12.4 ft	
LIT-2202B	AERATION BASIN CHANNEL FOR NO. 5 TO 8 LEVEL	RADAR LEVEL TRANSMITTER	00Y604	22	AI	24VDC	4-WIRE	8.6 ft	0-12.4 ft	
LIT-2201A	AERATION BASIN CHANNEL FOR NO. 1 TO 4 LEVEL	SUBMERSIBLE LEVEL TRANSMITTER	00Y604	22	AI	24VDC	4-WIRE	8.6 ft	3-12.4 ft	
LIT-2201B	AERATION BASIN CHANNEL FOR NO. 5 TO 8 LEVEL	SUBMERSIBLE LEVEL TRANSMITTER	00Y604	22	AI	24VDC	4-WIRE	8.6 ft	3-12.4 ft	
PIT-3120A	AERATION BASIN #5 TO 8 BLOWER DISCHARGE PRESSURE	PRESSURE TRANSMITTER	00Y606	31	AI	24VDC	LOOP POWER	N/A	0-30 psi	
PIT-3102B	AERATION BASIN #5 TO 8 BLOWER DISCHARGE PRESSURE	PRESSURE TRANSMITTER	00Y606	31	AI	24VDC	LOOP POWER	N/A	0-30 psi	
FIT-3121	AERATION BASIN #5 TO 8 BLOWER DISCHARGE FLOW	THERMAL MASS FLOWMETER	00Y606	31	AI	120VAC	4-WIRE		0-49,000 scfm	COMBINED WITH TIT-3121
TIT-3121	AERATION BASIN #5 TO 8 BLOWER DISCHARGE TEMPERATURE	THERMAL MASS FLOWMETER	00Y606	31	AI	120VAC	4-WIRE		0-400 °F	
PI-3105	BLOWER #3105 DISCHARE PRESSURE	PRESSURE GAUGE	00Y606	31	N/A					VENDOR SUPPLIED
VSH-3105	BLOWER #3105 HIGH VIBRATION SWITCH	VIBRATION SWITCH	00Y606	31	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
TSH-3105A	BLOWER #3105 COOLING TURBO MOTOR TEMPERATURE	TEMPERATURE SWITCH	00Y606	31	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
TSH-3105B	BLOWER #3105 COOLING TURBO MOTOR TEMPERATURE	TEMPERATURE SWITCH	00Y606	31	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
TSH-3105C	BLOWER #3105 MAIN TURBO MOTOR TEMPERATURE	TEMPERATURE SWITCH	00Y606	31	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
TSH-3105D	BLOWER #3105 MAIN TURBO MOTOR TEMPERATURE	TEMPERATURE SWITCH	00Y606	31	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
DPT-3105A	BLOWER #3105 FILTER DIFFERENTIAL PRESSURE	DIFFERENTIAL PRESSURE TRANSMITTER	00Y606	31	AI	24VDC	LOOP POWER			VENDOR SUPPLIED
DPT-3105B	BLOWER #3105 INLET NOZZLE DIFFERENTIAL PRESSURE	DIFFERENTIAL PRESSURE TRANSMITTER	00Y606	31	AI	24VDC	LOOP POWER			VENDOR SUPPLIED
PT-3105	BLOWER #3105 INLET PRESSURE	PRESSURE TRANSMITTER	00Y606	31	AI	24VDC	LOOP POWER			VENDOR SUPPLIED
TT-3105A	BLOWER #3105 DISCHARGE TEMPERATURE	TEMPERATURE TRANSMITTER	00Y606	31	AI	24VDC	LOOP POWER			VENDOR SUPPLIED
TT-3105B	BLOWER #3105 INLET TEMPERATURE	TEMPERATURE TRANSMITTER	00Y606	31	AI	24VDC	LOOP POWER			VENDOR SUPPLIED
PSH-3105	BLOWER #3105 OUTLET HIGH PRESSURE	PRESSURE SWITCH	00Y606	31	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
PI-3106	BLOWER #3106 DISCHARE PRESSURE	PRESSURE GAUGE	00Y606	31	N/A					VENDOR SUPPLIED
VSH-3106	BLOWER #3106 HIGH VIBRATION SWITCH	VIBRATION SWITCH	00Y606	31	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
TSH-3106A	BLOWER #3106 COOLING TURBO MOTOR TEMPERATURE	TEMPERATURE SWITCH	00Y606	31	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
TSH-3106B	BLOWER #3106 COOLING TURBO MOTOR TEMPERATURE	TEMPERATURE SWITCH	00Y606	31	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
TSH-3106C	BLOWER #3106 MAIN TURBO MOTOR TEMPERATURE	TEMPERATURE SWITCH	00Y606	31	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
TSH-3106D	BLOWER #3106 MAIN TURBO MOTOR TEMPERATURE	TEMPERATURE SWITCH	00Y606	31	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED

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SCHEDULE OF INSTRUMENTATION FOR PROCESS SYSTEMS

	QC CHECK			REVISION HISTORY		
	DATE	APPROVED	REV	DATE	ISSUE BY	DESCRIPTION
	6/3/2025	S. HORRAS	0	6/13/2025	P. KAPADIA	ISSUED FOR BID

Tag Number	Service Description	Instrument Type	P&ID Dwg. No.	Area	Signal	Voltage	Power Configuration	Set point	Calibrated Range	Application Notes
DPT-3106A	BLOWER #3106 FILTER DIFFERENTIAL PRESSURE	DIFFERENTIAL PRESSURE TRANSMITTER	00Y606	31	AI	24VDC	LOOP POWER			VENDOR SUPPLIED
DPT-3106B	BLOWER #3106 INLET NOZZLE DIFFERENTIAL PRESSURE	DIFFERENTIAL PRESSURE TRANSMITTER	00Y606	31	AI	24VDC	LOOP POWER			VENDOR SUPPLIED
PT-3106	BLOWER #3106 INLET PRESSURE	PRESSURE TRANSMITTER	00Y606	31	AI	24VDC	LOOP POWER			VENDOR SUPPLIED
TT-3106A	BLOWER #3106 DISCHARGE TEMPERATURE	TEMPERATURE TRANSMITTER	00Y606	31	AI	24VDC	LOOP POWER			VENDOR SUPPLIED
TT-3106B	BLOWER #3106 INLET TEMPERATURE	TEMPERATURE TRANSMITTER	00Y606	31	AI	24VDC	LOOP POWER			VENDOR SUPPLIED
PSH-3106	BLOWER #3106 OUTLET HIGH PRESSURE	PRESSURE SWITCH	00Y606	31	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
PI-3107	BLOWER #3107 DISCHARE PRESSURE	PRESSURE GAUGE	00Y606	31	N/A					VENDOR SUPPLIED
VSH-3107	BLOWER #3107 HIGH VIBRATION SWITCH	VIBRATION SWITCH	00Y606	31	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
TSH-3107A	BLOWER #3107 COOLING TURBO MOTOR TEMPERATURE	TEMPERATURE SWITCH	00Y606	31	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
TSH-3107B	BLOWER #3107 COOLING TURBO MOTOR TEMPERATURE	TEMPERATURE SWITCH	00Y606	31	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
TSH-3107C	BLOWER #3107 MAIN TURBO MOTOR TEMPERATURE	TEMPERATURE SWITCH	00Y606	31	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
TSH-3107D	BLOWER #3107 MAIN TURBO MOTOR TEMPERATURE	TEMPERATURE SWITCH	00Y606	31	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
DPT-3107A	BLOWER #3107 FILTER DIFFERENTIAL PRESSURE	DIFFERENTIAL PRESSURE TRANSMITTER	00Y606	31	AI	24VDC	LOOP POWER			VENDOR SUPPLIED
DPT-3107B	BLOWER #3107 INLET NOZZLE DIFFERENTIAL PRESSURE	DIFFERENTIAL PRESSURE TRANSMITTER	00Y606	31	AI	24VDC	LOOP POWER			VENDOR SUPPLIED
PT-3107	BLOWER #3107 INLET PRESSURE	PRESSURE TRANSMITTER	00Y606	31	AI	24VDC	LOOP POWER			VENDOR SUPPLIED
TT-3107A	BLOWER #3107 DISCHARGE TEMPERATURE	TEMPERATURE TRANSMITTER	00Y606	31	AI	24VDC	LOOP POWER			VENDOR SUPPLIED
TT-3107B	BLOWER #3107 INLET TEMPERATURE	TEMPERATURE TRANSMITTER	00Y606	31	AI	24VDC	LOOP POWER			VENDOR SUPPLIED
PSH-3107	BLOWER #3107 OUTLET HIGH PRESSURE	PRESSURE SWITCH	00Y606	31	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
PI-3108	BLOWER #3108 DISCHARE PRESSURE	PRESSURE GAUGE	00Y606	31	N/A					VENDOR SUPPLIED
VSH-3108	BLOWER #3108 HIGH VIBRATION SWITCH	VIBRATION SWITCH	00Y606	31	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
TSH-3108A	BLOWER #3108 COOLING TURBO MOTOR TEMPERATURE	TEMPERATURE SWITCH	00Y606	31	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
TSH-3108B	BLOWER #3108 COOLING TURBO MOTOR TEMPERATURE	TEMPERATURE SWITCH	00Y606	31	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
TSH-3108C	BLOWER #3108 MAIN TURBO MOTOR TEMPERATURE	TEMPERATURE SWITCH	00Y606	31	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
TSH-3108D	BLOWER #3108 MAIN TURBO MOTOR TEMPERATURE	TEMPERATURE SWITCH	00Y606	31	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
DPT-3108A	BLOWER #3108 FILTER DIFFERENTIAL PRESSURE	DIFFERENTIAL PRESSURE TRANSMITTER	00Y606	31	AI	24VDC	LOOP POWER			VENDOR SUPPLIED
DPT-3108B	BLOWER #3108 INLET NOZZLE DIFFERENTIAL PRESSURE	DIFFERENTIAL PRESSURE TRANSMITTER	00Y606	31	AI	24VDC	LOOP POWER			VENDOR SUPPLIED
PT-3108	BLOWER #3108 INLET PRESSURE	PRESSURE TRANSMITTER	00Y606	31	AI	24VDC	LOOP POWER			VENDOR SUPPLIED
TT-3108A	BLOWER #3108 DISCHARGE TEMPERATURE	TEMPERATURE TRANSMITTER	00Y606	31	AI	24VDC	LOOP POWER			VENDOR SUPPLIED
TT-3108B	BLOWER #3108 INLET TEMPERATURE	TEMPERATURE TRANSMITTER	00Y606	31	AI	24VDC	LOOP POWER			VENDOR SUPPLIED
PSH-3108	BLOWER #3108 OUTLET HIGH PRESSURE	PRESSURE SWITCH	00Y606	31	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
FIT-4051	RAS PUMPS P-4001 TO P-4022 DISCHARGE FLOW TO AB SPLITTER	MAGNETIC FLOWMETER	00Y607	40	AI	120VAC	4-WIRE	N/A	0-5730 gpm	
FIT-4052	RAS PUMPS P-4001 TO P-4022 DISCHARGE FLOW TO AB SPLITTER	MAGNETIC FLOWMETER	00Y607	40	AI	120VAC	4-WIRE	N/A	0-5730 gpm	
PI-4011A	RAS PUMP P-4011 INLET PRESSURE	PRESSURE GAUGE	00Y607	40	N/A			N/A	0-15 psi	
PI-4011B	RAS PUMP P-4011 DISCHARGE PRESSURE	PRESSURE GAUGE	00Y607	40	N/A			N/A	0-30 psi	
MSH-4011	RAS PUMP P-4011 MOTOR SEAL LEAK	MOISTURE SENSOR	00Y607	40	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
TSH-4011	RAS PUMP P-4011 HIGH TEMP SWITCH	TEMPERATURE SWITCH	00Y607	40	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
PI-4012A	RAS PUMP P-4012 INLET PRESSURE	PRESSURE GAUGE	00Y607	40	N/A			N/A	0-15 psi	
PI-4012B	RAS PUMP P-4012 DISCHARGE PRESSURE	PRESSURE GAUGE	00Y607	40	N/A			N/A	0-30 psi	
MSH-4012	RAS PUMP P-4012 MOTOR SEAL LEAK	MOISTURE SENSOR	00Y607	40	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
TSH-4012	RAS PUMP P-4012 HIGH TEMP SWITCH	TEMPERATURE SWITCH	00Y607	40	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
PI-4001A	RAS PUMP P-4001 INLET PRESSURE	PRESSURE GAUGE	00Y607	40	N/A			N/A	0-15 psi	
PI-4001B	RAS PUMP P-4001 DISCHARGE PRESSURE	PRESSURE GAUGE	00Y607	40	N/A			N/A	0-30 psi	
MSH-4001	RAS PUMP P-4001 MOTOR SEAL LEAK	MOISTURE SENSOR	00Y607	40	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
TSH-4001	RAS PUMP P-4001 HIGH TEMP SWITCH	TEMPERATURE SWITCH	00Y607	40	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
PI-4021A	RAS 2A PUMP P-4021 INLET PRESSURE	PRESSURE GAUGE	00Y607	40	N/A			N/A	0-15 psi	
PI-4021B	RAS 2A PUMP P-4021 DISCHARGE PRESSURE	PRESSURE GAUGE	00Y607	40	N/A			N/A	0-30 psi	
MSH-4021	RAS PUMP P-4021 MOTOR SEAL LEAK	MOISTURE SENSOR	00Y607	40	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
TSH-4021	RAS PUMP P-4021 HIGH TEMP SWITCH	TEMPERATURE SWITCH	00Y607	40	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
PI-4022A	RAS 2B PUMP P-4022 INLET PRESSURE	PRESSURE GAUGE	00Y607	40	N/A			N/A	0-15 psi	
PI-4022B	RAS 2B PUMP P-4022 DISCHARGE PRESSURE	PRESSURE GAUGE	00Y607	40	N/A			N/A	0-30 psi	
MSH-4022	RAS PUMP P-4022 MOTOR SEAL LEAK	MOISTURE SENSOR	00Y607	40	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
TSH-4022	RAS PUMP P-4022 HIGH TEMP SWITCH	TEMPERATURE SWITCH	00Y607	40	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
PI-4011C	RAS PUMP P-4011 SEAL WATER INLET PRESSURE TO SOLENOID VALVE	PRESSURE GAUGE	00Y608	40	N/A			N/A	0-120 psi	
PI-4011D	RAS PUMP P-4011 SEAL WATER SUPPLY PRESSURE AFTER SOLENOID VALVE	PRESSURE GAUGE	00Y608	40	N/A			N/A	0-20 psi	
PSL-4011	RAS PUMP P-4011 SEAL WATER SUPPLY LOW	PRESSURE SWITCH	00Y608	40	DI	24VDC	DRY CONTACT		0-20 psi	
SV-4011	RAS PUMP P-4011 SEAL WATER SOLENOID VALVE	SOLENOID VALVE	00Y608	40	DO	24VDC	DRY CONTACT			
PI-4012C	RAS PUMP P-4012 SEAL WATER INLET PRESSURE TO SOLENOID VALVE	PRESSURE GAUGE	00Y608	40	N/A			N/A	0-120 psi	
PI-4012D	RAS PUMP P-4012 SEAL WATER SUPPLY PRESSURE AFTER SOLENOID VALVE	PRESSURE GAUGE	00Y608	40	N/A			N/A	0-20 psi	
PSL-4012	RAS PUMP P-4012 SEAL WATER SUPPLY LOW	PRESSURE SWITCH	00Y608	40	DI	24VDC	DRY CONTACT	N/A	0-20 psi	
SV-4012	RAS PUMP P-4012 SEAL WATER SOLENOID VALVE	SOLENOID VALVE	00Y608	40	DO	24VDC	DRY CONTACT			
PI-4001C	RAS PUMP P-4001 SEAL WATER INLET PRESSURE TO SOLENOID VALVE	PRESSURE GAUGE	00Y608	40	N/A			N/A	0-120 psi	

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SCHEDULE OF INSTRUMENTATION FOR PROCESS SYSTEMS

	QC CHECK			REVISION HISTORY		
	DATE	APPROVED	REV	DATE	ISSUE BY	DESCRIPTION
	6/3/2025	S. HORRAS	0	6/13/2025	P. KAPADIA	ISSUED FOR BID

Tag Number	Service Description	Instrument Type	P&ID Dwg. No.	Area	Signal	Voltage	Power Configuration	Set point	Calibrated Range	Application Notes
PI-4001D	RAS PUMP P-4001 SEAL WATER SUPPLY PRESSURE AFTER SOLENOID VALVE	PRESSURE GAUGE	00Y608	40	N/A			N/A	0-20 psi	
PSL-4001	RAS PUMP P-4001 SEAL WATER SUPPLY LOW	PRESSURE SWITCH	00Y608	40	DI	24VDC	DRY CONTACT	N/A	0-20 psi	
SV-4001	RAS PUMP P-4012 SEAL WATER SOLENOID VALVE	SOLENOID VALVE	00Y608	40	DO	24VDC	DRY CONTACT			
PI-4021C	RAS PUMP P-4021 SEAL WATER INLET PRESSURE TO SOLENOID VALVE	PRESSURE GAUGE	00Y608	40	N/A			N/A	0-120 psi	
PI-4021D	RAS PUMP P-4021 SEAL WATER SUPPLY PRESSURE AFTER SOLENOID VALVE	PRESSURE GAUGE	00Y608	40	N/A			N/A	0-20 psi	
PSL-4021	RAS PUMP P-4021 SEAL WATER SUPPLY LOW	PRESSURE SWITCH	00Y608	40	DI	24VDC	DRY CONTACT	N/A	0-20 psi	
SV-4021	RAS PUMP P-4021 SEAL WATER SOLENOID VALVE	SOLENOID VALVE	00Y608	40	DO	24VDC	DRY CONTACT			
PI-4022C	RAS PUMP P-4022 SEAL WATER INLET PRESSURE TO SOLENOID VALVE	PRESSURE GAUGE	00Y608	40	N/A			N/A	0-120 psi	
PI-4022D	RAS PUMP P-4022 SEAL WATER SUPPLY PRESSURE AFTER SOLENOID VALVE	PRESSURE GAUGE	00Y608	40	N/A			N/A	0-20 psi	
PSL-4022	RAS PUMP P-4022 SEAL WATER SUPPLY LOW	PRESSURE SWITCH	00Y608	40	DI	24VDC	DRY CONTACT	N/A	0-20 psi	
SV-4022	RAS PUMP P-4022 SEAL WATER SOLENOID VALVE	SOLENOID VALVE	00Y608	40	DO	24VDC	DRY CONTACT			
FIT-4053	RAS PUMPS P-4002 TO P-4042 DISCHARGE FLOW TO SEC. CLARIFIER NO. 1 & 2	MAGNETIC FLOWMETER	00Y609	40	AI	120VAC	4-WIRE	N/A	0-5730 gpm	
FIT-4054	RAS PUMPS P-4002 TO P-4042 DISCHARGE FLOW TO SEC. CLARIFIER NO. 1 & 2	MAGNETIC FLOWMETER	00Y609	40	AI	120VAC	4-WIRE	N/A	0-5730 gpm	
FIT-4059	RAS PUMPS P-4002 TO P-4042 DISCHARGE FLOW TO SOLID DISCHARGE	MAGNETIC FLOWMETER	00Y609	40	AI	120VAC	4-WIRE	N/A	0-1400 gpm	
FIT-4060	RAS PUMPS P-4002 TO P-4042 DISCHARGE FLOW TO SOLID DISCHARGE	MAGNETIC FLOWMETER	00Y609	40	AI	120VAC	4-WIRE	N/A	0-1400 gpm	
PI-4031A	RAS PUMP P-4031 INLET PRESSURE	PRESSURE GAUGE	00Y609	40	N/A			N/A	0-15 psi	
PI-4031B	RAS PUMP P-4031 DISCHARGE PRESSURE	PRESSURE GAUGE	00Y609	40	N/A			N/A	0-30 psi	
MSH-4031	RAS PUMP P-4031 MOTOR SEAL LEAK	MOISTURE SENSOR	00Y609	40	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
TSH-4031	RAS PUMP P-4031 HIGH TEMP SWITCH	TEMPERATURE SWITCH	00Y609	40	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
PI-4032A	RAS PUMP P-4032 INLET PRESSURE	PRESSURE GAUGE	00Y609	40	N/A			N/A	0-15 psi	
PI-4032B	RAS PUMP P-4032 DISCHARGE PRESSURE	PRESSURE GAUGE	00Y609	40	N/A			N/A	0-30 psi	
MSH-4032	RAS PUMP P-4032 MOTOR SEAL LEAK	MOISTURE SENSOR	00Y609	40	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
TSH-4032	RAS PUMP P-4032 HIGH TEMP SWITCH	TEMPERATURE SWITCH	00Y609	40	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
PI-4002A	RAS PUMP P-4002 INLET PRESSURE	PRESSURE GAUGE	00Y609	40	N/A			N/A	0-15 psi	
PI-4002B	RAS PUMP P-4002 DISCHARGE PRESSURE	PRESSURE GAUGE	00Y609	40	N/A			N/A	0-30 psi	
MSH-4002	RAS PUMP P-4002 MOTOR SEAL LEAK	MOISTURE SENSOR	00Y609	40	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
TSH-4002	RAS PUMP P-4002 HIGH TEMP SWITCH	TEMPERATURE SWITCH	00Y609	40	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
PI-4041A	RAS 2A PUMP P-4041 INLET PRESSURE	PRESSURE GAUGE	00Y609	40	N/A			N/A	0-15 psi	
PI-4041B	RAS 2A PUMP P-4041 DISCHARGE PRESSURE	PRESSURE GAUGE	00Y609	40	N/A			N/A	0-30 psi	
MSH-4041	RAS PUMP P-4041 MOTOR SEAL LEAK	MOISTURE SENSOR	00Y609	40	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
TSH-4041	RAS PUMP P-4041 HIGH TEMP SWITCH	TEMPERATURE SWITCH	00Y609	40	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
PI-4042A	RAS 2B PUMP P-4042 INLET PRESSURE	PRESSURE GAUGE	00Y609	40	N/A			N/A	0-15 psi	
PI-4042B	RAS 2B PUMP P-4042 DISCHARGE PRESSURE	PRESSURE GAUGE	00Y609	40	N/A			N/A	0-30 psi	
MSH-4042	RAS PUMP P-4042 MOTOR SEAL LEAK	MOISTURE SENSOR	00Y609	40	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
TSH-4042	RAS PUMP P-4042 HIGH TEMP SWITCH	TEMPERATURE SWITCH	00Y609	40	DI	24VDC	DRY CONTACT			VENDOR SUPPLIED
PI-4031C	RAS PUMP P-4031 SEAL WATER INLET PRESSURE TO SOLENOID VALVE	PRESSURE GAUGE	00Y610	40	N/A			N/A	0-120 psi	
PI-4031D	RAS PUMP P-4031 SEAL WATER SUPPLY PRESSURE AFTER SOLENOID VALVE	PRESSURE GAUGE	00Y610	40	N/A			N/A	0-20 psi	
PSL-4031	RAS PUMP P-4031 SEAL WATER SUPPLY LOW	PRESSURE SWITCH	00Y610	40	DI	24VDC	DRY CONTACT		0-20 psi	
SV-4031	RAS PUMP P-4031 SEAL WATER SOLENOID VALVE	SOLENOID VALVE	00Y610	40	DO	24VDC	DRY CONTACT			
PI-4032C	RAS PUMP P-4032 SEAL WATER INLET PRESSURE TO SOLENOID VALVE	PRESSURE GAUGE	00Y610	40	N/A			N/A	0-120 psi	
PI-4032D	RAS PUMP P-4032 SEAL WATER SUPPLY PRESSURE AFTER SOLENOID VALVE	PRESSURE GAUGE	00Y610	40	N/A			N/A	0-20 psi	
PSL-4032	RAS PUMP P-4032 SEAL WATER SUPPLY LOW	PRESSURE SWITCH	00Y610	40	DI	24VDC	DRY CONTACT	N/A	0-20 psi	
SV-4032	RAS PUMP P-4032 SEAL WATER SOLENOID VALVE	SOLENOID VALVE	00Y610	40	DO	24VDC	DRY CONTACT			
PI-4002C	RAS PUMP P-4002 SEAL WATER INLET PRESSURE TO SOLENOID VALVE	PRESSURE GAUGE	00Y610	40	N/A			N/A	0-120 psi	
PI-4002D	RAS PUMP P-4002 SEAL WATER SUPPLY PRESSURE AFTER SOLENOID VALVE	PRESSURE GAUGE	00Y610	40	N/A			N/A	0-20 psi	
PSL-4002	RAS PUMP P-4002 SEAL WATER SUPPLY LOW	PRESSURE SWITCH	00Y610	40	DI	24VDC	DRY CONTACT	N/A	0-20 psi	
SV-4002	RAS PUMP P-4031 SEAL WATER SOLENOID VALVE	SOLENOID VALVE	00Y610	40	DO	24VDC	DRY CONTACT			
PI-4021C	RAS PUMP P-4021 SEAL WATER INLET PRESSURE TO SOLENOID VALVE	PRESSURE GAUGE	00Y610	40	N/A			N/A	0-120 psi	
PI-4021D	RAS PUMP P-4021 SEAL WATER SUPPLY PRESSURE AFTER SOLENOID VALVE	PRESSURE GAUGE	00Y610	40	N/A			N/A	0-20 psi	
PSL-4021	RAS PUMP P-4021 SEAL WATER SUPPLY LOW	PRESSURE SWITCH	00Y610	40	DI	24VDC	DRY CONTACT	N/A	0-20 psi	
SV-4021	RAS PUMP P-4021 SEAL WATER SOLENOID VALVE	SOLENOID VALVE	00Y610	40	DO	24VDC	DRY CONTACT			
PI-4022C	RAS PUMP P-4022 SEAL WATER INLET PRESSURE TO SOLENOID VALVE	PRESSURE GAUGE	00Y610	40	N/A			N/A	0-120 psi	
PI-4022D	RAS PUMP P-4022 SEAL WATER SUPPLY PRESSURE AFTER SOLENOID VALVE	PRESSURE GAUGE	00Y610	40	N/A			N/A	0-20 psi	
PSL-4022	RAS PUMP P-4022 SEAL WATER SUPPLY LOW	PRESSURE SWITCH	00Y610	40	DI	24VDC	DRY CONTACT	N/A	0-20 psi	
SV-4022	RAS PUMP P-4022 SEAL WATER SOLENOID VALVE	SOLENOID VALVE	00Y610	40	DO	24VDC	DRY CONTACT			

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SECTION 40 71 00
FLOW INSTRUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Flow Transmitters:
      a. Magnetic Flow Meters (Inline).
      b. Thermal Mass Flow Meters.

B. The instruments specified in this Specification Section are the primary element components for the control loops which are specified in Specification Section 40 61 96 and shown on the Control System Drawings.
   1. These instruments are integrated with other control system components specified under Specification Section 40 61 13 to produce the functional control system defined in the Contract Documents

C. Related Specification Sections include but are not necessarily limited to:
   1. Section 40 61 13 - Process Control System General Requirements.
   2. Section 40 61 96 - Process Control Descriptions.
   3. Section 40 70 06 - Schedule of Instrumentation for Process Systems

D. Referenced Standards:
   1. American Gas Association (AGA):
      a. Gas Measurement Committee Report #3.
   2. American Society of Mechanical Engineers (ASME):
      a. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
      b. A240, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
      c. B16.5, Pipe Flanges and Flanged Fittings.
      d. B626, Standard Specification for Welded Nickel and Nickel-Cobalt Alloy Tube.
      e. PTC 19.5, Application of Fluid Meters, Part 2.
   3. ASTM International (ASTM):
      a. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
   4. American Water Works Association (AWWA).
   5. National Sanitation Foundation (NSF).
   6. US Department of Interior Bureau of Reclamation (USDIBR):
      a. Water Measurement Manual.

1.2 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 40 61 13.

B. Operation and Maintenance Manuals:
   1. See Specification Section 01 78 23 for requirements for:
      a. The mechanics and administration of the submittal process.
      b. The content of Operation and Maintenance Manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the manufacturers listed in the Articles describing the elements are acceptable.

2.2 FLOW TRANSMITTERS

A. Magnetic Flow Meters (Inline):
   1. Acceptable manufacturers:
      a. Endress + Hauser (ProMag).
   2. Accessories:
   3. Design and fabrication:
      a. Utilize characterized field principle of electromagnetic induction to produce signal directly proportional to flow rate.
      b. High input impedance pre-amplifiers.
         1) Minimum impedance: 10^{10} ohms.
      c. Provide flanged end connections per ASME B16.5 up to 24 inches mechanical coupling end connections rated for piping system operating and test conditions. Meter body shall be rated to same pressure as the flanges.
      d. Grounding requirements:
         1) Nonmetallic or lined pipe:
            a) Inlet and outlet grounding rings of same material as electrode or as recommended by manufacturer to meet process requirements.
         2) Conductive piping:
            a) Conductive path between the meter and the piping flanges.
      e. Provide cable between magnetic flow meter and transmitter.
         1) Cable shall be potted and fitted by manufacturer at the factory.
      f. Pulsed DC magnetic field excitation.
      g. Automatic zero.
      h. Adjustable low flow cutoff.
      i. Minimum signal lock (empty tube zero) to prevent false measurement when tube is empty.
      j. Inaccuracy: ±0.4% of rate.
      k. 4-20 mA DC HART isolated output into maximum 800 ohms.
      l. Power supply: 117 V ±10%, 60 Hz.
      m. Indication of flow rate and totalized flow at transmitter.
      n. Meter operable as specified in liquids with 5.0 micro mho/cm or more conductivity.
      o. Transmitter electronics shall use microprocessor based architecture and be configured using parameters.
      p. All meters for drinking water service shall be NSF 61 certified.

4. Schedule:

TAG NUMBER	SERVICE	FLOW RANGE (GPM)	METER SIZE (IN)	NEMA (IP) RATING
FIT-2151	BLOWER #5 TO #8 DISCHARGE FLOW TO AB #5	0-8600 scfm	14"	CLASS 1 DIV 2
FIT-2161	BLOWER #5 TO #8 DISCHARGE FLOW TO AB #6	0-8600 scfm	14"	CLASS 1 DIV 2
FIT-2171	BLOWER #5 TO #8 DISCHARGE FLOW TO AB #7	0-8600 scfm	14"	CLASS 1 DIV 2
FIT-2181	BLOWER #5 TO #8 DISCHARGE FLOW TO AB #8	0-8600 scfm	14"	CLASS 1 DIV 2
FIT-2201	SECONDARY CLARIFIER #1 GST'S INCOMING FLOW	0-17,700 gpm	36"	CLASS 1 DIV 2
FIT-2202	SECONDARY CLARIFIER #2 GST'S INCOMING FLOW	0-17,700 gpm	36"	CLASS 1 DIV 2
FIT-2203	SECONDARY CLARIFIER #3 GST'S INCOMING FLOW	0-17,700 gpm	36"	CLASS 1 DIV 2
FIT-2204	SECONDARY CLARIFIER #4 GST'S INCOMING FLOW	0-17,700 gpm	36"	CLASS 1 DIV 2
FIT-3121	AERATION BASIN #5 TO 8 BLOWER DISCHARGE FLOW	0-49,000 scfm	36"	CLASS 1 DIV 2
FIT-4051	RAS PUMPS P-4001 TO P-4022 DISCHARGE FLOW TO AB SPLITTER	0-5730 gpm	12"	CLASS 1 DIV 2
FIT-4052	RAS PUMPS P-4001 TO P-4022 DISCHARGE FLOW TO AB SPLITTER	0-5730 gpm	12"	CLASS 1 DIV 2
FIT-4053	RAS PUMPS P-4002 TO P-4042 DISCHARGE FLOW TO SEC. CLARIFIER NO. 1 & 2	0-5730 gpm	12"	CLASS 1 DIV 2
FIT-4054	RAS PUMPS P-4002 TO P-4042 DISCHARGE FLOW TO SEC. CLARIFIER NO. 1 & 2	0-5730 gpm	12"	CLASS 1 DIV 2
FIT-4059	RAS PUMPS P-4002 TO P-4042 DISCHARGE FLOW TO SOLID DISCHARGE	0-1400 gpm	4"	CLASS 1 DIV 2
FIT-4060	RAS PUMPS P-4002 TO P-4042 DISCHARGE FLOW TO SOLID DISCHARGE	0-1400 gpm	4"	CLASS 1 DIV 2

TAG NUMBER	LINER MATERIAL	ELECTRODE MATERIAL	INTEGRAL, FIELD OR PANEL-MOUNTED TRANSMITTER
FIT-2201	SECONDARY CLARIFIER #1 GST'S INCOMING FLOW	SS 316L	REMOTE/FIELD
FIT-2202	SECONDARY CLARIFIER #2 GST'S INCOMING FLOW	SS 316L	REMOTE/FIELD
FIT-2203	SECONDARY CLARIFIER #3 GST'S INCOMING FLOW	SS 316L	REMOTE/FIELD
FIT-2204	SECONDARY CLARIFIER #4 GST'S INCOMING FLOW	SS 316L	REMOTE/FIELD
FIT-4051	RAS PUMPS P-4001 TO P-4022 DISCHARGE FLOW TO AB SPLITTER	SS 316L	INTEGRAL
FIT-4052	RAS PUMPS P-4001 TO P-4022 DISCHARGE FLOW TO AB SPLITTER	SS 316L	INTEGRAL
FIT-4053	RAS PUMPS P-4002 TO P-4042 DISCHARGE FLOW TO SEC. CLARIFIER NO. 1 & 2	SS 316L	INTEGRAL
FIT-4054	RAS PUMPS P-4002 TO P-4042 DISCHARGE FLOW TO SEC. CLARIFIER NO. 1 & 2	SS 316L	INTEGRAL
FIT-4059	RAS PUMPS P-4002 TO P-4042 DISCHARGE FLOW TO SOLID DISCHARGE	SS 316L	INTEGRAL
FIT-4060	RAS PUMPS P-4002 TO P-4042 DISCHARGE FLOW TO SOLID DISCHARGE	SS 316L	INTEGRAL

B. Thermal Mass Flowmeters:
   1. Acceptable manufacturer:
      a. Endress + Hauser (Proline T-mass).
   2. Design and fabrication:
      a. Materials:
         1) All wetted surfaces: 316 stainless steel.
   3. Design and fabrication:
      a. Microprocessor based electronics with field adjustable instrument performance parameters and build-in testing and diagnostics and nonvolatile memory.
      b. Provide digital LCD display at transmitter.
      c. Precisely matched RTDs and a heating element.
      d. Turndown ratio: 10:1 to 100:1.
         1) Accuracy: ±1% of reading +0.5% of calibrated full scale.
      e. Repeatability: ±0.5% of reading.
      f. Operating temperature:
         1) Sensor: -40 - 248 degrees F.

2) Transmitter electronics: 0 - 149 degrees F.

g. Process connection: 3/4 inches NPT.

h. Field adjustable insertion length.

i. Output: Isolated 4-20 mA.

j. Power supply: 120 VAC, 60 Hz.

k. Provide with suitable length of cable between sensor and transmitter.

4. Schedule:

TAG NUMBER	SERVICE	FLOW RANGE (SCFM)	PROCESS			PIPE SIZE (IN)	NEMA (IP) RATING
			MEDIUM	TEMP	PRESSURE		
FIT-2151	BLOWER #5 TO #8 DISCHARGE FLOW TO AB #5	TBD				14"	NEMA 4X
FIT-2161	BLOWER #5 TO #8 DISCHARGE FLOW TO AB #6	TBD				14"	NEMA 4X
FIT-2171	BLOWER #5 TO #8 DISCHARGE FLOW TO AB #7	TBD				14"	NEMA 4X
FIT-2181	BLOWER #5 TO #8 DISCHARGE FLOW TO AB #8	TBD				14"	NEMA 4X
FIT-3121	AERATION BASIN #5 TO 8 BLOWER DISCHARGE FLOW	TBD				36"	NEMA 4X

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

3.2 TRAINING

A. Provide on-site training in accordance with Specification Section 01 75 00.

END OF SECTION

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SECTION 40 72 00
LEVEL INSTRUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Level Transmitters:
      a. Ultrasonic Level Sensor and Transmitter.
      b. Non-contact Radar Level Sensor and Transmitter.
      c. Submersible Level Sensor and Transmitter.
   2. Level Switches:
      a. Float-Tilt Type Level Switch.

A. The instruments specified in this Specification Section are the primary element components for the control loops which are specified in Specification Section 40 61 96 and shown on the Control System Drawings.
   1. These instruments are integrated with other control system components specified under Specification Section 40 61 13 to produce the functional control system defined in the Contract Documents

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 40 61 13 - Process Control System General Requirements.
   2. Section 40 61 96 – Process Control Descriptions.
   3. Section 40 70 06 - Schedule of Instrumentation for Process Systems

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society of Mechanical Engineers (ASME):
      a. B16.5, Pipe Flanges and Flanged Fittings.
   2. ASTM International (ASTM):
      a. A106, Standard Specification for Seamless Carbon Steel Pipe for High Temperature Service.
      b. A743, Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 40 61 13.

B. Operation and Maintenance Manuals:
   1. See Specification Section 01 78 23 for requirements for:
      a. The mechanics and administration of the submittal process.
      b. The content of Operation and Maintenance Manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the manufacturers listed in the Articles describing the elements are acceptable.

2.2 LEVEL TRANSMITTERS

A. Ultrasonic Level Sensor and Transmitter:
   1. Manufacturers:

a. Endress + Hauser (*Prosonic* M).

2. Specifications:
   a. General:
      1) Measurement Principle: Ultrasonic, time-of-flight.
         a) Automatic temperature compensation with internal temperature sensor.
         b) Able to ignore false targets.
         c) Maximum Beam Angle: 10 degrees (±5.0 degrees).
      2) Measurement Range: See Schedule.
      3) Level Resolution: 0.10 inches.
      4) Accuracy: ±0.25% of measured distance or 0.25 inches.
      5) Blanking Distance: 12 inches.
      6) Update: 200 msec.
   b. Process Connection:
      1) Mounting Thread Size: 2 inches NPT.
      2) Optional: Flange connection.
   c. Display and Configuration:
      1) Integral Display for live measurement and configuration.
      2) Adjustable zero and span.
      3) Output variables: Level; optional: Volume, Flow (Open Channel Flow).
      4) Output Units: Feet, inches, meters, or millimeters (mm).
   d. Electrical:
      1) Signal Power: Isolated 4-wire, 120 VAC/60Hz.
      2) Current Output: Analog 4-20 Ma into a 400 ohm loop.
      3) High/Low signal alarms: 4.0 mA and 20.0 mA.
      4) Optional Communication: HART.
      5) Configuration: With remote hand-held configurator.
      6) Optional Relays: Two SPDT rated at 1A @ 30 VDC or 5A @ 120 VAC.
      7) Cable entry: 1/2 inches NPT connection.
   e. Materials of Construction.
      1) Wet-side material: PVDF, PVC, polypropylene, or Kynar.
      2) Body: Polyurethane-covered aluminum or cast aluminum.
   f. Environment:
      1) Ambient Temperature: -40 to 158 degrees F (-40 to 70 degrees C).
      2) Humidity: Up to 95%, non-condensing.
      3) Process Temperature: -4 to 158 degrees F (-20 to 70 degrees C).
      4) Process Pressure: 0 to 35 psiG.
      5) Protection: Refer to Area Classification Drawings.

3. Schedule (or Instrument List):

TAG NUMBER	SERVICE	SETPOINT	RANGE	MOUNT
LIT-1101	AERATION BASIN #1 (AB1) DISTRIBUTION ULTRASONIC LEVEL	12.6	0-16 FT	ABOVE SURFACE OF PROCESS LIQUID

B. Non-Contact Type Radar Level Transmitter:
   1. Manufacturers:
      a. Endress + Hauser (*Micropilot* FMRXX).
   2. Specifications:
      a. General:

1) Measurement Principle: Continuous level measurement via non-contact radar signal measuring the "time of flight" for the signal to travel from the sensor to the measured surface and back again.
   a) Level Measurement.
   b) Connection mounted above surface of process fluid.
   c) Blanking Distance: Up to 12 inches.
   d) Application: Liquids or Solids that are viscous or corrosive.
2) Measurement Range (see Schedule):
   a) Varies according to Antenna (High or Low) and Beam Angle (9 to 37 degrees).
   b) Maximum range: 10 to 115 feet.
3) Accuracy:
   a) ±0.1 inches (low frequency).
   b) ±0.4 inches (high frequency).
4) Resolution: 0.04 inches.
5) Temperature Stability: ±0.05%.
6) Response Time: 1 second.

b. Process Connection:
   1) Threaded (NPT): See Schedule.
   2) Flange (ASME): See Schedule.

c. Display and Configuration:
   1) RemoteDisplay for live measurement and configuration.
   2) Adjustable zero and span.
   3) Output variable: Level.
   4) Output Units: Feet, inches, meters, or millimeters (mm).

d. Electrical:
   1) Signal Power: Loop-powered, 2-wire, 24 VDC.
   2) Current Output: Analog 4-20 Ma into a 400 ohm loop.
   3) High/Low signal alarms (< 4.0 mA and > 20.0 mA).
   4) Optional Communication: HART.
   5) Configuration: With remote hand-held configurator.
   6) Cable entry: 1/2 inches NPT connection.
   7) Complies with FCC Part 15.

e. Materials of Construction:
   1) Antenna:
      a) Materials chemically inert in the mounting environment.
      b) Cone Antenna
      c) Sensor module: 316L SST
      d) Cone Antenna: 316 L SST.
   2) Housing: 316 STT.
   3) O-rings: Viton.
   4) Flanges (ASME B16.5): 316 stainless steel.

f. Environment:
   1) Ambient Temperature: -40 to 158 degrees F (-40 to 70 degrees C).
   2) Humidity: Up to 99%.
   3) Process Temperature: -4 to 185 degrees F (-20 to 85 degrees C).
   4) Process Pressure: 0 to 150 psiG.
   5) Protection: Refer to Area Classification Drawings.

3. Schedule (or Instrument List):

TAG NUMBER	SERVICE	ANTENNA TYPE and SIZE (IF HORN)	SPAN	MOUNT TYPE and SIZE
LIT-2202A	AERATION BASIN CHANNEL FOR NO. 1 TO 4 LEVEL	CONE	0-12.4 FT (SETPOINT: 8.6 FT)	ABOVE SURFACE OF PROCESS LIQUID

TAG NUMBER	SERVICE	ANTENNA TYPE and SIZE (IF HORN)	SPAN	MOUNT TYPE and SIZE
LIT-2202B	AERATION BASIN CHANNEL FOR NO. 5 TO 8 LEVEL	CONE	0-12.4 FT (SETPOINT: 8.6 FT)	ABOVE SURFACE OF PROCESS LIQUID

C. Submersible Level Sensor and Transmitter:
   1. Manufacturers:
      a. Endress + Hauser (*Waterpilot* FMX21).
   2. Specifications:
      a. General:
         1) Measurement Principle: Differential-pressure (hydrostatic) based on the height of the liquid head with the use an integrated strain gauge or Ceramic Capacitive Sensor (CCS).
            a) Open (to atmosphere) or Closed Tanks.
            b) Fully submersible.
            c) Vented cable.
         2) Minimum/Maximum Span: 1 to 100 psiG (2.31 to 230.67 feet).
         3) Accuracy: ±0.25% of span.
      b. Process Connection:
         1) None: Mount vertically at the bottom of tank.
         2) Option: 1/4 inches NPT connection on tank.
      c. Display and Configuration:
         1) Output variables: Pressure (converted to level).
         2) Output Units: psi.
      d. Electrical:
         1) Signal Power: Loop-powered, 2-wire, 24 VDC.
         2) Current Output: Analog 4-20 Ma into a 600 ohm loop.
         3) Cable entry: 1/4 inches NPT connection to attached jacketed cable.
      e. Materials of Construction:
         1) Probe: 316SS, Viton, Titanium.
         2) Cable: Hytrel, FEP, HDPE
      f. Environment:
         1) Ambient Temperature: -40 to 212 degrees F (-40 to 1000 degrees C).
         2) Humidity: Up to 100%, non-condensing.
         3) Process Temperature: -4 to 104 degrees F (-20 to 60 degrees C).
         4) Process Pressure: 0 to 35 psiG.
   3. Schedule (or Instrument List):

TAG NUMBER	SERVICE	RANGE	SETPOINT	AREA CLASSIFICATION
LIT-2201A	AERATION BASIN CHANNEL FOR NO. 1 TO 4 LEVEL	3-12.4 FT	8.6 FT	CLASS 1 DIV 2
LIT-2202B	AERATION BASIN CHANNEL FOR NO. 5 TO 8 LEVEL	3-12.4 FT	8.6 FT	CLASS 1 DIV 2

2.3 LEVEL SWITCHES

A. Float-Tilt Type Level Switch:

1. Manufacturers:
   a. Flygt Model ENM-10
   b. Mercoid FSW2

2. Materials:
   a. Float material: Polypropylene or Teflon coated type 316 stainless steel.
   b. Cable jacket: PVC, neoprene.
   c. Cable clamp: Polypropylene or 316 stainless steel.
3. Design and fabrication:
   a. Mercury-free switch.
   b. Provide switch complete with flexible electrical cables.
   c. The level switch will be self-counterweighted, needing no external counterweight
   d. SPDT contact rated at 1 amp at 120 VAC.
   e. Direct acting float switch:
      1) Switch actuates on rising level.
      2) Switch deactuates when liquid falls 1 inch below actuation level.
   f. Terminate cables in junction box.
   g. Process temperature: max. 120 degrees F.
   h. Install floats per drawing details.
4. Schedule (or Instrument List):

TAG NUMBER	SERVICE	CONTACT NO / NC / NO-NC	MOUNTING ELEVATION	MOUNTING (Suspended or Pipe)
LSHH-2201C	SECONDARY CLARIFIER SPLITTER HI HI LEVEL ALARM	NO-NC	24" FROM TOP LEVEL. ELEVATION 475.00 (REFER TO STANDARD INSTALLATION DRAWINGS FOR DETAILS	SUSPENDED
LSHH-2201D	SECONDARY CLARIFIER SPLITTER SUMP HI HI LEVEL ALARM	NO-NC	6" FROM BOTTOM LEVEL (REFER TO STANDARD INSTALLATION DRAWINGS FOR DETAILS	SUSPENDED

2.4 ACCESSORIES

A. Furnish all mounting brackets, hardware and appurtenances required for mounting primary elements and transmitters.
   1. Materials, unless otherwise specified, shall be as follows:
      a. Bolts, nuts, washers, expansion anchors: 316 stainless steel.
      b. Mounting brackets:
         1) Standard: 316 stainless steel.
         2) Highly corrosive areas: Aluminum.
      c. Mounting plates, angles:
         1) Standard: Carbon steel.
         2) Corrosive areas: Aluminum.
      d. Instrument pipe stands:
         1) Standard: Hot-dip galvanized 2 inches schedule 40, ASTM A106, Grade B carbon steel.
         2) Corrosive areas: Aluminum.

B. Provide handheld communicator compatible for all intelligent transmitters furnished.

1. Hand held communicator shall provide capability to check calibration, change transmitter range, and provide diagnostics.
2. If these features are provided with the intelligent transmitter that is accessible, the hand held communicator is not required.

C. Cable lengths between sensors and transmitters shall be continuous (without splices) and as required to accommodate locations as shown on Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install instrument mounting pipe stands level and plumb.

C. Instrument Valves:
1. Orient stems for proper operation.
2. Install arrays orderly and neat in appearance with true horizontal and vertical lines.
3. Provide a minimum of 2 inches clearance between valve handle turning radii where there are multiple valve handles appearing in a straight line.
4. Valves shall have bonnets and any soft seals removed during welding or soldering into the line.
   a. When cool, reassemble the valves.
5. Support each valve individually.
   a. The tubing system does not qualify as support for the valve.

D. Locate instrument piping and tubing so as to be free of vibration and interference with other piping, conduit, or equipment.

E. Keep foreign matter out of the system.

F. Remove all oil on piping and tubing with solvent before piping and tubing installation.

G. Plug all open ends and connections to keep out contaminants.

H. Threaded Connection Seals:
1. Use Tite-Seal or acceptable alternate.
2. Use of lead base pipe dope or Teflon tape is not acceptable.
3. Do not apply Tite-Seal to tubing threads of compression fittings.

I. Instrument Mounting:
1. Mount all instruments where they will be accessible from fixed ladders, platforms, or grade.
2. Mount all local indicating instruments with face forward toward the normal operating area, within reading distance, and in the line of sight.
3. Mount instruments level, plumb, and support rigidly.
4. Mount to provide:
   a. Protect from heat, shock, and vibrations.
   b. Provide accessibility for maintenance.
   c. Free from interference with piping, conduit and equipment.

3.2 TRAINING

A. Provide on-site training in accordance with Specification Section 01 75 00.

END OF SECTION

SECTION 40 73 00
PRESSURE INSTRUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Pressure Transmitters.
      a. Pressure Transmitters (Gauge and Absolute).
      b. Differential Pressure Transmitters.
   2. Pressure Switches.
      a. Electro-Mechanical.
   3. Pressure Indicators.
      a. Pressure Gauges – Mechanical.
   4. Isolation Devices.
      a. Annular diaphragm Seals.

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 40 61 13 - Process Control Systems General Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society of Mechanical Engineers (ASME):
      a. B16.5, Pipe Flanges and Flanged Fittings
   2. ASTM International (ASTM):
      a. A106/A106M, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 40 61 13.

B. Operation and Maintenance Manuals:
   1. See Specification Section 01 78 23 for requirements for:
      a. The mechanics and administration of the submittal process.
      b. The content of Operation and Maintenance Manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the manufacturers listed in the Articles describing the elements are acceptable.

2.2 PRESSURE SWITCHES

A. Electro-Mechanical:
   1. Manufacturers:
      a. Allen-Bradley (Model 836).
      b. Emerson / ASCO (S Series).
      c. Mercoid (Series DA/DS or SA1100).
   2. Materials:
      a. Wetted switch elements: 316 stainless steel.
      b. Diaphragm seal housing: annular flange mounted of 316 stainless steel.

c. Pressure snubber:
   1) Filter disc: 316 stainless steel.
   2) Housing: 316 stainless steel.

3. Accessories:
   a. Provide ball valve to isolate pressure switch from source.
   b. Utilize pressure snubber with porous metal discs to provide pulsation dampening on pressure switch as shown on schedule.
   c. On applications where a pressure switch and a pressure gauge are used at the same location, it is permissible to utilize one pulsation dampener and annular diaphragm seal to isolate both elements from the process fluid.
4. Design and fabrication:
   a. Utilize "Snap Action" type contact switches.
   b. No external power needed.
   c. One SPDT contact rated:
      1) 0.5 amps inductive at 125 VDC.
      2) 5 amps inductive at 120 VAC.
   d. Switch set points:
      1) Above 1,000 psi:
         a) Between 30 and 35% of switch rated working range.
         b) Operating pressure range not to exceed 35% of switch rated working pressure.
      2) Below 1,000 psi:
         a) Set points between 30 and 70% of switch rated working range.
         b) Operating pressure not to exceed 75% of switch rated working range.
   e. Accuracy: ±1% of full scale.
   f. Process connection: Minimum of 1/4 inches.
   g. Conduit connection: Minimum of 1/2 inches.
5. Schedule:

TAG NUMBER	SERVICE	SETPOINT	RANGE	ENCLOSURE RATING	SNUBBER REQ'D
PSL-4011	RAS PUMP P-4011 SEAL WATER SUPPLY LOW	TBD	0-20 PSI	NEMA 4X	NO
PSL-4012	RAS PUMP P-4012 SEAL WATER SUPPLY LOW	TBD	0-20 PSI	NEMA 4X	NO
PSL-4001	RAS PUMP P-4001 SEAL WATER SUPPLY LOW	TBD	0-20 PSI	NEMA 4X	NO
PSL-4021	RAS PUMP P-4021 SEAL WATER SUPPLY LOW	TBD	0-20 PSI	NEMA 4X	NO
PSL-4022	RAS PUMP P-4022 SEAL WATER SUPPLY LOW	TBD	0-20 PSI	NEMA 4X	NO
PSL-4031	RAS PUMP P-4031 SEAL WATER SUPPLY LOW	TBD	0-20 PSI	NEMA 4X	NO
PSL-4032	RAS PUMP P-4032 SEAL WATER SUPPLY LOW	TBD	0-20 PSI	NEMA 4X	NO

PSL-4001	RAS PUMP P-4001 SEAL WATER SUPPLY LOW	TBD	0-20 PSI	NEMA 4X	NO
PSL-4041	RAS PUMP P-4041 SEAL WATER SUPPLY LOW	TBD	0-20 PSI	NEMA 4X	NO
PSL-4042	RAS PUMP P-4042 SEAL WATER SUPPLY LOW	TBD	0-20 PSI	NEMA 4X	NO

2.3 PRESSURE INDICATORS

A. Pressure Gauge - Mechanical:
   1. Manufacturers:
      a. Ametek / USGauge (Solfrunt Model 1980).
      b. Ashcroft (Type 1279 or 1379).
   2. Materials:
      a. Bourdon tube, socket, connecting tube: 316 stainless steel.
      b. Case: Phenolic.
      c. Pressure snubber:
         1) Filter disc: 316 stainless steel.
         2) Housing: 316 stainless steel.
   3. Accessories:
      a. Provide valve at point of connection to equipment and at panel if panel mounted.
      b. Utilize pressure snubber with porous metal discs to provide pulsation dampening on gauge applications as shown on schedule.
      c. Provide 1/2 inches stainless steel anti-siphon pigtail inlet connection for hot water and steam applications.
   4. Design and fabrication:
      a. All components suitable for service at:
         1) 250 degrees F.
         2) The maximum process temperature to which the gauge is to be exposed.
      b. Provide viewer protection from element rupture.
      c. Calibrate gauges at jobsite for pressure and temperature in accordance with manufacturer's instructions.
      d. Unless otherwise required by codes, provide stem mounted or flush mounted, as required, with dial diameter as follows:

PIPE SIZE	DIAL SIZE	GAUGE CONNECTION
1-1/2 inches or less	2-1/2 inches	1/4 inches
Larger than 1-1/2 inches	4-1/2 inches	1/2 inches

      e. Equip with white faces, black numerals and black pointers.
      f. Gauge tapping position to be clear of equipment functions and movements, and protected from maintenance and operation of equipment.
         1) Gauge to be readable from an accessible standing position.
      g. Gauge accuracy: 1% of full range.
      h. Select gauge range so that:
         1) The normal operating value is in the middle third of the dial.
         2) Maximum operating pressure does not exceed 75% of the full scale range.

5. Schedule:

TAG NUMBER	SERVICE	PRESSURE RANGE (PSI)	CASE SIZE (IN)	PROTECTOR REQUIREMENTS	SNUBBER REQ'D
PI-4001A	RAS PUMP P-4001 INLET PRESSURE	Vacuum / 0-15 psi	SEE PIPE SCHD.	NO	NO
PI-4001B	RAS PUMP P-4001 DISCHARGE PRESSURE	0-30 psi	SEE PIPE SCHD.	NO	NO
PI-4001C	RAS PUMP P-4001 SEAL WATER INLET PRESSURE TO SOLENOID VALVE	0-160 psi	SEE PIPE SCHD.	NO	NO
PI-4001D	RAS PUMP P-4001 SEAL WATER SUPPLY PRESSURE AFTER SOLENOID VALVE	0-20 psi	SEE PIPE SCHD.	NO	NO
PI-4002A	RAS PUMP P-4002 INLET PRESSURE	Vacuum / 0-15 psi	SEE PIPE SCHD.	NO	NO
PI-4002B	RAS PUMP P-4002 DISCHARGE PRESSURE	0-30 psi	SEE PIPE SCHD.	NO	NO
PI-4002C	RAS PUMP P-4002 SEAL WATER INLET PRESSURE TO SOLENOID VALVE	0-160 psi	SEE PIPE SCHD.	NO	NO
PI-4002D	RAS PUMP P-4002 SEAL WATER SUPPLY PRESSURE AFTER SOLENOID VALVE	0-20 psi	SEE PIPE SCHD.	NO	NO
PI-4011A	RAS PUMP P-4011 INLET PRESSURE	Vacuum / 0-15 psi	SEE PIPE SCHD.	NO	NO
PI-4011B	RAS PUMP P-4011 DISCHARGE PRESSURE	0-30 psi	SEE PIPE SCHD.	NO	NO
PI-4011C	RAS PUMP P-4011 SEAL WATER INLET PRESSURE TO SOLENOID VALVE	0-160 psi	SEE PIPE SCHD.	NO	NO
PI-4011D	RAS PUMP P-4011 SEAL WATER SUPPLY PRESSURE AFTER SOLENOID VALVE	0-20 psi	SEE PIPE SCHD.	NO	NO
PI-4012A	RAS PUMP P-4012 INLET PRESSURE	Vacuum / 0-15 psi	SEE PIPE SCHD.	NO	NO
PI-4012B	RAS PUMP P-4012 DISCHARGE PRESSURE	0-30 psi	SEE PIPE SCHD.	NO	NO

TAG NUMBER	SERVICE	PRESSURE RANGE (PSI)	CASE SIZE (IN)	PROTECTOR REQUIREMENTS	SNUBBER REQ'D
PI-4012C	RAS PUMP P-4012 SEAL WATER INLET PRESSURE TO SOLENOID VALVE	0-160 psi	SEE PIPE SCHD.	NO	NO
PI-4012D	RAS PUMP P-4012 SEAL WATER SUPPLY PRESSURE AFTER SOLENOID VALVE	0-20 psi	SEE PIPE SCHD.	NO	NO
PI-4021A	RAS 2A PUMP P-4021 INLET PRESSURE	Vacuum / 0-15 psi	SEE PIPE SCHD.	NO	NO
PI-4021B	RAS 2A PUMP P-4021 DISCHARGE PRESSURE	0-30 psi	SEE PIPE SCHD.	NO	NO
PI-4021C	RAS PUMP P-4021 SEAL WATER INLET PRESSURE TO SOLENOID VALVE	0-160 psi	SEE PIPE SCHD.	NO	NO
PI-4021D	RAS PUMP P-4021 SEAL WATER SUPPLY PRESSURE AFTER SOLENOID VALVE	0-20 psi	SEE PIPE SCHD.	NO	NO
PI-4022A	RAS 2B PUMP P-4022 INLET PRESSURE	Vacuum / 0-15 psi	SEE PIPE SCHD.	NO	NO
PI-4022B	RAS 2B PUMP P-4022 DISCHARGE PRESSURE	0-30 psi	SEE PIPE SCHD.	NO	NO
PI-4022C	RAS PUMP P-4022 SEAL WATER INLET PRESSURE TO SOLENOID VALVE	0-160 psi	SEE PIPE SCHD.	NO	NO
PI-4022D	RAS PUMP P-4022 SEAL WATER SUPPLY PRESSURE AFTER SOLENOID VALVE	0-20 psi	SEE PIPE SCHD.	NO	NO
PI-4031A	RAS PUMP P-4031 INLET PRESSURE	Vacuum / 0-15 psi	SEE PIPE SCHD.	NO	NO
PI-4031B	RAS PUMP P-4031 DISCHARGE PRESSURE	0-30 psi	SEE PIPE SCHD.	NO	NO
PI-4031C	RAS PUMP P-4031 SEAL WATER INLET PRESSURE TO SOLENOID VALVE	0-160 psi	SEE PIPE SCHD.	NO	NO
PI-4031D	RAS PUMP P-4031 SEAL WATER SUPPLY PRESSURE AFTER SOLENOID VALVE	0-20 psi	SEE PIPE SCHD.	NO	NO

TAG NUMBER	SERVICE	PRESSURE RANGE (PSI)	CASE SIZE (IN)	PROTECTOR REQUIREMENTS	SNUBBER REQ'D
PI-4032A	RAS PUMP P-4032 INLET PRESSURE	Vacuum / 0-15 psi	SEE PIPE SCHD.	NO	NO
PI-4032B	RAS PUMP P-4032 DISCHARGE PRESSURE	0-30 psi	SEE PIPE SCHD.	NO	NO
PI-4032C	RAS PUMP P-4032 SEAL WATER INLET PRESSURE TO SOLENOID VALVE	0-160 psi	SEE PIPE SCHD.	NO	NO
PI-4032D	RAS PUMP P-4032 SEAL WATER SUPPLY PRESSURE AFTER SOLENOID VALVE	0-20 psi	SEE PIPE SCHD.	NO	NO
PI-4041A	RAS 2A PUMP P-4041 INLET PRESSURE	Vacuum / 0-15 psi	SEE PIPE SCHD.	NO	NO
PI-4041B	RAS 2A PUMP P-4041 DISCHARGE PRESSURE	0-30 psi	SEE PIPE SCHD.	NO	NO
PI-4042A	RAS 2B PUMP P-4042 INLET PRESSURE	Vacuum / 0-15 psi	SEE PIPE SCHD.	NO	NO
PI-4042B	RAS 2B PUMP P-4042 DISCHARGE PRESSURE	0-30 psi	SEE PIPE SCHD.	NO	NO
PI-4042C	RAS PUMP P-4043 SEAL WATER INLET PRESSURE TO SOLENOID VALVE	0-160 psi	SEE PIPE SCHD.	NO	NO
PI-4042D	RAS PUMP P-4042 SEAL WATER SUPPLY PRESSURE AFTER SOLENOID VALVE	0-20 psi	SEE PIPE SCHD.	NO	NO

2.4 ISOLATION DEVICES

A. Diaphragm Seal:
   1. Manufacturers:
      a. Ametek.
      b. Ashcroft.
      c. Emerson Rosemount.
   2. Materials:
      a. Lower housing: Monel.
      b. Diaphragm material: Monel.
   3. Design and fabrication:
      a. Isolates instrument from process fluids which are corrosive or contain solids.
      b. Upper housing with bleed screw.
      c. Lower housing with flushing connection.
      d. Fill fluid:
         1) Utilize halocarbon fill for process applications involving strong oxidizing agents.

a) Agents include but are not limited to: Cl2, KMNO4, FeCl, NaOH, and NaOCl.

2) Utilize manufacturer's standard fill for other applications.

a) Ensure fill is suitable for application temperatures.

e. Process connections:

1) Instrument: 1/2 inches NPT.

2) Process: 0.5 inches female NPT.

3) PVC pipe applications: Use a socket weld connection.

4. Installed where specified or shown on Drawings.

B. Sludge or Scum Service Instrument Isolators:

1. Manufacturers:
   a. Ashcroft, Inc. (Model 106).
   b. Or equal.
2. Materials:
   a. Diaphragm: Annular flange mounted of 316 stainless steel.
   b. Lower Housing: 316 stainless steel.
3. Design and fabrication:
   a. Isolates instruments from process fluids which are corrosive or contain solids.
   b. Upper housing with bleed screw.
   c. Lower housing with flushing connection.
   d. Fill fluid:
      1) Utilize halocarbon fill for process applications involving strong oxidizing agents.
         a) Agents include but are not limited to: Cl_2, $KMNO_4$, FeCl, NaOH, and NaOCl.
      2) Utilize manufacturer's standard fill for other applications.
         a) Ensure fill is suitable for application temperatures.
   e. Process connections:
      1) 0.5 inches female NPT.
      2) Process: In-lined flanged, match line size

2.5 ACCESSORIES

A. Furnish all mounting brackets, hardware and appurtenances required for mounting primary elements and transmitters.

1. Materials, unless otherwise specified, shall be as follows:
   a. Bolts, nuts, washers, expansion anchors: 316 stainless steel.
   b. Mounting brackets:
      1) Standard: 316 stainless steel.
      2) Highly corrosive areas: Aluminum.
   c. Mounting plates, angles:
      1) Standard: Carbon steel.
      2) Corrosive areas: Aluminum.
   d. Instrument pipe stands:
      1) Standard: Hot-dip galvanized 2 inches schedule 40, ASTM A106, Grade B carbon steel.
      2) Corrosive areas: 316 stainless steel.

B. Tubing Support Angles and Brackets:

1. Any of the following materials are acceptable:
   a. Aluminum support with dielectric material between support and tubing.
   b. Type 316 stainless steel.
   c. Fiberglass.

C. Tubing Tray or Channel:

1. Aluminum.
2. Provide dielectric material between tray or channel and tubing.

D. Provide handheld communicator compatible with all intelligent transmitters furnished.

1. Hand held communicator shall provide capability to check calibration, change transmitter range, and provide diagnostics.
2. If these features are provided with the intelligent transmitter, the hand held communicator is not required.

E. Cable lengths between sensors and transmitters shall be continuous (without splices) and as required to accommodate locations as shown on Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install instrument mounting pipe stands level and plumb.

C. Instrument Valves:
1. Orient stems for proper operation.
2. Install arrays orderly and neat in appearance with true horizontal and vertical lines.
3. Provide a minimum of 2 inches clearance between valve handle turning radii where there are multiple valve handles appearing in a straight line.
4. Valves shall have bonnets and any soft seals removed during welding or soldering into the line.
   a. When cool, reassemble the valves.
5. Support each valve individually.
   a. The tubing system does not qualify as support for the valve.

D. Locate instrument piping and tubing so as to be free of vibration and interference with other piping, conduit, or equipment.

E. Keep foreign matter out of the system.

F. Remove all oil on piping and tubing with solvent before piping and tubing installation.

G. Plug all open ends and connections to keep out contaminants.

H. Threaded Connection Seals:
1. Use Tite-Seal or acceptable alternate.
2. Use of lead base pipe dope or Teflon tape is not acceptable.
3. Do not apply Tite-Seal to tubing threads of compression fittings.

I. Instrument Mounting:
1. Mount all instruments where they will be accessible from fixed ladders, platforms, or grade.
2. Mount all local indicating instruments with face forward toward the normal operating area, within reading distance, and in the line of sight.
3. Mount instruments level, plumb, and support rigidly.
4. Mount to provide:
   a. Protection from heat, shock, and vibrations.
   b. Accessibility for maintenance.
   c. Freedom from interference with piping, conduit and equipment.

3.2 TRAINING

A. Provide on-site training in accordance with Specification Section 01 75 00.

END OF SECTION

SECTION 40 74 00
TEMPERATURE INSTRUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Room Temperature Transmitters.

B. The instruments specified in this Specification Section are the primary element components for the control loops which are specified in Specification Section 40 61 96 and shown on the Control System Drawings.
   1. These instruments are integrated with other control system components specified under Specification Section 40 61 13 to produce the functional control system defined in the Contract Documents

C. Related Specification Sections include but are not necessarily limited to:
   1. Section 40 61 13 - Process Control System General Requirements.
   2. Section 40 61 96 – Process Control Descriptions.
   3. Section 40 70 06 - Schedule of Instrumentation for Process Systems

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Iron and Steel Institute (AISI):
      a. Type 316 Stainless Steel.
   2. American Society of Mechanical Engineers (ASME):
      a. PTC 19.3, TW – 2016 Thermowells.
      b. B40.200, Thermometers, Direct Reading and Remote Reading.
   3. ASTM International (ASTM):
      a. A182/A182M, Standard Specification or Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
      b. E230/E230M-17 Standard Specification for Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples
      c. F316, Austenitic Stainless Steel.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 40 61 13 - Process Control Systems General Requirements.

B. Operation and Maintenance Manuals:
   1. See Specification Section 01 78 23 for requirements for:
      a. The mechanics and administration of the submittal process.
      b. The content of Operation and Maintenance Manuals.

PART 2 - PRODUCTS

2.1 ROOM TEMPERATURE AND HUMIDITY TRANSMITTERS

A. Room Temperature and Humidity Transmitters:
   1. Manufacturers:
      a. Comet (T3110).
      b. Dwyer (RHP-3010).
      c. Honeywell (6325).

2. Design and Fabrication:
   a. Measurement: Room Temp and/or Humidity.
   b. Range:
      1) Temperature: -10 to 160 degrees F (-23 to 71 degrees C).
      2) Humidity: 0 to 100% RH.
   c. Accuracy:
      1) Temperature: ±0.4 degrees F (0.2 degrees C).
      2) Humidity: ±2.5% RH.
   d. Output: 4-20 mA.
   e. Supply Voltage: 24 VDC (9 – 30 VDC).
   f. Environment Protection: IP65.
3. Schedule:

TAG NUMBER	SERVICE	MEASUREMENT (Temp, RH, Both)	WALL or OUTDOOR MOUNT
TT-3120	AERATION BASIN BLOWER ROOM AMBIENT TEMPERATURE	TEMPERATURE	WALLMOUNT

2.2 ACCESSORIES

A. Furnish all mounting brackets, hardware and appurtenances required for mounting primary elements and transmitters.
   1. Materials, unless otherwise specified, shall be as follows:
      a. Bolts, nuts, washers, expansion anchors: 316 stainless steel.
      b. Mounting brackets:
         1) Standard: Carbon steel.
         2) Corrosive areas: [Aluminum.] [316 stainless steel].
      c. Mounting plates, angles:
         1) Standard: Carbon steel.
         2) Corrosive areas: [Aluminum.] [316 stainless steel].
      d. Instrument pipe stands:
         1) Standard: carbon steel.
         2) Corrosive areas: [Aluminum] [316 stainless steel].

B. Provide handheld communicator compatible with all intelligent transmitters furnished.
   1. Hand held communicator shall provide capability to check calibration, change transmitter range, and provide diagnostics.
   2. If these features are provided with the intelligent transmitter, the hand held communicator is not required.

C. Cable lengths between sensors and transmitters shall be continuous (without splices) and as required to accommodate locations as shown on Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install instrument mounting pipe stands level and plumb.

C. Keep foreign matter out of the system.

D. Threaded Connection Seals:
   1. Use Tite-Seal or acceptable alternate.
   2. Use of lead base pipe dope or Teflon tape is not acceptable.

3. Do not apply Tite-Seal to tubing threads of compression fittings.

E. Capillary Tubing:
   1. Route capillary tubing in tubing tray.
   2. Install capillary tubing with a 2 inches minimum bend radius which does not kink or pinch the capillaries.
   3. Do not cut or disconnect at any point.
   4. Coil excess capillary tubing and secure at the instrument.

F. Temperature Elements:
   1. Assemble in the following sequence:
      a. Remove temperature sensor sheaths and terminal blocks from the head and nipple assembly.
      b. Connect nipple and head to thermowell installed in the pipe.
      c. Insert sheath and terminal block until it seats in the thermowell.
      d. Connect to the head.

G. Instrument Mounting:
   1. Mount all instruments where they will be accessible from fixed ladders, platforms, or grade.
   2. Mount all local indicating instruments with face forward toward the normal operating area, within reading distance, and in the line of sight.
   3. Mount instruments level, plumb, and support rigidly.
   4. Mount to provide:
      a. Protection from heat, shock, and vibrations.
      b. Accessibility for maintenance.
      c. Freedom from interference with piping, conduit and equipment.

3.2 TRAINING

A. Provide on-site training in accordance with Specification Section 01 75 00.

END OF SECTION

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SECTION 40 75 00
PROCESS LIQUID ANALYTICAL MEASUREMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. pH Analyzers.
2. ORP Analyzers.
3. Conductivity Analyzers.
4. Free Chlorine Analyzers.
5. Residual Chlorine Analyzers.
6. Dissolved Ammonia Analyzers (Probe-type)
7. Dissolved Ammonia Analyzers (Reagent-based)
8. Fluoride Analyzers.
9. Dissolved Oxygen Analyzers.
10. Dissolved Ozone Analyzers.
11. Turbidity Analyzers.
12. Suspended Solids/Sludge Density Analyzers.
13. Monochloramine Analyzers.
14. Streaming Current Monitors.
15. UV254 Analyzers.
16. Nitrate Analyzers.
17. Phosphate Analyzers.

B. Related requirements include but are not necessarily limited to:
1. Section 40 61 13 - Process Control Systems General Requirements.

1.2 REFERENCES

A. Abbreviations and Acronyms.
1. HART - Highway Addressable Remote Transducer.
2. LCD – Liquid crystal display.
3. LED – Light emitting diode.
4. NTU - Nephelometric turbidity unit.
5. PCT - Percent.
6. ppm – Parts per million.
7. TS – Total scale.

B. Reference Standards
1. National Electrical Manufacturers Association (NEMA)
a. Type 4 Enclosures.
b. Type 4X Enclosures.
c. 250, Enclosures for Electrical Equipment (1000 Volts Maximum)

1.3 SYSTEM DESCRIPTION

A. The instruments specified in this Specification Section are the primary element components for the control loops shown on the control system drawings.

B. These instruments are integrated with other control system components specified under Specification Section 40 61 13 to produce the functional control defined in the Contract Documents.

C. Instruments shall be compatible with intended service as shown in the Contract Documents.

D. Instruments shall be suitable for installation in hazardous areas as defined by NFPA 70 Article 500 or as required by area classification shown in the Contract Documents.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings.
      a. See Specification Section 40 61 13.

B. Closeout Submittals.
   1. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

C. Maintenance Material Submittals:
   1. Furnish the following items and submit documentation of delivery to and acceptance of such items by Owner, in accordance with Section 01 78 43 - Spare Parts and Extra Materials:
      a. Spare Parts.
         1) Provide reagents and calibration chemicals as applicable for one calibration per analyzer type.
         2) Luminescent type sensors: Provide one replacement sensor cap per sensor installed.
         3) Electrochemical type sensors: Provide one replacement sensor per each two (or fraction thereof) sensors installed.

D. Refer to Section 01 81 33 - Cyber Security Requirements for required cyber security related submittals.

PART 2 - PRODUCTS

2.1 PRODUCT REQUIREMENTS

A. Refer to Section 01 81 33 - Cyber Security Requirements for cyber security related product requirements.

2.2 ANALYTICAL ELEMENTS

A. pH Analyzers.
   1. Manufacturers.
      a. Hach DPS1 sensor and model sc200 controller (transmitter).
      b. Endress + Hauser: Orbipore CPS series sensor with Memosens technology and Liquiline CM44x series transmitter.
      c. Rosemount Analytical.
   2. Materials.
      a. Sensor: Polyethersulfone (PES), KYNAR, (polyvinylidene fluoride (PVDF)), liquid crystal polymer, or epoxy (less than 140 F).
      b. O-rings: VITON.
   3. Design and fabrication.
      a. Sensor.
         1) Immersion type.
         2) Range: 4 to 12 pH
         3) Accuracy: Less than 0.02 pH.
         4) Repeatability: Less than 0.05.
         5) Sensitivity: 0.01 pH.
         6) Process Temperature sensing element.
         7) Temperature Accuracy: less than 0.9 deg F (0.5 deg C).
         8) Temperature Compensation: Automatic.
         9) Sample pressure: 6.9 bar maximum.
         10) Sample temperature: 32 to 104 deg F (0 to 40 deg C).

11) Flow Rate: 10 ft per second, maximum.

b. Transmitter.
1) Compatible with sensor.
2) Display: 3-1/2 digit minimum LCD display.
3) [Relays: 4 SPDT (Form C) contacts].
4) Outputs: Two isolated 4-20 mA dc. One output shall be used for pH and one output shall be used for Temperature.
~~5)~~ Communication: [Modbus RS485] [Profibus DP] [HART][not used].
6) Accuracy: less than 1% of FS.
7) Enclosure: IP66/IP67, tightness and corrosion resistance in accordance with NEMA TYPE 4X.
8) Power: 120 V ac.
9) Operating temperature: -20 to 104 deg F (-20 to 40 deg C).
10) Operating humidity: 10 to 95%, non-condensing.

4. Schedule.

TAG NUMBER	SERVICE	MEASUREMENT RANGE	NEMA RATING	MOUNTING TYPE (SEE NOTES)

B. ORP Analyzers.
1. Manufacturers.
a. Rosemount Analytical.
b. Hach sensor and model sc200 controller.
c. Endress + Hauser sensor and liquiline CM400 transmitter.
d. Analytical Technology, Inc. (ATI)
2. Materials.
a. Body, cover: Polyethersulfone (PES), Kynar (PVDF), liquid crystal polymer, epoxy (less than 140F), or equal.
b. O-rings: VITON.
3. Design and fabrication.
a. Integral pre-amplifier to convert high impedance ORP measurement into stable, noise-free signal (if not furnished with integral transmitter).
b. Automatic temperature compensation.
c. Shielded cable.
d. Include a titanium ground electrode to eliminate ground loop currents in the measuring electrodes.
e. Sensitivity: ±0.5 mV
f. Range: -1500 mV to +1500 mV
g. Stability: 2 mV per 24 hours.
h. Transmitter.
1) Local digital display.
a) LCD or LED
b) Minimum 3-1/2 digit.
2) Power: 120 V ac.
3) Ambient temperature: - 4 to 122 deg F
4) Ambient humidity: 0 to 95%
5) Temperature compensated.
6) Output signal: 4-20 mA

4. Schedule.

TAG NUMBER	SERVICE	SPAN	NEMA RATING	SENSOR MOUNTING TYPE

C. Conductivity Analyzers.
1. Manufacturers.
   a. Hach 3700 Series.
   b. Rosemount Analytical Model 226
2. Materials.
   a. Wetted Materials: 316 Stainless Steel.
      1) O-Rings: Viton.
3. Design and fabrication.
   a. Sensor.
      1) Range: -1000 to +1000
      2) Adjustable signal gain.
      3) Adjustable zero offset.
      4) Self-diagnostics.
      5) Self-cleaning.
      6) Operating temperature: 34 to 120 deg F (1 to 49 deg C)
      7) Shielded cable.
   b. Transmitter.
      1) Up to three measured parameters.
      2) One 4-20mA output per measured parameter.
      3) Measurement range selectable.
      4) Display: LCD
         a) Minimum 3-1/2 digit.
      5) Communication: [Ethernet] [Modbus RTU]
      6) Power: 120 V ac.
      7) Enclosure: [NEMA 4X] [NEMA 4]
      8) Ambient temperature: 20 to 122 deg F
      9) Ambient humidity: 0 to 95 PCT
      10) Response time: 1 s to 1 min adjustable.
      11) Zero setting available via operator interface {keypad or touchscreen}
   c. Sampling.
      1) Sampling flow range: 1 to 5 liters/min.

4. Schedule.

TAG NUMBER	SERVICE	MEASUREMENT RANGE	NEMA RATING

D. Free Chlorine Analyzers.
1. Manufacturers.
   a. Hach CL17

b. Rosemount Analytical Model 56/1056
c. Endress + Hauser Liquisys M
d. Analytical Technology, Inc. (ATI)
e. Swan Analytical AMI Codes II
f. API Model Q45H-62 (no reagents)

2. Materials.
   a. Enclosure: NEMA 4X plastic with clear polycarbonate windows.
3. Design and fabrication.
   a. Utilize colorimeter with seal-free, solid state mixing system, including self-cleaning stir bar.
   b. Amperometric method is also acceptable with pH compensation.
   c. Accuracy: ±5% or ±0.035 MG/L as Cl_2, whichever is greater.
   d. Power: 120 V ac.
   e. Provided with amplifiers, signal converting circuitry, range and zero adjustment, all with coupling and voltage regulation circuitry as required to enable chlorine residual transmitter to meet criteria specified.
4. Accessories.
   a. Provide with one-month supply of reagents.
5. Schedule.

TAG NUMBER	SERVICE	SPAN	NEMA RATING

E. Residual Chlorine Analyzers.
1. Manufacturers.
   a. Hach CL17 sc
   b. Chemscan.
   c. Swan Analytical AMI Codes II
   d. Rosemount Analytical Model 56/1056
   e. Endress + Hauser Liquisys M
2. Materials.
   a. Enclosure: ABS plastic with clear polycarbonate windows.
3. Design and fabrication.
   a. Utilize colorimeter with seal-free, solid state mixing system, including self-cleaning stir bar.
   b. Amperometric method is also acceptable with pH compensation.
   c. Accuracy: ±5% or ±0.035 MG/L as Cl_2, whichever is greater.
   d. Power: 120 V ac.
   e. Provided with amplifiers, signal converting circuitry, range and zero adjustment, all with coupling and voltage regulation circuitry as required to enable chlorine residual transmitter to meet criteria specified.
4. Accessories.
   a. Provide with one-month supply of reagents.
5. Schedule.

TAG NUMBER	SERVICE	SPAN	NEMA RATING

TAG NUMBER	SERVICE	SPAN	NEMA RATING

F. Dissolved Ammonia Analyzers (Probe-type)
   1. Manufacturers.
      a. Endress + Hauser: ISEmax CAS40D with Liquiline CM400 series transmitter.
      b. ABB Aztec AAM631
      c. API Model Q46N
      d. YSI IQ SensorNet.
   2. Materials.
      a. Enclosure: plastic with clear polycarbonate windows.
   3. Design and fabrication.
      a. Utilize ion-selective sensor.
      b. Provide pH compensation.
      c. Direct measurement of ammonia without sampling.
      d. Manufacturer-furnished mounting system.
         1) Securely mount sensor apparatus with capability to easily access sensor.
      e. Accuracy: ±5% of measured value.
      f. Repeatability: ±3% of display value.
      g. Temperature compensated.
      h. Environment.
         1) Ambient temperature: -4 to 120 deg F
      i. Transmitter/Controller.
         1) Display: 3-1/2 digit minimum LCD, LED or Vacuum Fluorescent display
         2) Power supply: [120 V ac.] [24 V dc, 2-wire.]
         3) Output: Isolated 4-20 mA dc.
         4) Operating temperature: -4 to 140 deg F
         5) Operating humidity: 10 to 95% non-condensing.
         6) Enclosure: [NEMA 4X] [IP65]
   4. Schedule.

TAG NUMBER	SERVICE	MEASUREMENT RANGE	NEMA RATING	MOUNTING TYPE (SEE NOTES)

G. Dissolved Ammonia Analyzers (Reagent-based)
   1. Manufacturers.
      a. Hach Amtax sc, model sc1000 controller (transmitter) and Filtrax filtration system
   2. Design and fabrication.
      a. Analyzer.
         1) Utilize gas sensitive electrode (GSE) sensor.
         2) All process connections and electrical terminations located in single common enclosure.
         3) Reagent replacement not more than once every two months.
         4) Sample pH: 5 to 9
         5) Adjust the required Range, and resulting Accuracy, Reproducibility and Response Time, based on the specific needs of the project.
         6) Range: 0.02 to 5.0 mg/L NH_4-N
         7) Accuracy: ≤ 1 mg/L: 3% + 0.02 mg/L; > 1 mg/L: 5% + 0.02 mg/L

8) Reproducibility: 3% + 0.02 mg/L
9) Response time: 0.02 to 2.0 mg/L: 15 min; 2.0 to 5.0 mg/L: 5 min.
10) Measurement interval: 5 to 120 min (adjustable)
11) Temperature range: -4 to 113 deg F (outdoor service), 41 to 104 deg F (indoor service)
12) Sample Temperature range: 39 to 104 deg F
13) Power supply: 120 V ac.
14) Enclosure: [IP55 (suitable for outdoor service)] [IP54 (suitable for indoor service)], Wall, rail or stand mount.

b. Transmitter/Controller.
1) Display: ¼-in VGA backlit TFT color touch screen.
2) Resolution: 320 x 240 pixel.
3) Power: 120 V ac.
4) Output: Isolated 4-20 mA dc.
5) Operating temperature: -4 to131 deg F
6) Operating humidity: 5 to 95% non-condensing.
7) Enclosure: IP65 (suitable for outdoor service)

c. Sample Extraction & Filtration
1) Sample extraction and in-situ filtration device shall be provided for each sample location.
2) The device shall condition the sample and prevent particles larger than 15 µm from entering the sample stream.
3) The filter and pump(s) must provide flow equal to that of the requirements of the analyzer connected to it.
4) The filter shall incorporate an in place active filter cleaning system to preventing adhesion of solids to the filter membranes.
5) Sample line must be heated such that the sample will not freeze or decrease in temperature beyond the analyzers ability to provide an accurate measurement.
6) Power: 120 V ac.
7) Temperature range: -4 to 104 deg F
8) Sample Temperature range: 41 to 104 deg F
9) Enclosure: Heated, IP55 (suitable for outdoor service)

3. Schedule.

TAG NUMBER	SERVICE	MEASUREMENT RANGE	NEMA RATING

H. Fluoride Analyzers.
1. Manufacturers.
a. Hach CA610
b. ABB Aztec AFM631
c. Analytical Technology, Inc. (ATI)
2. Design and fabrication.
a. Accuracy: ±10% or ±0.10 ppm whichever is greater.
b. Repeatability: 2% of reading.
c. Response time: Less than 5 minutes for 90% step change.
d. Display: Fluorescent, LED or backlit LCD
e. Calibration: 2-point log/linear.
f. Operating temperature range: 41 to 104 deg F

g. Power supply: 120 V ac.
h. Output signal: 4-20 mA

3. Schedule.

TAG NUMBER	SERVICE	SPAN	NEMA RATING

I. Dissolved Oxygen Analyzers.
1. Manufacturers.
a. Hach Company, model LDO® sensor and model sc200 controller (transmitter)
b. Endress + Hauser: Oxymax COS61series sensor and Liquiline CM400 series transmitter.
2. Materials.
a. Sensor wetted parts: Noryl, Teflon, 316 stainless steel, PVC, polypropylene, PBT (thermoplastic polyesters based on polybutylene terephthalate), or PC (polycarbonate)
b. Sensor membrane: Polybutyl methoacrolate or Teflon.
c. If amperometric type sensor.
1) Anode: Silver.
2) Cathode: Gold.
3. Design and fabrication.
a. Sensor.
1) Utilize digital sensor capable of being calibrated with a lab analyzer and then connected to a second analyzer in the field without the need to recalibrate.
2) Temperature compensated.
3) Accuracy.
a) Dissolved oxygen: ±0.2 PPM or ±0.2% of span at calibrating temperature.
b) Temperature: ±0.5 deg C
4) Response time: 95% in 60 seconds.
5) Internal calibration standard.
6) Mounting: Per schedule below and Contract Documents.
7) Operating temperature: 32 to 104 deg F
b. Controller (analyzer/transmitter)
1) Capable of receiving inputs from two sensors.
2) Display: 3 digit minimum, LED or backlit LCD display.
a) 0.1 PPM resolution.
b) 0.1 deg F resolution.
c) Menu driven.
d) Indication of sensor fault condition.
3) Power: 24 V dc.
4) Output: Two isolated 4-20 mA dc, one for each sensor.
5) Operating temperature: 0 to 140 deg F
6) Operating humidity: 10 to 95%, non-condensing.
7) Enclosure: NEMA 4X
8) Mounting: Per schedule below.

4. Schedule.

TAG NUMBER	SERVICE	MEASUREMENT RANGE	NEMA RATING	MOUNTING TYPE

J. Dissolved Ozone Analyzers.
1. Manufacturers.
   a. Teledyne Model 480
   b. BMT
2. Materials.
   a. Wetted Materials: 316 Stainless Steel.
      1) O-Rings: Viton.
3. Design and fabrication.
   a. Sensor.
      1) Range: [0 to 1][0 to 500 ppm]
      2) Adjustable signal gain.
      3) Adjustable zero offset.
      4) Self-diagnostics with dry contact alarm output.
      5) Self-cleaning.
      6) Enclosure: NEMA 4X
      7) Operating temperature: 41 to 113 deg F (5 to 45 deg C)
   b. Transmitter.
      1) Up to three measured parameters.
      2) One 4-20mA output per measured parameter.
      3) Measurement range selectable.
      4) Display: LCD
         a) Minimum 3-1/2 digit.
      5) Communication: Ethernet.
      6) Power: 120 V ac.
      7) Enclosure: NEMA 4
      8) Ambient temperature: 20 to 122 deg F
      9) Ambient humidity: 0 to 95 PCT
      10) Response time: 1 s to 1 min adjustable.
      11) Zero setting available via operator interface {keypad or touchscreen}
   c. Sampling.
      1) Sampling flow range: 1 to 5 liters/min.
4. Schedule.

TAG NUMBER	SERVICE	MEASUREMENT RANGE	NEMA RATING

K. Turbidity Analyzers.
1. Manufacturers.
   a. Hach [TU5300sc] [TU5400sc] with SC200 controller.

2. Materials.
   a. Sensor: ASA S 777K / RAL7000, TPE RESIN Elastocon® STK40, Thermoplastic Elastomer TPS-SEBS.
3. Design and fabrication.
   a. Sensor.
      1) Measuring Range: 0 to 700 NTU.
      2) Accuracy: 0 to 40 NTU: ±2% of reading ±0.01 NTU, 40 to 1000 NTU: ±10% of reading.
      3) Resolution: 0.001 NTU.
      4) Response Time: T90 < 45 seconds at 100 mL/min.
      5) Sample temperature: 36 to 122 deg F.
      6) Operating temperature: 32 to 122 deg F (0 to 50 deg C).
      7) Operating humidity: 5 to 95% non-condensing.
      8) Lower limit of Detection: 0.002 NTU.
      9) An internal bubble removal system shall be included to vent entrained air from the sample stream.
      10) Light Source: Class 2 laser product, with embedded 650 nm (EPA) or 850 nm (ISO), max. 1.0 mW.
   b. Transmitter.
      1) Up to three measured parameters.
      2) Output: One 4-20 mA output per measured parameter.
      3) Measurement range selectable.
      4) Display: 3-1/2 digit minimum LCD display.
      5) Output: Isolated 4-20 mA dc.
      6) Communication Protocol: Modbus RTU.
      7) Power: 120 V ac.
      8) Enclosure: NEMA 4X and IP55.
      9) Operating temperature: 20 to 122 deg F.
      10) Operating humidity: 0 to 95 PCT.
4. Accessories.
   a. [None].
5. Schedule..

TAG NUMBER	SERVICE	MEASUREMENT RANGE	NEMA RATING

L. Suspended Solids/Sludge Density Analyzers.
1. Manufacturer.
   a. Toshiba LQ500.
   b. Valmet TS.
2. Materials.
   a. Wetted materials.
      1) Temperature detector sheath: 316 stainless steel.
      2) Applicator window: Polysulfone.
      3) Applicator window sealant: Fluoric rubber.
3. Design and fabrication.
   a. Method: microwave phase difference.
   b. Accuracy: ±2% of full scale.
   c. Resolution: 0.001percent TS.

d. Converter output signal: 4-20 mA.
e. Converter fault relay output contact.

4. Schedule:

TAG NUMBER	SERVICE	MEASUREMENT RANGE	NEMA RATING

M. Suspended Solids Analyzers.

1. Manufacturers.
   a. Hach: SOLITAX sensor and model sc200 controller (transmitter).
   b. Endress + Hauser: Turbimax CUS51D sensor and Liquiline CM44x series transmitter.
2. Materials.
   a. Probe: chemically resistant polyurethane, polymer, Teflon, or Stainless steel.
3. Design and fabrication.
   a. Sensor.
      1) Insitu probe with single light source and minimum of two sensors.
      2) Range: 0 to 300 g/L.
      3) Accuracy: Less than 5% of reading.
      4) Repeatability: Less than 3% of reading.
      5) Sample pressure: 6 bar (87 psi) maximum.
      6) Sample temperature: 32 to 104 deg F (0 to 40 deg C).
   b. Transmitter.
      1) Compatible with sensor.
      2) Display: 3-1/2 digit minimum LCD display.
      3) [Relays: 4 SPDT (Form C) contacts].
      4) Outputs: Two isolated 4-20 mA dc.
      5) Communication: [Modbus RS485] [Profibus DP] [HART][not used].
      6) Accuracy: less than 1% of FS.
      7) Enclosure: IP66/IP67, tightness and corrosion resistance in accordance with NEMA TYPE 4X.
      8) Power: 120 V ac.
      9) Operating temperature: -20 to 104 deg F (-20 to 40 deg C).
      10) Operating humidity: 10 to 95%, non-condensing.
4. Schedule.

TAG NUMBER	SERVICE	MEASUREMENT RANGE	NEMA RATING	MOUNTING TYPE

N. Monochloramine Analyzers:

1. Manufacturers:
   a. Hach 5500sc – combination ammonia and monochloramine measurement.
   b. Rosemount Analytical Model MCL – monochloramine.
   c. ChemScan® UV-2150/S - combination ammonia and monochloramine measurement.
   d. Analytical Technology, Inc. (ATI).

2. Design and fabrication:
   a. Enclosure: ABS plastic with clear polycarbonate windows.
   b. Accuracy: ±5% of reading or ±0.02 ppm as N, whichever is greater.
   c. Repeatability: ±3% of reading or ±0.01 PPM as N.
   d. Power: 120 V ac.
   e. Response Time: Less than 5 minutes for 90% change.
   f. Analysis method: Colorimetric modified Phenate or ultraviolet absorbance.
   g. Sample flow: 100 to 1,000 mL/min.
   h. Sample temperature: 41 to 122 deg F.
   i. Reagent use: 1 liter per month per reagent.
   j. Output: 4-20 mA.
   k. Enclosure: NEMA 4X plastic.
   l. Numeric data display.
   m. Capable of automatic calibration, cleaning, and self-priming.
3. Schedule.

TAG NUMBER	SERVICE	SPAN	NEMA RATING

O. Streaming Current Monitors.
1. Manufacturers.
   a. ChemTrac HydroACT with DuraTrac 4.
   b. Milton Roy [SC4200] [SC5200].
   c. MicroMetrix.
2. Materials.
   a. Wetted Materials: [316 Stainless Steel] [UHMW (Ultra-high molecular weight Polyethylene] [Delrin (polyoxymethylene)] [Polyethersulfone (PES)] [Kynar] [Polyvinylidene fluoride (PVDF)] [Liquid crystal polymer] [Epoxy (less than 140F)] [Nylon] [316 stainless steel].
      1) O-Rings: [Viton].
3. Design and fabrication.
   a. Sensor.
      1) Range: -1000 to +1000.
      2) Adjustable signal gain.
      3) Adjustable zero offset.
      4) Self-diagnostics with dry contact alarm output.
      5) Self-cleaning.
      6) Power: [120 V ac] [240 V ac] [24 V dc]
      7) Enclosure: [Refer to schedule] [None - Mounted on aluminum backplane] [NEMA 4X] [NEMA 4]
      8) Operating temperature: [1 to 49 deg C]
      9) Shielded cable.
   b. Transmitter.
      1) Up to [three] measured parameters.
      2) One 4-20mA output per measured parameter.
      3) Measurement range selectable.
      4) Display: [VGA color display] [LCD] [LED]
         a) Minimum [3-1/2] digit.
      5) Communication: [Modbus RTU] [Ethernet]
      6) Power: [120 V ac] [24 V dc]

7) Enclosure: [Refer to schedule] [NEMA 4X] [NEMA 4]
8) Ambient temperature: 20 to 122 deg F
9) Ambient humidity: 0 to 95%
10) Response time: 1 s to 1 min adjustable.
11) Zero setting available via operator interface {keypad or touchscreen}

c. .Sampling.
1) Sampling flow range: [1] [2] liter/min to [4] [5] liters/min.

4. Accessories.
a. Provide a [NSF-61 compliant] submersible sample pump sized to deliver the required flow range.

5. ..Schedule

TAG NUMBER	SERVICE	SENSOR MOUNTING TYPE	NEMA RATING

P. UV254 Analyzers.
1. Manufacturers.
a. Hach: UVAS sc Probe with sc1000 Controller.
b. Chemtrac: UV1 and HydroACT transmitter.
c. Real Tech: Real UV254

2. Materials.
a. Wetted Materials: 316 Stainless Steel.
b. O-Rings: Viton.

3. Design and fabrication.
a. Sensor.
1) Range: 0 to [1][2.5][5][10][20] Abs/cm
2) Adjustable signal gain.
3) Adjustable zero offset.
4) Self-diagnostics with dry contact alarm output.
5) Self-cleaning.
6) Power: 120 V ac.
7) Enclosure: NEMA 4
8) Operating temperature: 34 to 120 deg F (1 to 49 deg C)
9) Shielded cable.

b. Transmitter.
1) Up to three measured parameters.
2) Output: One 4-20mA output per measured parameter.
3) Measurement range selectable.
4) Display: LCD
a) Minimum 3-1/2 digit.
5) Communication: Ethernet.
6) Power: 120 V ac.
7) Enclosure: NEMA 4
8) Ambient temperature: 20 to 122 deg F
9) Ambient humidity: 0 to 95 PCT
10) Response time: 1 s to 1 min adjustable.
11) Zero setting available via operator interface {keypad or touchscreen}

c. Sampling.
1) Sampling flow range: 1 to 5 liters/min.

4. Schedule.

TAG NUMBER	SERVICE	MEASUREMENT RANGE	NEMA RATING

Q. Nitrate Analyzers.
1. Manufacturers.
   a. Hach Nitratax plus sc and model sc200 controller (transmitter)
2. Materials.
   a. Sensor enclosure: [Stainless steel]
   b. Wiper axle: [Stainless steel]
3. Design and fabrication.
   a. Sensor.
      1) Submersible type.
      2) Reagent-free, ultraviolet (UV) light absorption technology.
      3) Built-in wiper to automatically clean the sensor's detector windows.
      4) Gap path: 1 mm, 2 mm, 5 m.
      5) Range: [0.1 to 100.0 mg/L NO_{2+3}-N (1 mm)][0.1 to 50.0 mg/L NO_{2+3}-N (2 mm)][0.1 to 25.0 mg/L NO_{2+3}-N (5 mm)]
      6) Accuracy: +/- 3% of the mean +/- 0.5
      7) Resolution: 0.1 mg/L
      8) Measurement interval: 1 min.
      9) Response time (T100): 1 min.
      10) Operating pressure: 0.5 bar (7.2 psi), max.
      11) Temperature range: 36 to 104 deg F
      12) Sensor Cable Integral w/ Quick Disconnect Plug.
   b. Transmitter/Controller.
      1) Display: 3-1/2 digit minimum, LCD or LED
      2) Power supply: 120 V ac.
      3) Current output: Isolated 4-20 mA dc.
      4) Operating temperature: -4 to 140 deg F
      5) Operating humidity: 5 to 95%, non-condensing.
      6) Enclosure: NEMA 4X
4. Schedule.

TAG NUMBER	SERVICE	MEASUREMENT RANGE	NEMA RATING

R. Phosphate Analyzers.
1. Manufacturers.
   a. Hach Phosphax sc, model sc1000 controller (transmitter) and Filtrax filtration system.
2. Design and fabrication.

a. Analyzer.
   1) Utilize colorimetric method to determine phosphate concentration.
   2) All process connections and electrical terminations located in single common enclosure.
   3) Reagent replacement not more than once every two months.
   4) Range: [0.05 to 15][1.0 to 50] mg/L PO_4-P
   5) Accuracy: 2% +/- 0.05 mg/L
   6) Reproducibility:2% +/- 0.05 mg/L (low range)
   7) Response time (T90): Less than 5 min, including sample prep.
   8) Measurement interval: 5 to 120 min (adjustable)
   9) Temperature range: -4 to 113 deg F
   10) Sample Temperature range: 39 to 104 deg F
   11) Power supply: 120 V ac.
   12) Enclosure: IP55 (suitable for outdoor service)wall, rail or stand mount.

b. Transmitter/Controller.
   1) Display: ¼-in VGA backlit TFT color touch screen.
   2) Power: 120 V ac.
   3) Current output: Isolated 4-20 mA dc.
   4) Operating temperature: -4 to 131 deg F
   5) Operating humidity: 5 to 95% non-condensing.
   6) Enclosure: IP65 (suitable for outdoor service)

c. Sample Extraction & Filtration:
   1) Sample extraction and in-situ filtration device shall be provided for each sample location.
   2) The device shall condition the sample and prevent particles larger than 15 µm from entering the sample stream.
   3) The filter and pump(s) must provide flow equal to that of the requirements of the analyzer connected to it.
   4) The filter shall incorporate an in place active filter cleaning system to preventing adhesion of solids to the filter membranes.
   5) Sample line must be heated such that the sample will not freeze or decrease in temperature beyond the analyzers ability to provide an accurate measurement.
   6) Power supply: 120 V ac.
   7) Temperature range: -4 to 104 deg F
   8) Sample Temperature range: 41 to 104 deg F
   9) Enclosure: Heated, IP55 (suitable for outdoor service)

3. Schedule.

TAG NUMBER	SERVICE	MEASUREMENT RANGE	NEMA RATING

2.3 ACCESSORIES

A. Furnish all mounting brackets, hardware and appurtenances required for mounting primary elements and transmitters.
   1. Materials, unless otherwise specified, shall be as follows:

a. Bolts, nuts, washers, expansion anchors: 316 stainless steel.
b. Mounting brackets.
   1) Standard: 316 stainless steel.
   2) Highly corrosive areas: Aluminum.
c. Mounting plates, angles.
   1) Standard: Carbon steel.
   2) Corrosive areas: [Aluminum] [316 stainless steel]
d. Instrument pipe stands.
   1) Standard: Hot-dip galvanized 2 inch schedule 40, ASTM A106, Grade B carbon steel.
   2) Corrosive areas: [Aluminum] [316 stainless steel]

B. Provide Sun shields for outdoor controllers.

C. Tubing Support Angles and Brackets.
   1. Any of the following materials are acceptable.
      a. Aluminum support with dielectric material between support and tubing.
      b. Type 316 stainless steel.
      c. Fiberglass.

D. Tubing Tray or Channel.
   1. Aluminum.
   2. Provide dielectric material between tray or channel and tubing.

E. Provide handheld communicator compatible with all intelligent transmitters furnished.
   1. Handheld [HART] communicator shall provide capability to check calibration, change transmitter range, and provide diagnostics.
   2. If these features are provided with the intelligent transmitter, the handheld communicator is not required (provided the transmitter is easily accessible by an operator without the need for a ladder/step stool).

F. Cable lengths between sensors and transmitters shall be continuous (without splices) and as required to accommodate locations as shown on Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install instrument mounting pipe stands level and plumb.

C. Instrument Mounting.
   1. Mount all instruments where they will be accessible from fixed ladders, platforms, or grade.
   2. Mount all local indicating instruments with face forward toward the normal operating area, within reading distance, and in the line of sight.
   3. Mount instruments level, plumb, and support rigidly.
   4. Mount to provide:
      a. Protection from heat, shock, and vibrations.
      b. Accessibility for maintenance.
      c. Freedom from interference with piping, conduit and equipment.

3.2 TRAINING

A. Provide on-site training in accordance with Specification Section 01 75 00.

3.3 CLOSEOUT

A. Refer to Section 01 81 33 - Cyber-Security Requirements for cyber security related closeout requirements.

3.4 SERVICE CONTRACT

END OF SECTION

SECTION 40 76 00
PROCESS GAS ANALYTICAL MEASUREMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Analytical components.

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 40 61 13 - Process Control System General Requirements.
   2. Section 40 61 96 - Process Control Descriptions.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. A106, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.

1.3 SYSTEM DESCRIPTION

A. These instruments are integrated with other control system components specified under Specification Section 40 61 13 to produce the functional control defined in the Contract Documents.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 40 61 13.

B. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the manufacturers listed in the Articles describing the elements are acceptable.

2.2 ANALYTICAL ELEMENTS

A. Combustible and Toxic Gas Detectors:
   1. Acceptable manufacturers:
      a. Bacharach.
      b. Draeger.
      c. MSA Instruments.
      d. Sierra Monitor.
   2. Control unit:
      a. Front mounted indication.
         1) Minimum three-digit display of gas concentration associated with each sensor.
         2) Alarm status indicators for each gas sensing channel:
            a) Trouble.
            b) High gas level detected.

c) High high gas level detected.

b. Alarm relay outputs:
   1) Separate contacts for each alarm or trouble condition associated with each gas sensing channel.
   2) Separate "system trouble" contact to indicate trouble in the event any of the following conditions are true:
      a) System power loss.
      b) Signal loss from any sensor.
      c) Signal out of appropriate range.
      d) Control module malfunction or removal.
   3) Each output contact shall be Form C, DPDT, rated for 3 amps resistive at 120 VAC.
c. Output signals: 4-20 mA signal representing gas concentration for each gas sensor.
d. Temperature range: 32 to 140 degrees F.
e. Relative humidity range: 0-95% non-condensing.

3. Sensor and transmitter design and fabrication:
   a. Sensor mounting type shall be as indicated on schedule: Either diffusion mounted, duct mounted, or sample draw mounted.
   b. For sensors required by schedule to be sample draw type:
      1) Provide a compressed air aspirator or motorized pump to draw a sample past the sensor.
      2) Utilize a flow switch to provide annunciation of low sample flow rate to the sensor.
   c. Duct mounted gas sensor shall be able to monitor gas flow rates up to 85 fps.
   d. Combustible gas sensor shall be catalytic bead type with demonstrated resistance to poisoning by silicones and hydrogen sulfide gases.
   e. Toxic gas sensor shall be the electrochemical type and shall not require the periodic addition of reagents.
   f. Interconnect wiring from sensor to transmitter (if not integral) or control unit shall be 3-wire shielded cable.
   g. Sensing element shall have minimum useful life of one year.
   h. Transmitter output: 4-20 mA signal proportional to measured gas level.
      1) Capable of driving 600 ohm load at 24 VDC supply voltage.
   i. Accuracy:
      1) Combustible gas detection:
         a) +3% LEL to 50% full scale.
         b) +5% LEL, 50 to 100% full scale.
      2) Toxic gas detection:
         a) +10% full scale or 2 PPM, whichever is greater.
   j. Environmental:
      1) Ambient operating temperature: -40 to 158 degrees F.
      2) Relative humidity: 0-95% non-condensing.
   k. Housing: In accordance with the area classification shown on Drawings.
   l. Provide nonintrusive means of calibration.
   m. Local displays:
      1) 3-1/2 digit LCD or LED display of measured gas level.
      2) Fault LED.
   n. Standalone sensors and transmitters (without central control unit):
      1) Provide relay contacts rated at 1/2 amps at 120 VAC for each of the following conditions:
         a) High gas level (warning level).
         b) High high gas level (alarm level).
         c) Sensor fault condition.
   o. Relay contacts shall be normally energized (normally closed); contacts shall open in the event of a warning, alarm or trouble condition.
   p. Minimum detector response time when exposed to 100% LEL gas concentration:

1) 10 seconds to 50% LEL.
2) 30 seconds to 90% LEL.

q. Store calibration data in nonvolatile memory or back up with battery.

4. Provide one calibration kit for each type of gas monitored.
   a. Calibration kits shall be furnished complete with all tubing, regulators, fittings, communication devices, and accessories required to calibrate sensors.
   b. Calibration kit shall utilize nonintrusive means of calibrating sensors/transmitters.
5. Provide two full cylinders of each type of calibration check gas.
   a. Cylinder size: 17 liters.
6. Provide the same quantity of zero air cylinders as the total required number of calibration check gas cylinders (of all types).
7. Schedule:

TAG NO	SERVICE	GAS	MOUNT TYPE	RANGE	SETPOINTS	
					WARN (HI)	ALARM (HI HI)

MOUNT TYPE: D - diffusion type, DM - duct mounted, SD - sample draw.

2.3 ACCESSORIES

A. Furnish all mounting brackets, hardware and appurtenances required for mounting primary elements and transmitters.
   1. Materials, unless otherwise specified, shall be as follows:
      a. Bolts, nuts, washers, expansion anchors: 316 stainless steel.
      b. Mounting brackets:
         1) Standard: 316 stainless steel.
         2) Highly corrosive areas: Aluminum.
      c. Mounting plates, angles:
         1) Standard: Carbon steel.
         2) Corrosive areas: [Aluminum] [316 stainless steel].
      d. Instrument pipe stands:
         1) Standard: Hot-dip galvanized 2 inches schedule 40, ASTM A106, Grade B carbon steel.
         2) Corrosive areas: [Aluminum] [316 stainless steel].

B. Cable lengths between sensors and transmitters shall be continuous (without splices) and as required to accommodate locations as shown on Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Instrument Mounting:
   1. Mount all instruments where they will be accessible from fixed ladders, platforms, or grade.
   2. Mount all local indicating instruments with face forward toward the normal operating area, within reading distance, and in the line of sight.
   3. Mount instruments level, plumb, and support rigidly.
   4. Mount to provide:
      a. Protection from heat, shock, and vibrations.
      b. Accessibility for maintenance.
      c. Freedom from interference with piping, conduit and equipment.

3.2 TRAINING

A. Provide [4 hours] on-site training in accordance with Specification Section 01 75 00.

END OF SECTION

SECTION 40 78 00
PANEL MOUNTED INSTRUMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Signal modules:
      a. Loop isolator.
      b. Potentiometer transmitter.
      c. Adder/subtractor.
      d. Multiplier/divider.
      e. Square root extractors.
      f. Pneumatic/current transducer.
   2. Annunciators.
   3. Panel mounted digital display.
   4. Pilot devices:
      a. Selector switches.
      b. Pushbuttons.
      c. Indicating lights.
      d. Combination selector switch/indicator light.
      e. Potentiometer.
   5. Relays/timers:
      a. Program timers.
      b. Percentage timers.
      c. Reset timers.
      d. Control relay.
      e. Time delay relays.
   6. Termination equipment:
      a. Terminal blocks.
      b. Fuse holders.
   7. Power supplies:
      a. DC power supplies.
      b. Isolation transformers.
   8. Voltage surge protection devices.
   9. Running time indicator.
   10. Instrument air compressor.
   11. Clocks.
   12. Intrinsic Safety Isolators.
   13. Alarm Beacons.
   14. Horns.
   15. Alarm Dialer.

B. Related Sections include but are not necessarily limited to:
   1. Section 26 43 13 - Surge Protection Devices for Low-Voltage Electrical Power Circuits.
   2. Section 40 61 13 - Process Control Systems General Requirements.

1.2 REFERENCES

A. Referenced Standards:
   1. The International Society of Automation (ISA):
      a. S18.1, Annunciator Sequences and Specifications.
      b. ANSI/ISA-12.02.02-2014, Recommendations for the Preparation, Content, and Organization of Intrinsic Safety Control Drawings.
   2. National Electrical Manufacturers Association (NEMA):

a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
b. ICS 2, Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts.

B. Miscellaneous:
1. Assure units comply with electrical area classifications and NEMA enclosure type shown on Drawings.

1.3 SUBMITTALS

A. Action Submittals: Submit the following:
1. Shop Drawings:
a. Control Drawings for intrinsically safe systems:
1) Print on 8-1/2 x 11 inches sheets.
2) In accordance with recommendations of ANSI/ISA-12.02.02-2014.
3) One control drawing per sheet.
4) Identify model numbers of both the associated apparatus and the intrinsically safe apparatus.
5) Include wiring diagram showing interconnections of the intrinsically safe apparatus and the associated apparatus.
6) Provide entity parameters for both the associated apparatus and the intrinsically safe apparatus.
7) Identify line of demarcation between classified (hazardous) and unclassified (nonhazardous) locations and identify equipment that is installed in each location.
8) Identify hazardous areas by class, groups, and divisions.
9) Show maximum nonhazardous location voltage that may be used with the associated apparatus.
10) Include any specific conditions that are necessary to maintain the intrinsic safety protection.

B. Closeout Submittals: Submit the following:
1. Operation and Maintenance Data:
a. See Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the manufacturers listed in the applicable Articles below are acceptable.

B. Provide similar components from the same manufacturer for uniformity of appearance, operations, and maintenance.

2.2 SIGNAL MODULE

A. Loop Isolators:
1. Manufacturers:
a. AGM Electronics.
b. Moore Industries.
c. Weidmuller.
d. Phoenix Contact.
2. Design and fabrication:
a. Solid state electronics.
b. Transmit analog output signal directly proportional to measured input signal.
c. Power source: 24 VDC.
d. Analog input: 4-20 mA DC or 1-5 VDC.
e. Output signal: 4-20 mA DC into 1400 ohms.

f. Impedance:
    1) Voltage input: 10 Meg.
    2) Current input: 50 ohms.
    3) Voltage output: 1 ohm.
    4) Current output: 1650 ohms.
g. Accuracy: Better than ± 0.10% of span.
h. Isolation: Up to 500 V rms (input, output and case).
i. Temperature effect: ±0.0025% of span per DEGF.
j. Ambient temperature range: 0-140 degrees F.
k. Factory calibrated.

B. Potentiometer Transmitters:
1. Manufacturers:
    a. Moore Industries [Model PTX].
    b. AGM Electronics.
    c. Acromag Inc. [Model TT230/TT330 Series].
2. Design and fabrication:
    a. Solid state electronics.
    b. Transmit analog signal directly proportional to measured impedance input.
    c. Power source: 24 VDC.
    d. Input: 0-1000 ohms.
    e. Output signal: 4-20 mA DC.
    f. Accuracy (maximum error): ±0.25%.
    g. Ambient temperature range: 0-140 degrees F.

C. Adder/Subtractor:
1. Manufacturers:
    a. AGM Electronics.
    b. Moore Industries [Model ASM].
2. Design and fabrication:
    a. Solid-state electronics.
    b. Adds/subtracts input signals and transmits linear output signal proportional to corresponding added or subtracted quantity.
    c. Capability on inputs for obtaining variable scaling factors.
        1) When scaling factor is not unity, automatically adjust output signal to correspond.
    d. Power source: 120 VAC, 60 Hz.
    e. Input signal: 4-20 mA DC.
    f. Output signal: 4-20 mA DC.
    g. Accuracy (maximum error): +0.25%.
    h. Ambient temperature range: 0-140 degrees F.
    i. Adjustable zero and span.

D. Multiplier/Divider:
1. Manufacturers:
    a. AGM Electronics.
    b. Moore Industries [Model AXB – Multiplier] [ADB – Divider].
2. Design and fabrication:
    a. Solid-state electronics.
    b. Multiply/Divide input signal and transmit a linear signal proportional to corresponding multiplied or divided quantity.
    c. Power source: 120 VAC, 60 Hz.
    d. Input signal: 4-20 mA DC.
    e. Output signal: 4-20 mA DC.
    f. Accuracy (maximum error): +0.25%.
    g. Ambient temperature range: 0-140 degrees F.

E. Square Root Extractors:

1. Manufacturers:
   a. Moore Industries.
   b. Pyragon [Model 900F-P].
2. Design and fabrication:
   a. Solid-state electronics.
   b. Transmit a linear signal proportional to the square root of the input signal.
   c. Power source: 120 VAC, 60 Hz.
   d. Input signal: 4-20 mA DC.
   e. Output signal: 4-20 mA DC.
   f. Accuracy (maximum error): +0.25%.
   g. Ambient temperature range: 0-140 degrees F.

F. Current/Pneumatic Transducer:
1. Acceptable manufacturer:
   a. Fisher Controls.
2. Materials:
   a. Housing: Cast aluminum or fiberglass.
3. Design and fabrication:
   a. Force balance device.
   b. Capable of receiving an electronic signal and converting it to a directly proportional pneumatic signal.
   c. Input signal: 4-20 mA DC.
   d. Output signal: 3-15 psi.
   e. Accuracy (maximum error): +0.50% of output span.
   f. Ambient temperature range: 0-140 degrees F.

2.3 ANNUNCIATORS

A. Manufacturers:
1. SEL [Model 2523].
2. Ronan Engineering Co. [Model XII-2000].
3. Ametek/Panalarm.
4. Rochester Instrument Systems.
5. Apex Automation.

B. Design and fabrication:
1. [Automatic reset] [Manual reset] [Ringback] sequence per ISA S18.1.
2. Utilize both audio and visual indication in accordance with ISA S18.1 diagrams and descriptions.
3. [3 inches SQ] [_____] individual lighted annunciator windows.
4. Clearly identified nameplate for each annunciation window.
5. Cabinet rating: [NEMA 12] [NEMA 4X].
6. Lamps: 24 V.
7. Microprocessor based logic.
8. Pushbuttons providing following functions:
   a. Lamp test.
   b. Alarm acknowledge.
   c. Alarm reset.
   d. Alarm silence.
9. Mount: [Flush] [Surface].
10. Power source: 120 VAC, 60 Hz.
11. Provide power supply for field contact interrogation.
   a. Field interrogation voltage: 125 VDC.
12. Operating temperature rating: -40-140 degrees F.
13. Humidity: 10 to 95% non-condensing.

2.4 PILOT DEVICES

A. Selector Switches:
   1. Manufacturers:
      a. Eaton.
      b. Rockwell Automation (Allen-Bradley) [Bulletin 800H].
      c. Schneider Electric [Class 9001].
      d. GE [CR104P].
      e. Siemens [52 Series].
   2. Design and fabrication:
      a. Heavy-duty type.
      b. [Oiltight] [NEMA 4] [NEMA 4X].
      c. [For Class I Division 2 hazardous locations use Rockwell Automation (Allen Bradley) 800TC-XAF contact blocks.]
      d. Rotary cam units conforming to NEMA ICS 2-216.22.
      e. Mounting hole: [30.5 mm].
      f. Supply switches having number of positions required with contact blocks to fulfill functions shown and specified. [At a minimum provide DPDT contact blocks with two normally open (NO) and two normally closed (NC) contacts.]
      g. UL listed.
      h. Maintained contact type.
      i. [Knob] [Lever] type operators.
      j. [Black] [Red] [Green] [Yellow] [Orange] [Blue] [Brown] [Gray] [White] colored operators.
      k. Designed with cam and contact block with approximate area of 2 inches SQ.
      l. [Manufacturer furnished] Legend plate marked per Contract Documents.
      m. Contact block requirements:
         1) Dry and indoor locations: Standard contact blocks rated for 10 A continuous current.
         2) Wet or outside locations: Hermetically sealed contact blocks.

B. Pushbuttons:
   1. Manufacturers:
      a. Eaton.
      b. Rockwell Automation (Allen-Bradley) [Bulletin 800H].
      c. Schneider Electric [Harmony 9001K Series].
      d. GE [CR104P].
      e. Siemens [52 Series].
   2. Materials:
      a. Backing diaphragm: Buna-N.
   3. Design and fabrication:
      a. Heavy-duty type.
      b. [Oiltight] [NEMA 4] [NEMA 4X].
      c. Conforming to NEMA ICS 2-216.22.
      d. Mounting hole: [30.5 mm].
      e. Diaphragm backed.
      f. UL listed.
      g. Emergency stop pushbuttons to have mushroom head operator and two sets of maintained normally open (NO) and normally closed (NC) contacts. Emergency stop pushbutton shall be NEMA 4X rated [and pad-lockable]. [E-stops shall be pushed to engage and twist and pull to release.]
      h. Non-illuminated type:
         1) Momentary contact with necessary contact blocks.
         2) Molded, solid color melamine buttons.
         3) [Standard flush] [Long, mushroom] operators with [full] [half] [no] shroud.

4) [Black] [Green] [Red] colored buttons for START or ON and [black] [green] [red]color for STOP or OFF.
5) Appropriate contact blocks to fulfill functions shown or specified. [At a minimum provide DPDT contact blocks with two normally open (NO) and two normally closed (NC) contacts.]

i. Contact block requirements:
1) Dry and indoor locations: Standard contact blocks rated for 10 A continuous current.
2) Wet or outside locations: Hermetically sealed contact blocks.
3) [Manufacturer furnished] Legend plate marked per Contract Documents.

j. Illuminating type:
1) Momentary contact with necessary contact blocks.
2) Serves as both pushbutton control and indicating light.
3) [Green] [Red] colored lenses for start or on and [green] [red] for STOP or OFF.
4) Resistor-type full voltage light unit with lens and panel gasket.
5) Legend plate marked per Contract Documents.
6) Appropriate contact blocks to fulfill functions shown or specified.

C. Indicating Lights:
1. Manufacturers:
a. Eaton.
b. Rockwell Automation (Allen-Bradley) [Bulletin 800H].
c. GE [CR104P].
d. Siemens [52 Series].
2. Design and fabrication:
a. Heavy duty [_____].
b. [Oiltight] [NEMA 4] [NEMA 4X].
c. Type allowing replacement of bulb without removal from control panel.
d. [Full voltage] [LED].
e. UL listed.
f. 24 V lamp.
g. [Manufacturer furnished] Legend plate marked per Contract Documents.
h. Nominal 2 inches SQ face.
i. Mounting hole: [30.5 mm].
j. Push-to-test indicating lights.
k. Plastic lens.
l. Color code lights as follows:
1) Green: [OFF or stopped] [ON or running]; valve [open] [closed].
2) Amber: Standby; auto mode; ready.
3) Red: [ON or running] [OFF or stopped]; valve [open] [closed].

D. Combination Selector Switch/Indicator Light:
1. Acceptable manufacturer:
a. Micro Switch, Model CMC.
2. Design and fabrication:
a. Indicators, pushbuttons, selectors, and selector-push combination units as indicated on Drawings.
1) Contact arrangements and functions as shown on Drawings.
b. Integrally-mounted transformers for each indicating lamp.
1) Lens colors and engravings as shown on Drawings.
c. [NEMA 13] [, NEMA 4X] oil-tight and dust-tight.
d. Cover plate edge bezel: Chrome colored to match existing.
e. Contacts: Heavy-duty rated with easy wiring terminal screws.

E. Potentiometer:
1. Manufacturers:
a. Eaton.

b. Allen-Bradley.

2. Design and fabrication:
   a. Heavy-duty, NEMA type.
   b. Mounting hole: 30.5 mm.
   c. UL listed.
   d. Linear adjustment through 0-1000 ohms with 1% resolution.
   e. 3-wire interface.
   f. Dial plate with 0-100% scale.
   g. Panel mounted.
   h. One-turn adjustment knob.

2.5 RELAYS/TIMERS

A. Program Timers:
   1. Manufacturers:
      a. Tork.
      b. Paragon Electric Company, Inc.
   2. Design and fabrication:
      a. Microprocessor based.
      b. Serve as time program actuator control of final control elements.
      c. 24 hour time control.
      d. Up to [_____] operations per day.
      e. Programmable from panel face keys.
      f. Skip-A-Day feature allowing schedule to be skipped for an entire day or days.
      g. DPDT switch contacts rated at 15 amps at 120 VAC.
      h. Battery carryover to maintain time and program during power outage for 275 hours.

B. Percentage Timer:
   1. Acceptable manufacturer:
      a. Eagle Signal Controls.
   2. Design and fabrication:
      a. Dial setting made by turning a knob located in the center of dial.
      b. Dial calibrated with 100 divisions and a pointer to indicate percentage of each total cycle that the contact is closed.
      c. Set accuracy: 1%.
      d. Repeat accuracy: 1/2% of full scale.
      e. Percentage timer shall allow 0 to 100% time selector of the specified time range time setting of 24 hour timer control.
      f. Automatic repeat cycle-type timer.
      g. Switch rating: 25 amps at 120 VAC.
      h. Current input: 120 V, 1 PH, 60 HZ.
      i. Time range of percentage timer equal to 15 minutes.

C. Reset Timer:
   1. Acceptable manufacturer:
      a. Eagle Signal Controls.
   2. Design and fabrication:
      a. Heavy duty.
      b. Consisting of adjustable time delay with automatic reset feature when period is timed out.
      c. Auxiliary relays as required to perform functions specified or shown on Drawings.
      d. Operate on 120 VAC.
      e. Nominal dimensions: 4 x 4 inches.
      f. Switch rating: 10 amps.
      g. Dial range: 60 minutes.

D. Control Relays:
   1. Manufacturers:

a. Idec [RH Series].
b. TE Connectivity (Potter & Brumfield).
c. Rockwell Automation (Allen-Bradley) [Bulletin 700-HC].
d. Eaton [D Series].
e. [GE Industrial] [CR420 Series].

2. Design and fabrication:
a. Plug-in general purpose [ice cube] relay.
b. [Blade] [Pin] connector type.
c. Switching capacity: 10 A.
d. Contact material: Silver cadmium oxide.
e. Provide relays with a minimum of [2] [4] DPDT contacts.
f. Coil voltage: [120 VAC] [24 VDC].
g. Relay sockets are DIN rail mounted.
h. Internal neon or LED indicator is lit when coil is energized.
i. Clear polycarbonate dust cover with clip fastener.
j. Check button.
k. Temperature rise:
1) Coil: 85 degrees F max.
2) Contact: 65 degrees F max.
l. Insulation resistance: 100 Meg min.
m. Frequency response: 1800 operations/hour.
n. Operating temperature: -20 to +150 degrees F.
o. Life expectancy:
1) Electrical: 500,000 operations or more.
2) Mechanical: 50,000,000 operations or more.
p. UL listed.

E. Time Delay Relays:
1. Manufacturers:
a. Rockwell Automation (Allen Bradley) [Bulletin 700-HNC].
b. Idec [GT Series].
c. Eaton [TR Series].

2. Design and fabrication:
a. Melt design test and performance requirements of NEMA ICS 2-218.
b. Heavy-duty.
c. Solid-state construction.
d. [DPDT] [4PDT] contacts.
e. External adjusting dial.
f. Auxiliary relays as required to perform functions specified or shown on Drawings.
g. Operates on 120 VAC.
h. Contact rating: A150 per NEMA ICS 2-125.
i. Furnish with "on" and "timing out" indicators.

2.6 TERMINATION EQUIPMENT

A. Terminal Blocks:
1. Manufacturers:
a. Phoenix Contact [UT-4] [UT-6].
b. Rockwell Automation (Allen-Bradley) [Bulletin 1492].
c. Weidmuller [SAK Series].

2. Design and fabrication:
a. Modular type [feed-through] with screw compression clamp.
b. Screws: Stainless steel.
c. Current bar: Nickel-plated copper allow.
d. Thermoplastic insulation rated for -40 to +90 degrees C.
e. Wire insertion area: Funnel-shaped to guide all conductor strands into terminal.
f. Install end sections and end stops at each end of terminal strip.

g. Install machine-printed terminal markers on both sides of block.
h. Spacing: 6 mm.
i. Wire size: 22-12 AWG.
j. Rated voltage: 600 V.
k. Din rail mounting.
l. UL listed.

3. Standard-type block:
   a. Rated current: 30 A.
   b. Color: Gray body.
4. Bladed-type block:
   a. Terminal block with knife blade disconnect which connects or isolated the two (2) sides of the block.
   b. Rated current: 10 A.
   c. Color:
      1) Panel control voltage leaves enclosure - normal: Gray body, orange switch.
      2) Foreign voltage entering enclosure: Orange body, orange switch.
5. Grounded-type block:
   a. Electrically grounded to mounting rail.
   b. Use to terminal ground wires and analog cable shields.
   c. Color: Green and yellow body.

B. Fuse Holders:
1. Manufacturers:
   a. Phoenix Contact.
   b. Rockwell Automation (Allen-Bradley).
   c. Weidmuller.
   d. Eaton.
2. Design and fabrication:
   a. Modular-type with screw compression clamp.
   b. Screws: Stainless steel.
   c. Current bar: Nickel-plated copper alloy.
   d. Thermoplastic insulation rated for -40 to +105 degrees C.
   e. Wire insertion area: Funnel-shaped to guide all conductor strands into terminal.
   f. Blocks can be ganged for multi-pole operation.
   g. Install end sections and end stops at each end of terminal strip.
   h. Install machine-printed terminal markers on both sides of block.
   i. Spacing: 9.1 mm.
   j. Wire size: 30-12 AWG.
   k. Rated voltage: 300 V.
   l. Rated current: 12 A.
   m. Fuse size: 1/4 x 1-1/4.
   n. Blown fuse indication.
   o. DIN rail mounting.
   p. UL listed.

2.7 POWER SUPPLIES

A. DC Power Supplies:
1. Manufacturers:
   a. Sola Hevi-Duty.
   b. Phoenix Contact.
   c. Rockwell Automation.
2. Design and fabrication:
   a. Converts 120 VAC input to DC power at required voltage.
   b. DIN rail mount with enclosure (i.e., not open frame).
   c. Switching type.

d. Provide redundant 24VDC modules with diode redundancy module for automatic switchover to standby module on failure of primary module.
e. Hardwire module fault dry contact to associated PLC input for alarm at Plant SCADA.
f. AC input: 120 VAC, 60 Hz.
g. Efficiency: Minimum 86%.
h. Rated mean time between failure (MTBF): 500,000 hours.
i. Voltage regulation:
   1) Static: Less than 1.0% V_{out}.
   2) Dynamic: ±2% V_{out} overall.
j. Output ripple/noise: Less than 100 mV peak to peak (20 MHz).
k. Overload, short circuit and open circuit protection.
l. Temperature rating: 0 to 60 degrees C full rated, derated linearly to 50% at 70 degrees C.
m. Humidity rating: Up to 90%, non-condensing.
n. LED status indication for DC power.
o. UL listed.

B. Isolation Transformers:
1. Manufacturers:
   a. Topaz Noise Suppressor Noise Isolator.
   b. MGE UPS Systems, Topaz T1.
2. Design and fabrication:
   a. Protects sensitive electronic equipment from electrical noise.
   b. Common-mode noise attenuation: 146 dB at 0.0005 pF coupling capacitance.
   c. Normal-mode attenuation: 60 dB.
   d. Input voltage range: ±10% of rated.
   e. Regulation: 3.5% or less from full-load to no-load.
   f. Dielectric strength: 2,500 VAC minimum.
   g. Harmonic distortion: 1% maximum.
   h. Electromagnetic interference: 0-1 gauss maximum at 18 inches.
   i. UL listed.

2.8 VOLTAGE SURGE PROTECTION DEVICES

A. See Specification Section 26 43 13.

2.9 RUNNING TIME INDICATORS

A. Acceptable Manufacturer:
1. Eagle Signal Controls.

B. Design and Fabrication:
1. Six-digit wheels including a 1/10 digit.
2. Non-reset type.
3. Time range in hours.
4. Automatic recycle at zero.
5. Accuracy: 1%.
6. Sealed against dirt and moisture.
7. Tamper-proof.

2.10 PANEL MOUNTED DIGITAL DISPLAY

A. Manufacturer:
1. Red Lion [PAX] [PAX2].
2. Omron K3GN.
3. Precision Digital [Trident] [ProVu].

B. Design and Fabrication:
1. Type of Display: LCD, Reflective or Red/Green LED Backlighting.
   a. Display color change capability at setpoint output.

b. Minimum 0.4 inch display digit height requirement.
2. Power input: [Loop Powered] [24 Vdc] [120 Vac].
3. Front Panel: IP65/66 certified, NEMA 4X for indoor use.
4. Input Signal: [0-20 mA] [4-20 mA] [0-5V].
5. Output: ## DC Dry Contacts for Alarms.
6. Communication Protocol: To match process signal.
7. Operating Temperatures: 0 - 65 Degrees C.

2.11 INSTRUMENT AIR COMPRESSOR

A. Acceptable Manufacturer:
1. Gast.

B. Design and Fabrication:
1. Suitable for mounting in control panels.
2. Include compressor, receiver, motor, controls, and dryer.
3. Operate on 120 VAC.
4. Oil-free units.
5. Include a discharge pressure gage and automatic condensate drain.
6. Provide air filter, pressure regulator and pressure gage on discharge.
a. Provide units manufactured by Gast.
7. Capacity (free air): 1.3 cfm.
8. Discharge pressure: 70 psiG.
9. Receiver: 2 GAL.
10. Motor size: 1/3 hp.

2.12 CLOCKS

A. Manufacturers:
1. Newport.
2. Kessler-Ellis.

B. Design and Fabrication:
1. Panel/face mounted.
2. Electronic digital.
3. Main panel locations:
a. Red LED dot matrix digits with 1-1/2 inches minimum height.
4. Secondary panels:
a. Red LED dot matrix digits with 0.6 inches minimum height.
5. Format: [12] [24] HR.
6. Standby power with internal battery for main panel locations.

2.13 INTRINSIC SAFETY ISOLATORS

A. Manufacturers:
1. Phoenix Contact.
2. Pepperl and Fuchs.
3. MTL Instruments Group.
4. R. Stahl.

B. Design and fabrication:
1. Utilize in all circuits required to be intrinsically safe.
2. All instruments installed in hazardous locations per Section 40 67 00 shall be provided with intrinsic safety isolators.
3. DIN rail mountable.
4. Provide galvanic isolation; use of passive Zener diode type barriers is not permitted.
5. Limit voltage and current so that no spark or thermal effect can cause a potentially explosive atmosphere to ignite.
6. Provide redundant 24Vdc power supplies in accordance with Paragraph 2.5 A of this Specification. Power supplies shall be installed in the same enclosure as the intrinsic safety

isolators. Power supplies shall be sized based on the active load of the associated loop powered field instruments.

7. Furnish and install in accordance with requirements of NEC Article 504, Intrinsically Safe Systems.
8. Certified to be in accordance with latest edition of UL 913 for application.
9. Operating temperature: 0 to 122 degrees F.

2.14 ALARM BEACONS

A. Manufacturers:
   1. Edwards Signaling.
   2. Federal Signal.

B. Design and fabrication:
   1. LED beacons with snap-on high impact polycarbonate base.
   2. NEMA 4X enclosure.
   3. [120 VAC] [24 VDC] powered.
   4. Beacon shall be suitable for indoor and outdoor installations and shall be panel or conduit mountable.
   5. Beacon housing shall be capable of withstanding vibration.
   6. Dual-mode design which shall be field adjustable between steady-on OR flashing mode by changing a dipswitch inside the beacon housing.
   7. Shatter resistant polycarbonate lens. Lens color shall be [Amber] [Red] [Green]. [Gray] [Black] [White] color base.
   8. For outdoor locations provide manufacturer supplied gasket kit [Edwards Signaling cat. no. GSK-KIT] for weatherproofing.
   9. For wall mount installations provide manufacturer supplied wall mount bracket [Edwards Signaling cat. no. WBR].
   10. For panel mount installations provide manufacturer supplied mounting accessories.
   11. UL listed.

2.15 HORNS

A. Manufacturers:
   1. Edwards Signaling.
   2. Federal Signal.
   3. Rockwell Automation (Allen Bradley) [Bulletin 855H High Performance]

B. Design and fabrication:
   1. PLC compatible model.
   2. NEMA 4X enclosure.
   3. [Hazardous locations use Rockwell Automation (Allen Bradley) Bulletin 855X model].
   4. Volume adjustable.
   5. Coded or sustained tones.
   6. Shall be completely assembled. NO site assembly required.
   7. Corrosion resistant finish.
   8. Designed for semi-flush panel mount.
   9. Manufacturer supplied mounting accessories.
   10. [Plastic sound projection accessory].
   11. Minimum [100] [_____] dBa sound at [10] feet.
   12. [120 VAC] [24 VDC] powered.
   13. Beacon shall be suitable for indoor and outdoor installations and shall be panel or conduit mountable.
   14. Beacon housing shall be capable of withstanding vibration.
   15. Dual-mode design which shall be field adjustable between steady-on OR flashing mode by changing a dipswitch inside the beacon housing.
   16. Shatter resistant polycarbonate lens. Lens color shall be [Amber] [Red] [Green]. [Gray] [Black] [White] color base.

17. For outdoor locations provide manufacturer supplied gasket kit [Edwards Signaling cat. no. GSK-KIT] for weatherproofing.
18. For wall mount installations provide manufacturer supplied wall mount bracket [Edwards Signaling cat. no. WBR].
19. For panel mount installations provide manufacturer supplied mounting accessories.
20. UL listed.

2.16 ALARM DIALER:

A. General.
   1. The system shall receive input from the various monitored items.
      a. Digital Inputs: Minimum of [4],[8], [16], [24], [32], monitored digital inputs in the form of a change in the status of a dry contact.
      b. Analog Inputs: Minimum of [1],[4], [8], [16] analog Input signals.
         1) [4-20 mA], [1-5 VDC].
   2. Upon such change, the system shall be capable of automatically dialing up to [8] pre-selected phone numbers.
   3. When answered, the system shall send voice messages reporting the specific alarm condition.
      a. User recordable
      b. Generic Default message also provided.
   4. The system shall also be capable of reporting the status of all monitored items upon receipt of an inquiry phone call.
   5. Arrange for and install a dedicated telephone line.
   6. [Autodialer shall be provided with integrated Cellular Modem option. Cellular modem option consist of:].
      a. Cellular Phone Transceiver.
      b. Antenna.
      c. Antenna accessories (Bulkhead, antenna pigtails, etc.).

B. The system shall make provisions for the following input alarms:
   1. Insert signals to be alarmed here.
   2. .
   3. .
   4. [AC Power Failure]

C. Equipment Description:
   1. The automatic dialer shall be an advanced microprocessor and synthesized voice technology capable of dialing up to eight phone numbers, 16 digits each, maximum.
   2. Phone numbers and standard tone dialing shall be used on standard phone lines.
   3. Surge Protection: Integral gas tube and solid-state protectors on all phone, power, and signal lines.
   4. The unit shall permit the user to program, right from the keyboard, the following functions:
      a. Each fault channel to a normally open or closed mode.
      b. A different fault sense delay from 1 to 99 seconds.
      c. Programmable answering delay of 1 to 20 rings.
      d. Dialing and re-dialing up to eight separate pre-determined telephone numbers and delivering a synthesized voice message.
   5. Normal power shall be 120 VAC, 60 Hz.
   6. The unit shall contain its own rechargeable battery which shall automatically be kept charged when AC power is present.
   7. The system shall operate on battery power for a minimum of 20 hours in the event of AC power failure.

D. Enclosure:
   1. Exterior panel mounting: NEMA 4X.
   2. Interior panel mounting: panel mount.

E. Configuration:
   1. Obtain phone numbers, calling sequence, and calling schedule from the Owner and configure the unit with these initial parameters.

F. Firmware
   1. The Autodialer shall have the latest of Firmware revision installed.

G. Autodialer Manufacturer:
   1. Raco Verbatim Series VSS [with Cellularm option].
   2. Cattron (formerly Antx, Inc.) [Dialog Elite] [with cellular Modem option] [Elite IQ].
   3. Or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Mount adder/subtractors, multiplier/dividers, square root extractors, transducers and program timers on separate subpanel in control panel.

C. Instrument Air Compressors:
   1. Pipe condensate outside panel to nearest floor drain.
   2. Mount compressors with rubber vibration isolators.

END OF SECTION

SECTION 43 11 23
HIGH SPEED TURBO AERATION BLOWERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. High speed turbo blowers including:
      a. Integral variable frequency drive (VFD).
      b. Blow-off (bypass) valve.
      c. Check valve.
      d. Inlet filter/silencers.
      e. Blow-off silencer.
      f. Flexible connectors.
      g. Pressure and temperature monitoring devices.
   2. Control panels:
      a. Master control panel (MCP)
      b. Local control panels (LCPs).
      c. Custom software for control.

B. Related Sections include but are not necessarily limited to:
   1. Section 01 14 16 – Coordination with Owner's Operations
   2. Section 01 33 00 – Submittal Procedures
   3. Section 01 61 03 – Equipment Basic Requirements
   4. Section 01 65 00 – Product Delivery Requirements
   5. Section 01 75 00 – Checkout and Start-Up Procedures
   6. Section 01 78 23 – Operation and Maintenance Data
   7. Section 40 61 43 – Surge Protection Devices for Instrumentation and Control Equipment
   8. Section 40 63 43 – Programmable Logic Controllers
   9. Section 40 66 05 – Network Equipment
   10. Section 40 67 00 – Control System Equipment Panels and Racks
   11. Section 40 67 63 – Uninterruptible Power Supply

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Acoustical Society of America (ASA):
      a. ANSI/ASA S2.19, Standard Mechanical Vibration - Balance Quality Requirements of Rigid Rotors, Part 1: Determination of Possible Unbalance, Including Marine Applications.
   2. American Bearing Manufacturers Association (ABMA):
      a. ABMA/ANSI 9, Load Ratings and Fatigue Life for Ball Bearings.
      b. ABMA/ANSI 11, Load Ratings and Fatigue Life for Roller Bearings.
   3. American Gear Sellers Association (AGMA).
   4. American Institute of Steel Construction (AISC).
   5. American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE):
      a. ANSI/ASHRAE 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
   6. American Society of Mechanical Engineers (ASME):
      a. PTC 13, Performance Test Code on Compressors and Exhausters.
   7. American Society of Testing and Materials (ASTM):
      a. B16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
   8. American Welding Society (AWS).
   9. Anti-Friction Bearing Sellers Association (AFBMA).
   10. ASTM International (ASTM).

11. Institute of Electrical and Electronics Engineering (IEEE):
    a. 519, Recommended Practice and Requirements for Harmonic Control in Electric Power Systems.
12. International Organization for Standardization (ISO):
    a. 1217, Displacement Compressors – Acceptance Tests.
13. National Electrical Code (NEC).
14. National Electrical Manufacturers Association (NEMA):
    a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
15. Underwriters Laboratories (UL):
    a. 508, Industrial Control Panels.
16. Occupational Safety and Health Act (OSHA).

B. Responsibilities and Qualifications:
1. A single manufacturer shall provide all components as a complete integrated package to ensure proper coordination, compatibility, and operation of the equipment.
2. Blowers shall be Manufacturer's standard product and only modified as necessary to comply with the drawings, specifications, and specified service conditions.
3. Manufacturers shall have a minimum of 10 years' experience designing high speed turbo blower system of the type specified herein.
4. Manufacturers shall provide evidence of a minimum of ten municipal U.S. installations in operation for verification by the Engineer.
5. All welding shall be performed in accordance with AWS D1.1.
6. The Contract Documents represent the minimum acceptable standards for equipment for this project. All equipment will conform fully in every respect to the requirements of the respective parts and sections of these drawings and specifications.

1.3 SUBMITTALS

A. General:
1. See Section 01 61 03.
2. All products required for submittal under this section shall be furnished in one complete package.
3. All submittal dimensions, calculations and other information shall be in USA English units of measure.
4. See Section 01 33 00 for requirements for the mechanics, administration, and content of the submittal process.
5. Acknowledgement that products submitted meet requirements of standards referenced.
6. Manufacturer's installation instructions.
7. Blower characteristics, specifications, and performance.
    a. Descriptive brochures and blower data, including general description of blower with all performance data, blower curves, and model.
        1) Minimum air flow at design pressure.
        2) Maximum air flow at design pressure.
        3) Blower's minimum pressure and airflow at that pressure.
        4) Blower's maximum pressure and airflow at that pressure.
    b. Factory certified performance curves indicating speed, capacity, horsepower, and efficiency over the range of operation.
        1) Submit blower curves at minimum, maximum, and average temperature listed in 2.3.C.4.
        2) Plot surge boundary on blower curves.
    c. SCFM at discharge pressure.
    d. ICFM at EAP discharge pressure.
    e. Dynamic minimum speed to avoid surge.
    f. Total power consumption at identified points, in kW.
    g. Material list and catalog information showing the details of blower construction.

h. Outline installation Drawings for each unit including overall dimensions, maintenance clearances, connection locations / sizes / descriptions, anchorage, and similar details.
i. Blower weight and weights of each separate item of equipment.
j. Complete bill of materials of all components and equipment supplied.

8. Motor characteristics, Specifications, and performance.
   a. Descriptive bulletins.
   b. Outline Drawings with dimensions.
   c. Cut-away and exploded view Drawings.
   d. Parts list with material designations.
   e. Nameplate data.
   f. Description of insulation system.
   g. Horsepower rating and service factor.
   h. Ambient temperature rating.
   i. RPM at full load.
   j. Electrical supply (number of phases, frequency, and voltage).
   k. Temperature rise at full load and service factor load.
   l. Over temperature protection.
   m. Efficiency, current, and power factor at 1/2, 3/4, and full load.
9. Variable frequency drive (VFD):
   a. Harmonic data showing blower electrical model system characteristics that affect frequency response.
   b. VFD line side voltage and current transient protection.
   c. Certifications:
   d. Submit data to verify and certify service life in accordance with specified parameters.
10. Furnish a detailed identification of couplings, supports, and accessories. Identify valves and instrumentation with designated tag numbers.
11. Test reports:
    a. Certified acoustical test results for each blower package or results from previous test of the same sized blower and horsepower.
    b. Certified and guaranteed wire to air power test results.
    c. Certified report of dynamic balancing and maximum vibration amplitude.
    d. Certified blower performance test in accordance with ASME PTC 13.
       1) Inlet airflow conditions may be simulated or calculated to standard conditions. Equations used to calculate standard inlet conditions must be approved by the engineer and noted in the manufactures testing protocol. Ambient air temperature, relative humidity and pressure shall be used. Manufacturer to provide calibration standard used for each equipment item.
12. Factory Blower Testing:
    a. Submit a detailed test plan with complete piping and instrumentation configuration diagram per ASME PTC-13 showing inlet and discharge air test pipe size. The location, type, and quantity of all major instruments necessary for performance data, including those on air with corresponding distances from reference points, shall be identified per ASME PTC-13 requirements. As a minimum, the detailed test plan shall include:
       1) Quality control procedures.
       2) ASME PTC-13 test procedure and method of calculating results.
       3) Functional testing of entire package, including instrumentation, ancillary components, and LCP.
    b. Submit the actual ASME PTC-13 test report with the blower system O&M manuals.
13. A priced list of Manufacturer's recommended spare parts.
14. Configuration parameters for the VFDs.

B. Shop Drawings:
   1. Unloading, handling, storage, and maintenance requirements.
   2. Certified Dimensional Drawings of the blower unit, including cutaway views.
   3. Mechanical drawings with general arrangement showing blower base dimensions, floor mounting, piping, and connection locations.

4. Instrumentation and control system schematics, tubing and conduit details, and wiring diagrams for electrical and control components furnished.
5. Any necessary dimensional Drawings to coordinate piping layout with structural, architectural, electrical, and/or mechanical work.
6. Description of process control logic and process and instrumentation diagrams.
7. Certified Drawings of the local control and master control panels.
    a. Submittal requirements included in Section 40 67 00.
    b. Electrical ladder diagram.
    c. Interconnect to all components outside the panel.
    d. Door layout.
    e. Interior layout.
    f. Sample Operator Interface screens for the LCPs and MCP.

C. Operation and Maintenance Manuals:
1. See Section 01 78 23 for requirements for the mechanics, administration, and content of Operation and Maintenance Manual Submittals.
2. Equipment shall not be started until a manufacturer Operation and Maintenance manual has been submitted and approved.
3. Operation and maintenance manual will include the following:
    a. All dimensions, calculations and other information to be in USA English units of measure.
    b. Provide a list of components and catalog cuts fully describing all items:
        1) Mechanical and structural components.
        2) Instruments.
        3) Programmable Logic Controllers (PLC) or Central Processing Unit (CPU).
        4) Operator Interface/machine monitors.
        5) Network equipment.
        6) Electrical components.
    c. Specific description of the supplied blowers with all performance data, blower curves, and model. Provide detailed information on structural, mechanical, electrical, or other changes or modifications necessary to adapt non-specified materials to the arrangement or details shown. Include the actual ASME PTC 13 test report.
    d. Mechanical Drawings with general arrangement showing enclosure dimensions, overall weights, weights of largest components requiring removal for maintenance, and clearances required around unit for maintenance access. Indicate surface preparation and paint specifications.
    e. Description of process control logic and process and instrumentation diagrams.
    f. Drawings of all control panels to include:
        1) Submittal requirements included in Section 40 67 00.
        2) Electrical ladder diagram.
        3) Interconnect to all components outside the panel.
        4) Door layout with Bill of Material.
        5) Interior layout with Bill of Material.
        6) Sample Operator Interface screens for the MCP and LCP.
    g. Operating description for the MCP and LCP. Provide for backup purposes, a copy of the software ladder logic covering all logic and sequences of operation of MCP. If PLC based, provide a soft copy of all documented PLC code on CD. Provide for backup purposes, OWNER with four (4) software licenses of any PLC or Touchscreen OIT software that is used. Provide a list of instrument settings.
    h. Provide a detailed description of the data acquisition, monitoring, and predicted preventative maintenance software. Where applicable, provide typical Operator Interface screens with detailed descriptions, the various tattletale monitors, preventative maintenance items, and data logging features.
    i. Provide input/output (I/O) listing for all control panel PLCs.
    j. Indicate all scheduled maintenance requirements and routine inspections. Include maintenance summary forms.

k. Provide list of recommended spare parts and lubricants.
l. Provide a troubleshooting guide.
m. Provide the local sales representative contact information with the company name, contact person, phone number and address.

D. Software
1. Provide two copies of unrestricted software for each equipment type:
a. MCP (if PLC-based).
2. Provide two copies of software for each equipment type:
a. LCP (if PLC-based)
3. Provide two cables of each type for connection from each equipment type to a laptop computer.

E. Programmed Settings:
1. For each protective relay, PLC, etc. with programmable requirements, provide the final "as-built" settings for all devices.
2. Submit on 8.5"x11" sheets in an electronic pdf format.
3. Provide in accordance with the submittals section.

F. Seller certification of proper installation and satisfactory performance.

1.4 DELIVERY, STORAGE AND HANDLING

A. See Section 01 65 00.

B. Manufacturer shall coordinate scheduling of shipments with CMAR and Installing Contractor.

C. Installing Contractor shall store and protect equipment in accordance with the Manufacturers' recommendations.

1.5 WARRANTY

A. A 24 month equipment warranty shall be provided by the manufacturer. The warranty date shall start at the time of substantial completion as defined in Division 00. Warranty shall cover the full cost of problem diagnosis, problem part replacement (including onsite removal and reinstallation), shipping and testing.

B. Warranty shall not be contingent upon any remote monitoring or other plant network access by the manufacturer.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Four (4) new aeration blowers shall provide process air for the new Plant II Aeration Basin Nos. 5-8. These blowers will be located within the new Plant II Blower Building. Blowers 1-4 will be installed in a **future** project on a common discharge header that supplies Aeration Basin No. 1-4. Blowers 5-8 (this project) are installed on a common discharge header that supplies Aeration Basin No. 5-8. Each blower will have its own separate suction line with an air inlet silencer. Before connecting to the common discharge header, each blower will have a separate check valve (by Manufacturer) and butterfly valve (by Manufacturer). Provide blowers, drivers, and accessories through a single manufacturer.

B. Contractor shall provide and install all external piping, pipe supports, wiring, instrumentation, conduit, and appurtenances not provided by the blower manufacturer for a complete functional blower system.

C. Blower Manufacturer shall take total system responsibility for the proper performance and warranty of the blowers and blower control system.

D. The blower Manufacturer shall review the Contract Documents to ensure that all equipment necessary for fully operational blower control system is furnished.

2.2 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. ABS Sulzer
   2. APG-Neuros

2.3 GENERAL

A. The system shall include factory assembled single or dual core high speed turbo blower with integral variable frequency drive and programmable logic controller in a complete package that does not require lubrication of the bearings for operation. The blower manufacturer shall supply, coordinate, start-up, and calibrate all items specified in this section.

B. After reaching operational speed, noise emission from the blower package shall not exceed 80 dBa in free field conditions as defined in Standards on Noise Measurements, Rating Schemes, and Definitions: A Compilation as published by U.S. Department of Commerce National Bureau of Standards for free field measured in the test facility. All noise emission restrictions equally apply within the blower room and outdoors by the air intake.

C. No special foundations shall be required for installation.

D. Each blower skid shall be designed to be powered by a single 480V/3Ø/60Hz power connection and shall include all transformers, power supplies, etc., for a complete system.

2.4 PERFORMANCE AND DESIGN CONDITIONS

A. All the conditions specified herein shall be as defined in ASME PTC 13 - 2018 Performance Test Code on Compressors and Exhausters (re affirmed in 2003) and/or other applicable test codes such as ISO 5389:1992 Turbo Compressors, VDI 2045: 1993 Acceptance and Performance Tests on Turbo Compressors and Displacement Compressors.

B. All the pressures and temperatures specified herein refer to stagnation conditions as defined in ASME PTC-13. Inlet conditions are defined as the conditions that exist at the inlet flange of the blower.

C. The discharge conditions are defined as the conditions that exist at the discharge flange of the blower or the discharge cone. The blower shall be designed to handle filtered air for the following rated conditions. All specified performance is per single blower unit; Each set of four blowers shall support operation of any one, two, three, or four blowers operating concurrently over the range of conditions per blower indicated in the design criteria below.

   1. Aeration Basins No. 5-8 Blowers (B-3105, B-3106, B-3107, B-3108)
      a. Site Elevation: 467 FT.
      b. Diffuser submergence: 19.43 FT
      c. Relative Humidity: 10 to 60 PCT
      d. Outdoor Inlet Air Temperature: 17 to 122 DegF
      e. Atmospheric Pressure: 14.45 psia
      f. Inlet pressure at blower inlet flange: 13.95 psia
      g. Discharge air Pressure: 10.5 psig
      h. Minimum Blower turndown, percent of capacity: 100 percent to 50 percent at each of Design Point 1 and Design Point 4 humidity and inlet air temperature conditions per table below.
      i. Maximum motor horsepower: 533 HP
      j. Operating Conditions:

Design Point	Capacity (%)	Flow (SCFM)	Discharge Pressure (psig)	Relative Humidity (%)	Inlet Air Temp (DEG F)
1	Min	4,010	9.5	10	17
2	65.0	4,940	9.8	60	110
3	80.0	6,080	9.9	60	110
4	100.0	7,600	10.5	60	110

D. Room Conditions:
   1. For Blowers where all components including PLC or LCP, BMCP, and harmonic filters are rated for at least 50°C room air temperature: Contractor shall furnish blower room ventilation and heating as indicated on the HVAC drawings. Blowers shall tolerate operation with room air temperatures up to 50°C and process intake air temperatures as indicated above.
   2. For Blowers where some components such as PLC or LCP, BMCP, and harmonic filters are rated for at least 40°C, and not 50°C: Contractor shall furnish blower room air-conditioning as indicated on the HVAC drawings. In this case, the blower room will normally be air conditioned with the temperature maintained between 50 to 90 °F (10 to 32 °C), however the blowers shall tolerate operation with room air temperatures up to 40°C and process intake air temperatures as indicated above.

E. Blowers shall not surge or exceed the nameplate motor rating over the entire range of operation.

F. The blower shall maintain a minimum of 2.0 psig away from surge at any operating point in the capacity range above. The blowers shall be capable of operating continuously and satisfactorily at any point between the minimum and the maximum flows without surge, vibration, hunting, overload of motor or AFD or excessive heating of the blower and motor.

G. Blowers with curves that reflect two possible capacities for a given pressure (head) at a single speed will not be acceptable.

H. The vibration of the blower shall not exceed 50% of Manufacturer's maximum allowable during factory testing.

I. The blower manufacturer shall inform the Contractor of any additional requirements, if needed but not shown on P&IDs and the Electrical Drawings. The additional requirements, if needed, shall be included in the bid package as part of the requirements for the project. The blower manufacturer shall be responsible to inform the Contractor of any external wiring and conduit requirements.

2.5 ENCLOSURES

A. The standard enclosure shall also act as a sound enclosure and must be designed for easy inspection and maintenance of all blower package components. Hinged doors shall provide easy and quick access for routine maintenance of the blower and the package components. Doors shall use a frame, reinforcements and supporting elements as required.

B. Blower electrical components and instrumentation and instrument connections shall all be mounted inside the blower enclosure and shall all be factory wired to skid-mounted electrical panels.

C. For any blowers cooled by glycol:
   1. All heat rejection from glycol shall be into the process intake air such that no room makeup air is required and no heat is rejected to the room from glycol. It is acceptable for the control cabinet to be ventilated from room air as long as the above is provided.
   2. Contractor shall furnish blower room air-conditioning as shown on HVAC drawings.
   3. Contractor shall coordinate all HVAC requirements with the furnished blower equipment.

D. For any blowers with air-cooling only (no glycol): Blower shall vent heated air from the cooling system through ducts shown on HVAC drawings to the outside of the building.
   1. Contractor shall furnish ventilation and heating equipment including makeup air as shown on the HVAC Drawings.
   2. Contractor shall coordinate all ventilation requirements with the furnished blower equipment.

E. Enclosure shall be suitable for indoor use within a damp area.

2.6 BLOWERS

A. Blowers shall be air bearing or magnetic bearing type turbo blowers and shall not require oils or lubricants for adequate operation. Blowers shall be capable of variable speed and output operation.

B. Blowers shall have the capability to start and stop 10 times per hour.

C. Blowers may include an "off-loading" capability as part of the normal programming. Off-loading shall be defined as the ability to operate the blower in an idle mode at minimum RPM while discharging air through the blow-off control valve.
   1. If Seller utilizes contact bearings while the blower is still rotating during the START and STOP cycle, the off-loading shall be used to minimize the starting and stopping of each blower to no more than once per 24 hour period.

D. Blowers shall be UL or TUV certified, with certification label shown on nameplate, at point of manufacturing.

E. Blower casing shall have a maximum continuous duty design temperature of 400 DegF, and a design pressure of 50 psig.

F. Blower impellers shall be of the backswept three dimensional high efficiency configuration, designed using Computational Fluid Dynamics (CFD) with two stages in one (axial and centrifugal), and milled from forged or cast aluminum alloy or cast stainless steel and with first lateral critical speed at least 110 percent of the maximum allowable operating speed. The impeller shall be mounted directly to the motor shaft and shall be statically and dynamically balanced. The axial gap between the impeller and blower casing shall be adjusted by shims as needed.

G. Each blower shall have built-in vibration isolation mounts. The manufacturer shall be responsible for attenuating noise and vibration in the blower package so that no vibration from the blower shall be transmitted to the floor, intake, or discharge piping.

H. Blowers shall have inlet flange connections, 150lb ANSI.

I. Blowers shall have discharge flange connections, 150lb ANSI.

2.7 MOTORS

A. Each blower shall be supplied with a high-efficiency motor that shall operate on 460 V, 3 Phase, 60 Hertz current, and be totally enclosed, fan cooled.
   1. The motor shall be able to start under the starting conditions required.
   2. The blower manufacturer shall be responsible for coordinating the starting torque requirement of the blower and the motor.
   3. The motor shall be capable of continuous operation at full load and rated frequency with a voltage variance of ±10 percent of the nameplate voltage.
   4. The motor shall be capable of operation at the rated voltage with a variance of ±5 percent of the nameplate frequency and over the range of frequencies that may be generated by the VFD.
   5. Motor Accessories:
      a. The motor and controls shall not require any space heaters.
      b. The winding shall be provided with embedded thermocouples for remote temperature sensing and alarm.

2.8 BEARINGS:

A. Blowers shall be provided with a magnetic bearing system or air foil bearing system as follows:
   1. Magnetic Bearing System:
      a. The motor rotor shaft shall be continuously levitated in a magnetic field by the magnetic bearing system. This system shall consist of:
         1) Two radial and two axial active magnetic bearings.
         2) Two rotor position sensors.
         3) Magnetic bearing controller (MBC).
      b. The position sensors shall continuously measure the shaft position and send a signal to the MBC controlling the energy in the active magnetic bearings to keep the motor rotor shaft levitated and centered.
      c. There shall be no mechanical contact between any moving surfaces at any time during the blower operation.
      d. The magnetic bearing system shall not require any oil lubrication.
      e. The magnetic bearing controller shall be an MBC-12 powered by a 3 phase, 60 Hz, 480V power supply.
   2. Air Foil Bearing System:
      a. Composed of corrugated bump foil and inner high temperature alloy core.
      b. Bearing manufactured from synthetic media.
      c. Bearing clearance of 1/30,000 IN or less.
      d. The air bearing system shall not require any oil lubrication.

2.9 ACCESSORIES

A. Inlet Filter/Silencers
   1. Inlet filter/Silencers shall be:
      a. Endustra TKT, 24" size, or Stoddard F21-204 / F22-204.
   2. Powder coated steel construction suitable for outdoor installation. Filters elements shall be as required to meet all recommendations of blower and filter manufacturers for the specified air flow ranges.
   3. The filter media shall have an efficiency of 90 percent by weight per ASHRAE 52-76 with synthetic dust equivalent to separation > 95 percent @ 10 microns.
   4. Maximum clean pressure loss across the filter shall be less than 0.05 psig.
   5. If recommended by Blower Manufacturer, or if required to meet the sound level requirements elsewhere in this specification, then Blower Manufacturer shall furnish inlet silencer for each blower in accordance with their recommendations.
   6. Filter performance losses across dirty filters to be included in the blower performance calculation.
   7. Filters shall be freestanding with supports furnished by the filter manufacturer. Contractor shall coordinate filter housing supports with the filter installation elevation shown on the Drawings.

B. Flexible Connectors
   1. Provide each blower package with EPDM or 316 stainless steel inlet and discharge expansion joints capable of withstanding the vacuum, pressure, and temperature under all operating conditions. The expansion joints shall be included with control rods and 304 stainless steel flanges drilled for ASME/ANSI B16 Inch, Class 150 bolt pattern. Expansion joints shall be the same size as the blower inlet and discharge flanges, respectively.

C. Discharge isolation valves
   1. Blower packages shall be furnished by the manufacturer with 20" diameter manually operated 304 SST high performance butterfly valves for discharge isolation installed by others downstream of the discharge check valves. Valve hardware shall be 316 SST. Valves shall be lugged or flanged for dead end service. Valves smaller than 20" diameter will NOT be accepted. Iron valve construction and centric disc design are NOT acceptable.

2.10 BLOW OFF (BYPASS) VALVES

A. Provide manufacturer's standard pilot actuated pressure-relief blow-off valve to allow unloaded startup of blower. Controls for the valve shall be mounted in each blower LCP. The blower LCP shall automatically operate the valve during startup and surge conditions.

2.11 CHECK VALVES

A. Provide each blower package with a discharge check valve.

B. Check valves shall be rated for temperatures up to 300 DegF.

C. Check valves shall be especially designed and suitable for use with centrifugal blowers and shall retain positive sealing capability at 300 DegF.

D. Check valve shall be split disc, wafer style, 304 stainless steel disc and body

E. Furnish valve with 316 stainless steel spring and Viton seal

F. Check valve shall be 16-inch or 20 inch size for Blowers 5-8 and shall be no less than the blower discharge connections size.

2.12 BLOW OFF SILENCER

A. A blow off silencer shall be provided for the blow-off (bypass) valve.
   1. Internal baffles, packed with sound absorbent material, shall direct airflow around three 90-degree turns in an annular flow configuration.
   2. The blow off silencer shall be an integral unit, fitted with one (1) flange for direct bolting to the blow off valve.

2.13 OPERATION

A. General
   1. All sensors necessary for optimal and safe operation shall be integrated into the packaged units and the control system.
   2. In case of failure, the control of the operating data, regulating and shutdown processes shall run completely automated.
   3. Blower package control shall be available via the MCP OIT, LCP OIT, local blower HOR switch or OIT selectable HOR.
   4. Blower package will have all startup and shutdown processes and internal locking carried out automatically by the packaged control unit.
   5. The blower package operating setpoint shall be adjustable automatically according to the corresponding MCP input.
   6. The blower operation shall provide for a common pressure control setpoint from the MCP.
   7. Surge protection:
      a. Blower will have automatic surge protection based on actual flow/pressure and dynamic operation.

B. Aeration and Master Blower Control
   1. Aeration control is provided by others at the Plant Control System.
   2. The Vendor Master Control Panels shall each coordinate blower capacity controls, bringing blowers online/offline, and lead/lag alternation in response to a discharge pressure setpoint provided from the Plant Control System. MCP shall adjust blower capacity to maintain pressure as monitored at blower-vendor-furnished pressure transmitters to be field installed on the discharge header.

2.14 CONTROL PANELS AND INSTRUMENTATION

A. The blower manufacturer shall provide the blower control panels and instrumentation described in this section. Panels and instruments shall be as specified in this section. The MCP shall be as specified in Division 40. These components shall be mounted within the enclosure except as noted.
   1. Blower MCP will be provided in accordance with Section 40 67 00.

2. Blower panels will be prewired, pre-programmed and pre-tested by the Manufacturer.
3. Communication:
   a. Ethernet/IP communication will be provided between the LCPs and the MCP.
   b. Ethernet/IP communication will be provided between the MCP and the plant control system.
   c. All hardware, software and programming shall be furnished to implement these data links.
   d. LCPs and MCPs shall be each have a red mushroom-type twist-to-reset E-stop pushbutton, Allen Bradley 800H or equal. E-stops shall be configured for hard-wired field interconnection of the E-stop pushbuttons of each set of 4 blowers and the associated MCP.
4. Plant Control System HMI Coordination:
   a. Coordinate with the Owner and system integrator to enable the presentation of all blower related status monitoring indications and alarms to be presented at the Plant Control System's HMIs in a format consistent with the blower's OIT screens.
5. Ethernet Switches per Specification Section 40 66 05:
   a. Provide an unmanaged Ethernet switch in the master and each local control panel and provide all coordination required to enable communication via Ethernet IP to the Plant Control System of all monitored status points, measured variables, alarm points, and diagnostic information. Provide all required coordination to ensure that the Ethernet switches furnished with the blower control panels are of the same manufacturer and model series as all other Ethernet switches furnished on this project.
   b. Manufacturers:
      1) Hirschmann.
      2) N-TRON.
      3) Phoenix Contact.
      4) Allen-Bradley/Cisco.
      5) Moxa.
   c. Design and fabrication:
      a) Support Ethernet 100/1000 Mbps.
      b) Two backbone ports for connection to multimode fiber via type LC connectors (ST not allowed).
      c) 16 100/1000 Mbps twisted pair ports (RJ45) as required for communication with devices as depicted in the Contract Documents. 16 port minimum.
         1. Unless otherwise noted, provide at least two spare 100/1000 MBit/s port (twisted pair) at each Ethernet switch.
      d) Support SNMP v3 and Web based management.
      e) Rapid Spanning Tree Protocol.
      f) IGMP (Internet Group Management Protocol) support for IP multicast filtering to enable switches to automatically route messages only to appropriate ports.
      g) Check all received data for validity.
         1. Discard invalid and defective frames or fragments.
      h) Monitor connected TP/TX line segments for short-circuit or interrupt using regular link test pulses in accordance with IEEE 802.3.
      i) Monitor attached fiber optic lines for open circuit conditions in accordance with IEEE 802.3.
      j) As applicable, meet requirements of IEEE 802.3.
      k) One rack unit (RU) form factor.
      l) Power switch with 120 VAC power input.
      m) Provide dual redundant power supplies.
      n) Provide LED status lights to indicate:
         1. Power: Supply voltage present.
         2. Fault.
         3. Port status.
      o) Environmental rating:

1. Operating temperature: 32 degrees F to 122 degrees F.
2. Humidity: 95% relative humidity, non-condensing.

d. Function in self-healing ring structure.
   1) If one section in the ring fails, the ring structure changes to a line structure within 0.5 seconds.
e. DIN Rail mounted.

6. Small Form-Factor Pluggable (SFP) Modules:
   1) Provide SFPs as required to support the communication capability shown on the Drawings. Use SFPs instead of media converters. Media converter use is prohibited unless approved in writing.
   2) Hardware Features:
      a) At least two SFP ports per switch supplied with 1 Gbps fiber transceivers for connection to multimode fiber via type LC connectors. Quantity and type as required for communication with devices as depicted in the Contract Documents.
      b) Diagnostic data for the associated media type available through the command line interface of the switch.
      c) 10/100/1000 MBit/s twisted pair ports (RJ45) as required for communication with devices as depicted in the Contract Documents.
         (1) Unless otherwise noted, provide at least two spare 10/100/1000 MBit/s port (twisted pair) at each Ethernet switch.
      d) Check all received data for validity.
      (1) Discard invalid and defective frames or fragments.
      e) Monitor connected TP/TX line segments for short-circuit or interrupt using regular link test pulses in accordance with IEEE 802.3.
      f) Monitor attached fiber optic lines for open circuit conditions in accordance with IEEE 802.3.
      g) As applicable, meet requirements of IEEE 802.3.
      h) Power switch with 24 VDC power input.
      i) Provide LED status lights to indicate:
      (1) Power: Supply voltage present.
      (2) Fault.
      (3) Port Status
      j) Environmental rating:
      (1) Operating temperature: 32 degrees F to 122 degrees F.
      (2) Humidity: 95% relative humidity, non-condensing
      k) Accessories: Provide port locks for all unused ports

7. Blower panels will be provided with an Uninterruptible Power Supply per specification Section 40 67 63 and as follows:
   a. Master Control Panel
      1) Manufacturers
         a) APC Smart-UPS.
         b) Eaton 9PX.
         c) Liebert GXT5.
         d) Phoenix Contact – TRIO
      2) Design and fabrication:
         a) Double conversion, true online type.
         b) Waveform: Pure sine wave.
         c) Power factor correction.
         d) Minimum 10 minutes power ride through 100% of connected load without incoming power. Provide extended battery or batteries as necessary to achieve the specified battery run time.
   b. Local Control Panels

1) Blowers with a magnetic bearing system will be provided with Local Controls Panels with an Uninterruptible Power Supply.
2) Manufacturer Standard

c. Utilize alarm contacts to enable remote annunciation of the following conditions.
1) UPS Fault.
2) UPS on battery.
3) Low battery.
4) UPS in bypass.

8. Each new Blower shall be supplied with a UL certified VFD inverter.
a. Each VFD shall have passive or active harmonic mitigation to ensure 5% THD per IEEE 519.
1) Any harmonic filters shall match the temperature rating of the blowers. For blowers rated 40°C where air-conditioning is furnished for the blower room, harmonic filters shall be rated for 40°C ambient temperature, minimum. For blowers rated 50°C where ventilation/heating is furnished for the blower room, harmonic filters shall be rated for 50°C ambient temperature, minimum.

b. Each VFD shall constitute a complete combination motor controller per NFPA 70, Article 430 and shall provide the following per the requirements of that article without the addition of any external components or devices.
1) Motor control.
2) Motor overload protection.
3) Motor and motor branch circuit short circuit and ground fault protection.
4) Motor and controller disconnecting means.

B. Master Control Panel
1. A Master Control Panel, BMCP-3120 will be provided to control the four new blowers via Ethernet/IP communication with each blower's Local Control Panel. BMCP-3120 will control the blowers for Aeration Basins No. 5-8 (B-3105, 3106, 3107, 3108) via Ethernet/IP communication with CP-B-3105, 3106, 3107, 3108. BMCP-3120 will also communicate via Ethernet/IP with Plant PLC-101 and the Plant Control System.
2. BMCP-3120 will be equipped with an Allen Bradley CompactLogix PLC based control system per Specification Section 40 63 43.
3. All controls, alarms and monitoring shall be accessible through the Manufacturer's standard touch screen operator interface/display.
4. Provide a Category IC1 Surge Protective Device per Specification Section 40 61 43 on power input section of each BMCP.
5. Minimum BMCP status indications for each blower:
a. Blower in auto.
b. Blower ready for start.
c. Blower running.
d. Common alarm.
6. Minimum MCP inputs from the Plant Control System:
a. Operational mode command (pressure setpoint or flow setpoint).
b. Pressure setpoint value for applicable blower discharge header.
c. Setting of maximum number of blowers available in Auto Mode (1, 2, 3, or 4 blowers available, default setting of 3 blowers).
d. Individual blower Manual start/stop commands.
e. Individual blower Manual speed command.
7. Enclosure: Wall mounted, NEMA 12.
a. Manufacture shall furnish heat calcs to verify thermal design of blower MCP and shall furnish filter fan or panel air conditioner as required for compatibility with either 40°C (air conditioned room) or 50°C (ventilated room) Blower Room air temperature as indicated above.
8. Power supply: 120VAC/60 Hz/1ph, 20 amp.

C. Local Control Panels
   1. Each blower shall be equipped with a local control panel including an Allen Bradley PLC or CPU based control system for motor start/stop and speed control as well as communicating alarms and status monitoring via Ethernet/IP communication protocol
   2. All controls, alarms and monitoring shall be accessible through the Manufacturer's standard touch screen operator interface/display. This information will also be provided to the Master Control Panel and the Plant Control System. At a minimum this will include:
      a. Inlet pressure.
      b. Low inlet air pressure alarm.
      c. Inlet filter differential pressure.
      d. High inlet filter differential pressure alarm.
      e. Discharge air pressure.
      f. High and low discharge pressure alarm.
      g. Inlet air temperature.
      h. Discharge air temperature.
      i. High discharge air temperature alarm and shutdown indication.
      j. Motor speed (rpm).
      k. Power.
      l. Discharge Flow.
      m. Run time.
      n. Run indication
      o. Stopped indication
      p. Status
      q. Mode selection (Pressure or Flow)
      r. All fault indications.
      s. All impending fault indications.
   3. Enclosure: Mounted integral to the blower skid.
   4. Power supply: 120VAC/60 Hz/1ph, 20 amp from skid-mounted / vendor-furnished control power transformer.

D. Blower Instrumentation:
   1. Instrumentation for each blower shall include, as a minimum:
      a. Inlet and discharge air temperature sensors. Inlet and discharge air temperatures and alarms will be displayed on OIT and provided to the Plant Control System (via BMCP-3120).
      b. Inlet air filter differential pressure transmitter. Differential pressure and alarms will be displayed on OIT and provided to the Plant Control System. Provide manufacturer's recommended configuration in order to detect clogging of **both** external and, if applicable, internal inlet filters.
      c. Blower discharge air pressure transmitter. Air pressure and alarms will be displayed on OIT and provided to Plant Control System.
      d. The blower motor monitoring system shall monitor and display actual winding temperatures at the LCP. A high temperature (as determined by the blower manufacturer) shuts down the blower and provides an alarm. The PLC shall receive and the Operator Interface shall graphically display the temperature measurements. The alarm/shutdown shall be displayed until reset. Provide necessary hardware for direct communication between temperature sensor, PLC and Operator Interface.
      e. Motor vibration sensor and transmitter. Vibration measurements and alarms will be displayed on OIT and provided to Plant Control System.
      f. Surge detection monitoring and dynamic control to avoid surge.

E. Blower Header Instrumentation:
   1. Blower Vendor shall furnished two gauge pressure transmitters at the blower discharge header for overall capacity control at the Blower Master Control Panel. Pressure transmitters shall be as follows:
   2. Manufacturers: Endress + Hauser (Cerabar S).

3. Materials:
   a. Vent/drain valve: 316 stainless steel.
   b. Isolating diaphragm: 316 stainless steel.
   c. Housing: Aluminum.
   d. Fill fluid: Utilize manufacturer's standard fill. Ensure fill is suitable for application temperatures.
4. Design and fabrication:
   a. Smart transmitters utilizing microprocessor-based electronics.
   b. Signal Output: 4-20 mA DC proportional to pressure.
   c. Optional Communication: HART.
   d. Nonvolatile EEPROM memory.
   e. Power supply: 24 VDC Loop Power.
   f. Adjustable zero and span.
   g. Temperature limits:
      1) -20 to 180 degrees F (without digital display).
      2) -4 to 175 degrees F (with digital display).
   h. Overpressure limits: Withstand 150% of stated maximum service pressure without damage.
   i. Humidity limits: 0 to 100% relative humidity.
   j. Damping: Adjustable between 0 and 60 seconds.
   k. Accuracy (includes effects of linearity, repeatability, and hystere-sis): ±0.10% of calibrated span for 15:1 rangeability.
   l. Stability: ±0.2% of upper range limit for 12 months.
   m. Temperature effect:
      1) Total effect including span and zero errors: + 0.2% of upper range limit per 100 DEGF for minimum 15:1 rangeability.
   n. Minimum 1/2 inches pressure connection.
   o. Equip with test jacks or accessible terminals for testing output.
   p. Equip with isolation valve and test connections with isolation valves and/or plugs.
5. Schedule: (or Instrument List).

TAG NUMBER	SERVICE	RANGE	PROCESS CONNECTION	VALVE MANIFOLD
PIT-3120A	AERATION BASIN #5 TO 8 BLOWER DISCHARGE PRESSURE	0-30 PSIG	1/2" NPT	YES
PIT-3120B	AERATION BASIN #5 TO 8 BLOWER DISCHARGE PRESSURE	0-30 PSIG	1/2" NPT	YES

2.15 SURFACE PREPARATION AND SHOP PRIMING

A. All carbon steel or iron surfaces shall be prepared, shop primed, and finish painted with two finish coats of epoxy paint system:
   1. Tnemec N69 Hi-Build Epoxoline II, Sherwin Williams Macropoxy 646, equal by Carboline Protective Coatings, or equal by PPG.
   2. Surface Preparation SSPC-SP 6/ NACE No. 3 or better if recommended by paint manufacturer.
   3. 3.0 to 4.0 mils Dry Film Thickness (DFT) per coat.
   4. Comply with all instructions and recommendations of paint manufacturer.

5. Powder coating, 4 mils minimum total dry film thickness, is an acceptable alternative to the above painting system.

B. Machine surfaces that are not painted shall be protected by coating with the manufacturer's recommended corrosive protective compound.

2.16 SOURCE QUALITY CONTROL

A. Upon completion of assembly, the blower package shall be functionally tested at the place of assembly, witnessed by Owner and/or Engineer. If as shop test fails and an extension of time at the factory is required for retesting or a retest is scheduled at a later date, the Equipment Supplier shall bear all costs associated with inspection and testing of materials, products, or equipment at the place of manufacture by Owner and/or Engineer. In event of such failure, the Equipment Supplier will pay costs for travel, meals, lodging, and car rental for Owner designated inspectors' days required to complete such inspections or observations at no additional cost to Owner.

B. At a minimum, the blower system shall be factory tested for a duration of not less than 4 HRS at maximum load and maximum temperature.

C. The entire blower system shall be tested as an operational system before shipment. The CP shall be connected to all enclosure instruments, electric valves, and appurtenances. All start/stop and running sequences and all safety and alarm systems shall be tested. The Witness shall sign the test procedure and results, certifying that the assembled blowers, system were tested together, as a system, in the blower manufacturer's shop.

D. The blower shall be performance tested in accordance with the ASME PTC 13 - 2018 Performance Test Code on Compressors and Exhausters (re affirmed in 2003). All tests shall be conducted at the constant pressure as shown on the performance tables contained in these specifications. Tests shall be conducted using the test rig.

E. A calibrated wattmeter or other measuring means shall measure the electrical shaft power input to the VFD drive including all auxiliary systems. Measured power shall include wire-to-air and include all losses associated with electrical shaft power, including, but not limited to the motor, inverter, and cooling system, if used.

F. The Witness shall sign each copy of the test data log sheet certifying that the required tests were performed in strict accordance with these specifications and the ASME PTC 13 Codes:
   1. The capacity of the blower shall be defined by the appropriate sections of the test codes. Air flow shall be measured on the discharge side of the compressor.\
      a. Inlet airflow conditions may be simulated or calculated to standard conditions. Equations used to calculate standard inlet conditions must be approved by the engineer and noted in the manufactures testing protocol. Ambient air temperature, relative humidity and pressure shall be used. Manufacturer to provide calibration standard used for each equipment item.
   2. All test equipment shall be calibrated and certified by an independent test agency no more than 12 months prior to the test date. Certificates shall show the stability of calibration over a period of at least one year per ISO 9001, Paragraph 4.11.
   3. Velocity vibration versus frequency levels shall be recorded within 10-1,000 and 10-10,000 Hz frequency range. Report vibration in velocity versus frequency.

G. The blower test report shall present computations in exact accordance with the appropriate section or testing codes with performance curves showing capacity, pressure, and horsepower inputs.

H. Test results of the motors and blowers shall be included in the Operations & Maintenance Manual.

2.17 MAINTENANCE AND SPARE PARTS

A. <u>Master Control Panel - The following spare parts shall be furnished::</u>
   1. Control Transformer.

2. Circuit Breakers for Control Circuits (1 of each type).
3. Fuse for Control Circuits (5 of each type).
4. EMI Filters/Surge Suppressors (1 of each type).
5. CPU/PLC.
6. IO Modules (1 of each type).
7. HMI/OIT/Touchscreen.
8. Ethernet Switch.
9. Communication Gateway, if provided.
10. DC Power Supply with Redundancy Module, if provided.
11. UPS, if provided.
12. Battery for DC Power Supply/UPS.
13. Safety Relay, if provided.
14. Control Relays (1 of each type).
15. Pushbuttons/Selector Switches/Pilot Lamps (1 of each type).
16. Additional Electronic Modules, if provided.

B. Local Control Panel:

1. One (1) set of fuses for each blower.
2. Control Transformer.
3. Circuit Breakers for Control Circuits (1 of each type).
4. Fuse for Control Circuits (5 of each type).
5. EMI Filters/Surge Suppressors (1 of each type).
6. CPU/PLC (1 of each type) and HMI/OIT/Touchscreen (1 of each type).
   a. For CPU's / PLC's and HMI/OIT/Touchscreens not compatible with Rockwell programming software, furnish all software licenses and hardware required to load furnished programs such that provided spares can be used with any blower (large or small) without manufacturer's intervention.
7. IO Modules (1 of each type).
8. Ethernet Switch.
9. Communication Gateway, if provided.
10. DC Power Supply with Redundancy Module, if provided.
11. UPS, if provided.
12. Battery for DC Power Supply/UPS.
13. Safety Relay, if provided.
14. Control Relays (1 of each type).
15. Pushbuttons/Selector Switches/Pilot Lamps (1 of each type).
16. Additional Electronic Modules, if provided.

C. Other than fuses, if some items are used in both Master Control Panel and Local Control Panel, provide only one set of spares.

D. Furnish all special tools and appliances necessary to disassemble, service, repair, and adjust the blower equipment and appurtenances.

E. The following spare parts shall be furnished:
   1. One (1) complete set of air filters for each blower furnished.
   2. One (1) full set of instrumentations for a blower motor package in the quantity used for one package

F. All spare parts shall be suitably packaged and clearly identified with indelible marking on the containers. Tools and spare parts (except for the air filters) shall be supplied in a tool chest for long-term storage and marked with manufacturer's name, along with a complete description on contents.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with Section 01 61 03.

B. Comply with manufacturer's written instructions.

3.2 FIELD QUALITY CONTROL

A. At a minimum, each blower package shall be field tested for duration of not less than 24 HRS at maximum load.

B. The CONTRACTOR shall provide third party electrical mitigation testing of all VFDs associated with the blower system. The third party testing shall:
   1. Demonstrate to the satisfaction of the ENGINEER that there is no harmonic distortion to the electrical system per IEEE 5.
   2. Be performed for each blower package for a duration of not less than 24 HRS.
   3. Be repeated if necessary at no cost to the OWNER or ENGINEER.

C. Noise Level:
   1. The blower manufacturer shall include all necessary provisions for reducing noise to meet the maximum sound pressure level requirements of this section (excluding piping noise).
   2. The maximum sound pressure level at any point at a distance of 3 FT or more from any blower/motor surface shall not exceed 80 dBA with the blower running at any speed:
      a. The specified maximum sound pressure level of 80 dBA includes the noise emitted from the blower package including but not limited to, the noise from the motor; the blower; fittings, valves and silencers.
   3. The sound pressure level shall be measured by the contractor with free field preliminary equipment tests with one blower running.
   4. If it is found that the actual sound pressure level 3 FT away from the blower exceeds the maximum specified sound pressure level, the blower manufacturer shall make such modifications and additions as approved by ENGINEER as are necessary to limit the noise to 80 dBA unless it is determined that the source of the noise is not from the blower or accessories supplied by the blower manufacturer.

D. Field Vibration Testing and Field Infrared Thermography Testing are required for equipment furnished under this Section. This testing shall be as specified in Section 01 61 03 and shall be performed by the Installing Contractor.

3.3 BLOWER MANUFACTURER'S FIELD SERVICES

A. The blower manufacturer shall have an established base of operation in North America that furnishes experienced technical resources to continually improve the product and service personnel to carry out start-up and trouble-shooting.

B. The blower manufacturer shall have an already developed Service Network in North America to support the operation of the blower; providing responses to technical inquiries within 8 - 24 HRS and typical parts replacement and within 48 HRS.

C. The VFD and PLC shall be supplied by US based manufacturers that provide local parts and technical support service.

D. The blower manufacturer must provide onsite technical personnel to inspect the final installation (one trip / one onsite day) and additional service as follows to supervise the field start-up tests of the equipment and software. The services of the representative shall be provided for a minimum of four (4), 8 HR days over as many as three (3) trips for the blowers startup and commissioning. If there are difficulties in operation of the equipment due to the blower manufacturer's fabrication and programming or CONTRACTOR's installation, additional service shall be provided at no extra cost to OWNER:

1. Provide, as a minimum, the following field services: Provide written documentation for check out including who performed the work, when performed, what was final setting or tolerance and who witnessed the final settings:
   a. Verify proper connection of piping and installation of accessories.
   b. Check leveling of blower enclosure.
   c. Confirm proper wiring of all instruments and field wired items.
2. A minimum 4 HR, for each blower, field acceptance test shall demonstrate that, under all conditions of operation, each unit:
   a. Has not been damaged by transportation or installation.
   b. Has been properly installed.
   c. Have no mechanical defects.
   d. Has fully functional instrumentation that are properly calibrated and set.
   e. Will start, run, and stop in the prescribed manner.
   f. Will run through the entire range of specified pressure and flow.
   g. Has the proper shutdown sequence of standard stop, soft stop, and emergency stop.
   h. Is free of overheating of any parts.
   i. Is free of objectionable vibration and noise.
   j. Is free of overloading of any parts.
3. Field acceptance testing shall be conducted after the installation of all equipment has been completed and all instrumentation calibrated and working as intended and the equipment has operated for a sufficient period to make all desirable corrections and adjustments. CONTRACTOR shall schedule testing with the full knowledge and consent of OWNER.

E. The blower manufacturer shall have the services of the programmer responsible for programming the blower readily available. The services of the programmer shall be provided for a minimum of three (3), 8 HR days to assist OWNER's programmer with programming and troubleshooting of aeration system and blower software programs as well as coordinate with monitoring for the plant SCADA system. The programmer must have complete knowledge of proper blower operation and of the blower and aeration system software programs supplied in this section.

F. The blower manufacturer shall include an allowance to provide an experienced start up/service factory representative to be present during the phases of start-up and testing.

G. Experienced factory representatives having complete knowledge of proper operation and maintenance of the blower system shall provide a minimum of 8 HRS of Owner personnel training at the job site per Section 01 75 00. This quantity is in addition to the quantities above.

END OF SECTION

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SECTION 43 21 00
PUMPING EQUIPMENT - BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Pumping equipment.

B. Related Specification Sections include but are not necessarily limited to:
   1. Section 09 96 00 - High Performance Industrial Coatings.
   2. Section 01 61 03 - Equipment - Basic Requirements.
   3. Section 03 15 19 – Anchorage to Concrete

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ANSI/Hydraulic Institute (ANSI/HI):
      a. 9.6.3, Rotodynamic (Centrifugal and Vertical) Pumps – Guideline for Allowable Operating Region.
      b. 9.6.4, Rotodynamic Pumps for Vibration Measurements and Allowable Values.
      c. 9.6.6, Rotodynamic Pumps for Pump Piping.
      d. 11.6, Rotodynamic Submersible Pump for Hydraulic Performance, Hydrostatic Pressure, Mechanical, and Electrical Acceptance Tests.
      e. 14.6, Rotodynamic Pumps for Hydraulic Performance Acceptance Tests.

B. Coordinate all mechanical seal systems specified to ensure pump and seal compatibility.

C. Pump/motor and VFD coordination: See Specification Section 01 61 03.

1.3 DEFINITIONS

A. The abbreviations used in this section are defined as follows:
   1. AOR: Allowable Operating Range.
   2. BEP: Best Efficiency Point.
   3. IPS: Iron Pipe Size.
   4. NPSH3: Net Positive Suction Head for 3% head loss.
   5. POR: Preferred Operating Range.
   6. TDH: Total Dynamic Head.
   7. TEFC: Totally Enclosed Fan Cooled.
   8. VFD: Variable Frequency Drive.

B. Pump Service Category: Pump or pumps having identical names (not tag numbers) used for specific pumping service.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 61 03.
   2. Product technical data including:
      a. Performance data and curves with flow (GPM), head (FT), horsepower, hydraulic efficiency, rotating speed (RPM), AOR, BEP, POR, NPSH3 requirements, minimum bowl submergence requirements for vertical mixed flow, axial and turbine pumps.
      b. Pump accessory data.
      c. Bearing supports, shafting details and lubrication provisions.
         1) Bearing life calculations.
         2) Critical speed calculations.
      d. Solids passage information.

e. Anchor design information required by Section 03 15 19.

3. Certifications:
   a. Certified pump performance curves as described in the SOURCE QUALITY CONTROL Article.
   b. Verification of Primary and Secondary conditions in POR and AOR.
4. Test reports:
   a. Factory hydrostatic test.

B. Contract Closeout Information:
1. Operation and Maintenance Data:
   a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

C. Informational Submittals:
1. Certifications:
   a. Provide a written statement that manufacturer's equipment has been installed properly, started up and is ready for operation by Owner's personnel.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Pumps:
   a. See individual pump Specification Sections.
2. Mechanical seals:
   a. Chesterton.
   b. John Crane.
   c. Garlock.
   d. Or as noted in the individual pump Specification Sections.
3. Seal water station:
   a. Chesterton.
   b. John Crane.
   c. AESSEAL.

2.2 CENTRIFUGAL PUMP DESIGN

A. Provide units with increasing head characteristics from the end run out portion of the curve to:
1. Shut-off condition.
2. For Mixed flow, Axial Flow and Propeller pumps to the right hand edge of the AOR.

2.3 ACCESSORIES

A. See Specification Section 01 61 03.

B. Each Unit:
1. Lifting eye bolts or lugs.
2. Plugged gage cock connection at suction and discharge nozzles.
3. Tapped and plugged openings for casing and bearing housing vents and drains.
4. Fittings for properly adding flushing lubricant.
5. Pressure relief fittings for grease lubrication.

C. Packing Seal:
1. Provide packing unless mechanical seal is specified in narrow-scope pump sections.
2. Minimum of five rings graphite impregnated synthetic packing.
3. Provide minimum 1/4 inches diameter supply tap and 1/2 inches diameter minimum drain tap.
4. Provide split Teflon or bronze water seal ring.
5. Adjustable split follower cast iron or bronze gland.

D. Mechanical Seals:
   1. Provide as specified in the narrow-scope pump sections.
   2. Materials (unless otherwise specified in the narrow-scope pump sections):
      a. Metal parts except springs: 316 stainless steel.
      b. Springs: Hastelloy C.
      c. Seal faces: Unfilled carbon graphite versus silica-free Grade 99.5 ceramic.
      d. Elastomers: Viton.

E. Seal Water Station:
   1. Provide one unit per pump with manual shut-off valve on all pumps with seals.
   2. Features:
      a. Pressure regulating.
      b. Flow regulating.
      c. Cleanable flow tube(s) while in service.
      d. Hose barb connection.
      e. Liquid filled pressure gage.
   3. Materials of construction:
      a. Flowmeter tubes: Polysulfone.
      b. Unit body: Polyoxymethylene.
      c. Pressure gage: 316 stainless steel case and wetted parts.
      d. Pressure regulating valve: 316 stainless steel.
      e. Flow regulating valve: 316 stainless steel.
      f. Tube fittings: 316 stainless steel.
      g. Mounting brackets: 316 stainless steel.
   4. Service:
      a. Temperatures up to 150 degrees F.
      b. Pressure up to 140 psiG.
   5. Connection:
      a. Hose barb threaded to pump.
      b. Hose barb to seal water unit.
      c. Reinforced polyurethane hose:
         1) Minimum size: 3/8 inches ID.
         2) Minimum pressure rating:
            a) At 180 degrees F: 115 psi.
            b) At 73 degrees F: 200 psi.
         3) Minimum wall thickness: 1/8 inches.
      d. Non-potable water to shut-off valve: See Section 40 05 00 with isolation ball valve.
   6. Mounting:
      a. To pump or pipe flange with stainless steel bracket.
      b. Maximum distance from non-potable water to shut-off ball valve to seal water station and seal water station to pump seal, 2 feet each direction.

F. Local Control Station and Motor Disconnect
   1. Local Control Station (LCS)
      a. Fabricated and completely wired Local Control Station mounted on a pedestal stand
      b. The temperature and motor leak sensor will be wired back from Motor to LCS
   2. Motor Disconnect – see Electrical Drawings

2.4 FABRICATION

A. Pump Support:
   1. Design base to support weight of drive, shafting and pump.
   2. Comply with HI vibration limitations.
   3. Mount horizontal pump, motor and coupling on single piece drip lip type machine base.
   4. Mount vertical pumps on single piece pedestal machine base.

5. Mount vertical turbine/propeller/can pumps on a rigid machined base plate attached to the discharge elbow. Base plate to be bolted to the pump can or an independent rigid machined sole plate grouted to the concrete substructure with anchor rods and leveled with jackscrews.
6. Fabricate to withstand all operating loads transmitted from the pump and drive.
7. On vertically configured end suction centrifugal pumps when supplied with a fabricated steel mounting frame and suction elbow, the suction elbow shall be a long radius reducing elbow with greater than 50% area reduction to comply with Table 9.6.6.3.2 of ANSI/HI 9.6.6 standard for straight pipe lengths.

2.5 SOURCE QUALITY CONTROL

A. Verification primary design condition in POR.

B. Verification secondary design condition in AOR.

C. Factory hydrostatic test all pumps at 150% of shut-off head for a minimum of five minutes.

D. If specifically required in the individual pump specification sections, provide factory tests:
   1. All units:
      a. Conduct tests in accordance with HI.
         1) Shut-off head and design condition: Positive unilateral performance tolerance meeting Grade 1U per ANSI/HI 14.6 for Rotodynamic Pumps.
         2) Shut-off head and design conditions: Positive unilateral performance tolerances meeting Grade 1U per ANSI/HI 11.6 for Rotodynamic Submersible Pumps.
   2. All pumps:
      a. Head (FT) versus flow (GPM) pump curves:
         1) Efficiencies along curve.
         2) Brake horsepower along each curve.
   3. Results certified by a registered professional engineer.

E. Statically and dynamically balance each pump per ANSI/HI standards.
   1. If specifically required in the individual pump specification sections or in Specification Section 01 61 03, field vibration test pumps:
      a. To meet requirements of ANSI/HI 9.6.4 for Rotodynamic Pumps at any point on the pumps and motor.

F. To meet requirements of ANSI/HI 11.6 for Submersible Pumps.

PART 3 - EXECUTION

3.1 INSTALLATION

A. See Specification Section 01 61 03.

B. Floor or Pad-Mounted Units (Non-Submersible):
   1. Align vertically and horizontally level, wedge and plumb units to match piping interfaces.
   2. Assure no unnecessary stresses are transmitted to equipment flanges.
   3. Tighten flange bolts at uniform rate and manufacturer's recommended torque for uniform gasket compression.
   4. Support and match flange faces to uniform contact over entire face area prior to bolting pipe flange and equipment.
   5. Permit piping connecting to equipment to freely move in directions parallel to longitudinal centerline when and while bolts in connection flange are tightened.
   6. Grout equipment into place prior to final bolting of piping but not before initial fitting and alignment.
   7. Assemble connecting piping with gaskets in place and minimum of four bolts per joint installed and tightened.
      a. Test alignment by loosening flange bolts to see if there is any change in relationship of piping flange with equipment connecting flange.

b. Realign as necessary, install flange bolts and make equipment connection.

8. Field paint units as defined in Specification Section 09 96 00.
9. Provide pressure gage, visible from grade or operating floor, on discharge of all pumps and on suction and discharge of all non-submersible units.

C. Submersible Units:

1. Assemble connecting piping with gaskets in place and minimum of four bolts per joint installed and tightened.
   a. Test alignment by loosening flange bolts to see if there is any change in relationship of piping flange with equipment connecting flange.
   b. Realign as necessary, install flange bolts and make equipment connection.
2. Field paint units as defined in Specification Section 09 96 00.
3. Provide discharge pressure gage visible from grade or operating floor.

3.2 FIELD QUALITY CONTROL

A. Provide services of equipment manufacturer's field service representative(s) to:

1. Inspect equipment covered by this Specification Section.
2. Supervise pre-start adjustments and installation checks.
3. Conduct initial start-up of equipment and perform operational checks.
4. Instruct Owner's personnel for the specified minimum number of hours at jobsite per Specification Section 01 79 23 - Instruction of Operation and Maintenance Personnel on operation and maintenance of each of the specified pumping equipment.

END OF SECTION

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SECTION 43 23 24
PUMPING EQUIPMENT: LOW HEAD PROPELLER PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Low head propeller pumps and accessories.

B. Related Sections include but are not necessarily limited to:
   1. Section 01 33 00 – Submittal Procedures
   2. Section 01 61 03 - Equipment: Basic Requirements.
   3. Section 01 65 00 - Product Delivery Requirements
   4. Section 01 66 00 - Product Storage and Handling Requirements
   5. Section 01 75 00 - Checkout and Start-Up Procedures
   6. Section 01 78 23 - Operation and Maintenance Data
   7. Section 01 78 36 – Warranties
   8. Section 26 29 23 - Variable Frequency Drives
   9. Section 43 21 00 - Pumping Equipment: Basic Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Iron and Steel Institute (AISI):
      a. Steel Products Manual.
   2. FM Global (FM).
   3. National Fire Protection Agency (NFPA):
      a. 70, National Electrical Code (NEC).
   4. Underwriters Laboratories, Inc. (UL).

B. Responsibilities and Qualifications
   1. A single manufacturer shall provide all components as a complete integrated package to ensure proper coordination, compatibility, and operation of the equipment.
   2. Pumps shall be Manufacturer's standard product and only modified as necessary to comply with the drawings, specifications, and specified service conditions.
   3. Manufacturer shall have a minimum of 15 years' experience designing mixer of the type specified herein.
   4. Manufacturer shall provide a list of names and dates of installations for verification by the Engineer.
   5. All welding shall be performed in accordance with AWS D1.1.
   6. The Contract Documents represent the minimum acceptable standards for equipment for this project. All equipment will conform fully in every respect to the requirements of the respective parts and sections of these drawings and specifications.

C. For variable frequency drives, pump manufacturer shall coordinate the pump, motor and VFD. Motor controllers are furnished under Division 26.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Requirements in Section 01 33 00, Section 01 61 03 and Section 43 21 00.
   2. Product technical data including:
      a. Performance data and curves with flow (GPM), head (FT), horsepower, efficiency and submergence requirement.

b. Pump accessory data.
c. Drawings demonstrating adequate davit crane reach length and lift height to remove pump from basin and verifying swing gate location to pass pump through.

3. Certifications:
   a. Certified pump performance curves.

B. Operation and Maintenance Manuals: See Section 01 78 23.

C. Informational Submittals: Results of factory and field testing.

1.4 SYSTEM DESCRIPTION

A. General Requirements:
1. Pumps shall be suitable for pumping of aeration basin mixed liquor.
2. Aeration basins are fed with anoxic basin effluent and return activated sludge.
3. Solids concentration range: 0.2 to 1.0 PCT.
4. Wastewater temperature range: 40 DEGF - 86 DEGF.
5. Continuous pumping.

B. Aeration Basins No. 5-8 Mixed Liquor Recycle:
1. Aeration basin sidewater depth: 20.0 FT.

1.5 DELIVERY, STORAGE AND HANDLING

A. See Sections 01 65 50 and 01 66 00.

B. Equipment shall be stored by manufacturer until Contractor is ready to install.

C. Equipment shall be stored and protected in accordance with the Manufacturers' recommendations.

1.6 WARRANTY

A. An 18-month equipment warranty shall be provided by the Manufacturer. The warranty date shall start at the time of substantial completion as defined in Division 00. Warranty shall cover the full cost of problem diagnosis, problem part replacement (including onsite removal and reinstallation), shipping and testing.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Low head propeller pumps:
   a. Xylem Flygt.
   b. KSB.
   c. Sulzer.
2. Davit Crane:
   a. Thern 5PT20 Commander 2000
   b. Approved equal

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

A. Design Requirements:
1. Design for stable pumping in liquid level as stated above.
2. Coordinate pump mounting with tank configuration, equipment layout, and access opening size as shown on the Drawings.
3. Aeration Basins No. 5-8 Mixed Liquor Recycle Pumps (P-2153, P-2163, P-2173, P-2183, plus spare unit) - Aerated Zone to Anoxic Zone 1:
   a. Number of blades per impeller: Three.
   b. Minimum impeller diameter: 500 MM.

c. Rated pumping capacity: 11,120 GPM at 2.3 FT TDH.
d. Maximum rated motor HP: 25 HP.
e. Motor voltage: 3/60/460.
f. Maximum rotating speed: 700 RPM.
g. Prop blade angle: 15 DEG.
h. Drive type: Variable speed submersible.
i. Drive configuration: Close coupled.
j. Suitable for 4'x6.5' access opening.
k. Discharge Pipe Connection: 30 inch.

4. Duty cycle: Continuous.

2.3 MATERIALS

A. Pump:
1. Inner stator base: Cast iron, ASTM A48 35B.
2. Outer stator jacket: Type 316 stainless steel.
3. Lifting device: Type 316 stainless steel.
4. Impeller shaft: Stainless steel, AISI 431.
5. Propeller: Stainless steel, AISI 316L.
6. Jet ring: 304 stainless steel.
7. Sliding bracket: 304 stainless steel.
8. O-ring: Nitrile rubber.
9. Outer mechanical seal: Tungsten carbide, WCC R or silicon carbide.
10. Inner mechanical seal: Tungsten carbide, silicon carbide, or silicon carbide/ceramic.
11. Guiding rollers: Type 316 stainless steel.
12. Oil casing: Vinylester (fiberglass reinforced) corrosion resistant composite.
13. Mounting system:
    a. Mast: Type 316 stainless steel.
    b. Mounting brackets: Type 316 stainless steel.
14. Hoist assembly: Type 316 stainless steel.
15. For any items above specified as Type 316 stainless steel, duplex stainless steel is an acceptable substitute.
16. Davit Crane:
    a. Base: galvanized steel
    b. Crane: galvanized steel
    c. Anchor bolts and hardware: Type 316 stainless steel
    d. Winch: Manufacturer's standard corrosion resistant coating
    e. Cable: Type 316 stainless steel

2.4 FABRICATION AND MANUFACTURE

A. General:
1. Provide pump capable of handling activated sludge as described under Article 1.4.
2. Where watertight sealing is required, machine and fit mating surfaces with O-rings.
3. Provide with heavy duty lift lugs or hoisting bail designed for lifting the entire pump and motor assembly.
4. Pumps shall be capable of meeting design requirements in aerated conditions where aeration diffusers are placed at a distance of 6 FT or more from the pump inlet.

B. Pump:
1. Lapped and face type mechanical seal for propeller shaft with one stationary and one positively driven rotary seal running in oil.
2. One oil chamber for shaft sealing system with nominal 4-quart capacity total.
3. Propeller:
    a. Three blades with backward curved front edge design.
    b. Dynamically balanced.
    c. Slide fit to shaft with expansion sleeve.
    d. Designed for solids handling.

4. The motor shaft end shall be supported by two bearings. A roller and an angular contact ball bearing shall take up the axial and radial loads while an angular contact ball bearing shall take up the axial loads.
5. The bearings shall be pre-loaded by a bearing loading nut located on the motor end of the shaft in order to reduce shaft deflection and increase bearing life and seal life. Mixed Liquor Recycle Pumps without pre-loaded bearings will not be considered acceptable or equal.
6. Propeller shaft supported by two single row deep groove ball bearings and motor shaft supported on inner, single row deep groove ball bearing.
7. All watertight mating surfaces machined and fitted for uniform O-ring compression. No secondary sealing appurtenances shall be utilized.
8. Junction chamber:
   a. Cable entry water sealing separate from grommet compression.
   b. Primary seal from grommet compression.
   c. Secondary seal via terminal board.
9. Frame connection for hoist lifting hook and cable.

C. Propeller:
1. Provide non-clog type dynamically balanced impeller in accordance with HI Standards.

D. Shaft:
1. Design pump shaft of sufficient size to transmit full driver output.
2. Use shaft which is accurately machined and constructed with sufficient materials.
3. Design shaft for a maximum deflection of 0.002 IN.

E. Shaft Seal:
1. Seal shaft with double mechanical seal running in an oil filled chamber.
2. The plug-in mechanical seal assembly shall contain positively driven rotary, corrosion resistant, seal face rings for both the inner and outer seals of materials specified above. One face of the inner seal ring pair shall have spiral grooves laser etched in it, to provide a pumping action to move leakage from the stator housing back into the oil chamber. In order to avoid seal failure due to sticking, clogging, and misalignment from elements contained in the mixed media, only the seal faces of the outer seal assembly and its retaining clips shall be exposed to the mixed media. All other components shall be contained in the oil housing.
3. Provide seals requiring neither routine maintenance nor adjustment, but capable of being easily inspected and replaced.
4. Hold interface in contact by its own spring system.
5. The Pump shall be equipped with a seal shield that prevents fibrous material from winding up around the shaft and outer seal. The shield shall be welded to the propeller hub and extend towards the motor. The shield shall rotate with the propeller and there shall be a radial micro-gap between the shield and oil-housing.

F. Bearings:
1. Support shaft on upper and lower permanently lubricated bearings with a minimum L-10 life of 100,000 HRS.

G. Motor:
1. Motors shall comply with Section 01 61 03.
   a. 15% service factor requirements per Section 01 61 03 shall apply to the maximum design condition described in this specification.
2. Motor sizing shall be non-overloading over the entire pump curve (1.0 service factor on VFD).
   a. Have the following minimum turndown ratio.
      1) Constant torque: 6:1.
3. Provide pump with FM or UL listed motor designed for area classification shown on Drawings.
4. Provide motor of totally submersible design, the stator windings shall be insulated with moisture resistant Class H insulation rated for 180 DEGC (356 DEGF). The stator shall be insulated by the trickle impregnation method using Class H monomer-free polyester resin resulting in a winding fill factor of at least 95 PCT. The motor shall be inverter duty rated in accordance with NEMA MG1, Part 31. The motor shall be designed for continuous duty, capable of no less than 10 evenly spaced

starts per hours. The rotor bars and short circuit rings shall be made of aluminum. Motor shall be 3 PH, 60 cycle, 460 V.
   a. Motor design to be compliant with MG 1 part 31 inverter duty ratings.
   b. See Section 26 29 23 for VFD/motor coordination.
5. Assure motor is capable of running dry for extended periods without damage to motor or seal.

H. Power and Control Cable:
1. Manufacturer to provide power cable and control cable to pump suitable for submersible applications in wastewater and indicate same by a code or legend permanently embossed on cables.
2. Size cables in accordance with applicable NEC Specifications.
3. Manufacturer to provide power cable and control cable as required.

I. Temperature and Moisture Monitor:
1. Furnish the motor with a temperature monitor embedded in the motor windings.
   a. Arrange monitor so as to activate an alarm should any one of the monitors detect high temperature with manual reset once the stator temperature returns to normal.
   b. Set activation of the temperature monitors at not higher than 90 PCT of insulation temperature rating.
2. Provide sensor as needed for detecting the presence of water in the seal chamber and motor housing.
   a. If water enters, the sensor shall energize an electrical circuit shutting down the pump and indicating at the HMI/OIT.
3. Outputs from the monitoring system shall include:
   a. Temperature fault.
   b. Moisture fault.
   c. Common alarm.
4. Manufacturer or Manufacturer's designated representative shall furnish a Local Control Station (LCS) as shown on the Instrumentation Drawings to house an alarm module furnished by the Manufacturer or Manufacturer's designated representative for monitoring the above fault sensors.
5. LCS shall be compatible with installation in a Class I, Division 2, Group D hazardous classified area.

J. Coatings:
1. Protect all metallic surfaces coming into contact with sewage except stainless steel and bronze by a corrosion-resistant coating.
2. All castings must be blasted before coating. All wet surfaces are to be coated with two-pack oxyrane ester Duasolid 50. The total layer thickness should be at least 120 microns. Zinc dust primer shall not be used.

K. Pump Guides System provided by Manufacturer:
1. Provide sliding guide bracket integral to pump unit which properly aligns the pump.
2. Guide the entire weight of the pumping unit by two guide rail(s) per pump. Rails shall be 2-inch minimum diameter or larger if recommended by manufacturer. Single rail systems are not acceptable.
3. Provide crane system for pumps as specified in Section 2.5/G. .
4. Design pump and crane system to allow for removal without entering the tank and without removal of bolts, nuts or other fastenings.
5. Provide intermediate "standoff" supports for guide rails as required by Manufacturer for layout configuration shown on the Drawings.

2.5 MANUFACTURER-FURNISHED ACCESSORIES

A. Mounting Assembly:
1. Provide wall or floor mounted mast arrangement with all mounting brackets and hardware to mount pumps as shown on Drawings.

B. Designed for raising and lowering pump as well as for pump support.
1. Allows lowering and raising of pump without personnel entering tankage.
2. Provide stainless steel cable to raise and lower pump from tank.

C. Power Cable:
1. Jacket: Chlorinated Polyethylene Rubber.

2. Insulation: Ethylene-propylene rubber.
3. Minimum four conductor.
4. Length to allow full tank depth lowering of pump with connection to electrical power source shown on Drawings without splices.

D. Local Control Station (LCS) as shown on the Instrumentation Drawings:
1. Manufacturer shall furnish NEMA 4X, 316 SST local control station with all panel-front devices rated for Class I, Division 2, Group D hazardous area. Furnish pump alarms relay, Flygt MiniCAS or equal by actual pump supplier, installed in LCS. All LCS devices shall comply with applicable requirements of Division 40.

E. Jet or Flow Ring:
1. 360 DEG around propeller.
2. Close clearance maintained between flow ring and propeller to maintain high hydraulic efficiency.

F. Pump Flange Mounts:
1. Provide each pump with a wall/pipe flange mount.
2. Flange mount will support the weight of the pump and will provide the connection between the pump discharge and flanged discharge pipe.
   a. No gaskets or secondary sealing systems allowed.
   b. Flange mount shall be either in iron or stainless-steel materials.
3. Provide each pump with minimum of two, 2 IN diameter guide rails.

G. Davit Crane
1. Provide one (1) portable davit crane to allow for removal of pumps. Multiples of various components are required as specified below.
2. Crane capacity shall be as required by equipment manufacturer for the configuration shown in the Drawings. Provide custom boom length if required to allow pump removal in the configuration shown on the Drawings. Manufacturer shall coordinate crane capacity and hook height for both pump removal locations and for locations at Effluent Channel where pumps may be lowered to ground level.
3. Provide unit with worm gear hand winch, wire rope, swivel hook/latch, bases with cap and anchor kit, and base extension (**required**) suitable for use with pumps
   a. Furnish a wire rope with attachment ring for each pump plus an additional wire rope with hook in the same rope size. Each wire rope shall be configured for attachment to the crane winch drum. Each wire rope shall be of sufficient length to reach 25ft below the crane base.
   b. Furnish a wire rope keeper at each pump with provision to lock the rope end and prevent accidental dropping.
   c. Winch shall be compatible with power drill for motorized crane operation upon removing the winch handle. Furnish 120V/1Ø power drill compatible with NEMA 5-15P or NEMA 5-20P receptacle suitable for winch operation at crane rated load.
   d. Furnish flush-mount base with cap for every pump.
   e. Furnish total of five (5) wall-mount bases with caps for installation by Contractor at the Effluent Channel at the Aeration Basins and SC Splitter Structure.
   f. Contractor shall furnish additional davit crane bases compatible with vendor-furnished davit crane at locations shown as "Contractor furnished" on the Areas 21 and 22 drawings.

2.6 ANCHOR BOLTS AND HARDWARE:

A. Installing Contractor shall furnish adhesive epoxy anchors per Section 03 15 19. Anchors and hardware shall be Type 316 stainless steel.

2.6 MANUFACTURER-FURNISHED MAINTENANCE MATERIALS

A. Provide one set of all special tools required for pump and accessory operations and maintenance.

B. Furnish one spare pump of each type furnished. Pump shall include submersible cable(s).

C. Provide the following spare parts and accessories for each pump supplied:
1. One of each type of mechanical seal.

2.7 SURFACE PREPARATION AND SHOP COATINGS

A. Pumping unit manufacturer/supplier shall install finish paint systems on all required surfaces unless specified otherwise. Surface preparation and coating application shall be Manufacturer's recommended premium system for service in aeration basins that are not preceded by primary clarification.

B. The following surfaces shall not be painted:
   1. Stainless steel.
   2. Aluminum and other non-ferrous metals, unless specifically noted otherwise.
   3. Packing glands and other non-adjustable parts.
   4. Nameplates.
   5. Flexible connectors.

C. Surface preparation of ferrous metal surfaces shall be per SSPC-SP6 and cleaned of all grease, oil, and debris using required solvents unless a higher degree of preparation is recommended by the manufacturer.

D. Finish paint system shall consist of Manufacturer's recommended epoxy primer and a minimum of two coats of manufacturer's recommended epoxy finish product.

2.8 SOURCE QUALITY CONTROL

A. Factory and Field Tests:
   1. The pump Manufacturer or Manufacturer's designated representative shall perform the following inspections and tests on each Pump before shipment from the factory:
      a. Propeller, motor rating, and electrical connections shall first be checked for compliance to the customer's purchase order.
      b. A dielectric test shall be carried out in accordance to IEC 60034-1 (two times rated voltage plus 1000 V). This test shall be done after assembly but before any performance tests. No records shall normally be provided.
      c. Prior to shipment, the Pump shall be run dry to establish correct rotation and mechanical integrity.
   2. A written report stating the foregoing steps have been done may be supplied with each pump at the time of shipment (upon request).
   3. Factory certified hydraulic test shall be conducted on each pump type provided as part of these specifications. Test reports shall be submitted to the engineer and approved prior to shipment from the factory.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation by Installing Contractor of equipment specified herein shall be in strict accordance with the Contract Documents and requirements of the manufacturer's written instructions and Shop Drawings. It is the Installing Contractor's responsibility to verify the accuracy of all necessary dimensions in the field to ensure compatibility with the Specifications and equipment.

B. Contractor shall coordinate davit crane base installation with concrete work and with grating wherever required. Any changes in location shall be submitted to the Engineer for approval. Contractor shall coordinate and verify guardrail swing gate locations with furnished davit crane and pump to verify pump will fit through the swing gates.

C. See Section 01 61 03 for additional general requirements.

D. Anchor Bolts: Accurately place using templates provided by manufacturer and as specified in Specification Section 03 15 19.

3.2 FIELD QUALITY CONTROL

A. See Section 01 75 00 for general starting and adjusting requirements.

B. Manufacturer shall provide at a minimum the following field service quantities or such larger quantity as required to provide the indicated field services:
   1. One Trip of One onsite day for installation supervision
   2. Two Trips each One onsite day for startup and commissioning
   3. One Trip of One onsite day for Owner staff training.

C. Manufacturer shall provide services of equipment manufacturer's field service representative(s) to:
   1. Inspect equipment covered by these Specifications.
   2. Supervise adjustments and installation checks.
   3. Provide test equipment, tools, and instruments necessary to accomplish equipment testing.
   4. Conduct start-up of equipment and perform operational checks.
   5. Provide Owner with a written statement that manufacturer's equipment has been installed properly, has been started up, and is ready for operation by Owner's personnel.

D. Manufacturer or Manufacturer's designated representative shall provide operations and maintenance training as specified in Section 01 75 00.

E. Contractor to coordinate field service work with the Manufacturer's service representative, Owner, and Engineer prior to initiating such work.

END OF SECTION

SECTION 43 25 13

PUMPING EQUIPMENT: END SUCTION CENTRIFUGAL NON-CLOG

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Horizontal, dry-pit, direct-connected, centrifugal non-clog pumps.

B. Related Sections include but are not necessarily limited to:
   1. Division 01 - General Requirements.
   2. Section 01 61 03 - Equipment: Basic Requirements.
   3. Section 09 96 00 - High Performance Industrial Coatings.
   4. Section 26 29 23 –Variable Frequency Drives – Low Voltage.
   5. Section 43 21 00 - Pump Equipment - Basic Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Bearing Manufacturers Association (ABMA).
   2. American National Standards Institute (ANSI).
   3. ASTM International (ASTM):
      a. A48, Standard Specification for Gray Iron Castings.
   4. FM Global (FM).
   5. ANSI/Hydraulic Institute (ANSI/HI):
      a. 9.6.3, Rotodynamic (Centrifugal and Vertical) Pumps – Guideline for Allowable Operating Region.
      b. 9.6.4, Rotodynamic Pumps for Vibration Measurements and Allowable Values.
      c. 9.6.6, Rotodynamic Pumps for Pump Piping.
      d. 14.6, Rotodynamic Pumps for Hydraulic Performance Acceptance Tests.
   6. International Organization for Standardization (ISO):
      a. 1940, Mechanical Vibration - Balance Quality Requirements for Rotors in a Constant (Rigid) State - Part 1: Specification and Verification of Balance Tolerances.
      b. 21940-11, Mechanical Vibration - Rotor Balancing - Part 11: Procedures and Tolerances for Rotors with Rigid Behavior.
   7. National Electrical Manufacturers Association (NEMA):
      a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
   8. National Fire Protection Agency (NFPA):
      a. 70, National Electrical Code (NEC):
         1) Article 500, Hazardous (Classified) Locations, Classes I, II, and III, Divisions 1 and 2.

B. Responsibilities and Qualifications
   1. A single manufacturer shall provide all components as a complete integrated package to ensure proper coordination, compatibility, and operation of the equipment.
   2. Pumps shall be Manufacturer's standard product and only modified as necessary to comply with the drawings, specifications, and specified service conditions.
   3. Manufacturer shall have a minimum of 15 years' experience designing pumps of the type specified herein.
   4. Manufacturer shall provide a list of names and dates of installations for verification by the Engineer.

1.3 DEFINITIONS

A. The abbreviations used in this section are defined as follows:
   1. AOR: Allowable Operating Range.

2. BEP: Best Efficiency Point.
3. IPS: Iron Pipe Size.
4. NPSH3: Net Positive Suction Head for 3 PCT head loss.
5. POR: Preferred Operating Range.
6. TDH: Total Dynamic Head.
7. TEFC: Totally Enclosed Fan Cooled.
8. VFD: Variable Frequency Drive.

1.4 SYSTEM DESCRIPTION

A. The herein specified pumps shall be used to convey return activated sludge (RAS) from the secondary clarifiers to the Aeration Basin Splitter Structure.

B. Provide single source coordination responsibility through the pump manufacturer for the entire system including but not limited to the following:
   1. Pumps.
   2. Motors.
   3. VFDs.

1.5 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data including:
      a. All data required by Sections 01 61 03 and 43 21 00.
      b. Acknowledgement that products submitted meet requirements of standards referenced.

B. Contract Closeout Information:
   1. Operation and Maintenance Data:
      a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

1.6 WARRANTY

A. An 18-month warranty shall be provided by the manufacturer. The warranty date shall start at the time of substantial completion. Warranty shall cover full cost of pump failure diagnosis and testing and pump replacement/repair. See Section 01 78 36 for additional requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Pumps:
      a. Pentair Fairbanks Nijhuis.
      b. KSB.
      c. Flowserve.
      d. Grundfos.
   2. Mechanical Seals:
      a. Split Seal:
         1) Chesterton 442C.
         2) Equal Model by John Crane.
      b. Double Mechanical Seals:
         1) John Crane Type 21.
         2) Approved equal.
   3. Throat Bushing:
      a. Spiral Trac™.
      b. Approved equal.

4. Couplings:
    a. TB Wood's.
    b. Approved equal.

2.2 DESIGN AND PERFORMANCE REQUIREMENTS

A. Design Criteria:
1. RAS Pumps (P-4001, P-4002, P-4011, P-4012, P-4021, P-4022, P-4031, P-4032, P-4041, P-4042):
    a. Number of pumps: 10.
    b. Primary design condition: 1,860 gpm at 31 FT TDH with minimum pump efficiency of 81 percent and NPSH3 less than 9.5 FT.
    c. Secondary condition: 1,740 gpm at 33 FT TDH with minimum pump efficiency of 81 percent and NPSH3 less than 9.5 FT.
    d. Run-out condition: 2,650 gpm at 20 FT TDH with minimum pump efficiency of 73 percent and NPSH3 less than 15 FT.
    e. Maximum shutoff condition: 0 gpm at 53 FT.
    f. Minimum shutoff condition: 0 gpm at 42 FT.
    g. Maximum nominal full speed: 900 rpm.
    h. Maximum nameplate driver horsepower: 20.
    i. Drive type: Variable speed.
    j. Minimum size solids passage (sphere): 4 IN.
    k. Solids concentration range: 1 to 2%.
    l. Discharge flange diameter: 8 IN DIA.
    m. Suction flange diameter: 10 IN DIA.
    n. Ambient conditions:
        1) Maximum wastewater temperature: 80 DegF.
        2) Maximum air maximum: 112 DegF.

B. Performance Requirements
1. The pump manufacturer shall perform both lateral and torsional critical speed analyses of the assembled pumping units to identify and ensure:
    a. That the first lateral critical speed is at least 25 percent above the maximum operating speed of the pumping unit;
    b. The no torsional natural frequencies occur within a range extending from 25 percent below to 25 percent above the operating speed of the pumping over the entire operating speed range defined.; and
    c. That any blade excited resonant frequency shall be no closer than plus or minus 25 percent of the natural frequency of any part of the installed assembled pumping unit over the entire operating speed range.
2. Each pumping unit and motor shall be designed and fabricated to limit operating sounds pressure levels on the operating floor to 85 dBA in any direction at a distance of 3 FT from the equipment over the specified speed operating and flow range.
3. Provide pumps with increasing head characteristics from run-out conditions to shutoff condition.

2.3 MATERIALS

A. Dry-Pit Pumps:
1. Volute: Cast iron, ASTM A48, Class 35.
2. Impeller: Cast iron, ASTM A48.
3. Shaft:
    a. Alloy steel RS4140, or
    b. ASTM A276 Type 420 stainless steel.
4. Shaft sleeve: AISI 420 hardened stainless steel, 300-350 BHN.
5. Wear rings:
    a. Impeller: Hardened stainless steel, ASTM A743 CA-15, 300-350 BHN.

b. Casing: Hardened stainless steel, ASTM A743 CA-15, 450 BHN
6. Frame: ASTM A36 carbon steel.
7. Mechanical seal: Type 316 stainless steel, face materials as recommended by manufacturer.
8. Throat bushing: Carbon graphite PTFE or manufacturer standard for specified service.
9. O-rings: Nitrile (Buna-N) or fluorocarbon (Viton).
10. Fasteners: Type 316 stainless steel.
11. Coupling guard: Aluminum or Type 316 stainless steel.
12. Impeller eye-nut covers: Type 316 stainless steel.

2.4 FABRICATION AND MANUFACTURE

A. General:
1. Pumps shall be solids handling, bearing frame design, non-clog, centrifugal horizontal pumps.

B. Casing/Volute
1. The pump casing shall be designed for the type of service herein specified and shall be of sufficient strength and metal thickness to insure long life, accurate alignment and reliable operation. The volute of the pump casing shall have smooth fluid passages large enough at all points to pass any size solid which can pass through the impeller and provide smooth unobstructed flow. The casing shall have a separate and removable suction cover and stuffing box cover.
2. The casing shall be designed to permit rear pump rotating assembly removal without disturbing either the suction or discharge piping. The casing shall have connections for vents, drains, and gauges.
3. A hand hole shall be provided in the casing to give convenient access to the impeller and interior parts of the pump. The inner contours of the hand hole cover shall match the contours of the casing.
4. The suction and discharge flange shall conform to ANSI B16.1, Class 125 LB, flat face, of standard size with drilled holes.

C. Impeller:
1. The impeller shall be two vane, enclosed, single suction, non-clogging type designed to pass minimum sphere size specified herein. Wiper vanes on the impeller back shroud are not allowed.
2. The impeller shall be dynamically balanced and secured to the shaft by means of a key and locknut and matched to the volute.
3. The key and locknut shall be fully covered with the eye-nut cover secured to the shaft and matched to the volute.

D. Wearing Rings
1. A replaceable casing wear ring providing 1/8 IN minimum wear shall be installed with its wear surface parallel to the suction end of the pump impeller. The wear ring shall be installed with recessed screws for attachment to the casing.
2. A replaceable impeller wear ring providing 1/8 IN minimum wear shall be mounted on the impeller to provide a renewable surface opposite the suction cover wear ring. The wear ring shall be secured to the impeller with recessed screws.

E. Shaft and Shaft Sleeve:
1. Design pump shaft of sufficient size to transmit full driver output.
2. Use shaft which is accurately machined and constructed with sufficient materials.
3. Design shaft for a maximum deflection of 0.002 IN measured at the stuffing box.
4. The pump shaft shall be protected from the pumped liquid by a shaft sleeve extending from the impeller hub through the area of adjustment of the gland follower.
5. A renewable, shaft sleeve extending from the hub of the impeller through the stuffing box packing and of sufficient length to cover the complete area of adjustment of the gland follower shall be provided. The shaft sleeve shall utilize a system of sealing between the shaft and shaft sleeve which will not allow leakage of the liquid being pumped between

them or allow air to enter the pump casing. Shaft sleeve wall thickness shall be a minimum of 0.25 IN.

6. The shaft sleeve shall be positively secured to the shaft by a set screw to prevent slip between sleeve and shaft.

F. Stuffing Box and Shaft Seal:
   1. The stuffing box shall be an integral part of the stuffing box cover and shall be designed to collect the leakage from the stuffing box. It shall have a minimum (3/4 - 14 NPT) drain connection at its lowest point.
   2. The stuffing box shall be designed to allow for installation of a mechanical split seal with split throat bushing designed for water flush or a flush-less, double mechanical seal.

G. Bearings:
   1. Radial bearings shall be grease lubricated, double row deep grooved, ball type. Thrust bearings shall be grease lubricated, angular contact, duplex mounted ball bearings.
   2. Bearings shall have a minimum ABMA L10 life of 100,000 HRS.

H. Couplings
   1. The coupling between the pump and the drive system shall be a horizontal type unit providing a flexible connection between the pump and the drive.
   2. The selection of the size of the coupling required shall be based on the maximum horsepower of the drive system including the service factor and any other special conditions outlined in this hydraulic specification.
   3. In addition to the torque requirements of the drive system, the selection of the coupling size shall be verified through the pump manufacturer calculating and submitting to the engineer for approval the torsional analysis of the complete pump/driver system. There shall be no torsional critical speed within 15% above or below the specified speed range. The number of vanes times the RPM are part of this speed range.
   4. Coupling guards shall be of adequate size and type and comply with OSHA safety standards.

I. Frame and Pedestal
   1. Pump and drive motor shall be mounted on a heavy-duty bearing frame. Frame shall be line bored for permanent bearing alignment.
   2. Anchor bolts shall be designed by the pump supplier and supplied by the Contractor.

J. Motors:
   1. Motors shall be 460 VAC, totally enclosed, fan cooled (TEFC), inverter duty rated as specified in Section 01 61 03. Provide with Class F insulation, NEMA Design B.

2.5 MAINTENENACE MATERIALS

A. Provide one set of all special tools required for pump and accessory operations and maintenance.

B. Provide the following spare parts and accessories:
   1. Two mechanical seals.
   2. Two throat bushings and installation accessories.
   3. One set of all manufacturer recommended O-rings, gaskets, and similar accessories.

2.6 SURFACE PREPARATION AND SHOP COATINGS

A. Pumping unit manufacturer/supplier shall install finish paint systems on all required surfaces unless specified otherwise.

B. The following surfaces shall not be painted:
   1. Stainless steel.
   2. Aluminum and other non-ferrous metals, unless specifically noted otherwise.
   3. Packing glands and other non-adjustable parts.
   4. Nameplates.
   5. Flexible connectors.

C. All colors will be selected by the Owner from color charts submitted by the pumping unit manufacturer.

D. Surface preparation of ferrous metal surfaces shall be per SSPC-SP6 / NACE No.3 and cleaned of all grease, oil, and debris using required solvents.

E. Coating system shall consist of 3.0 to 4.0 mil DFT coat of manufacturer's standard epoxy primer and a minimum of two 3.0 to 4.0 mil DFT coats of manufacturer's standard epoxy finish.

2.7 SOURCE QUALITY CONTROL

A. Factory Testing
   1. Pumping units shall be factory tested per the requirements of Section 43 21 00, except that pumps shall be tested at five (5) equally spaced speeds between minimum and maximum speed. This will be a non-witness test. All pumps shall be tested.
   2. Testing shall conform to the latest requirements of the Test Code of the Hydraulic Institute Standards.
   3. Hydrostatic testing shall be per Hydraulic Institute.
   4. Owner and Engineer acceptance required prior to shipment.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation of equipment specified herein shall be in strict accordance with the Contract Documents and requirements of the manufacturer's written instructions and Shop Drawings. It is the Contractor's responsibility to verify the accuracy of all necessary dimensions in the field to ensure compatibility with the Specifications and equipment.

B. Field vibration testing is required for equipment furnished under this Section. This testing shall be as specified in Section 01 61 03 and shall be performed by the Contractor.

C. See Sections 01 61 03 and 43 21 00 for additional general requirements.

D. Pump and motor baseframe shall be leveled to within 0.001 IN per FT of span, or such closer tolerance required by the manufacturer prior to grouting, using a machinists level. After grout curing, tolerance to remain within 0.002 IN per FT or such closer tolerance required by the manufacturer.

3.2 FIELD QUALITY CONTROL

A. See Section 01 75 00 for general starting and adjusting requirements.

B. Construction sequencing requirements apply to the work in this section. Separate startup, commissioning, and acceptance are required for pumps at Plant II Secondary Clarifier Nos. 1-4. Refer to Section 01 14 16 for additional requirements.

C. Manufacturer shall provide at a minimum the following field service quantities or such larger quantity as required to provide the indicated field services:
   1. One Trip of One onsite day for installation supervision
   2. Three Trips each One onsite day for startup and commissioning
   3. One Trip of One onsite day for Owner staff training.

D.

E. Employ and pay for services of equipment manufacturer's field service representative(s) to:
   1. Inspect equipment covered by these Specifications.
   2. Supervise adjustments and installation checks.
   3. Provide test equipment, tools, and instruments necessary to accomplish equipment testing.
   4. Conduct start-up of equipment and perform operational checks.
   5. Provide Owner with a written statement that manufacturer's equipment has been installed properly, has been started up, and is ready for operation by Owner's personnel.

F. Provide operations and maintenance training as specified in Section 01 78 23.

G. Contractor to coordinate field service work with the manufacturer's service representative, Owner, and Engineer prior to initiating such work.

END OF SECTION

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SECTION 46 41 34
VERTICAL SHAFT MIXERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Vertical shaft mixers and appurtenances.

B. Related Sections include but are not necessarily limited to:
   1. Section 01 33 00 – Submittal Procedures.
   2. Section 01 61 03 – Equipment – Basic Requirements.
   3. Section 01 65 00 – Product Delivery Requirements.
   4. Section 01 66 00 – Product Storage and Handling Requirements.
   5. Section 01 75 00 – Checkout and Start-Up Procedures .
   6. Section 01 78 23 – Operation and Maintenance Data .
   7. Section 01 78 36 – Warranties .

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Bearing Manufacturers Association (ABMA):
      a. 9, Load Ratings and Fatigue Life for Ball Bearings
      b. 11, Load Ratings and Fatigue Life for Roller Bearings.
   2. American Gear Manufacturers Association (AGMA):
      a. 2000-A88, Gear Classification and Inspection Handbook - Tolerances and Measuring Methods for Unassembled Spur and Helical Gears.
   3. Deutsches Institut fur Normung (DIN-ISO)
   4. American Iron and Steel Institute (AISI).

B. Responsibilities and Qualifications:
   1. A single manufacturer shall provide all components as a complete integrated package to ensure proper coordination, compatibility, and operation of the equipment.
   2. Mixers shall be Manufacturer's standard product and only modified as necessary to comply with the drawings, specifications, and specified service conditions.
   3. Manufacturers shall have a minimum of 15 years' experience designing mixer of the type specified herein.
   4. Manufacturer shall provide a list of names and dates of installations for verification by the Engineer.
   5. All welding shall be performed in accordance with AWS D1.1.
   6. The Contract Documents represent the minimum acceptable standards for equipment for this project. All equipment will conform fully in every respect to the requirements of the respective parts and sections of these drawings and specifications.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. See Section 01 61 03.
   3. Product technical data:
      a. Provide calculations supporting all shaft and impeller design criteria (stresses and critical speed).
      b. Submit all loadings, torques and forces imposed by operating equipment.
      c. Pumping capacity and water horsepower at delivered power.

B. Contract Closeout Information:

1. Operation and Maintenance Data:
    a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

1.4 SYSTEM DESCRIPTION

A. Mixers will be installed in the anoxic zones of the aeration basins as shown on the Drawings.

A. Water temperature: 45 to 86 DegF.

B. Ambient temperature: 5 to 115 DegF.

1.5 DELIVERY, STORAGE AND HANDLING

A. See Sections 01 65 00 and 01 66 00.

B. Equipment shall be stored by Contractor until ready to install.

C. Equipment shall be stored and protected in accordance with the Manufacturers' recommendations.

1.6 WARRANTY

A. An 18 month warranty shall be provided by the manufacturer. The warranty date shall start at the time of substantial completion. Warranty shall cover full cost of mixer failure diagnosis and testing and mixer replacement/repair. See Section 01 78 36 for additional requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Mixers:
    a. INVENT Environmental Technologies.
    b. Pre-approved equal.
2. Gearboxes:
    a. Nord.
    b. SEW Eurodrive.
    c. Approved equal.

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

A. Performance Requirements:
1. Aeration Basin Nos. 5-8 Anoxic Zones 1-2 (MX-2151, MX-2152, MX-2161, MX-2162, MX-2171, MX-2172, MX-2181, MX-2182)
    a. Quantity: 8
    b. Velocity gradient (G): 51 Seconds -1.
    c. Design speed: 21.9 rpm.
    d. Impeller diameter: 98.4 IN.
    e. Motor size (maximum): 3.0 HP.
    f. Drive type: Constant speed, top-mounted drive with parallel shaft helical gear.
    g. Shaft length: 232.4 IN

2.3 MATERIALS

A. Mixers:
1. Mixer housing: Fabricated carbon steel or cast iron, powder coated; or aluminum.
2. Impeller shaft: Fiberglass reinforced plastic (FRP).
3. Impeller: Evo7 (high-strength, impact resistant thermoplastic).
4. Mounting base: Fabricated carbon steel, powder coated.
5. Bolts, nuts, and connection accessories: Type 316 stainless steel.

6. Anchor bolts and hardware: Type 316 stainless steel.

2.4 FABRICATION AND MANUFACTURE

A. Speed Reducer:
   1. Designed and rated per AGMA standards with AGMA nameplate or DIN ISO.
   2. Type:
      a. Parallel shaft helical gear drive.
      b. Totally enclosed.
      c. Worm gears not acceptable.
   3. Service factor: 2.0 of nameplate on motor.
   4. Gearing:
      a. AGMA quality number 10 or better AGMA 2000-A88, or
      b. DIN ISO No. 7 (DIN ISO 3990_1970) of better.
   5. Bearing design:
      a. Antifriction type, ball or roller, oil or grease lubricated.
      b. All shaft bearings located outside of tankage.
      c. All bearings minimum ABMA L-10 life of 100,000 HRS at full motor nameplate HP at design speed.
   6. Lubrication:
      a. Mineral oil lubricated.
      b. Positive lubrication of all gears and bearings.
      c. Sight glass.
      d. Adequate separation between oil and grease lubricated parts.
      e. Oil breather located above possible oil foam level.
   7. Reducer agitator and output shaft and impeller shaft.
      a. Mixer shaft oversized for direct, rigid coupling to impeller shaft below reducer.
      b. Maximum indicated run-out at lower end of impeller shaft not to exceed 1/8 IN for every 10 FT of overhang, as measured when turning by hand.
      c. Maximum stress: 8,000 PSI at maximum load.

B. Impeller Body:
   1. Body shall be hyperboloid design.
   2. Shaft impeller system design shall ensure operating speed does not exceed 70 percent of its first critical speed.

C. Mounting Base:
   1. Base shall consist of a gear base plate mounted in rubber buffers connected permanently to the concrete mounting deck with a bolted connection. Provide threaded bolts for unit leveling.
   2. Rubber buffers shall absorb start-up torque and prevent transfer of vibration to concrete deck.

D. Motor:
   1. Motor and all furnished electrical appurtenances shall be rated for installation in a Class I, Division 2, Group D hazardous classified area.
   2. TEFC as specified in Section 01 61 03.
   3. Inverter duty rated for use for a variable frequency drive – 4:1 minimum constant torque turndown rating.
   4. CSA rated motors are acceptable in lieu of UL listed.

E. Anchor Bolts:
   1. Anchor bolts and hardware shall be designed by the equipment manufacturer and supplied by the Contractor.

2.5 FINISHES

A. For non-stainless steel and non-aluminum metal surfaces, prepare, and prime, and finish coat with two finish coats of paint system as follows.

1. One coat 3.0 to 4.0 mils Dry Film Thickness (DFT) of Tnemec N69 Hi-Build Epoxoline II, Sherwin Williams Macropoxy 646, equal by Carboline Protective Coatings, or equal by PPG.
2. Top coat 2.5 to 3.5 mils DFT of Tnemec 1095 Endurashield, Sherwin Williams Acrolon Ultro, equal by Carboline Protective Coatings, or equal by PPG.
3. Surface Preparation SSPC-SP 6/ NACE No. 3 or better if recommended by paint manufacturer.
4. Comply with all instructions and recommendations of paint manufacturer.
5. Installing Contractor shall coordinate compatibility of specified paint system with manufacturer furnished coatings and provide a compatible tie coat, if required.

B. Machined surfaces that are not painted shall be protected by coating with the manufacturer's recommended corrosive protective compound.

2.6 MAINTENANCE MATERIALS AND SPARE PARTS

A. Manufacturer shall provide the following spare parts and maintenance tools:
1. One set of rubber buffers **per unit**.
2. One set of gearbox shaft seals **per unit**.
3. One shaft holder for each shaft diameter provided to allow gearbox removal with impeller suspended in place.

2.7 SOURCE QUALITY CONTROL

A. Mixers shall be given the manufacturer's standard quality control inspections and tests to ensure the quality of materials used in the manufacture of the units and workmanship to conform to the specified requirements and highest industry practice, the units operate properly, and the units have been correctly and adequately prepared for shipment, long-term storage and operation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units in accordance with manufacturer's recommendations.

B. Comply with Section 01 61 03.

3.2 FIELD QUALITY CONTROL

A. See Section 01 75 00 for general starting and adjusting requirements.

B. Manufacturer shall provide at a minimum the following field service quantities or such larger quantity as required to provide the indicated field services:
1. One Trip of One onsite day for installation supervision
2. Two Trips each One onsite day for startup and commissioning
3. One Trip of One onsite day for Owner staff training.

C.

D. Provide services of equipment manufacturer's field service representative(s) to:
1. Inspect equipment covered by these Specifications.
2. Supervise adjustments and installation checks.
3. Provide test equipment, tools, and instruments necessary to accomplish equipment testing.
4. Conduct start-up of equipment and perform operational checks.
5. Provide Owner with a written statement that manufacturer's equipment has been installed properly, has been started up, and is ready for operation by Owner's personnel.

E. Manufacturer shall provide operations and maintenance training as specified in Section 01 79 23.

F. Contractor to coordinate field service work with the manufacturer's service representative, Owner, and Engineer prior to initiating such work.

SECTION 46 51 33
FINE BUBBLE DIFFUSED AERATION SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Requirements for the design, fabrication, and installation of fine bubble aeration equipment in Plant II Aeration Basin Nos. 5-8 to satisfy process oxygen requirements and maintain solids suspension. System shall include but is not limited to:
      a. Fine-bubble membrane diffusers.
      b. Distribution and manifold piping including drop pipes as indicated on the Drawings.
      c. Adjustable pipe supports.
      d. Moisture blow-offs.
      e. Cooling loops (if required).
      f. Air piping expansion provisions.
      g. Anchor bolts and expansion anchors.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 01 61 03 - Equipment - Basic Requirements.
   4. Section 05 50 00 - Metal Fabrications.
   5. Section 40 05 00 - Pipe and Pipe Fittings - Basic Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Society of Civil Engineers (ASCE):
      a. 18-96, Standard Guidelines for In-Process Oxygen Transfer Testing.
   2. American Society of Civil Engineers/Environmental and Water Resources Institute (ASCE/EWRI):
      a. 2-06, Measurement of Oxygen Transfer in Clean Water.
   3. American Society for Testing and Materials (ASTM):
      a. A240, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
      b. A312, Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipe.
      c. A380, Standard Practice of Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
      d. A530, Standard Specification for General Requirements for Specialized Carbon and Alloy Steel Pipe.
      e. A554, Standard Specification for Welded Stainless Steel Mechanical Tubing.
      f. A774, Standard Specification for As-welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperature.
      g. A778, Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products.
      h. D412, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension.
      i. D573, Standard Test Method for Rubber-Deterioration in an Air Oven.
      j. D1171, Standard Test Method for Rubber Deterioration-Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens).
      k. D1784, Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
      l. D1785, Standard Specification for Poly (Vinyl Chloride) PVC Plastic Pipe, Schedules 40, 80 and 120.

m. D2240, Standard Test Method for Rubber Property-Durometer Hardness.
n. D2241, Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Related Pipe (SDR Series).
o. D2466, Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
p. D2467, Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
q. D2855, Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
r. D3034, Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
s. D3915, Standard Specification for Poly (Vinyl Chloride) (PVC) and Related Plastic Pipe and Fitting Compounds for Pressure Applications.
t. F438, Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40.
u. F441, Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.

B. Qualifications:
1. All equipment shall be supplied by a single Manufacturer or Supplier.
2. Manufacturer of fine bubble membrane disc diffusers shall have a minimum of 10 installations in operation for more than three years.
3. Supplier to provide with first submittal a list of 10 membrane disk installations that have operated for a minimum of three years continuously.

1.3 SUBMITTALS

A. Shop Drawings:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Product technical data including:
a. Acknowledgement that products submitted meet requirements of standards referenced.
b. Manufacturer's installation instructions.
3. Fabrication and/or layout drawings.
a. Diffusers:
1) Manufacturer.
2) Type and model.
3) Dimensional information.
4) Stable airflow rate range and corresponding headloss.
5) Oxygen transfer efficiency (clear water) for design conditions.
6) Mounting arrangement.
7) Mounting instructions.
8) Number and distribution per basin.
9) Acceptable air flow range per diffuser.
10) Diffuser layout drawing.
11) Engineering calculations.
a) Documenting number of diffusers.
b) Document SOTR achieved.
c) Document mixing achieved.
d) Document uniform: Distribution of air throughout each drop leg basin grid so that the air flow per diffuser does not vary by more than 5 PCT at any specified air flow rate.
b. Air distribution system:
1) Dimensional information including size and spacing of all piping, Drawings to scale showing installation in existing or new aeration basins.
2) Materials.
3) Joint restraint.

4) Expansion compensation.
5) Moisture blow-off details.
6) Pipe support details including layout for laterals, manifolds, and headers.
7) Installation instructions.
8) Engineering calculations.
    a) Thrusts due to pressurized pipes.
    b) Forces due to expansion of pipes.
    c) Forces on pressurized pipe due to sudden loss of air pressure.
    d) Temperature of pipe walls for site conditions in air distribution piping.
    e) Headloss calculations.
        (1) Diffusers to top of drop leg over the air flow range specified.
    f) Performance curves.
        (1) SOTE versus diffuser air flow over the air flow range specified.
    g) Thermal dissipation calculations:
        (1) Manufacturer shall identify recommended temperature rating criteria for proposed furnished aeration system materials.
        (2) Furnish thermal dissipation calculations demonstrating that proposed piping including any cooling loops adequately reduces air temperature to be compatible with proposed materials. If multiple materials are used, furnish calculations that demonstrate for each material.

B. Contract Closeout Information:
    1. Operation and Maintenance Data:
        a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

C. Informational Submittals:
    1. See Specification Section 01 78 23 for requirements for the mechanics and administration of the submittal process.
    2. Performance test data (results and reports):
        a. Including but not limited to:
            1) Certified oxygen transfer tests.
            2) Quality control tests.
            3) Uniformity test.
            4) Strength testing.
            5) Chemical resistance data.
        b. Reports signed by registered professional engineer.
        c. Reports to include:
            1) Description of test facility.
            2) Description of sampling procedures.
            3) Engineering calculations.
            4) Summary of test results.
    3. Warranty.
    4. Certificate of Proper Installation:
        a. Include benchmark pressure at the connection drop leg to the airflow control butterfly valve.
        b. Determine benchmark pressure as specified in the FIELD TESTING Article in PART 3 of this Specification Section.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect the diffusers when exposed to the elements before being placed into operation per manufacturer's recommendations.

1.5 WARRANTY

A. All aeration equipment components and accessories to be free of defects in materials, workmanship, and installation for a period of five (5) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:1
   1. Xylem Sanitaire.
   2. Nexom – Environmental Dynamics International (EDI).

STAMFORD SCIENTIFIC, INC. (SSI AERATION).

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

A. Design Criteria:
   1. General Criteria

CRITERIA	Aeration Basins No. 5-8
Maximum air supply discharge pressure, psig	10.5
Minimum dissolved oxygen concentration, mg/L	2.0
Minimum standard oxygen transfer efficiency, %	31

   2. Aeration Basin Nos. 5-8 Elevations

CRITERIA	Aeration Basins No. 5-8
Minimum water surface elevation, ft	474.75
Maximum water surface elevation, ft	475.1
Floor slab elevation, ft	454.6

   3. Aeration Basins No. 5-8 Approximate Floor Dimensions and Surface Area:

ZONE	FLOOR AREA (SQ FT)	MIN SOTR (LBS O2/DAY)	MIN AIR FLOW (SCFM)	PEAK SOTR (LBS O2/DAY)	PEAK AIR FLOW (SCFM)	NUMBER OF DROPLEGS	DROPLEG DIAMETER
Ox-5-1	4,125	4,400	492	25,710	2,850	1	14
Ox-5-2	4,125	4,400	492	15,430	1,710	1	12
Ox-5-3	4,125	4,400	492	10,290	1,140	1	10
Ox-6-1	4,125	4,400	492	25,710	2,850	1	14
Ox-6-2	4,125	4,400	492	15,430	1,710	1	12
Ox-6-3	4,125	4,400	492	10,290	1,140	1	10
Ox-7-1	4,125	4,400	492	25,710	2,850	1	14
Ox-7-2	4,125	4,400	492	15,430	1,710	1	12
Ox-7-3	4,125	4,400	492	10,290	1,140	1	10
Ox-8-1	4,125	4,400	492	25,710	2,850	1	14

ZONE	FLOOR AREA (SQ FT)	MIN SOTR (LBS O2/DAY)	MIN AIR FLOW (SCFM)	PEAK SOTR (LBS O2/DAY)	PEAK AIR FLOW (SCFM)	NUMBER OF DROPLEGS	DROPLEG DIAMETER
Ox-8-2	4,125	4,400	492	15,430	1,710	1	12
Ox-8-3	4,125	4,400	492	10,290	1,140	1	10

4. Design Temperatures

CRITERIA	Aeration Basins No. 5-8
Minimum Temperature of Mixed Liquor, deg C	17.0
Maximum Temperature of Mixed Liquor, deg C	26.0
Ambient Temperature (Summer), deg C	40.6
Ambient Temperature (Winter), deg C	-9.4
Discharge Air Temperature at top of dropleg with Peak Air Flow, deg C	124

B. Diffusers shall be arranged in such a manner that each diffuser shall be easily accessible for manual removal and replacement and for in-place manual cleaning of the diffusers. The rows shall also provide a clear walking space of a minimum of 12 IN between the laterals or diffusers. Maximum spacing between diffusers on lateral pipes and laterals shall be based on the Manufacturer's recommendations to meet the requirement of this Section and to prevent deposition of solids.

C. Distribution piping shall be designed to carry at least 150 percent of air flow rate.

D. Install sufficient diffusers to meet the minimum oxygen demand at the low flow condition, while maintaining 0.5 SCFM per diffuser.
   1. Install additional diffusers to meet the maximum flow, plus an additional 10 PCT blank diffusers.
   2. Space diffuser "blanks" such that uniform aeration and additional mixing of the basin contents is maintained when additional diffusers are added.
   3. For each diffuser blank, furnish diffuser element holder mounted on air distribution header but with PVC, CPVC, stainless steel, or rubber plug in place of diffuser.

E. Where required to protect piping and diffuser materials, furnish submerged cooling loops within the dropleg piping as required to lower aeration air temperature. It is acceptable to use CPVC instead of PVC materials in order to reduce cooling requirements. Manufacturer shall include cooling loops in verifying the proposed system meets the specified available pressure at top of dropleg.

2.3 MATERIALS

A. Membrane Diffusers:
   1. Diffusers shall be EPDM synthetic rubber compound with precision die formed slits.
   2. Add carbon black to the material for resistance to ultraviolet light.
   3. Produce diffusers free of tears, voids, bubbles, creases, or other structural defects.
   4. Furnish diffuser material to meet the following:
      a. Base polymer: EPDM, ASTM D573.
      b. UV resistance: Carbon black.
      c. Specific gravity: 1.25 or less.

d. Durometer: Minimum 58 durometer, +5 PCT, ASTM D2240.
e. Modulus of elasticity: 425 PSI, ASTM D412.
f. Ozone resistance (72 HRS: 104 DEGF, 50 PPHM): No cracks at 2X magnification, ASTM D1171, Test A.
g. Tensile strength: 1200 PSI, ASTM D412.
h. Elongation percentage:
    1) Retained 70 HRS at 212 DEGF: 75 PCT maximum, ASTM D573.
    2) Minimum at break: 350 PCT, ASTM D412.

5. Diffuser holders and support plates shall be PVC, CPVC, or glass fiber reinforced polypropylene (GFPP).

B. Air Supply Drop Pipes
1. Pipe and fittings shall be Schedule 10, Type 316 stainless steel.
2. Stainless Steel Pipe and Fittings
    a. All welded parts and assemblies shall be fabricated from sheets and plates with a No. 1 finish conforming to AISI 316L and ASTM A240.
    b. All non-welded parts and pieces shall be fabricated from sheets and plates conforming to ANSI 316 and ASTM A240
    c. Stainless steel piping shall be fabricated in accordance with ASTM A778 and stainless steel fittings in accordance with ASTM A774.

C. Air Distribution Manifolds and Laterals
1. Air distribution manifold pipe and fittings shall be Schedule 40 PVC or Schedule 40 CPVC.
2. Air distribution lateral pipe and fittings shall be Schedule 40 PVC or Schedule 40 CPVC.
3. PVC Pipe and Accessories
    a. All PVC moldings and extrusions shall be produced from PVC compound conforming to ASTM D1784, compound cell classification 12454-B with a minimum tensile strength of 7,000 psi.
    b. The manufacturer shall blend PVC resins and limit number of fillers to achieve a minimum "K" value of 58 for fittings and a minimum "K" value of 64 for pipes.
    c. PVC pipe shall meet the requirements of ASTM D1785.
    d. PVC fittings shall be provided as necessary and conforming to ASTM D2466 (Schedule 40) and ASTM D2467 (Schedule 40).
    e. Two parts by weight of titanium dioxide per 100 parts of resin shall be added to PVC compounds for air distribution headers, diffuser element holders and retainer rings to minimize ultraviolet light degradation.
    f. All PVC joints shall be solvent welded in the factory in accordance with ASTM D2855 except edges need not be chamfered.
    g. Solvent welding shall be with solvent cements specifically formulated for use with PVC.
4. CPVC Pipe and Accessories
    a. All CPVC moldings and extrusions shall be produced from CPVC compound conforming to ASTM D1784, compound cell classification 22454-B with a minimum tensile strength of 7,000 psi.
    b. The manufacturer shall blend CPVC resins and limit number of fillers to achieve a minimum "K" value of 58 for fittings and a minimum "K" value of 64 for pipes.
    c. CPVC pipe shall meet the requirements of ASTM F441.
    d. CPVC fittings shall be provided as necessary and conforming to ASTM F438 (Schedule 40).
    e. Two parts by weight of titanium dioxide per 100 parts of resin shall be added to CPVC compounds for air distribution headers, diffuser element holders and retainer rings to minimize ultraviolet light degradation.
    f. All CPVC joints shall be solvent welded in the factory in accordance with ASTM D2855 except edges need not be chamfered.
    g. Solvent welding shall be with solvent cements specifically formulated for use with CPVC.

D. Pipe Supports and Accessories
   1. Drop pipe to manifold connection couplings: Type 316 stainless steel.
   2. Air distribution manifold supports: Type 316 stainless steel.
   3. Air distribution lateral supports: Type 316 stainless steel.

E. Moisture Blow-off Assemblies
   1. Drain pipe: Schedule 40 PVC or Schedule 40 CPVC.
   2. Ball valves: PVC or CPVC, meeting requirements of Section 40 05 63.

F. Anchor Bolts and Hardware
   1. Pipe support anchors: Type 316 stainless steel.
   2. Flange hardware (submerged service): Type 316 stainless steel.
   3. Flange hardware (exposed service): Type 316 stainless steel.

2.4 FABRICATION

A. Membrane Diffusers and Holders
   1. Diffusers shall be circular, 9 IN diameter.
   2. Furnish diffuser assemblies consisting of a diffuser membrane with integral O-ring gasket, diffuser holder, air flow control orifice and retaining device.
   3. Furnish diffuser element holders with an air plenum chamber below the diffuser support plate. Provide a mechanism to attach the diffuser to the holder.
      a. Element holders shall provide complete peripheral edge support for the membrane diffuser element.
      b. Solvent weld element holders to the distribution laterals in the factory to resist the following torque values.
         1) About polar axis of holder: 150 ft-lbs.
         2) About longitudinal axis of holder: 100 ft-lbs.
   4. Furnish a retaining device to securely hold and seal the membrane diffuser to the holder.
      a. Design diffuser assembly and retaining device to prevent air escape at the diffuser element-holder interface.
      b. Provide a method to vary the applied sealing force between the holder and membrane diffuser. Sealing method or retaining device shall generate a minimum of 50 lbs/in of circumference of the holder to provide a long-term positive seal and prevent air escape through the active area of the diffuser membrane.
   5. Screw on retainer rings shall be provided with a positive O-ring seat and a minimum of 2-1/2 complete threads for engagement. Threads shall have a minimum cross section of 1/8 IN.
   6. Manufacture each diffuser and holder assembly with an air flow control orifice of a size that will ensure that air distribution throughout each grid will be evenly distributed at the ranges of air flow specified herein. The air release of the orifice shall be such that air entering the diffuser assembly shall be distributed evenly under the horizontal surface of the diffuser element. Orifice size shall also result in system head losses that meet these requirements.
   7. Furnish the number of disc shaped diffuser assemblies required to supply the total air flows and oxygen transfer as required to meet the level of performance specified herein.
   8. Furnish diffuser membranes with uniform distribution of air bubble release across the active surface of the diffuser element when submerged in water.
   9. Furnish diffuser membranes to meet or exceed the following criteria:
      a. Membrane shall collapse and seal when aeration system air is turned off.
      b. Membrane shall be able to collapse onto support base when air is not being diffused.

B. Aeration Piping
   1. General
      a. Provide a diffused aeration piping system including air distribution manifold and laterals to distribute air from the aeration air supply pipe (supplied by others) to the fine bubble diffusers.
      b. Diffused aeration piping shall be provided complete with all valves, fittings, specials, flanges, couplings, expansion joints, slip joints, anchors, gaskets, bolts and nuts, pipe

supports, end caps, connections, appurtenances, and accessories which are required for proper installation and functioning of the diffused aeration system.

2. Drop Pipes
   a. A dropleg pipe shall be provided to connect each air distribution manifold to the air supply header. Connection to the air supply header shall be by an ANSI B16.1 150 LB flat-face flange. Connection to the stainless steel drop pipe shall be with a bolted band-style coupling. See Drawings for size of each stainless steel drop pipe connection.
3. Air Distribution Manifolds
   a. Manifolds shall be provided perpendicular to the air distribution laterals.
   b. Distribution manifolds shall be fabricated in sections up to 20 FT in length, jointed with drilled flanged and gaskets or flexible coupling.
   c. Distribution manifolds shall be provided with flanged or flexible coupling connections to distribution laterals.
   d. Distribution manifolds shall be provided with flexible couplings, expansion joints, pipe supports, etc, as required for alignment of the system to meet expansion/contraction under the temperature condition specified in Paragraph 1.06.D above.
   e. Each manifold shall be supported by a minimum of two stainless steel supports. Maximum spacing between supports shall not exceed 8 FT.
4. Air Distribution Laterals
   a. The air distribution laterals shall be fabricated in sections up to 25 FT in length. Sections of distribution laterals shall be jointed with fixed joints or expansion joints.
   b. Distribution laterals shall be fabricated with diffuser element holders/connectors suitably connected at the factory to the lateral.
   c. Each section of distribution lateral shall be supported with a minimum of two supports. Maximum spacing between supports shall not exceed 7 FT, 6 IN.
      1) Distribution lateral supports shall be located at approximately ¼ span to coincide with the zero bending moment point.
      2) Each distribution lateral section shall be anchored with only one fixing support to prevent longitudinal and rotational movement of the lateral at the fixing support with a positive clamping device. Anchors that rely on friction will be unacceptable.
      3) Intermediate distribution lateral supports, or guides, shall allow longitudinal movement of the lateral section to prevent stress buildup in the lateral due to thermal expansion/contraction forces. Guides that clamp or grip the lateral will be acceptable.
      4) An expansion joint as specified herein for each distribution lateral shall be provided between fixing supports to allow longitudinal movement to prevent stress buildup in the lateral due to thermal expansion/contraction forces over the temperature range specified herein.

C. Air Piping Supports
   1. Manifold supports
      a. Include manifold hold downstrap (U-bolt or equal), cross-tree and supporting structure.
      b. Supports to be adjustable to allow the diffuser grid to be installed at the same level throughout the basins.
      c. Stands shall be designed to resist the following uplift without exceeding 24,000 psi design stress.

Manifold Diameter (IN)	Uplift Force Per Support (LBS)
6 and 8	325
10 and 12	543

      d. Supports shall be provided with a mechanism to provide for plus or minus 2 IN vertical and ½ IN lateral adjustment for alignment of the manifold in the field.
   2. Distribution lateral supports

a. Fixed supports shall consist of a hold-down mechanism and self-limiting clamp device.
   1) The hold-down mechanism and clamp shall provide a wide contoured bearing surface for the air distribution lateral.
   2) The clamping device shall positively grip the air distribution lateral when tight and be self-limiting to prevent over-stressing the lateral if the clamp is over-tightened.
b. Intermediate guide supports shall consist of a self-limiting hold-down and sliding mechanism.
   1) The hold-down and sliding mechanism shall provide a contoured bearing surface with chamfered leading edges to minimize binding of the air distribution lateral.
   2) The sliding mechanism shall provide minimum resistance to movement of the air distribution lateral under full buoyant uplift load. The mechanism shall provide 1/8-in clearance around the header and be self-limiting if the mechanism is over-tightened.
   3) A maximum horizontal thrust of 20 lbs or less shall be sufficient to initiate movement of the lateral relative to the mechanism under full buoyant uplift load.
c. Supports shall be provided with a mechanism to provide for plus or minus 1-1/2 IN vertical adjustment for alignment of the air distribution laterals in the field. The adjusting and aligning mechanism shall be infinitely adjustable within its limits to allow precise leveling of the air distribution laterals and diffuser assemblies to within plus or minus 1/8 IN of a common horizontal plane without removing the header from the support.
d. Supports shall be anchored to the concrete basin floor with wedge or adhesive anchor bolts.
e. Each anchorage shall be designed to withstand at least 450 lbs of withdrawal force.

D. Moisture Blow-off Assemblies
1. Provide two drain line, sump, and air lift purge systems for each grid to drain the entire submerged fixed grid fine bubble diffuser aeration piping.
   a. Furnish two drain lines, sump, and air-lift purge systems (one for each side of the grid) to drain the entire submerged aeration piping system for each aeration grid. The drain lines shall be perpendicular to, at the same elevation and of the same diameter as the lateral piping. At the option of the manufacturer, the drain lines may be located either at each end of the grid or at any point further distant than 15 FT from the manifold.
   b. The sump shall be integral with the drain line and its bottom elevation shall be lower than the invert of the air distribution headers and drain line.
   c. Connect drain sump to ¾ IN diameter airlift line extending from the drain line invert elevation. Extend this airlift line to a point above the tank water level and terminate with a horizontally mounted ball valve at elevation 1-FT above the top of the aeration basin walkway. Provide handles for operation of ball drain valves from walkway. Air lift line shall utilize a flexible connection between the drain sump and the vertical pipe run at the aeration tank wall.
2. System utilizing drain lines at the ends of the aeration grids shall be provided with a combination support/thrust anchor at each header-drain line connection to prevent joint separation. Drain lines shall meet expansion and contraction requirements specified herein. Expansion joints shall meet lateral pipe expansion joint requirements.

E. Expansion Joints
1. An expansion joint shall be provided between each section of air distribution lateral restrained by fixing supports to prevent thermally induced stresses due to expansion and contraction over the temperature range specified herein.
2. Expansion joints shall be of PVC consisting of a plain end, O-ring, follower flange and expansion barrel to accommodate movement over the temperature ranges specified herein. Provide positive means to prevent joint blow-apart.

2.5 SPARE PARTS

A. Furnish, tag and box for shipment and storage the following spare parts:

1. Diffusers:
   a. 50 extra diffuser assemblies consisting of a diffuser membrane with integral O-ring gasket, diffuser holder, air flow control orifice and retaining device
   b. 10 PCT extra diffusers, including gaskets.
   c. 10 PCT extra diffuser tap plugs.
2. One set of special tools required to assemble/disassemble the diffusers and grid piping.

2.6 SHOP CLEANING AND PICKLING

A. All stainless steel piping and fittings shall be immersion pickled subsequent to manufacturing and fabrication operations and prior to shipping in accordance with ASTM A380.
   1. Pickling solution of 6-10 PCT nitric acid and 3-4 PCT hydrofluoric acid.
   2. Temperature and exact concentrations to be such only a modest etch is produced but all oxidation and ferrous contamination is removed from metal surface.
   3. All pickling solution residues are to be neutralized after pickling.

2.7 SHOP TESTING

A. Shop Oxygen Transfer Test:
   1. Conduct a performance test to demonstrate capability of the aeration equipment to meet the specified oxygen transfer requirements.
      a. The test will be witnessed by a representative of the Owner.
   2. Base all tests on the following criteria:
      a. A minimum of three tests for the average and peak conditions in complete accordance with ASCE/EWRI 2-06 normalized to 1000 MG/l TDS for each aerobic zone.
      b. Conduct tests by an aeration testing firm in a full scale aeration test tank (minimum of 200 SQFT) at the specified submergence and water depth with a diffuser density equivalent to the specified tank configuration.
         1) Diffuser density is defined as the ratio of the total tank surface area to the total active diffuser surface area.
      c. Conduct shop test with air rate and mass rate of oxygen transfer directly proportional to the ratio of the shop test tank volume and the design tank volume.
      d. Plot of standard condition pounds of oxygen transferred per day per 1000 CUFT of tank volume versus standard condition cubic feet of air per minute per 1000 CUFT of tank volume: (LBS-O_2/day/1000 CUFT-tank) vs. (SCFM/1000 CUFT-tank).
         1) Standard conditions of oxygen transfer are defined as 68 DEGF, 1 atmosphere ambient pressure, clean water.
         2) Standard air is defined as 68 DEGF, 1 atmosphere, 36 PCT R.H., containing 23 percent oxygen by weight.
   3. Certify and stamp all tests by a Professional Engineer.
   4. Include all costs for testing (exclusive of witnesses' expenses) in the equipment price.
      a. All tests may be witnessed at Owner/Engineer option.
      b. Cost of travel and living expenses for Owner/Engineer to be paid by the Owner.
   5. Submit all test data from oxygen transfer tests for approval by the Engineer prior to manufacturing equipment.

PART 3 - EXECUTION

3.1 INSTALLATION

A. See Specification Section 01 61 03.

B. Install in compliance with manufacturer's instructions:
   1. Do not use power tools to secure orifice bolts, clamps, or retaining rings.
   2. Use calibrated torque wrenches that slip when set torque is exceeded.

C. Pipe Supports and Tie Downs:
   1. Sliding support: As required to compensate for expansion/contraction.

D. Diffuser Leveling:
   1. Installed within ±1/4 IN of common horizontal plane.
   2. Check installation elevation by filling basin to top of diffusers.
   3. Adjust diffuser elevations as required to achieve horizontal plane.

E. Cleaning:
   1. Clean all piping to remove visible dirt, dust, and other matter before starting system or installing diffusers.
   2. Do not use process air compressors for air cleaning.
   3. Air furnished by Contractor.

3.2 FIELD QUALITY CONTROL

A. Provide manufacturer's field services in accordance with Specification Section 01 75 00.
   1. For each basin or set of basins, provide Owner with a written Certificate of Proper Installation that manufacturer's equipment has been installed properly, has been started up, and is ready for operation by Owner's personnel.
   2. Include results of benchmark pressure test.
   3. Construction sequencing requirements apply to work in this section. Up to four (4) separate rounds of startup may be required for the 8 aeration basins.

3.3 TRAINING

A. Manufacturer shall provide on-site training of Owner's operations and maintenance staff in accordance with Specification Section 01 75 00.

3.4 FIELD TESTING

A. Contractor is to pay for all testing and remedial action.

B. Manufacturer shall provide at a minimum the following field service quantities or such larger quantity as required to provide the indicated field services:
   1. One Trip of One onsite day for installation supervision
   2. Two Trips each One onsite day for startup and commissioning
   3. One Trip of One onsite day for Owner staff training.

C. Quality Control Tests:
   1. Perform the quality control tests described below by the equipment supplier.
      a. Submit detailed reports on all test results to the Engineer for acceptance prior to shipment.
   2. Unless otherwise specified, perform each test on a minimum total sample size of 40 diffusers selected at random from the total number of diffusers to be supplied.
      a. If diffuser production requires multiple batches, select, at random, an equal number of diffusers from each batch so that the total number of diffusers tested is not less than 40.
   3. For each quality control test, 95 PCT of the diffusers tested shall comply with the requirements of the test.
      a. If more than 5 PCT of the test sample fails to meet the requirements of the specific test, then the entire batch of diffusers shall be tested to ensure that 95 PCT of all diffusers meet the test requirements.

D. Uniformity Testing:
   1. Perform a uniformity test to demonstrate an even distribution of air bubbles when the diffusers are submerged.
      a. For the number of diffusers selected for the test, submerge the diffusers to a depth of 1 IN of clean tap water.
      b. Apply an initial air flow of 2.5 SCFM per diffuser for a period of five minutes and then reduce the air flow per diffuser in increments of 0.5 SCFM for a period of five minutes at each air flow rate to a minimum of 0.5 SCFM per diffuser.
      c. Visually observe and photograph the water surface to assure uniformity of air distribution.

2. Conduct the uniformity test with diffusers arranged and spaced in a pattern similar to that proposed for the installation.
    a. 95 PCT of the diffusers tested shall show a substantially even distribution of air at air flows from 0.5 to 2.0 SCFM per diffuser.

E. Benchmark Pressure Test.
1. Perform following benchmark pressure test for each basin.
    a. Temporarily provide and install calibrated 0-15 PSI pressure reading device with 0.05 PSI graduations located at connection of air line to butterfly valve.
    b. Adjust airflow to basin drop leg to equal 2.5 SCFM per installed diffuser as measured by flowmeter installed at drop leg.
    c. Measure and record:
        1) Drop leg pressure in psig.
        2) Airflow in SCFM using flowmeter port installed in air line.
        3) Ambient air temperature.
        4) Relative humidity.
        5) Barometric pressure.
        6) Basin liquid elevation.
2. Submit test results attesting in writing that values provided represent aeration system benchmark pressures.
    a. Benchmark pressures will be compared with subsequent like testing results by the Owner, at its discretion, with diffusers in a cleaned condition to determine compliance with warranty requirements.

END OF SECTION

LEWISVILLE

Deep Roots. Broad Wings. Bright Future.

ISSUED FOR BID

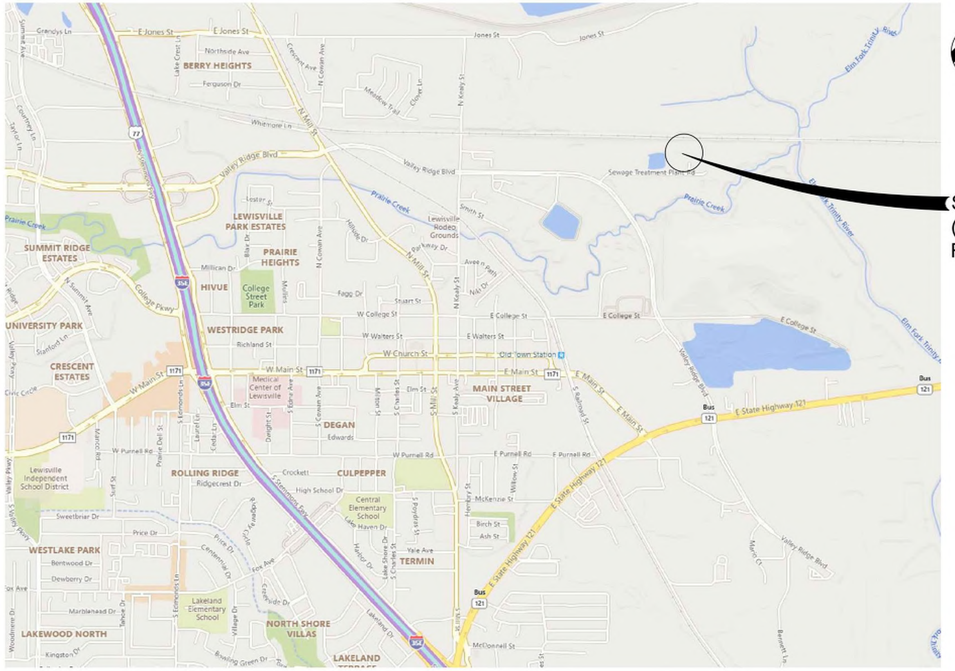
CITY OF LEWISVILLE

PRAIRIE CREEK WASTEWATER TREATMENT PLANT AERATION BASIN EXPANSION

COL PROJECT NO.: U2100
BID NO.: 26-02-C

HDR PROJECT NO.:
000000010342803

LEWISVILLE, TEXAS
OCTOBER 2025



VICINITY MAP
NTS

LOCATION MAP
NTS

IN ASSOCIATION WITH:

JQ Infrastructure
TBPE Firm No. F-7986

HDR
Texas P.E. Firm
Registration No. F-754

STATE OF TEXAS
JOEL R. CANTWELL
86209
LICENSED
PROFESSIONAL ENGINEER
10/16/2025

SHEET NAMING CONVENTION

AREA DESIGNATION

00	GENERAL AND CIVIL
09	PLANT I
10	HEADWORKS EFFLUENT STRUCTURE
11	AERATION BASIN SPLITTER STRUCTURE
20	PLANT II AERATION BASIN NO. 1-4
21	PLANT II AERATION BASIN NO. 5-8
22	SECONDARY CLARIFIER SPLITTER STRUCTURE
30	PLANT II BLOWER BUILDING (EXISTING)
31	PLANT II BLOWER BUILDING (PROPOSED)
40	RAS/WAS PUMP STATION
50	MISCELLANEOUS VAULTS AND STRUCTURES
60	PLANT III DEMOLITION
99	STANDARD DETAILS

DISCIPLINE DESIGNATOR & DISCIPLINE ORDER

G	GENERAL
V	SURVEYING/MAPPING
X	DEMOLITION
C	CIVIL
U	MULTI-DISCIPLINE
S	STRUCTURAL
A	ARCHITECTURAL
D	PROCESS
M	MECHANICAL (HVAC)
P	PLUMBING
E	ELECTRICAL
Y	INSTRUMENTATION

DRAWING TYPE DESIGNATOR

0	GENERAL (SYMBOLS, LEGENDS)
1	PLANS
2	ELEVATIONS
3	SECTIONS
4	LARGE SCALE VIEWS
5	DETAILS
6	SCHEDULES AND DIAGRAMS
8	PROFILES
9	3D REPRESENTATIONS

EXAMPLE

RAS/WAS PUMP STATION DEMOLITION PLAN ELECTRICAL

0	4					

AREA DESIGNATION

		E	X			

DISCIPLINE DESIGNATOR

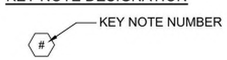
				1		

DRAWING TYPE DESIGNATOR

					0	1

DRAWING NUMBER

KEY NOTE DESIGNATION



GENERAL NOTES:

1. THIS IS A STANDARD SHEET SHOWING COMMON SYMBOLOGY. ALL SYMBOLS ARE NOT NECESSARILY USED ON THIS PROJECT.
2. SCREENING OR SHADING OF WORK IS USED TO INDICATE EXISTING COMPONENTS OR TO DE-EMPHASIZE PROPOSED IMPROVEMENTS TO HIGHLIGHT SELECTED TRADE WORK. REFER TO CONTEXT OF EACH SHEET FOR USAGE.

INDEX OF DRAWINGS

SHEET NO.	SHEET DESCRIPTION
	SERIES 00 - GENERAL AND CIVIL
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00G002	DRAWING INDEX AND SHEET NAMING CONVENTION (1 OF 2)
00G003	DRAWING INDEX AND SHEET NAMING CONVENTION (2 OF 2)
00G004	SYMBOLS AND LEGEND
00G005	NOTES
00G006	ABBREVIATIONS
00G007	GENERAL NOTES, LEGEND, & SYMBOLS
00G601	LIQUID PROCESS FLOW SCHEMATIC
00G602	HYDRAULIC PROFILE
00C001	EROSION AND SEDIMENTATION CONTROL NOTES
00C104I	EXISTING INTERIM SITE DEMOLITION PLAN
00C140I	OVERALL INTERIM GRADING AND DRAINAGE PLAN
00C101	OVERALL EXISTING SITE PLAN
00C102	SURVEY DATA
00C103	EROSION AND SEDIMENT CONTROL PLAN
00C104	FINAL SITE DEMOLITION PLAN
00C120	OVERALL SITE LAYOUT AND CONTROL PLAN
00C121	SITE LAYOUT AND CONTROL PLAN - AREA 1
00C122	SITE LAYOUT AND CONTROL PLAN - AREA 2
00C123	SITE LAYOUT AND CONTROL PLAN - AREA 3
00C124	SITE LAYOUT AND CONTROL PLAN - AREA 4
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00C144	GRADING AND DRAINAGE PLAN - AREA 4
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00C741	STORM DRAIN PROFILES
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00CX161	CIVIL - INTERIM YARD PIPING DEMO PLAN- AREA 1
00CX162	CIVIL - INTERIM YARD PIPING DEMO PLAN- AREA 2
00CX163	CIVIL - INTERIM YARD PIPING DEMO PLAN- AREA 3
00CX164	CIVIL - INTERIM YARD PIPING DEMO PLAN- AREA 4
00C160I	CIVIL - INTERIM OVERALL YARD PIPING PLAN
00C161I	CIVIL - INTERIM YARD PIPING PLAN - AREA 1
00C162I	CIVIL - INTERIM YARD PIPING PLAN - AREA 2
00C163I	CIVIL - INTERIM YARD PIPING PLAN - AREA 3
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00CX161	CIVIL - YARD PIPING DEMO PLAN - AREA 1
00CX162	CIVIL - YARD PIPING DEMO PLAN - AREA 2
00CX163	CIVIL - YARD PIPING DEMO PLAN - AREA 3
00CX164	CIVIL - YARD PIPING DEMO PLAN - AREA 4
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00C162	CIVIL - YARD PIPING PLAN - AREA 2
00C163	CIVIL - YARD PIPING PLAN - AREA 3
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Date 6/13/2025 5:53:39 PM

HDR
TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	T. PAULMANN
DRAWN BY	A. FREEMON
CHECKED BY	M. BOND
APPROVED BY	T. PAULMANN
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
THOMAS A. PAULMANN
128794
LICENSED
PROFESSIONAL ENGINEER
6/13/25

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

GENERAL
DRAWING INDEX
AND
SHEET NAMING CONVENTION (1 OF 2)

FILENAME	00G002.dwg	SHEET	00G002
SCALE	NO SCALE		

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99I502	INSTRUMENTATION II
99I503	INSTRUMENTATION III

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	T. PAULMANN
DRAWN BY	A. FREEMON
CHECKED BY	M. BOND
APPROVED BY	T. PAULMANN
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
THOMAS A. PAULMANN
128794
LICENSED
PROFESSIONAL ENGINEER
6/13/25

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

GENERAL
DRAWING INDEX
AND
SHEET NAMING CONVENTION (2 OF 2)

FILENAME	00G003.dwg
SCALE	NO SCALE

SHEET **00G003**

SITE PLAN SYMBOLOGY

- EMBANKMENT SLOPE
- 50.5 — CONTOUR
- VEGETATION (SIZE)
- CO — CLEAN OUT
- MH — MANHOLE
- MW — MONITORING WELL
- PZ — PIEZOMETER
- CB — STORM DRAIN CATCH BASIN
- UV — UTILITY VAULT
- PP — POWER POLE
- TP — TELEPHONE POLE
- FH — FIRE HYDRANT
- YH-X — YARD HYDRANT
- 75.5 — EXISTING SPOT ELEVATION
- 75.8 — FINISHED SPOT ELEVATION
- HORIZONTAL CP-X, CONTROL POINT
- BENCHMARK
- TH-"X" — IDENTIFICATION AND APPROXIMATE LOCATION OF SOIL TEST HOLE
- DOWNGUY
- EXTERIOR PADMOUNTED TRANSFORMER
- POLE MOUNTED TRANSFORMER
- Y — ELECTRICAL HANDHOLE OR Y - MHX OR HHX WHERE X INDICATES MANHOLE SEQUENCE NUMBER

NOTES:

1. UTILITIES THAT ARE SUSPENDED ABOVE GRADE ARE DESIGNATED BY THE PREFIX "OH".

- T — TELEPHONE LINE
- E — ELECTRIC LINE
- F — FIBER OPTIC
- C — COMMUNICATION
- HANDRAIL AND GUARDRAIL
- PIPELINE
- LARGE PIPELINE
- UTILITY BENEATH STRUCTURE
- RAILROAD
- DRAINAGE FLOW
- NATURAL WATERWAY
- X — X — CHAIN LINK FENCE
- X — X — FIELD FENCE
- PROPERTY LINE
- CENTERLINE
- RB — ROCK BERM
- SF — SILT FENCE
- EASEMENT
- LIMITS OF CONSTRUCTION
- ROW

EXISTING SITE SYMBOLOGY

SITE CONDITIONS LEGEND

CIRS	5/8" IRON ROD WITH CAP SET STAMPED "SPOONER 5922"
CIRF	IRON ROD WITH CAP FOUND
IRF	IRON ROD FOUND
XCF	"X" CUT FOUND
P.R.D.C.T.	PLAT RECORDS DENTON COUNTY, TEXAS

- CONTROL POINT
- PLANT BENCHMARK
- PROPERTY CORNER MARKER FOUND - AS NOTED
- POWER POLE
- GUY WIRE
- LIGHT POLE
- E — ELECTRIC PULL BOX
- E — ELECTRIC MANHOLE
- ELECTRIC BOX (PANEL)
- AC — AC COMPRESSOR UNIT
- TREE (AS DESCRIBED)
- W — WATER METER
- WATER VALVE
- WATER FAUCET
- FIRE HYDRANT
- S — SAN. SEWER MANHOLE
- SAN. SEWER CLEANOUT
- D — STORM DRAIN MANHOLE
- BOLLARD POST
- SIGN
- U — UTILITY RISER/BOX
- MH — UTILITY MANHOLE
- G — GROUNDING WELL
- OHE — OVERHEAD ELEC.
- O — CHAIN LINK FENCE
- X — FENCE / RAIL
- ASPHALT EDGE
- CONCRETE AREA
- GRAVEL AREA

Ci	CURB INLET
Gi	GRATE INLET
Gw	GRATE WALKWAY
ABS	ADMIN BUILDING SIGN
BFP	BACKFLOW PREVENTER
BoP	BLOWER OR PUMP
CW	CATWALK
DA	DUMPSTER AREA
EO	ELEC. OUTLET
EVT	ELECTRICAL VAULT
OAS	OZONE ALERT SIGN
OHT	OVERHEAD TRACK
POTB	PILE OF TRASH BAGS
PSC	PIPE SIZE CHANGE
SC	SECURITY CAMERA
SLS	SPEED LIMIT SIGN
SS	SUPPORT STRUCTURE
SW	STAIRWAY
UPE	UNKOWN PLANT EQUIPMENT
UVT	UNKOWN VAULT
V	VALVE
R/W	RETAINING WALL
X 555.55	SPOT ELEVATION
EC 555.55	EDGE OF CONCRETE ELEVATION
GT 555.55	GUTTER ELEVATION
TC 555.55	TOP OF CURB ELEVATION
TW 555.55	TOP OF WALL ELEVATION

- CANOPY - COVERED AREA

MATERIALS IN PLAN/SECTION

- ABANDON PIPE / STRUCTURES
- ACOUSTICAL CEILING TILE (SECTION)
- ASPHALT (PLAN OR SMALL SCALE SECTION)
- ASPHALT (LARGE SCALE SECTION)
- BATT INSULATION (SECTION)
- BRICK MASONRY (PLAN/SECTION)
- CONCRETE (PLAN/SECTION)
- CONCRETE MASONRY (PLAN/SECTION)
- DEMOLITION (PLAN/SECTION)
- EARTH (SECTION)
- FILTER POINT MAT (PLAN)
- FINISHED WOOD (SECTION)
- GLU-LAM LUMBER (SECTION)
- GRANULAR FILL (SECTION)
- GRATING (SECTION)
- GRATING (PLAN)
- GROUT (SECTION)
- GYPSUM BOARD (SECTION)
- METAL (SECTION)
- ORIENTED STRAND BOARD (SECTION)
- PARTICLE BOARD (SECTION)
- PLYWOOD (LARGE SCALE SECTION)
- PLYWOOD (SMALL SCALE SECTION)
- PRECAST CONCRETE (PLAN/SECTION)
- RIGID INSULATION (SECTION)
- RIPRAP (PLAN/SECTION)
- SAND (SECTION)
- SOD (SECTION)
- WEEP JOINT MORTAR PROTECTION SYSTEM (SECTION)
- WOOD - CONTINUOUS (SECTION)
- WOOD BLOCKING (SECTION)

GENERAL SYMBOLOGY

ARROW INDICATES DIRECTION OF PLAN NORTH — N

PLAN
1/4" = 1'-0"

SECTION LETTER
FLAG INDICATES DIRECTION OF SECTION CUT
* DRAWING WHERE SECTION VIEW IS LOCATED

SECTION CUT MARKER

SECTION LETTER — * DRAWING WHERE SECTION VIEW IS FIRST CUT

SECTION
3/8" = 1'-0"

DETAIL NUMBER
* DRAWING WHERE DETAIL IS LOCATED

DETAIL MARKER

DETAIL NUMBER — * DRAWING WHERE DETAIL WAS TAKEN

DETAIL
3" = 1'-0"

ELEVATION/PHOTO NUMBER
ARROW INDICATES POINT OF VIEW
* DRAWING WHERE ELEVATION OR PHOTO IS LOCATED

SINGLE ELEVATION OR PHOTO MARKER

ELEVATION LETTER
ARROW INDICATES POINT OF VIEW ELEVATION
INDICATES DRAWING WHERE ELEVATION OR PHOTO IS LOCATED
X02

MULTIPLE ELEVATION OR PHOTO MARKER

* IF PLAN AND SECTION, OR DETAIL CALL-OUT AND DETAIL ARE SHOWN ON SAME DRAWING, DRAWING NUMBER IS REPLACED BY A LINE (-).

TARGET ELEVATION

ARCHITECTURAL

- ROOM NAME / XX-XX — ROOM NUMBER
- DOOR NUMBER
- COLUMN GRID LINE
- WALL TYPE
- WINDOW TYPE
- LOUVER
- GLASS TYPE
- ACCESSORY, FURNITURE & MISCELLANEOUS EQUIPMENT IDENTIFIER

KEYED NOTE DESIGNATION

KEYED NUMBER

IDENTIFICATION SYMBOLOGY

PIPING:

FIGURE — 18-FM — EXAMPLE
LINE SIZE — 18"
SERVICE — FORCEMAIN

EQUIPMENT IDENTIFICATION

WWWW_XXXQ_YYY*_ZZ_s

- EQUIPMENT ABBREVIATION
- PROCESS AREA
- LOCATION
- SUFFIX (AS REQUIRED)
- SEQUENCE
- LOOP*

PIPING FLUID ABBREVIATIONS

AA	AERATION AIR
ABI	AERATION BASIN INFLUENT
CS	CHLORINE SOLUTION
DR	DRAIN
MLR	MIXED LIQUID RECYCLE
NPW	NON–POTABLE WATER
PW	POTABLE WATER
RAS	RETURN ACTIVATED SLUDGE
RS	RAW SEWAGE
SCI	SECONDARY CLARIFIER INFLUENT
WAS	WASTE ACTIVATED SLUDGE

GENERAL NOTES:

1. THIS IS A STANDARD SHEET SHOWING COMMON SYMBOLOGY. ALL SYMBOLS ARE NOT NECESSARILY USED ON THIS PROJECT.
2. SCREENING OR SHADING OF WORK IS USED TO INDICATE EXISTING COMPONENTS OR TO DE-EMPHASIZE PROPOSED IMPROVEMENTS TO HIGHLIGHT SELECTED TRADE WORK. REFER TO CONTEXT OF EACH SHEET FOR USAGE.

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Date 6/13/2025 10:00:40 AM

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	T. PAULMANN
DRAWN BY	A. FREEMON
CHECKED BY	M. BOND
APPROVED BY	T. PAULMANN
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS — THOMAS A. PAULMANN — 128794 — LICENSED PROFESSIONAL ENGINEER — 6/13/25

LEWISVILLE — Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

GENERAL SYMBOLS AND LEGEND

FILENAME 00G004.dwg
SCALE NO SCALE
SHEET 00G004

GENERAL:

1. NOTIFY ENGINEER 48 HOURS IN ADVANCE OF COMMENCING CONSTRUCTION STAKING.
2. IMPLEMENT ALL EROSION AND SEDIMENTATION CONTROLS BEFORE CONSTRUCTION COMMENCES. LEAVE IN PLACE UNTIL FINAL STABILIZATION AND OWNER AND TCEQ APPROVAL.
3. CONDUCT ALL CONSTRUCTION OPERATIONS IN ACCORDANCE WITH APPLICABLE REGULATIONS OF THE U.S. OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION.
4. CONDUCT CONSTRUCTION OPERATIONS IN SUCH A MANNER AS TO PROTECT EXISTING FACILITIES AT ALL TIMES.
5. CALL TEXAS ONE CALL CENTER AT 811 OR 800-344-8377 AT LEAST TWO WORKING DAYS PRIOR TO BEGINNING ANY EXCAVATION. COORDINATE WITH THE OWNER FOR THE LOCATION OF ANY PRIVATE UTILITIES THAT MAY NOT BE IDENTIFIED BY ONE CALL.
6. PROTECT ALL HOLES, TRENCHES, AND OTHER HAZARDOUS AREAS WITH BARRICADES, LIGHTS, OR OTHER PROTECTIVE DEVICES.
7. NOTIFY ENGINEER OF ANY UNREPORTED OBSTACLES THAT MAY IMPEDE OR PREVENT COMPLETION OF THE WORK.
8. THERE IS NO PAY ITEM FOR DEWATERING AND NO SEPARATE PAYMENT WILL BE MADE FOR DEWATERING. ANY DEWATERING OF THE TRENCH/EXCAVATION REQUIRED IS THE RESPONSIBILITY OF THE CONTRACTOR AND SHALL BE INCIDENTAL TO THE BID.
9. ALL MATERIALS TESTING SHALL BE DONE BY AN INDEPENDENT LABORATORY AT THE OWNER'S EXPENSE. ANY RE-TESTING SHALL BE PAID FOR BY THE CONTRACTOR. AN INSPECTOR SHALL BE PRESENT DURING ALL TESTS. INSPECTORS SHALL BE GIVEN A MINIMUM OF 24 HOURS NOTICE PRIOR TO ANY TESTING.
10. ACQUIRE WRITTEN AUTHORIZATION FROM THE CITY OF LEWISVILLE PRIOR TO OPENING OR CLOSING ANY VALVES.
11. RECORD AND SUPPLY TO THE ENGINEER THE FOLLOWING INFORMATION:
    - A. LOCATION AND ELEVATION OF ALL APPURTENANT CONNECTIONS.
    - B. "AS-BUILT" INVERTS AND PROFILE OF CONSTRUCTED PIPELINE.
    - C. THE NEW LOCATION AND DEPTH OF ALL RELOCATED AND/OR ADJUSTED UTILITIES.
12. USE OF EXPLOSIVES WILL NOT BE PERMITTED.
13. ALLOW OWNER FIRST RIGHT OF REFUSAL FOR ALL SALVAGE ITEMS.
14. SATURDAY, SUNDAY OR HOLIDAY WORK WILL NOT BE PERMITTED FOR THE INSTALLATION OF ANY UTILITY LINE UNLESS DIRECTED OR APPROVED BY THE OWNER.
15. CONSTRUCTION HOURS: MONDAY THROUGH FRIDAY 7AM TO 5:30PM.

ACCESS:

1. ALL GATES AND FENCES SHALL BE SECURED AND CLOSED AT ALL TIMES WHEN NOT IN USE.
2. OWNER WILL FURNISH ACCESS BADGES FOR CONTRACTOR USE OF PLANT GATE DURING CONSTRUCTION HOURS.
3. PLANT SAFETY TRAINING IS REQUIRED OF ALL PERSONNEL ENTERING THE PLANT SITE PRIOR TO ENTRY. CMAR WILL COORDINATE PLANT SAFETY TRAINING.
4. CONTRACTOR SHALL NOT ENTER THE RAILWAY EASEMENT NORTH OF THE PLANT PROPERTY AT ANYTIME DURING CONSTRUCTION OR FENCE WORK.

SITE CONDITION AND RESTORATION:

1. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE REMOVAL AND REPLACEMENT OF ALL EXISTING PAVEMENTS, CURBS, DRIVEWAYS, SIDEWALKS, GRAVEL ROADWAYS, PIPE CULVERTS, CULVERT HEADWALLS, FENCES, BILLBOARDS, HYDRANTS AND MISCELLANEOUS ITEMS WHERE REQUIRED TO COMPLETE THE CONSTRUCTION.
2. REPAIR TO ORIGINAL OR BETTER CONDITION ANY PROPERTY DAMAGED DURING CONSTRUCTION, AT NO EXPENSE TO OWNER.
3. ANY PORTION OF THE PROJECT IMPROPERLY PLACED AND/OR CONFLICTING WITH ANY EXISTING STRUCTURE SHALL BE REMOVED AND CORRECTLY PLACED. THE CONTRACTOR WILL BE RESPONSIBLE FOR ALL ASSOCIATED COSTS.
4. REVEGETATE ALL AREAS DISTURBED OR EXPOSED DURING CONSTRUCTION IN ACCORDANCE WITH THE PLANS AND SPECIFICATIONS. REVEGETATION OF ALL DISTURBED OR EXPOSED AREAS SHALL CONSIST OF SODDING OR SEEDING.
5. ALL ROCKS, BRUSH, TIMBER AND OTHER DEBRIS THAT IS CLEARED FROM THE RIGHT OF WAYS AND EASEMENTS SHALL BE REMOVED FROM THE PREMISES AND SHALL NOT BE PLACED ON ADJOINING LANDS, EXCEPT WHERE ARRANGEMENTS FOR SUCH PLACEMENT OR DISPOSAL ARE MADE WITH THE APPROPRIATE PROPERTY OWNERS.
6. RESTORE SWALES UPON COMPLETION OF CONSTRUCTION, GRADE TO DRAIN WITH 3:1 (MAX.) SIDE SLOPES.

PIPE AND MECHANICAL:

1. COVER FOR ALL BURIED PIPE SHALL BE A MINIMUM OF FOUR (4) FEET UNLESS OTHERWISE SHOWN ON THE PLANS. ANY DEVIATION IN MINIMUM COVER REQUIREMENTS CAUSED BY DIMENSIONAL OR ELEVATION CALL OUTS MUST BE REPORTED TO THE ENGINEER PRIOR TO CONSTRUCTION.
2. PROVIDE RESTRAINED JOINTS AT ALL TEES, BENDS, CROSSES, PLUGS, HYDRANTS, REDUCERS AND WHERE IDENTIFIED ON THE PLANS. PROVIDE CONCRETE THRUST BLOCKS ONLY WHERE APPROVED BY THE ENGINEER.
3. SEE SPECIFICATION 40 05 00 FOR PRESSURE TESTING REQUIREMENTS.

TRENCH SAFETY NOTES

1. IN ACCORDANCE WITH LAWS OF THE STATE OF TEXAS AND THE U. S. OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION REGULATIONS, ALL TRENCHES OVER 5-FEET IN DEPTH IN EITHER HARD AND COMPACT OR SOFT AND UNSTABLE SOIL SHALL BE SHORED, SHEETED, BRACED, OR OTHERWISE SUPPORTED. FURTHERMORE, ALL TRENCHES LESS THAN 5-FEET IN DEPTH SHALL ALSO BE EFFECTIVELY PROTECTED WHEN HAZARDOUS GROUND MOVEMENT MAY BE EXPECTED.
2. IN ACCORDANCE WITH THE U.S. OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION REGULATIONS, WHEN EMPLOYEES ARE REQUIRED TO BE IN TRENCHES 4-FEET DEEP OR MORE, ADEQUATE MEANS OF EXIT, SUCH AS A LADDER OR STEPS, MUST BE PROVIDED AND LOCATED SO AS TO REQUIRE NO MORE THAN 25-FEET OF LATERAL TRAVEL.

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY NOTES

1. ALL WATER AND WASTEWATER INSTALLATIONS TO BE IN ACCORDANCE WITH TCEQ REQUIREMENTS.
2. ALL SANITARY SEWER CROSSINGS AND RELOCATIONS SHALL BE IN COMPLIANCE WITH REQUIREMENTS OF TCEQ CHAPTER 290 AND/OR CHAPTER 217.

HDR
TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	OCT 16/2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	T. PAULMANN
DRAWN BY	A. FREEMON
CHECKED BY	M. BOND
APPROVED BY	T. PAULMANN
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
THOMAS A. PAULMANN
128794
LICENSED
PROFESSIONAL ENGINEER
Thomas A. Paulmann
10/16/25

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

GENERAL NOTES

FILENAME	00G005.dwg
SCALE	NO SCALE
SHEET	00G005

File Path C:\Users\KHENDERSON\DC\ACCDocs\HDR\10342803_COL_PCWWT_AB_Expansion_2024\Project Files\01_HDR\00_General_G00.03_Sheet Files\GMP3\00G005.dwg
Date 10/16/2025 9:52:30 AM

A/C	AIR CONDITIONING
A/E	ARCHITECT/ENGINEER
A	ARCHITECTURAL (DWG DISCIPLINE), AMP
AB	ANCHOR BOLT
ABC	AGGREGATE BASE COURSE
ABAN	ABANDON
AC	ALTERNATING CURRENT
ACK	ACKNOWLEDGE
ACP	ACOUSTIC CEILING PANEL, ASPHALTIC CONCRETE PAVEMENT
ACST	ACOUSTIC
AD	ADDENDUM, AREA DRAIN
ADDL	ADDITIONAL
ADH	ADHESIVE
ADJ	ADJUSTABLE, ADJACENT
AF	AMP FRAME, AMP FUSE
AFF	ABOVE FINISH FLOOR
AFG	ABOVE FINISH GRADE
AGGR	AGGREGATE
AI	AREA INLET
AIC	AMPS INTERRUPTING CAPACITY
ALIG	ALIGNMENT
ALUM	ALUMINUM
ALT	ALTERNATE, ALTITUDE
AM	ACOUSTICAL MATERIAL
AMB	AMBIENT
ANC	ANCHOR
AP	ACCESS PANEL
APRX	APPROXIMATE
APVD	APPROVED
ARCH	ARCHITECTURAL
ASSY	ASSEMBLY
AT	AMP TRIP
ATC	ACOUSTICAL TILE CEILING
ATM	ATMOSPHERE
AUTO	AUTOMATIC
AUX	AUXILIARY
AVE	AVENUE
AVG	AVERAGE
AWG	AMERICAN WIRE GAGE
AWT	ACOUSTICAL WALL TILE
B/B	BACK TO BACK
BAL	BALANCE
BBD	BULLETIN BOARD
BC	BASE CABINET, BOTTOM CHORD, BOLT CENTER, BOLT CIRCLE
BD	BOARD
BE	BOTH ENDS, BELL END
BF	BOTH FACES, BOTTOM FACE, BLIND FLANGE, BOARD FEET
BITUM	BITUMINOUS
BKG	BACKING
BL	BASE LINE
BLDG	BUILDING
BLK	BLOCK
BLKG	BLOCKING
BM	BENCHMARK, BEAM
BOC	BACK OF CURB
BOD	BOTTOM OF DUCT
BOG	BOTTOM OF GRILLE
BOL	BOTTOM OF LOUVER
BOP	BOTTOM OF PIPE
BOR	BOTTOM OF REGISTER
BOT	BOTTOM
BOU	BOTTOM OF UNIT
BP	BASE PLATE
BRG	BEARING
BRGP	BEARING PLATE
BRKT	BRACKET
BS	BOTH SIDES
BTU	BRITISH THERMAL UNIT
BTW	BETWEEN
BTWLD	BUTT WELD
BU	BELL UP, BUILT UP
BUR	BUILT-UP ROOFING
BW	BOTH WAYS
BYP	BYPASS
C TO C	CENTER TO CENTER
C&G	CURB & GUTTER
C	CHANNEL SHAPE, CENTIGRADE, CONDUIT, CIVIL (DRAWING DISCIPLINE)
CAB	CABINET
CAP	CAPACITY
CAT	CATALOG
CAV	CAVITY
CB	CATCH BASIN
CCB	CONCRETE BLOCK
CCFRP	CENTRIFUGALLY CAST FIBERGLASS-REINFORCED POLYMER
CCW	COUNTER CLOCKWISE
CDF	CONTROLLED DENSITY FILL
CE	CONCRETE EDGE
CER	CERAMIC
CF	CUBIC FEET (FOOT)
CFL	COUNTER FLASHING
CHFR	CHAMFER
CHBD	CHALKBOARD
CHD	CHORD
CHH	COMMUNICATION HANDHOLE
CI	CURB INLET
CIP	CAST-IN-PLACE
CIPB	CONCRETE INTERLOCKING PAVER BALLAST
CIRC	CIRCULATION, CIRCULAR
CJ	CONSTRUCTION JOINT
CKT	CIRCUIT
CL	CENTERLINE, CLASS, CLOSE
CLG	CEILING
CLJ	CONTROL JOINT
CLKG	CAULKING
CLR	CLEAR
CMH	COMMUNICATION MANHOLE
CMU	CONCRETE MASONRY UNIT
CO	CLEAN OUT, CONCRETE OPENING
COL	COLUMN
COM	COMMON
COMB	COMBINATION
COMM	COMMUNICATION
COMP	COMPOSITION, COMPRESSIBLE, COMPOSITE
CONC	CONCENTRIC, CONCRETE
CONN	CONNECTION
CONST	CONSTRUCTION
CONT	CONTINUOUS
COOR	COORDINATE
CORR	CORROSIVE, CORRUGATED
CP	CHECKER PLATE, CONTROL POINT
CPLG	COUPLING
CRL	CORROSION RESISTANT LINING
CSC	COMPRESSION SLEEVE COUPLING
CSK	COUNTERSINK
CSS	CLINIC SERVICE SINK
CT	CERAMIC TILE
CTR	CENTER
CTRL	CONTROL
CVT	CULVERT
CU	COPPER, CUBIC
CW	CLOCKWISE
CY	CUBIC YARD
d	PENNY (NAIL MEASURE)
D	DEEP, DRAIN
DB	DUCT BANK, DECIBEL, DRY BULB
DBA	DEFORMED BAR ANCHOR
DBL	DOUBLE
DC	DIRECT CURRENT
DEG	DEGREE
DEG C	DEGREE CENTIGRADE
DEG F	DEGREE FAHRENHEIT
DEMO	DEMOLITION
DEP	DEPRESSED
DEPT	DEPARTMENT
DET	DETAIL
DI	DROP INLET, DUCTILE IRON
DIA	DIAMETER
DIAG	DIAGONAL, DIAGRAM
DIFF	DIFFERENTIAL, DIFFERENCE
DIM	DIMENSION
DISCH	DISCHARGE
DIST	DISTANCE, DISTRIBUTION
DIV	DIVISION
DL	DEAD LOAD
DMJ	DOUBLE MECHANICAL JOINT
DMPF	DAMP PROOFING
DN	DOWN
DO	DISSOLVED OXYGEN, DITTO
DP	DEPTH
DPDT	DOUBLE POLE, DOUBLE THROW
DPST	DOUBLE POLE, SINGLE THROW
DS	DOWN SPOUT
DT	DOUBLE TEE, DRIP TRAP ASSEMBLY
DUP	DUPLICATE
DWG	DRAWING
DWL	DOWEL
DWR	DRAWER
E	EAST, ELECTRICAL (DWG DISCIPLINE)
EA	EACH, EXHAUST AIR
EC	ELECTRICAL CONTRACTOR
ECC	ECCENTRIC
ED	EQUIPMENT DRAIN
EDB	ELECTRICAL DUCT BANK
EE	EACH END
EF	EACH FACE
EFF	EFFLUENT, EFFICIENCY
EHH	ELECTRICAL HANDHOLE
EIFS	EXTERIOR INSULATION & FINISH SYSTEM
EJ	EXPANSION JOINT
EL	ELBOW, ELEVATION
ELEC	ELECTRICAL
EMBD	EMBEDDED
EMER	EMERGENCY
EMH	ELECTRICAL MANHOLE
ENCL	ENCLOSURE
ENGR	ENGINEER
ENTR	ENTRANCE
EOP	EDGE OF PAVEMENT
EQ	EQUAL
EQUIP	EQUIPMENT
EQUIV	EQUIVALENT
ES	EACH SIDE, EQUAL SPACE, EMERGENCY SHOWER
ESEW	EMERGENCY SHOWER AND EYE WASH
EST	ESTIMATE
EW	EACH WAY, EMERGENCY EYE/FACE WASH
EWC	ELECTRIC WATER COOLER
EWEF	EACH WAY, EACH FACE
EWTB	EACH WAY, TOP AND BOTTOM
EXC	EXCAVATION
EXH	EXHAUST
EXST	EXISTING
EXP	EXPANSION, EXPOSED
EXT	EXTERIOR, EXTERNAL, EXTENSION
F&B	FACE & BYPASS
F TO F	FACE TO FACE
FAB	FABRICATE
FB	FLOOR BEAM
FBD	FIBERBOARD
FBG	FIBERGLASS
FBM	BOARD FOOT MEASURE
FBO	FURNISHED BY OWNER
FCIR	FOUND CAPPED IRON ROD
FC	FLUSHING CONNECTION
FCA	FLANGED COUPLING ADAPTER
FD	FLOOR DRAIN
FDC	FLEXIBLE DUCT CONNECTION
FDTN	FOUNDATION
FE	FLANGED END
FEC	FIRE EXTINGUISHER CABINET
FES	FLARED END SECTION
FEXT	FIRE EXTINGUISHER
FF	FAR FACE, FACTORY FINISH, FLAT FACE
FG	FINISHED GRADE
FIG	FIGURE
FH	FIRE HYDRANT
FIN	FINISH
FJT	FLUSH JOINT
FL	FLOW, FLOW LINE
FLEX	FLEXIBLE
FLG	FLANGE
FLOR	FLUORESCENT
FLR	FLOOR
FLS	FLASHING, FLUSH
FM	FORCE MAIN
FN	FENCE
FOB	FENCE FLAT ON BOTTOM
FOC	FACE OF CONCRETE, FACE OF CURB
FOF	FACE OF FINISH
FOM	FACE OF MASONRY
FOS	FACE OF STUDS
FOT	FLAT ON TOP
FPT	FEMALE PIPE THREAD
FR	FRAME
FRP	FIBERGLASS REINFORCED PLASTIC
FRPM	FIBERGLASS REINFORCED POLYMER MORTAR
FRTM	FIRE RETARDANT TREATED MATERIAL
FS	FLOOR SINK, FAR SIDE
FT	FEET, FOOT
FTG	FOOTING, FITTING
FUR	FURRED, FURRING
FURN	FURNITURE, FURNISH
FUT	FUTURE
FV	FACE VELOCITY
FW	FIELD WELD, FIRE WALL
FWD	FORWARD
FWE	FURNISHED WITH EQUIPMENT
FXTR	FIXTURE
G	GRILLE, GROUND, GENERAL (DWG DISCIPLINE)
GA	GAGE (METAL THICKNESS)
GAL	GALLON
GALV	GALVANIZED
GB	GRAB BAR, GRADE BREAK
GC	GROOVED COUPLING
GD	GUARD
GEN	GENERAL
GFCI	GROUND FAULT CIRCUIT INTERRUPTER
GFMU	GROUND FACE MASONRY UNIT
GG	GUTTER GRADE
GJ	GROOVED JOINT
GL	GLASS
GLB	GLASS BLOCK
GND	GROUND
GP	GUY POLE
GR	GRADE
GRTG	GRATING
GSB	GYPSUM SHEATHING BOARD
GT	GREASE TRAP
GVL	GRAVEL
GWB	GYPSUM WALLBOARD
GYP	GYPSUM HARDBOARD
H	HIGH
HB	HOSE BIB
HBD	HARDBOARD
HC	HANDICAPPED, HOLLOW CORE, HORIZONTAL CURVE
HC	HORIZONTAL CENTERLINE
HDR	HEADER
HDW	HARDWARE
HEX	HEXAGONAL
HGR	HANGER
HH	HANDHOLE
HID	HIGH INTENSITY DISCHARGE
HM	HOLLOW METAL
HORIZ	HORIZONTAL
HP	HIGH POINT, HORSEPOWER
HPC	HORIZONTAL POINT OF CURVATURE
HPS	HIGH PRESSURE SODIUM
HPT	HORIZONTAL POINT OF TANGENCY
HR	HOSE REEL, HOUR
HS	HEADED STUD, HIGH STRENGTH
HSS	HOLLOW STRUCTURAL SHAPE
HT	HEIGHT
HTG	HEATING
HV	HIGH VOLTAGE
HVAC	HEATING, VENTILATION & AIR CONDITIONING
HWD	HARDWOOD
HWL	HIGH WATER LEVEL
HYD	HYDRAULIC
HZ	HERTZ, CYCLES PER SECOND
I	INSTRUMENTATION (DWG DISCIPLINE)
ID	INSIDE DIAMETER, INTERIOR DIMENSION
IE	INVERT ELEVATION
IF	INSIDE FACE
IH	INTAKE HOOD
IMP	IMPACT
IN	INCH
INC	INCLUDE, INCANDESCENT
INF	INFLUENT
INSTR	INSTRUMENTATION
INSUL	INSULATION
INT	INTERIOR, INTERSECTION
INTR	INTERMEDIATE, INTERIOR
INV	INVERT
IPS	IRON PIPE SIZE
IPT	INTERNAL PIPE THREAD
IR	INSIDE RADIUS, IRON ROD
IRR	IRRIGATION
ISO	ISOMETRIC
JB	JUNCTION BOX
JCT	JUNCTION
JF	JOINT FILLER
JST	JOIST
JT	JOINT
K	KIP
KB	KNEE BRACE
KCMIL	THOUSAND CIRCULAR MILS
KD	KNOCK DOWN
KO	KNOCK OUT
KSI	KIPS PER SQUARE INCH
L	ANGLE, LENGTH, LAVATORY
LAD	LADDER
LAM	LAMINATE
LATL	LATERAL
LB	LAG BOLT, POUND
LCTB	LIQUID CHALK AND TACK BOARD
LDG	LANDING
LDR	LEADER
LE	LIFTING EYE
LF	LINEAR FOOT
LG	LONG
LO	LOADOUT
LH	LEFT HAND
LIN	LINEAR
LIQ	LIQUID
LLH	LONG LEG HORIZONTAL
LLV	LONG LEG VERTICAL
LMLU	LIQUID MARKER LECTURE UNIT
LNG	LONGITUDINAL
LOC	LOCATION
LP	LOW POINT
LPS	LOW PRESSURE SODIUM
LR	LONG RADIUS
LT	LEFT
LTD	LIMITED
LTG	LIGHTING
LTL	LINTEL
LTNG	LIGHTNING
LV	LOW VOLTAGE
LVR	LOUVER
LW	LIGHTWEIGHT
LWC	LIGHTWEIGHT CONCRETE
LWL	LOW WATER LEVEL
M	MECHANICAL (DWG DISCIPLINE)
MA	MIXED AIR
MACH	MACHINED
MAINT	MAINTENANCE
MAN	MANUAL
MATL	MATERIAL
MAX	MAXIMUM
MB	MACHINE BOLT
MBR	MEMBER
MC	MECHANICAL CONTRACTOR, MECHANICAL COUPLING
MCB	METAL CORNER BEAD
MCJ	MASONRY CONTROL JOINT
MDMJ	MODIFIED DOUBLE MECHANICAL JOINT
MECH	MECHANICAL
MED	MEDIUM
MFR	MANUFACTURER
MH	MANHOLE, METAL HALIDE
MIN	MINIMUM
MIR	MIRROR
MISC	MISCELLANEOUS
MJ	MECHANICAL JOINT
MLO	MAIN LUGS ONLY
MMB	MEMBRANE
MO	MASONRY OPENING
MOD	MODULAR, MODIFY
MON	MONUMENT
MPT	MALE PIPE THREAD
MRGWB	MOISTURE RESISTANT GYPSUM WALLBOARD
MS	MOP SINK
MSL	MEAN SEA LEVEL
MT	MOUNT
MU	MASONRY UNIT
MULL	MULLION
MV	MEDIUM VOLTAGE
MW	MONITORING WELL
N	NORTH, NEUTRAL
NA	NOT APPLICABLE
NAT	NATURAL
NC, N.C.	NORMALLY CLOSED
NEG	NEGATIVE
NF	NEAR FACE, NON-FUSED
NIC	NOT IN CONTRACT
NO, N.O.	NORMALLY OPEN, NUMBER
NOM	NOMINAL
NPS	NOMINAL PIPE SIZE
NPT	NATIONAL PIPE THREAD
NS	NEAR SIDE
NTS	NOT TO SCALE
NWL	NORMAL WATER LEVEL
O TO O	OUT-TO-OUT
OA	OUTSIDE AIR, OVERALL
OC	ON CENTER
OCPD	OVER CURRENT PROTECTION DEVICE
OD	OUTSIDE DIAMETER
OED	OPEN END DUCT
OF	OUTSIDE FACE, OFFICE FURNISHING
OG	ORIGINAL GROUND
OH	OVERHEAD
OHU	OVERHEAD UTILITY
OPNG	OPENING
OPP	OPPOSITE
OPT	OPTIONAL
OR	OUTSIDE RADIUS
ORD	OVERFLOW ROOF DRAIN
ORIG	ORIGINAL
OVFL	OVERFLOW
OVHG	OVERHANG
OZ	OUNCE
P	PAINT, PROCESS (DWG DISCIPLINE)
PA	PUBLIC ADDRESS
PAR	PARALLEL, PARAPET
PB	PANIC BAR, PULL BOX
PBD	PARTICLE BOARD
PC	POINT OF CURVE, PIECE, PRECAST
PCC	POINT OF COMPOUND CURVATURE
PCF	POUNDS PER CUBIC FOOT
PCT	PERCENT
PE	PLAIN END
PED	PEDESTAL
PEN	PENETRATION
PERF	PERFORATED
PERM	PERMANENT
PERP	PERPENDICULAR
PF	POWER FACTOR
PFMU	PREFACED MASONRY UNIT
PH	PHASE
PI	POINT OF INTERSECTION
PJF	PREMOLDED JOINT FILLER
PKG	PACKAGE
PL	PLATE, PROPERTY LINE
PLAS	PLASTER
PLAT	PLATFORM
PLBG	PLUMBING
PLF	POUNDS PER LINEAR FOOT
PNEU	PNEUMATIC
POL	POLISH
POS	POSITIVE, POSITION
PP	POLYPROPYLENE, POWER POLE
PRC	POINT OF REVERSE CURVATURE
PREF	PREFINISHED
PREFAB	PREFABRICATED
PRELIM	PRELIMINARY
PREP	PREPARE
PRES	PRESSURE
PRI	PRIMARY
PROP	PROPERTY
PROT	PROTECTION
PS	PIPE SUPPORT
PSF	POUNDS PER SQUARE FOOT
PSI	POUNDS PER SQUARE INCH
PSIA	POUNDS PER SQUARE INCH ABSOLUTE
PSIG	POUNDS PER SQUARE INCH GAGE
PST	PRESTRESSED
PT	POINT, POINT OF TANGENCY
PTN	PARTITION
PVC	POLYVINYL CHLORIDE
PVMT	PAVEMENT
PW	POTABLE WATER
PWD	PLYWOOD
PWJ	PLYWOOD WEB JOIST
PZ	PIEZOMETER
Q	RATE OF FLOW
QT	QUARRY TILE
QTR	QUARTER
QTY	QUANTITY
QUAL	QUALITY
R&R	REMOVE AND REPLACE
R&S	REMOVE AND SALVAGE
R	RADIUS, REGISTER, RISER
RA	RETURN AIR
RB	RESILIENT BASE, ROCK BERM
RCPT	RECEPTACLE
RD	ROOF DRAIN
REC	RECESS
RECD	RECEIVED
RECT	RECTANGULAR
RED	REDUCER
REF	REFERENCE
REINF	REINFORCING
REM	REMOVE
REQD	REQUIRED
RESIL	RESILIENT
RET	RETAINING, RETURN
REV	REVISION, REVERSE
RF	RESILIENT FLOORING
RFG	ROOFING
RFL	REFLECTED, REFLECTOR
RGH	ROUGH
RGS	RIGID GALVANIZED STEEL
RGS-PVC	PVC COATED RGS
RH	RELIEF HOOD, RIGHT HAND, RELATIVE HUMIDITY
RL	REQUIRED LAP
RLFA	RELIEF AIR
RND	ROUND
RNG	RUNNING
RO	ROUGH OPENING
ROW	RIGHT OF WAY
RPM	REVOLUTIONS PER MINUTE
RR	RAILROAD
RS	RAW SEWAGE
RSP	ROCK SLOPE PROTECTION
RT	RIGHT
RVT	RESILIENT VINYL TILE
RY	READY
S	SOUTH, SINK, STRUCTURAL (DWG DISCIPLINE)
SA	SUPPLY AIR
SAMU	SOUND ABSORBING MASONRY UNIT
SAN	SANITARY
SB	SPLASH BLOCK
SC	SOLID CORE
SCH	SCHEDULE
SCHEM	SCHEMATIC
SCN	SCREEN
SE	STEEL/ALUMINUM EDGE
SEC	SECONDARY, SECONDS
SECT	SECTION
SEP	SEPARATE
SF	SQUARE FOOT
SG	SHEET GLASS, SEALANT GROOVE
SH	SHOWER
SHT	SHEET
SHTG	SHEATHING
SIL	SILENCE
SIM	SIMILAR
SL	SLOPE
SLTD	SLOTTED
SLV	SLEEVE
SMLS	SEAMLESS
SOG	SLAB ON GRADE
SP	SOUNDPROOF, STANDPIPE
SPA	SPACING
SPEC	SPECIFICATION
SPLY	SUPPLY
SPST	SINGLE POLE SINGLE THROW
SPT	SET POINT
SQ	SQUARE
SR	SHORT RADIUS
SS	SERVICE SINK
SST	STAINLESS STEEL
ST	STREET
STA	STATION
STD	STANDARD
STIF	STIFFENER
STIR	STIRRUP
STL	STEEL
STOR	STORAGE
STR	STRUCTURAL, STRAIGHT
SUB	SUBSTITUTE
SUC	SUCTION
SUSP	SUSPENDED
SY	SQUARE YARD
SYM	SYMBOL
SYMM	SYMMETRICAL
SYN	SYNTHETIC
SYS	SYSTEM
T&B	TOP AND BOTTOM
T&G	TONGUE AND GROOVE
T	TILE, TREAD
TA	TOILET ACCESSORY, TEMPERED AIR
TAN	TANGENT
TBM	TEMPORARY BENCHMARK
TCE	TEMPORARY CONSTRUCTION EASEMENT
TEF	TROWELED EPOXY FLOORING
TEMP	TEMPORARY, TEMPERATURE
THD	THREAD
THK	THICK
THRESH	THRESHOLD
THRU	THROUGH
TKBD	TACK BOARD
TOB	TOP OF BOLT, TOP OF BANK, TOP OF BEAM
TOC	TOP OF CURB, TOP OF CONCRETE
TOD	TOP OF DUCT
TOF	TOP OF FOOTING
TOG	TOP OF GRATING
TOL	TOLERANCE, TOP OF LEDGER
TOM	TOP OF MASONRY
TOP	TOP OF PLATE
TOPO	TOPOGRAPHY
TOS	TOP OF SLAB, TOP OF STEEL
TOW	TOP OF WALL
TP	TOILET PARTITION, TELEPHONE POLE, TOE PLATE, TRAP PRIMER
TPD	TOILET PAPER DISPENSER
TPG	TOPPING
TR	TRANSOM
TRANS	TRANSITION
TRD	TRENCH DRAIN
TYP	TYPICAL
U	URINAL
UG	UNDERGROUND
ULT	ULTIMATE
UNFN	UNFINISHED
UNO	UNLESS NOTED OTHERWISE
UTIL	UTILITY
V	VENT, VELOCITY, VOLT
VA	VOLT AMPERE
VAC	VACUUM
VAR	VARNISH, VARIABLE, VOLT AMPERES REACTIVE
VB	VAPOR BARRIER, VINYL BASE, VALVE BOX
VC	VERTICAL CURVE
VCT	VINYL COMPOSITION TILE, VERTICAL CENTERLINE
VEL	VELOCITY
VENT	VENTILATION
VERT	VERTICAL
VG	VERTICAL GRAIN
VIF	VERIFY IN FIELD
VIN	VINYL
VS	VERSES, VAPOR SEAL
VOL	VOLUME
VPC	VERTICAL POINT OF CURVATURE
VPI	VERTICAL POINT OF INTERSECTION
VPT	VERTICAL POINT OF TANGENCY
VTR	VENT THROUGH ROOF
VWC	VINYL WALL COVERING
W/	WITH
W/O	WITHOUT
W	WATT, WEST, WIDE, WINDOW, WIRE, WIDE FLANGE BEAM
WB	WOOD BASE
WC	WATER CLOSET, WATER COLUMN
WD	WOOD, WIDTH
WF	WIDE FLANGE, WASH FOUNTAIN
WG	WIRE GLASS, WATER GAGE
WH	WALL HYDRANT, WEEP HOLE
WI	WROUGHT IRON
WL	WATER LEVEL
WLD	WELDED
WM	WIRE MESH
WP	WATERPROOF, WORKING POINT
WTHP	WEATHERPROOF
WS	WATERSTOP, WATER SURFACE
WSCT	WAINSCOT
WT	WEIGHT, WATER TIGHT
WWF	WELDED WIRE FABRIC
XP	EXPLOSION PROOF
XS	EXTRA STRONG
XXS	DOUBLE EXTRA STRONG
XSECT	CROSS SECTION
YH	YARD HYDRANT
YS	YIELD STRENGTH

GENERAL NOTES:

1. THESE ABBREVIATIONS APPLY TO THE ENTIRE SET OF CONTRACT DRAWINGS.
2. LISTING OF ABBREVIATIONS DOES NOT IMPLY ALL ABBREVIATIONS ARE USED IN THE CONTRACT DRAWINGS.
3. ABBREVIATIONS SHOWN ON THIS SHEET INCLUDE VARIATIONS OF THE WORD. FOR EXAMPLE, "MOD" MAY MEAN MODIFY OR MODIFICATION; "INC" MAY MEAN INCLUDED OR INCLUDING; "REINF" MAY MEAN EITHER REINFORCE OR REINFORCING.
4. SCREENING OR SHADING OF WORK IS USED TO INDICATE EXISTING COMPONENTS OR TO DE-EMPHASIZE PROPOSED IMPROVEMENTS TO HIGHLIGHT SELECTED TRADE WORK. REFER TO CONTEXT OF EACH SHEET FOR USAGE.
5. SEE P&ID LEGEND SHEET FOR PROJECT SPECIFIC EQUIPMENT SYMBOLS, EQUIPMENT ABBREVIATIONS AND PIPING SYSTEM ABBREVIATIONS.

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Date 6/13/2025 9:57:06 AM

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	T. PAULMANN
DRAWN BY	A. FREEMON
CHECKED BY	M. BOND
APPROVED BY	T. PAULMANN
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
THOMAS A. PAULMANN
128794
LICENSED PROFESSIONAL ENGINEER
6/13/25

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

GENERAL ABBREVIATIONS

FILENAME 00G006.dwg
SCALE NO SCALE
SHEET 00G006

PRIMARY ELEMENT SYMBOLOGY

- ORIFICE PLATE
- PITOT TUBE OR ANNUBAR
- FI — ROTOMETER
- SONIC OR ULTRASONIC FLOWMETER
- M — MAGNETIC FLOWMETER
- FT — MASS DISPERSION FLOWMETER
- FLUME
- WEIR
- PROPELLER OR TURBINE METER
- VENTURI TUBE
- FLOAT SWITCH
- TE — TEMPERATURE ELEMENT WITH THERMOWELL
- INLINE SEAL
- DIAPHRAGM SEAL
- ANNULAR SEAL
- ULTRASONIC LEVEL SENSOR
- RADAR LEVEL SENSOR

LINE TYPES

- MAIN PROCESS LINE
- SECONDARY PROCESS LINE
- AUXILIARY PROCESS LINE
- DIRECTION OF FLOW
- PNEUMATIC SIGNAL
- ELECTRICAL SIGNAL
- EH — ELECTRICAL HEAT TRACING
- HYDRAULIC SIGNAL
- SOFTWARE OR DATA LINK
- SIGNAL CONNECTION
- CROSSOVER – NO CONNECTION
- X — CAPILLARY

CROSS REFERENCE SYMBOLOGY

- 00Y–03 A — CONTINUATION TO POINT A ON SHEET 00Y–03
- A 00Y–02 — CONTINUATION FROM POINT A ON SHEET 00Y–02

INSTRUMENT SYMBOLOGY

- LOCALLY MOUNTED FIELD INSTRUMENTATION
- MOUNTED ON PANEL FRONT
- MOUNTED INSIDE PANEL
- XXX — FRONT PANEL MOUNTED ON AUXILIARY PANEL (SUBSCRIPT INDICATES PANEL)
- MOUNTED INSIDE AUXILIARY PANEL
- PILOT LIGHT
- BEACON
- INSTRUMENT FUNCTIONS SHARING COMMON HOUSING
- COMPLEX INTERLOCK AS DEFINED IN CONTROL DIAGRAM OR IN SPECIFICATIONS
- SHARED DISPLAY, SHARED CONTROL, FIELD MOUNTED
- SHARED DISPLAY, SHARED CONTROL, PRIMARY LOCATION – NORMALLY ACCESSIBLE TO OPERATOR
- PROGRAMMABLE LOGIC CONTROL, PRIMARY LOCATION – NORMALLY ACCESSIBLE TO OPERATOR
- PROGRAMMABLE LOGIC CONTROL, FIELD MOUNTED

ACTUATOR SYMBOLOGY

- X — OPERATOR ABBREVIATIONS: M = MOTOR, P = PNEUMATIC, S = SOLENOID
- FLOAT OPERATOR
- SPRING–OPPOSED SINGLE–ACTING PNEUMATIC CYLINDER
- DOUBLE–ACTING PNEUMATIC CYLINDER
- PNEUMATIC DIAPHRAGM
- PNEUMATIC DIAPHRAGM WITH POSITIONER

TYPES OF POWER SUPPLY

A	PLANT COMPRESSED AIR
IA	INSTRUMENTATION AIR
ES	ELECTRIC SUPPLY
NG	NATURAL GAS
HYD	HYDRAULIC
120VAC	120VAC POWER
480VAC	480VAC POWER

INSTRUMENT IDENTIFICATION LETTERS

	FIRST LETTER		SUCCEEDING LETTERS		
	MEASURED OR INITIATING VARIABLE	MODIFIER	READOUT OR PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
A	ANALYSIS		ALARM		
B	BURNER, COMBUSTION		USER'S CHOICE	USER'S CHOICE	USER'S CHOICE
C	USERS CHOICE			CONTROL	CLOSED
D	USERS CHOICE	DIFFERENTIAL			
E	VOLTAGE		SENSOR (PRIMARY ELEMENT)		
F	FLOW RATE	RATIO (FRACTION)			
G	USER'S CHOICE		GLASS, VIEWING DEVICE		
H	HAND				HIGH
I	CURRENT (ELECTRICAL)		INDICATE		
J	POWER	SCAN			
K	TIME, TIME SCHEDULE	TIME; RATE OF CHANGE		CONTROL STATION	
L	LEVEL		LIGHT		LOW
M	MOISTURE	MOMENTARY			MIDDLE, INTERMEDIATE
N	USER'S CHOICE		USER'S CHOICE	USER'S CHOICE	USER'S CHOICE
O	TORQUE		ORIFICE, RESTRICTION		
P	PRESSURE, VACUUM		POINT (TEST) CONNECTION		
Q	QUANTITY	INTEGRATE, TOTALIZE			
R	RADIATION		RECORD		
S	SPEED, FREQUENCY	SAFETY		SWITCH	
T	TEMPERATURE			TRANSMIT	
U	MULTIVARIABLE		MULTIFUNCTION	MULTIFUNCTION	MULTIFUNCTION
V	VIBRATION, MECH. ANALYSIS			VALVE, DAMPER, LOUVER	
W	WEIGHT, FORCE		WELL		
X	UNCLASSIFIED	X AXIS	UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED
Y	EVENT, STATE OR PRESENCE	Y AXIS		RELAY, COMPUTE, CONVERT	
Z	POSITION, DIMENSION	Z AXIS		DRIVER, ACTUATOR, UNCLASSIFIED FINAL CONTROL ELEMENT	

MISCELLANEOUS INSTRUMENTATION ABBREVIATIONS

AI	ANALOG INPUT
ALK	ALKALINITY (ANALYZER MODIFIER)
AO	ANALOG OUTPUT
CL2	CHLORINE (ANALYZER MODIFIER)
CO	CARBON MONOXIDE (ANALYZER MODIFIER)
CO2	CARBON DIOXIDE (ANALYZER MODIFIER)
COMB	COMBUSTIBLES (ANALYZER MODIFIER)
COND	CONDUCTIVITY (ANALYZER MODIFIER)
DEN	DENSITY (ANALYZER MODIFIER)
DI	DIGITAL INPUT
DO	DIGITAL OUTPUT
DO	DISSOLVED OXYGEN (ANALYZER MODIFIER)
E/P	VOLTAGE TO PNEUMATIC
H2S	HYDROGEN SULFIDE (ANALYZER MODIFIER)
I/O	INPUT/OUTPUT
I/P	CURRENT TO PNEUMATIC
NH3	AMMONIA (ANALYZER MODIFIER)
NO3	NITRATE (ANALYZER MODIFIER)
NOX	NITROGEN OXIDE (ANALYZER MODIFIER)
OIT	OPERATOR INTERFACE TERMINAL
O2	OXYGEN (ANALYZER MODIFIER)
P&ID	PROCESS AND INSTRUMENTATION DIAGRAM
PHOS	PHOSPHORUS (ANALYZER MODIFIER)
SS	SUSPENDED SOLIDS (ANALYZER MODIFIER)
TURB	TURBIDITY (ANALYZER MODIFIER)
WAN	WIDE AREA NETWORK
VFD	VARIABLE FREQUENCY DRIVE
LCP	LOCAL CONTROL PANEL
LCS	LOCAL CONTROL STATION
MCC	MOTOR CONTROL CENTER
MSH	MOTOR SPACE HEATER
TSH	MOTOR TEMPERATURE SWITCH
INF	PLANT INFLUENT
FIL	FILTRATE
D	DRAIN
PS	PRIMARY SLUDGE
WAS	WASTE ACTIVATED SLUDGE
TPS	THICKENED PRIMARY SLUDGE
TWAS	THICKENED WASTE ACTIVATED SLUDGE
CLGV	CHLORINE GAS VACUUM
CLS	CHLORINE SOLUTION
POL	POLYMER SOLUTION
SDGV	SULPHUR DIOXIDE GAS VACUUM
FA	FOUL AIR
NPW	NON POTABLE WATER
DG	DIGESTER GAS
SDGP	SULPHUR DIOXIDE GAS PRESSURE
CLGP	CHLORINE GAS PRESSURE

- △ DISCRETE INPUT (DI)
- ▲ ANALOG INPUT (AI)
- ▽ DISCRETE OUTPUT (DO)
- ▼ ANALOG OUTPUT (AO)

CONTROL SWITCH NOTATION ABBREVIATIONS

XXX / XXXX — XXX

ACK	ACKNOWLEDGE
CLS	CLOSE
ESTOP	EMERGENCY STOP
FAIL	FAILURE
FOR	FORWARD–OFF–REVERSE
FR	FORWARD–REVERSE
FS	FAST–SLOW
FWD	FORWARD
HA	HAND–AUTO
HOA	HAND–OFF–AUTO
HOR	HAND–OFF–REMOTE
LL	LEAD–LAG
LLS	LEAD–LAG–STANDBY
LOA	LOCAL–OFF–AUTO
LSR	LOCAL–STOP–REMOTE
LR	LOCAL–REMOTE
LS	LEAD–STANDBY
MA	MANUAL–AUTO
OAC	OPEN–AUTO–CLOSE
OC	OPEN–CLOSE
OO	ON–OFF
OPN	OPEN
OSC	OPEN–STOP–CLOSE
REV	REVERSE
RJ	RUN–JOG
RJR	RUN–JOG–REVERSE
SIL	SILENCE
SS	START–STOP

VALVES

- EXPANSION JOINT
- BALL VALVE
- BUTTERFLY VALVE, DAMPER
- CONE VALVE
- CHECK VALVE
- DOUBLE–DISK CHECK VALVE
- BALL CHECK VALVE
- DIAPHRAGM VALVE
- GATE VALVE
- GLOBE VALVE
- KNIFE GATE VALVE
- NEEDLE VALVE
- PINCH VALVE
- PLUG VALVE
- THREE–WAY BALL VALVE
- THREE–WAY PLUG VALVE
- PRESSURE–REDUCING VALVE
- PRESSURE–REGULATING VALVE
- THREE–WAY CONTROL VALVE
- OR — PRESSURE–RELIEF VALVE
- X — AIR–RELEASE VACUUM VALVE, A = AIR RELEASE, VAC = VACUUM
- S — SOLENOID VALVE
- VACUUM REGULATING VALVE
- MUD VALVE

MISCELLANEOUS SYMBOLOGY

- CENTRIFUGAL PUMP
- M — MOTOR
- CENTRIFUGAL BLOWER OR FAN
- INSTRUMENTS/EQUIPMENT SUPPLIED BY ELECTRICAL CONTRACTOR
- INSTRUMENTS/EQUIPMENT SUPPLIED BY EQUIPMENT VENDOR
- STOP LOG
- GATE
- M — SUMP PUMP
- M — PERISTALTIC METERING PUMP
- JB — JUNCTION BOX
- AXIAL PUMP
- TD — THERMAL MASS FLOWMETER
- SLIDE GATE VALVE
- WEIR
- FLOAT SWITCH WITH WEIGHT

PROCESS ABBREVIATIONS

GENERAL NOTES:

1. SEE GENERAL DRAWINGS FOR PROCESS ABBREVIATIONS.

EQUIPMENT TAGGING

XXX – XXXXX

EQPT. ABBR. — TAG NO.
1ST/2ND NUMBERS: PROCESS AREA
3RD/4TH NUMBERS: SEQUENCE
5TH NUMBER: OPTIONAL SEQUENCE (1 LETTER ONLY IF NEEDED)

GENERAL NOTES:

1. THIS IS A STANDARD INSTRUMENTATION SYMBOLOGY AND ABBREVIATIONS SHEET. LISTING OF SYMBOLS AND ABBREVIATIONS DOES NOT IMPLY ALL SYMBOLS AND ABBREVIATIONS HAVE BEEN USED ON THIS PROJECT.
2. SEE PROCESS, MECHANICAL AND PLUMBING LEGEND SHEET FOR MISCELLANEOUS PIPING SYMBOLS.
3. SCREENING OR SHADING OF WORK IS USED TO INDICATE EXISTING COMPONENTS OR TO DE–EMPHASIZE PROPOSED IMPROVEMENTS TO HIGHLIGHT SELECTED TRADE WORK. REFER TO CONTEXT OF EACH SHEET FOR USAGE.
4. VALVE SYMBOLS SHOWN HERE ARE APPLICABLE ONLY TO INSTRUMENTATION DIAGRAMS. SEE PROCESS, MECHANICAL AND PLUMBING LEGEND SHEET FOR VALVE SYMBOLS USED ELSEWHERE ON THE SHEETS.

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TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	T. PAULMANN
DRAWN BY	A. FREEMON
CHECKED BY	M. BOND
APPROVED BY	T. PAULMANN
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS — THOMAS A. PAULMANN — 128794 — LICENSED PROFESSIONAL ENGINEER — 6/13/25

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

GENERAL GENERAL NOTES, LEGEND, & SYMBOLS

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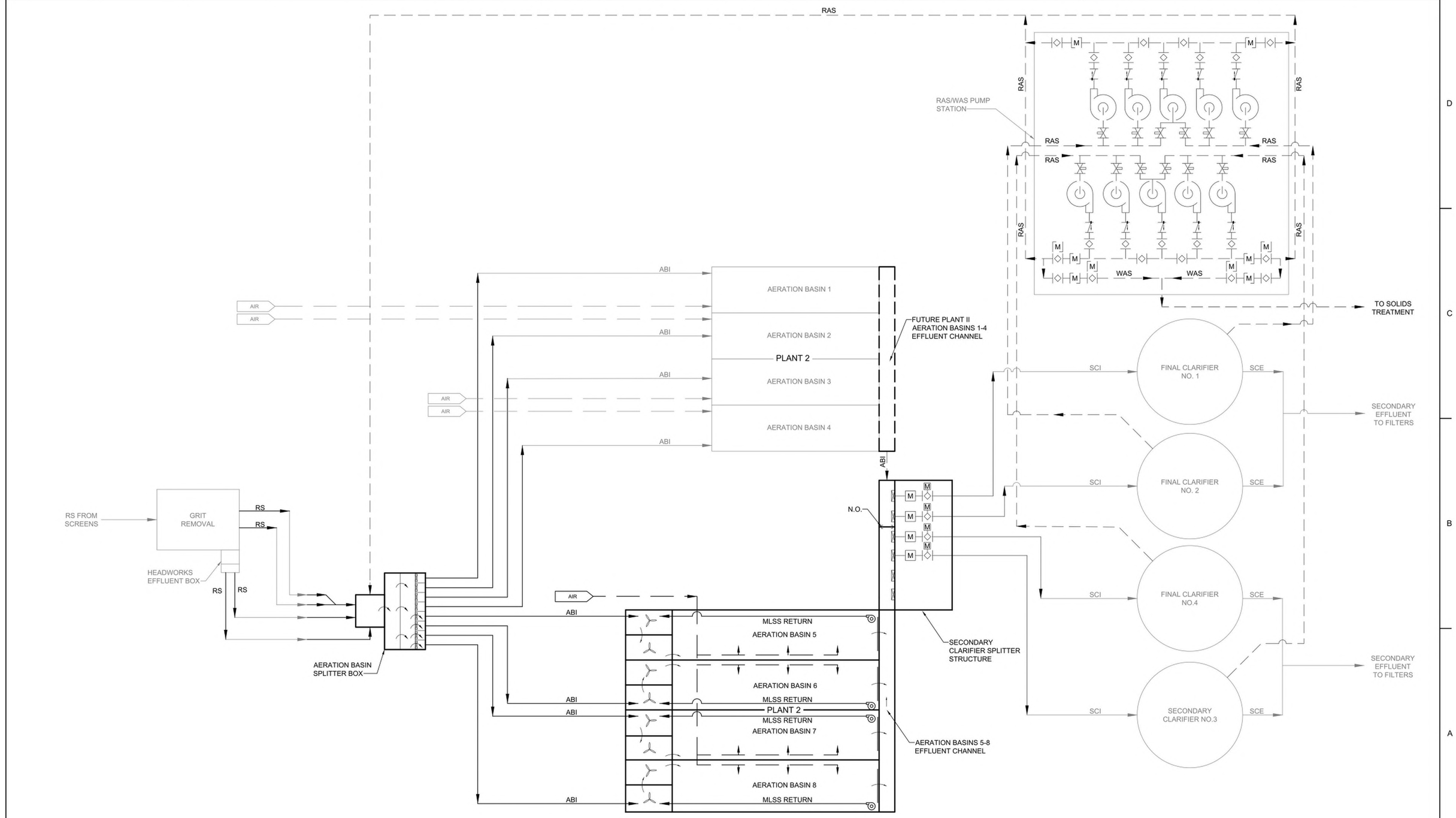

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TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	T. PAULMANN
DRAWN BY	A. FREEMON
CHECKED BY	M. BOND
APPROVED BY	T. PAULMANN
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
THOMAS A. PAULMANN
128794
LICENSED PROFESSIONAL ENGINEER
6/13/25

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

GENERAL
LIQUID PROCESS FLOW SCHEMATIC

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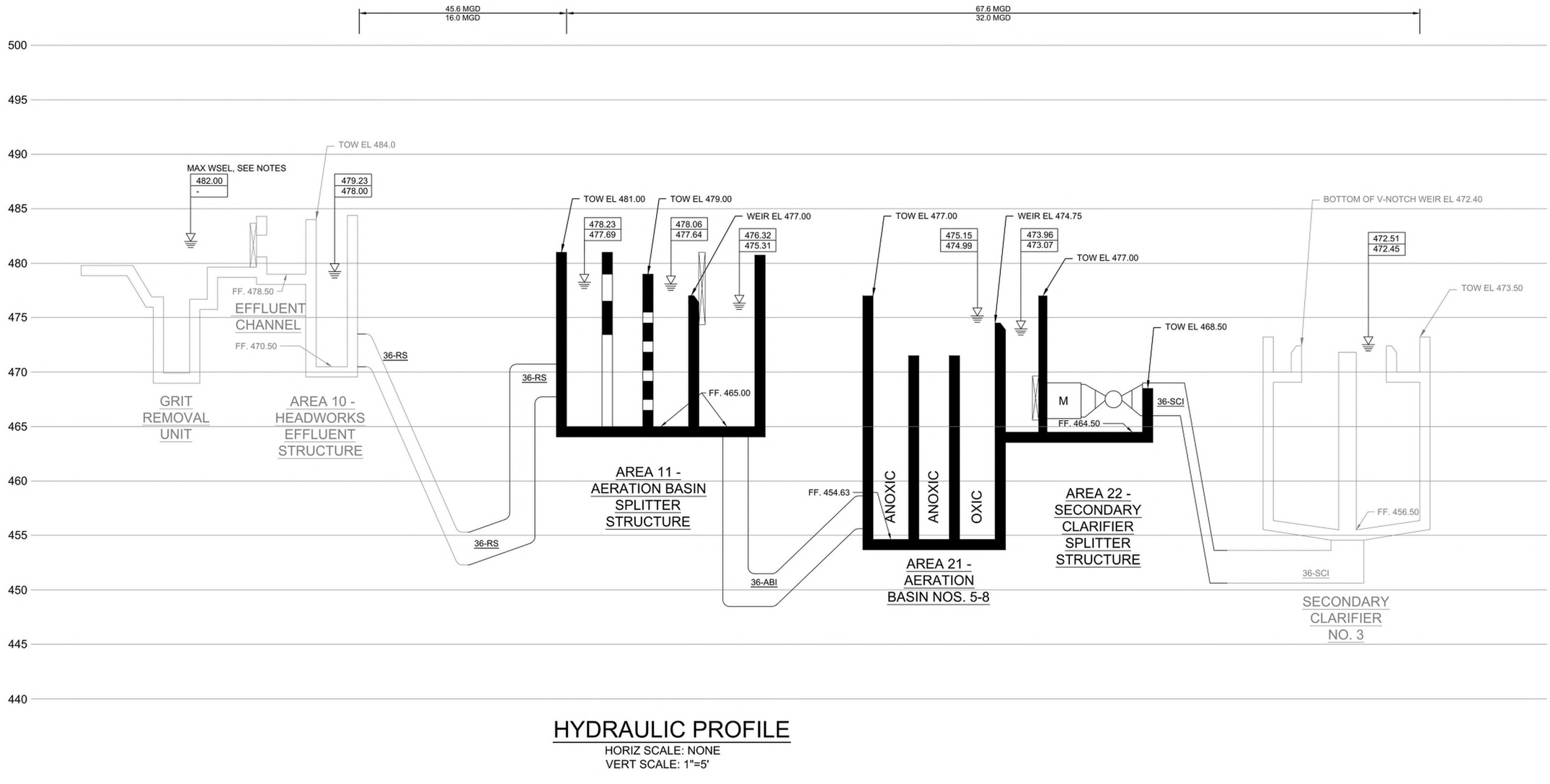

HYDRAULIC PROFILE

HORIZ SCALE: NONE
VERT SCALE: 1"=5'

NOTES:

1. MAX WSEL SHOWN FOR GRIT UNIT IS THE MAXIMUM ALLOWABLE OPERATING LEVEL OF THE GRIT UNIT EFFLUENT CHANNEL.

FLOW CONDITION	PEAK FLOW (MGD)	ANNUAL AVERAGE FLOW (MGD)
INTERIM PERMIT NET	45.6	16
INTERIM PERMIT + RAS	67.6	32
FINAL PERMIT ABs 1-8 NET	65	22
FINAL PERMIT ABs 1-8 + RAS	98	44
FINAL PERMIT ABs 5-8 ONLY NET	47.3	16
FINAL PERMIT ABs 5-8 + RAS	71.3	32

XXX.XX
XXX.XX

WSEL @ PEAK FLOW - INTERIM PERMIT
(45.6 MGD + 22 MGD RAS RETURN)
WSEL @ ANNUAL AVERAGE FLOW - INTERIM PERMIT
(16 MGD+ 100% RAS RETURN)

TEXAS P.E. FIRM
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THOMAS A. PAULMANN
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LICENSED
PROFESSIONAL ENGINEER
6/13/25

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

GENERAL HYDRAULIC PROFILE

FILENAME 00G602.dwg
SCALE AS NOTED

SHEET
00G602

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EROSION / SEDIMENTATION CONTROL NOTES:

1. IF TOTAL DISTURBED AREA OF THE SITE (INCLUDING COMMON PLAN OF DEVELOPMENT) IS ONE (1) ACRE OR MORE. THE CONTRACTOR IS RESPONSIBLE FOR PREPARING, IMPLEMENTING AND MAINTAINING A STORM WATER POLLUTION PREVENTION PLAN FOR STORM WATER DISCHARGES ASSOCIATED WITH CONSTRUCTION ACTIVITY UNDER TPDES GENERAL PERMIT NO. TXR150000 THROUGH TCEQ. THE CONTRACTOR MUST FOLLOW ALL CURRENT FEDERAL, STATE, AND LOCAL AUTHORITY REGULATIONS.
2. THE CONTRACTOR SHALL INSTALL EROSION/SEDIMENTATION CONTROLS AND TREE/NATURAL AREA PROTECTIVE FENCING PRIOR TO ANY SITE PREPARATION WORK (CLEARING, GRUBBING OR EXCAVATION.) SWPPP SHALL BE APPROVED ON FILE AND AVAILABLE, AND SITE SIGNAGE INSTALLED PRIOR TO INSTALLATION OF EROSION/SEDIMENTATION CONTROLS. INSPECTIONS OF SWPPP CONTROLS SHALL BE WEEKLY AND AFTER RAIN EVENTS.
3. THE PLACEMENT OF EROSION/SEDIMENTATION CONTROLS SHALL BE IN ACCORDANCE WITH THE APPROVED PLANS AND SPECIFICATIONS FOR THE PROJECT AND SHALL BE CONSISTENT WITH REQUIREMENTS SPECIFIED IN APPLICABLE SEDIMENT AND EROSION SITE PLANS OR SITE PERMITS, OR STORM WATER MANAGEMENT SITE PLANS OR SITE PERMITS APPROVED BY THE FEDERAL, STATE, TRIBAL OR LOCAL OFFICIALS. CHANGES TO THE PLAN SHALL BE APPROVED BY THE ENGINEER, THE OWNER'S REPRESENTATIVE AND GOVERNING AUTHORITIES INSPECTING THE SITE.
4. IF OFF-SITE BORROW OF SPOIL SITES ARE USED IN CONJUNCTION WITH THIS PROJECT, THIS INFORMATION SHALL BE DISCLOSED AND THE EROSION CONTROL PLAN UPDATED BY THE CONTRACTOR TO SHOW LOCATION OF SUCH SITES. OFF-SITE BORROW AND SPOIL AREAS ARE TO BE CONSIDERED A PART OF THE PROJECT SITE AND THEREFORE SHALL COMPLY WITH REQUIREMENTS IN NOTE THREE ABOVE. THESE AREAS SHALL BE STABILIZED WITH PERMANENT GROUND COVER PRIOR TO FINAL APPROVAL OF THIS PROJECT.
5. THE PLACEMENT OF TREE/NATURAL AREA PROTECTIVE FENCING SHALL BE IN ACCORDANCE WITH THE APPROVED PLANS AND SPECIFICATIONS FOR THE PROJECT AND THE LOCAL GOVERNING AUTHORITY'S (MS4) DESIGN GUIDE STANDARDS FOR TREE AND NATURAL AREA PROTECTION. REFER TO PLAN, NOTES, DETAILS AND SPECIFICATIONS.
6. AFTER SWPPP APPROVAL, PRIOR TO BEGINNING ANY SOIL DISTURBING ACTIVITIES ON SITE, A CONSTRUCTION CONFERENCE SHALL BE HELD AT THE SITE WITH THE CONTRACTOR, PERMIT APPLICANT(S)/OWNER'S REP., AND THE LOCAL GOVERNING AUTHORITY (MS4) IF APPLICABLE AFTER INSTALLATION OF THE EROSION/SEDIMENTATION CONTROLS AND TREE/NATURAL AREA PROTECTION MEASURES. THE CONTRACTOR SHALL NOTIFY THE ABOVE PARTIES AT LEAST THREE DAYS PRIOR TO THE MEETING DATE.
7. CONTRACTOR SHALL MAINTAIN ALL EROSION AND SEDIMENT CONTROLS FOR THE DURATION OF THE PROJECT OR AS DIRECTED BY THE OWNER'S REPRESENTATIVE, ENGINEER OR THE LOCAL GOV. AUTHORITY. SHOULD THE ENGINEER/OWNER NOT AGREE WITH THE LEVEL OF MAINTENANCE, THE OWNER SHALL HAVE THE OPTION OF WITHHOLDING SCHEDULED PAYMENTS UNTIL SUCH TIME AS SATISFACTION IS REACHED.
8. ANY MAJOR VARIATION IN MATERIALS OR LOCATION OF CONTROLS OR FENCES FROM THOSE SHOWN ON THE PLANS WILL REQUIRE APPROVAL BY THE REVIEWING ENGINEER, OWNER'S REP., AND/OR THE GOV. AUTHORITY, AS APPROPRIATE. MINOR CHANGES BY THE CONTRACTOR MAY BE REQUIRED DURING THE COURSE OF CONSTRUCTION TO CORRECT CONTROL INADEQUACIES. THESE CHANGES MAY BE MADE AS FIELD REVISIONS TO THE EROSION AND SEDIMENTATION CONTROL PLAN. CONTRACTOR IS RESPONSIBLE FOR KEEPING PLAN CURRENT AND UPDATED WITH ALL CHANGES MADE IN THE FIELD.
9. ALL CONTROL MEASURES SHALL BE INSPECTED BY THE CONTRACTOR DURING CONSTRUCTION AT LEAST ONCE WEEKLY AND AFTER RAIN EVENTS, AND THE NECESSARY MODIFICATIONS COMPLETED. CONTRACTOR SHALL ALSO INSPECT ALL CONTROL MEASURES AFTER FINAL STABILIZATION (PERENNIAL VEGETATIVE COVER HAS BEEN ESTABLISHED ON THE SITE WITH A DENSITY OF 80% OF THE NATIVE BACKGROUND VEGETATIVE COVER.).
10. IF STOCKPILES ARE REQUIRED ON SITE, INSTALL SEDIMENT FENCING/BARRIER CONTROL AT TOE OF SLOPE. DURING WET WEATHER SEASON, STOCKPILES SHALL BE COVERED WITH POLYETHYLENE PLASTIC SHEETING 6 MIL. MIN. THICKNESS AND HELD TIGHTLY IN PLACE BY USING SANDBAGS ON ROPES OR OTHER APPROVED METHODS.
11. SOIL RETENTION BLANKETS SHALL BE INSTALLED ON ALL GRADED EARTH SLOPES 6:1 AND STEEPER.
12. ALL DISTURBED EARTH SHALL BE PERMANENTLY SODDED OR SEEDED WHEN THE PROJECT IS COMPLETED. THE SPECIFIC PLANT MATERIAL PROPOSED TO PROTECT FILL AND EXCAVATED SLOPES MUST BE SUITABLE FOR USE UNDER LOCAL CLIMATE AND SOIL CONDITIONS. IN GENERAL, SODDING BERMUDA GRASS IS ACCEPTABLE DURING THE SUMMER MONTHS (MAY 01 TO SEPTEMBER 30). WINTER RYE OR FESCUE GRASS MAY BE PLANTED DURING TIMES OTHER THAN THE SUMMER MONTHS AS A TEMPORARY MEASURE UNTIL SUCH TIME AS THE PERMANENT PLANTING CAN BE MADE. REFER TO LANDSCAPE PLAN FOR PLANTING INFORMATION IF ONE HAS BEEN PROVIDED FOR THE PROJECT.
13. PROTECT TREES AS INDICATED ON PLAN BY PLACING FENCING AT THE TREE'S DRIP LINE AT A MINIMUM. ADDITIONAL PROTECTIVE MEASURES MAY BE NEEDED. REFER TO NOTES AND/OR DETAILS.
14. AS INLETS ARE CONSTRUCTED ON SITE, TEMPORARY SEDIMENT BARRIERS SHALL BE INSTALLED TO PROTECT AGAINST CONSTRUCTION RUN-OFF FROM ENTERING STORM SEWER SYSTEM.
15. CONTRACTOR SHALL NOT CLEAN VEHICLES ON SITE UNLESS A CLEANING/WASH STATION FOR SEDIMENT CONTROL IS CONSTRUCTED. SOLIDS WASHDOWN NEED TO BE FROM VEHICLES COORDINATED WITH CITY SUPERVISOR, IN ACCORDANCE WITH SWPPP AND CITY'S STORMWATER PERMIT.
16. CONTRACTOR SHALL USE APPROPRIATE SEDIMENT CONTROL WHILE DEWATERING ON SITE. A SEDIMENT TANK OR SUMP PIT DEWATERING STRUCTURE MAY BE USED. SUBMIT PLAN FOR APPROVAL BY OWNER.
17. CONTRACTOR SHALL HAVE ADDITIONAL FILTER DIKES AVAILABLE TO INSTALL ON SITE, AS REQUIRED FOR UNFORESEEN EMERGENCY USE DURING CONSTRUCTION WHERE ADDITIONAL EROSION/SEDIMENTATION PROTECTION IS NEEDED.
18. PRIOR TO FINAL ACCEPTANCE BY THE OWNER/OWNER REP., ANY HAUL ROADS AND/OR WATERWAY CROSSINGS CONSTRUCTED FOR TEMPORARY CONTRACTOR ACCESS MUST BE REMOVED. ACCUMULATED SEDIMENT SHALL BE REMOVED FROM THE WATERWAY AND THE AREA RESTORED TO THE ORIGINAL GRADE AND RE-VEGETATED. ALL LAND CLEARING DEBRIS SHALL BE DISPOSED OF IN APPROVED SPOIL DISPOSAL SITES BY THE CONTRACTOR.
19. ALL WORK MUST STOP IF A VOID IN THE ROCK SUBSTRATE IS DISCOVERED WHICH IS; ONE SQUARE FOOT IN TOTAL AREA;BLOWS AIR FROM WITHIN THE SUBSTRATE AND/OR CONSISTENTLY RECEIVES WATER DURING ANY RAIN EVENT. THE CONTRACTOR SHALL NOTIFY THE OWNER'S REPRESENTATIVE IMMEDIATELY FOR FURTHER INVESTIGATION.
20. IF THE EROSION CONTROL PLANS, AS APPROVED, CANNOT CONTROL EROSION AND OFF SITE SEDIMENTATION, IT IS REQUIRED BY THE GENERAL TCEQ PERMIT THAT THE PLAN BE REVISED AND ADDITIONAL EROSION CONTROL DEVICES BE INSTALLED. ADDITIONAL TEMPORARY BMP MEASURES SHALL BE INSTALLED BY THE CONTRACTOR.
21. THE ENGINEER/OWNER OR GOV. AUTHORITY HAS THE AUTHORITY TO DIRECT THE CONTRACTOR TO ADD AND/OR MODIFY EROSION/SEDIMENTATION CONTROLS ON SITE TO KEEP PROJECT IN COMPLIANCE WITH TCEQ RULES AND PERMIT REGULATIONS.
22. THE GENERAL CONTRACTOR SHALL COORDINATE SCHEDULES WITH SUBCONTRACTORS FOR INSTALLATION AND REMOVAL OF SEDIMENT CONTROLS WITH THE ENGINEER'S/OWNER'S AND GOV. AUTHORITY'S APPROVAL.

TEMPORARY VEGETATION

VEGETATION IS USED AS A TEMPORARY OR PERMANENT STABILIZATION TECHNIQUE FOR AREAS DISTURBED BY CONSTRUCTION, BUT NOT COVERED BY PAVEMENT, BUILDINGS, OR OTHER STRUCTURES. AS A TEMPORARY CONTROL, VEGETATION CAN BE USED TO STABILIZE STOCKPILES AND BARREN AREAS THAT ARE INACTIVE FOR LONG PERIODS OF TIME.

MATERIALS:
THE TYPE OF TEMPORARY VEGETATION USED ON A SITE IS A FUNCTION OF THE SEASON AND THE AVAILABILITY OF WATER FOR IRRIGATION.

OTHER VEGETATION MAY PERFORM AS WELL AS THE RECOMMENDED VARIETIES, ESPECIALLY WHERE IRRIGATION IS AVAILABLE. COUNTY AGRICULTURAL EXTENSION AGENTS ARE A GOOD SOURCE FOR SUGGESTIONS FOR OTHER TYPES OF TEMPORARY VEGETATION. ALL SEED SHOULD BE HIGH QUALITY, U.S. DEPT. OF AGRICULTURE CERTIFIED SEED.

INSTALLATION:
1. INTERIM OR FINAL GRADING MUST BE COMPLETED PRIOR TO SEEDING, MINIMIZING ALL STEEP SLOPES. IN ADDITION, ALL NECESSARY EROSION STRUCTURES SUCH AS DIKES, SWALES, DIVERSIONS, SHOULD ALSO BE INSTALLED.
2. SEEDBED SHOULD BE WELL PULVERIZED, LOOSE, AND UNIFORM.
3. FERTILIZER SHOULD BE APPLIED AT THE RATE OF 40 POUNDS OF NITROGEN AND 40 POUNDS OF PHOSPHORUS PER ACRE, WHICH IS EQUIVALENT TO ABOUT 1.0 POUNDS OF NITROGEN AND PHOSPHORUS PER 1000 SQUARE FEET. COMPOST CAN BE USED INSTEAD OF FERTILIZER AND APPLIED AT THE SAME TIME AS THE SEED.

TABLE 2.4 RECOMMENDED GRASS MIXTURE FOR TEMPORARY EROSION CONTROL

SEASON	COMMON NAME	PURE LIVE SEED RATE (LBS/ACRE)
SEPT 1 TO NOV 30	TALL FESCUE OATS WHEAT (RED,WINTER) **TOTAL**	4.5 5.6 34.0 **44.1**
MAY 1 - AUG 31	FOXTAIL MILLET	34
FEB 15 - MAY 31 SEP 1 - DEC 31	ANNUAL RYE	20

1. SEEDING RATES SHOULD BE AS SHOWN IN TABLE 1-3 AS RECOMMENDED BY THE COUNTY AGRICULTURAL EXTENSION AGENT.
2. THE SEED SHOULD BE APPLIED UNIFORMLY WITH A CYCLONE SEEDER, DRILL, CULTIPACKER SEEDER OR HYDROSEEDER (SLURRY INCLUDES SEED, FERTILIZER AND BINDER).
3. SLOPES THAT ARE STEEPER THAN 3:1 SHOULD BE COVERED WITH APPROPRIATE SOIL STABILIZATION MATTING AS DESCRIBED IN THE FOLLOWING SECTION TO PREVENT LOSS OF SOIL AND SEED.

IRRIGATION
TEMPORARY IRRIGATION SHOULD BE PROVIDED ACCORDING TO THE SCHEDULE DESCRIBED BELOW, OR TO REPLACE MOISTURE LOSS TO EVAPOTRANSPIRATION (ET), WHICHEVER IS GREATER. SIGNIFICANT RAINFALL (ON-SITE RAINFALL OF 1/2" OR GREATER) MAY ALLOW WATERING TO BE POSTPONED UNTIL THE NEXT SCHEDULED IRRIGATION.

TIME PERIOD	IRRIGATION AMOUNT AND FREQUENCY
WITHIN 2 HOURS OF INSTALLATION	IRRIGATE ENTIRE ROOT DEPTH, OR TO GERMINTATE SEED
DURING THE NEXT 10 BUSINESS DAYS	IRRIGATE ENTIRE ROOT DEPTH EVERY MONDAY, WEDNESDAY, AND FRIDAY
DURING THE NEXT 30 BUSINESS DAYS OR UNTIL SUBSTANTIAL COMPLETTION	IRRIGATION ENTIRE ROOT DEPTH A MINIMUM OF ONCE PER WEEK, OR AS NECESSARY TO ENSURE VIGOROUS GROWTH
DURING THE NEXT 4 MONTHS OR UNTIL FINAL ACCEPTANCE OF THE PROJECT	IRRIGATE ENTIRE ROOT DEPTH ONCE EVERY TWO WEEKS, OR AS NECESSARY TO ENSURE VIGOROUS GROWTH

IF COOL WEATHER INDUCES PLANT DORMANCY, WATER ONLY AS NECESSARY TO MAINTAIN PLANT HEALTH. IRRIGATE IN A MANNER THAT WILL NOT ERODE THE TOPSOIL BUT WILL SUFFICIENTLY SOAK THE ENTIRE DEPTH OF ROOTS.

INSPECTION AND MAINTENANCE GUIDELINES:
1. TEMPORARY VEGETATION SHOULD BE INSPECTED WEEKLY AND AFTER EACH RAIN EVENT TO LOCATE AND REPAIR ANY EROSION.
2. EROSION FROM STORMS OR OTHER DAMAGE SHOULD BE REPAIRED AS SOON AS PRACTICAL BY REGRADING THE AREA AND APPLYING NEW SEED.
3. IF THE VEGETATED COVER IS LESS THAN 80%, THE AREA SHOULD BE RESEEDED.

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Date 6/12/2025 4:20:06 PM

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	B. SMITH
DRAWN BY	G. MCCLINTON
CHECKED BY	K. LEISSING
APPROVED BY	K. LEISSING
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

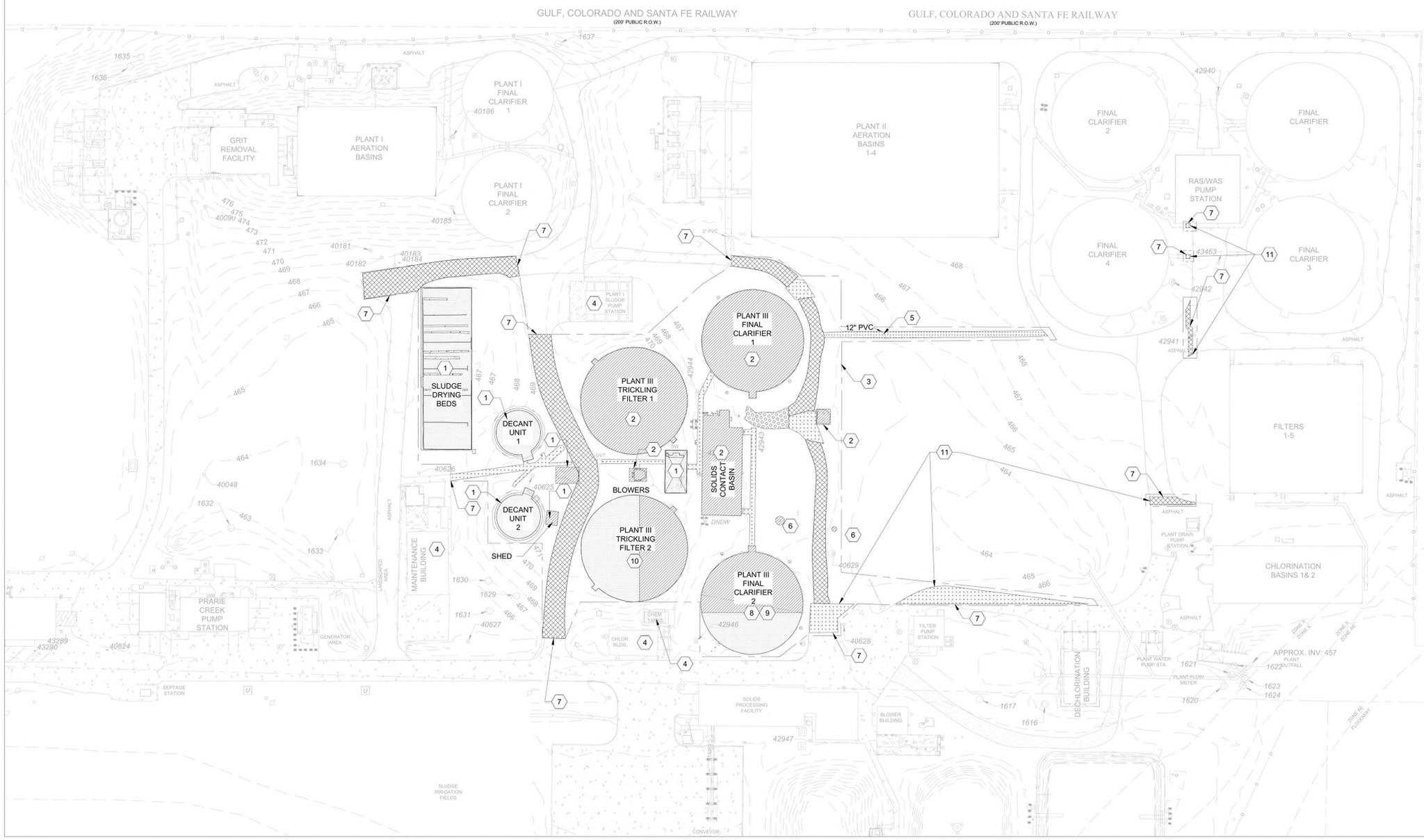
STATE OF TEXAS · KARIN S. LEISSING · 143328 · LICENSED PROFESSIONAL ENGINEER

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

EROSION AND SEDIMENTATION CONTROL NOTES

FILENAME	00C001.dwg
SCALE	NO SCALE
SHEET	**00C001**



SHEET NOTES:

1. SEE GENERAL NOTES ON SHEET 00G005.
2. THIS DEMOLITION PLAN IS FOR SITE ITEMS ONLY. FOR YARD PIPING, PLEASE SEE SHEETS 00CX161-00CX164. FOR PROCESS SEE SHEET 60X101.
3. EXISTING STRUCTURES TO REMAIN SHALL BE PROTECTED.
4. SEE SHEET 00G004 FOR LEGEND
5. SEE SECTION 01 14 16 - COORDINATION WITH OWNER'S OPERATIONS FOR CONSTRUCTION SEQUENCING REQUIREMENTS AND CONSTRAINTS.
6. ALL FULL DEPTH SAWCUT IS REQUIRED AT ALL EDGES OF PAVEMENT REMOVAL.
7. REMOVE ALL SIDEWALK AND PAVEMENT TO THE NEAREST JOINT LINE. REMOVAL LIMITS SHOWN ARE APPROXIMATED TO THE NEAREST JOINT LINE.
8. REFER TO SPECIFICATION 02 41 00 FOR ADDITIONAL REQUIREMENTS FOR DEMOLITION.
9. ALL WORK TO BE PERFORMED IN A MANNER THAT DOES NOT DISRUPT THE USE OF THE FIRELANE.

KEY NOTES:

1. DEMOLISH STRUCTURE TO 5 FEET BELOW GRADE. REMOVE MISCELLANEOUS METALS, EQUIPMENT, VALVES, GATES, AND SIMILAR EQUIPMENT BEFORE BURYING REMAINING CONCRETE STRUCTURE. BACKFILL AND COMPACT REMAINING CONCRETE STRUCTURE TO FINISHED GRADE PER PROPOSED GRADING PLANS.
2. DEMOLISH STRUCTURE COMPLETELY, INCLUDING BASE SLAB AND UNDERDRAIN SYSTEMS INCLUDING ASSOCIATED PIPING, MANHOLES. REMOVE MISCELLANEOUS METALS, EQUIPMENT, VALVES, GATES, AND SIMILAR EQUIPMENT.
3. DEMOLISH ALL ROADS, PAVING, SIDEWALKS, AND SIMILAR SURFACE STRUCTURES WITHIN PLANT III AREA.
4. FACILITY TO REMAIN IN SERVICE DURING CONSTRUCTION.
5. EXISTING STORM PIPE TO BE REMOVED.
6. EXISTING ELECTRICAL EQUIPMENT. SEE SHEET 60EX101 FOR MORE INFORMATION.
7. SAWCUT EXISTING ASPHALT OR CONCRETE.
8. DEMOLISH ENTIRE STRUCTURE TO 3-FT BELOW GRADE. AFTER EXISTING STRUCTURE IS DEMOLISHED 3-FT BELOW GRADE, DEMOLISH THE NORTH HALF OF THE STRUCTURE COMPLETELY, INCLUDING BASE SLAB AND UNDER DRAIN SYSTEM. THICKENED FOUNDATION AT CENTER OF CLARIFIER CAN REMAIN AT CONTRACTOR'S OPTION. REMOVE MISCELLANEOUS METALS, EQUIPMENT, VALVES, GATES, AND SIMILAR EQUIPMENT BEFORE BURYING REMAINING CONCRETE STRUCTURE. BACKFILL AND COMPACT REMAINING CONCRETE STRUCTURE TO FINISHED GRADE PER PROPOSED GRADING PLANS.
9. DO NOT SURCHARGE AT LEAST 10 FEET BEHIND EXISTING STRUCTURE TO REMAIN UNTIL BACKFILL AND COMPACTION INSIDE OF STRUCTURE TO TOP OF EXISTING WALL IS COMPLETE.
10. EAST OF EASTING 2435127.87, TRICKLING FILTER 2 IS TO BE FULLY DEMOLISHED. WEST OF EASTING 2435127.87, TRICKLING FILTER 2 IS TO BE DEMOLISHED TO 5' BELOW FINAL GRADE. PLEASE REFER TO 60X101 FOR MORE DETAILS. FOR COMPLETE DEMOLITION AREAS, DEMOLISH THE BASE SLAB AND UNDERDRAIN SYSTEMS INCLUDING ASSOCIATED PIPING, MANHOLES, AND FILTER MEDIA. REMOVE MISCELLANEOUS METALS, EQUIPMENT, VALVES, GATES, AND SIMILAR EQUIPMENT. FOR 5' BELOW GRADE DEMOLITION AREAS, REMOVE MISCELLANEOUS METALS, EQUIPMENT, VALVES, GATES, AND SIMILAR EQUIPMENT BEFORE BURYING REMAINING CONCRETE STRUCTURE. BACKFILL AND COMPACT APPROVED FILL TO FINISHED GRADE PER GRADING PLANS.
11. SEE SITE PLANS FOR CONCRETE AND ASPHALT REPLACEMENT. FINISH WITH GRAVEL DURING THE INTERIM PHASE.

SITE DEMOLITION LEGEND

LIMITS OF DEMOLITON

- EXISTING STRUCTURE TO BE DEMOLISHED COMPLETELY
- EXISTING STRUCTURE TO BE PARTIALLY DEMOLISHED
- EXISTING CONCRETE TO BE REMOVED
- EXISTING GRAVEL TO BE REMOVED
- EXISTING ASPHALT TO BE REMOVED

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Date 6/12/2025 4:20:38 PM

HDR
TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	B. SMITH
DRAWN BY	G. MCCLINTON
CHECKED BY	K. LEISSING
APPROVED BY	K. LEISSING
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS — KARIN S. LEISSING — 143328 — LICENSED PROFESSIONAL ENGINEER — 13 JUNE 2025

LEWISVILLE
Deep Roots. Broad Wings. Bright Future

CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

N
0 1" 2"

EXISTING INTERIM SITE DEMOLITION PLAN

FILENAME 00C104I.dwg
SCALE 1" = 50'
SHEET 00C104I

SHEET NOTES:

1. SEE GENERAL NOTES ON SHEET 00G005.
2. SEE SHEET 00G004 FOR LEGEND.
3. THIS SHEET IS FOR TEMPORARY GRADING IN THE DEMOLITION PACKAGE ONLY.
4. APPLY TEMPORARY VEGETATION TO DISTURBED AREA PER TABLE ON 00C001.

KEY NOTES:

1. EXCAVATION AREA FOR FILL. MAXIMUM SLOPE 3H:1V. SEE DETAIL 1 ON SHEET 99C501.
2. PUMP FOR EXCAVATION PIT. CONTRACTOR TO SIZE AND SELECT PUMP. SEE DETAIL 1 ON SHEET 99C501 FOR MORE INFORMATION.
3. RIPRAP OUTFALL PROTECTION. SEE DETAIL 3/99C502.
4. SPECIAL STILLING BASIN. SEE DETAIL 2 ON SHEET 99C501 FOR MORE INFORMATION.
5. PROTECT AND PRESERVE EXISTING GUY WIRE.

GRADING PLAN LEGEND

EXISTING CONTOUR 468

PROPOSED CONTOUR 468

LIMIT OF EXCAVATION

GULF, COLORADO AND SANTA FE RAILWAY (200' PUBLIC R.O.W.)

GULF, COLORADO AND SANTA FE RAILWAY (200' PUBLIC R.O.W.)

PLANT I FINAL CLARIFIER 1

PLANT I FINAL CLARIFIER 2

GRIT REMOVAL FACILITY

PLANT I AERATION BASINS

PLANT I SLUDGE PUMP STATION

PLANT II AERATION BASINS 1-4

FINAL CLARIFIER 2

FINAL CLARIFIER 1

RAS/WAS PUMP STATION

FINAL CLARIFIER 4

FINAL CLARIFIER 3

EL 466.67

EL 467.93

EL 458.98

EL 459.78

EL 468.15

EL 460.11

EL 468.20

EL 467.06

EL 456.00

EL 467.23

EL 466.23

EL 464.59

-4.00:1

-0.92%

-0.85%

-1.64%

-2.01%

-1.31%

-1.00%

EL 472.43

PRAIRIE CREEK PUMP STATION

MAINTENANCE BUILDING

GENERATOR AREA

CHLOR. BLDG.

FILTER PUMP STATION

SOLIDS PROCESSING FACILITY

BLOWER BUILDING

DECHLORINATION BUILDING

FILTERS 1-5

CHLORINATION BASINS 1 & 2

APPROX. INV: 457

ASPHALT

CONVEYOR

STAIRS

ZONE X

ZONE A

ZONE AE

ZONE AE FLOODWAY

PROJECT MANAGER	JOEL R. CANTWELL	
DESIGNED BY	B. SMITH	
DRAWN BY	G. MCCLINTON	
CHECKED BY	K. LEISSING	
APPROVED BY	K. LEISSING	
CITY PROJECT NO.	U2100	
PROJECT NUMBER	10342803	

ISSUE	DATE	DESCRIPTION
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TEXAS P.E. FIRM Registration No. F-754

STATE OF TEXAS · KARIN S. LEISSING · 143328 · LICENSED PROFESSIONAL ENGINEER

LEWISVILLE Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

OVERALL INTERIM GRADING AND DRAINAGE PLAN

N

0 1" 2"

FILENAME 00C140I.dwg

SCALE 1" = 50'

SHEET 00C140I

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SHEET NOTES:

1. EXISTING CONDITION AS SHOWN WAS OBTAINED FROM TOPOGRAPHIC SURVEY OF PRAIRIE CREEK WASTE WATER TREATMENT PLANT, FIELD DATE SEPTEMBER 12, 2022, PREPARED BY SPOONER & ASSOCIATES.
2. SEE SHEET 00G004 FOR SURVEY LEGEND.
3. EXISTING 12" RCP STORM PIPE WAS OBTAINED FROM AS-BUILT PROVIDED BY THE CITY, TITLED "PROPOSED DECHLORINATION FACILITY PAVING AND DRAINAGE" BY SHIMEK, JACOBS & FINKLEA CONSULTING ENGINEERS, DATE NOVEMBER, 1991.
4. SEE 00C102 FOR SURVEYOR'S NOTES AND ADDITIONAL SURVEY INFORMATION.
5. EXISTING 30" RCP STORM PIPE LAYOUT WAS OBTAINED FROM AS-BUILT PROVIDED BY THE CITY, TITLED "WASTEWATER TREATMENT PLANT EXPANSION" BY BIRKHOFF, HENDRICKS & CONWAY, L.L.P. CONSULTING ENGINEERS, DATED SEPTEMBER, 2004.

GULF, COLORADO AND SANTA FE RAILWAY (200' PUBLIC R.O.W.)

GULF, COLORADO AND SANTA FE RAILWAY (200' PUBLIC R.O.W.)

SPLITTER BOX

GRIT REMOVAL FACILITY

PLANT I AERATION BASINS

PLANT I FINAL CLARIFIER 1

PLANT I FINAL CLARIFIER 2

EXISTING BLOWER BUILDING

PLANT II AERATION BASINS 1-4

FINAL CLARIFIER 2

FINAL CLARIFIER 1

RAS/WAS PUMP STATION

FINAL CLARIFIER 4

FINAL CLARIFIER 3

SEE SHEET NOTE 3

PLANT I SLUDGE PUMP STATION

PLANT III FINAL CLARIFIER 1

PLANT III TRICKLING FILTER 1

PLANT III TRICKLING FILTER 2

PLANT III FINAL CLARIFIER 2

SOLIDS CONTACT BASIN

DECANT UNIT 1

DECANT UNIT 2

SLUDGE DRYING BEDS

LOT 4, BLOCK A
LEWISVILLE SERVICE CENTER
CAB. P, SLD. 17,
P.R.D.C.T.

MAINTENANCE OFFICE

MAINTENANCE BUILDING

PRAIRIE CREEK PUMP STATION

GENERATOR AREA

CHEM. TANKS

CHLOR. BLDG.

SEPTAGE STATION

SLUDGE IRRIGATION FIELDS

CONVEYOR

SOLIDS PROCESSING FACILITY

BLOWER BUILDING

FILTER PUMP STATION

DECHLORINATION BUILDING

PLANT WATER PUMP STA.

PLANT FLOW METER

PLANT OUTFALL

SEE SHEET NOTE 5

FILTERS 1-5

PLANT DRAIN PUMP STATION

CHLORINATION BASINS 1& 2

30" CONC. PIPE

OWNER:
UNITED STATES OF AMERICA
VOL. 383, PG. 530,
O.P.R.D.C.T.

ZONE X
ZONE AE
ZONE AE FLOODWAY

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TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	B. SMITH
DRAWN BY	G. MCCLINTON
CHECKED BY	K. LEISSING
APPROVED BY	K. LEISSING
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
KARIN S. LEISSING
143328
LICENSED
PROFESSIONAL ENGINEER
13 JUNE 2025

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

N

0 1" 2"

FILENAME 00C101.dwg
SCALE 1" = 50'

OVERALL EXISTING SITE PLAN

SHEET 00C101

GENERAL NOTES:

- THE BEARINGS, DISTANCES AND COORDINATES SHOWN HEREON ARE REFERENCED TO THE TEXAS COORDINATE SYSTEM OF 1983, TEXAS NORTH CENTRAL ZONE 4202, AND ARE BASED ON THE NORTH AMERICAN DATUM OF 1983, 2011 ADJUSTMENT. COORDINATES SHOWN ARE SCALED TO SURFACE DISTANCES AT N: 0.0 AND E: 0.0 USING A COMBINED SCALE FACTOR OF 1.000150630. ALL AREAS SHOWN HEREON ARE CALCULATED BASED ON SURFACE MEASUREMENTS.
- VERTICAL CONTROL IS ESTABLISHED FROM PLANT BENCHMARK ID NORTH EAST CORNER GRADE BEAM, HAVING A PUBLISHED ELEVATION OF 466.72.
- ALL MANHOLE / VAULT INVERT DATA PROVIDED HEREON (EG. PIPE SIZES, PIPE TYPES, FLOWLINE ELEVATIONS) IS MEASURED OR ESTIMATED FROM THE TOP OF THE STRUCTURE BY FIELD CREW PERSONNEL. WHILE REASONABLE PRECAUTIONS ARE ALWAYS TAKEN, SPOONER AND ASSOCIATES EXPRESSLY ASSUMES NO LIABILITY FOR THE RISK OF OBTAINING INCORRECT VALUES INHERENT WHEN MAKING INDIRECT MEASUREMENTS OR ESTIMATES. NO UNDERGROUND UTILITY STRUCTURES ARE ENTERED BY SPOONER PERSONNEL TO OBTAIN MEASUREMENTS DUE TO SAFETY CONCERNS.
- THE SIZE OR SHAPE OF THE TREE/BUSH SYMBOLS INCLUDED HEREON DO NOT NECESSARILY REPRESENT THE ACTUAL SIZE AND SHAPE OF THE CORRESPONDING TREES/BUSHES OR THEIR CANOPIES. THEY REPRESENT LOCATION ONLY.

SHEET NOTES:

1. EXISTING CONDITION AS SHOWN WAS OBTAINED FROM TOPOGRAPHIC SURVEY OF PRAIRIE CREEK WASTE WATER TREATMENT PLANT, FIELD DATE SEPTEMBER 12, 2022, PREPARED BY SPOONER & ASSOCIATES.
2. SEE SHEET 00G004 FOR SURVEY LEGEND.

CONTROL POINT TABLE

POINT	DESCRIPTION	NORTHING	EASTING	ELEV.
1	BM METAL DISK IN CONC	7,072,265.75	2,434,610.78	485.97'
2	BM METAL DISK IN CONC	7,072,095.54	2,435,708.51	472.01'
3	BM METAL DISK IN CONC	7,071,847.77	2,435,547.05	467.78'
400	5/8" CIRS "S&A CONTROL"	7,072,183.03	2,434,998.17	468.91'
401	5/8" CIRS "S&A CONTROL"	7,072,201.99	2,434,652.32	469.62'
402	5/8" CIRS "S&A CONTROL"	7,072,143.25	2,435,690.05	469.69'
403	5/8" CIRS "S&A CONTROL"	7,071,737.51	2,435,564.13	466.33'
404	5/8" CIRS "S&A CONTROL"	7,071,799.96	2,434,948.41	465.54'

TREE TABLE

TAG #	DESCRIPTION
1616	40" PECAN
1617	22" PECAN
1620	14" HACKBERRY
1621	10" HACKBERRY
1622	12" ELM
1623	10" HACKBERRY
1624	10" HACKBERRY
1625	6" HACKBERRY
1626	10" HACKBERRY
1627	6" HACKBERRY
1628	14" HACKBERRY
1629	6" PINE
1630	6" PINE
1631	6" PINE
1632	16" PECAN
1633	16" OAK
1634	22" OAK
1635	22" PECAN
1636	26" PECAN
1637	52" PECAN

WATER VALVE AND TOP NUT TABLE

POINT #	RIM ELEVATION	TOP NUT OR SILT ELEVATION	POINT #	RIM ELEVATION	TOP NUT OR SILT ELEVATION
40079	477.98'	TOP OF NUT EL= 474.21'	41664	465.31'	TOP OF NUT EL= 462.30'
40081	477.81'	TOP OF NUT EL= 473.97'	41671	465.32'	TOP OF NUT EL= 461.41'
40098	472.37'	TOP OF NUT EL= 471.71'	41759	467.72'	TOP OF NUT EL= 464.30'
40099	475.08'	TOP OF NUT EL= 474.31'	41971	467.26'	TOP OF NUT EL= 466.66'
40100	475.04'	TOP OF NUT EL= 476.57'	41991	467.82'	TOP OF NUT EL= 465.11'
40102	475.15'	TOP OF NUT EL= 474.42'	42012	467.08'	TOP OF NUT EL= 466.39'
40104	474.50'	TOP OF NUT EL= 468.78'	42013	467.22'	TOP OF NUT EL= 464.35'
40107	473.62'	TOP OF NUT EL= 470.46'	42095	467.02'	TOP OF NUT EL= 462.92'
40108	473.48'	TOP OF NUT EL= 470.04'	42096	466.84'	TOP OF NUT EL= 464.61'
40195	477.18'	TOP OF NUT EL= 478.41'	42106	467.39'	TOP OF NUT EL= 466.52'
40198	478.16'	TOP OF NUT EL= 473.88'	42108	467.76'	TOP OF NUT EL= 465.52'
40199	478.59'	TOP OF NUT EL= 474.12'	42124	467.28'	TOP OF NUT EL= 466.27'
40201	478.21'	TOP OF NUT EL= 476.37'	42125	467.94'	TOP OF NUT EL= 465.43'
40202	478.21'	TOP OF NUT EL= 476.44'	42166	468.00'	TOP OF NUT EL= 466.02'
40203	478.31'	TOP OF NUT EL= 476.07'	42178	469.58'	TOP OF NUT EL= 469.26'
40216	478.37'	TOP OF NUT EL= 476.46'	42189	469.63'	TOP OF NUT EL= 468.00'
40228	479.77'	TOP OF NUT EL= 477.77'	42254	467.51'	UNABLE TO OPEN
40229	479.66'	TOP OF NUT EL= 478.04'	42281	467.35'	TOP OF NUT EL= 466.94'
40230	479.62'	TOP OF NUT EL= 477.71'	42282	467.43'	TOP OF NUT EL= 463.32'
40327	NO LID	TOP OF NUT EL= 472.28'	42283	467.35'	TOP OF NUT EL= 463.40'
40546	466.19'	TOP OF NUT EL= 461.89'	42468	466.26'	TOP OF NUT EL= 465.83'
40583	NO LID	TOP OF NUT EL= 465.92'	42469	466.24'	TOP OF NUT EL= 466.04'
40614	464.45'	TOP OF NUT EL= 461.82'	42470	466.11'	TOP OF NUT EL= 464.88'
40934	470.30'	TOP OF NUT EL= 470.30'	42471	466.13'	TOP OF NUT EL= 465.74'
40999	465.00'	TOP OF NUT EL= 463.09'	42503	466.00'	TOP OF NUT EL= 464.58'
41054	471.10'	UNABLE TO OPEN	42666	465.78'	TOP OF NUT EL= 463.31'
41055	471.46'	UNABLE TO OPEN	42669	465.64'	TOP OF NUT EL= 461.76'
41075	470.71'	TOP OF NUT EL= 470.39'	42675	466.36'	TOP OF NUT EL= 460.79'
41081	470.72'	TOP OF NUT EL= 470.51'	42681	466.33'	TOP OF NUT EL= 462.05'
41186	465.18'	TOP OF NUT EL= 462.63'	42707	466.83'	TOP OF NUT EL= 465.74'
41228	465.48'	TOP OF NUT EL= 462.11'	42708	466.82'	TOP OF NUT EL= 465.50'
41229	465.56'	TOP OF NUT EL= 462.13'	42731	466.98'	TOP OF NUT EL= 465.17'
41251	466.88'	TOP OF NUT EL= 464.13'	42786	466.99'	TOP OF NUT EL= 465.64'
41252	466.86'	TOP OF NUT EL= 466.29'	42789	466.78'	TOP OF NUT EL= 464.97'
41259	466.89'	TOP OF NUT EL= 464.79'	42790	466.56'	TOP OF NUT EL= 464.92'
41265	467.14'	TOP OF NUT EL= 464.60'	42792	466.94'	TOP OF NUT EL= 465.33'
41266	467.14'	TOP OF NUT EL= 464.54'	42793	467.19'	TOP OF NUT EL= 465.17'
41285	467.71'	TOP OF NUT EL= 466.01'	42794	467.40'	TOP OF NUT EL= 465.44'
41293	467.56'	TOP OF NUT EL= 465.79'	42795	466.77'	TOP OF NUT EL= 464.83'
41299	467.36'	TOP OF NUT EL= 465.98'	42847	467.46'	TOP OF NUT EL= 463.90'
41303	467.91'	TOP OF NUT EL= 467.33'	42854	466.60'	TOP OF NUT EL= 464.66'
41311	467.91'	TOP OF NUT EL= 467.51'	42914	466.94'	TOP OF NUT EL= 465.14'
41640	467.40'	TOP OF NUT EL= 466.86'	42919	466.81'	TOP OF NUT EL= 463.90'
41643	466.89'	TOP OF NUT EL= 464.50'	42920	466.91'	TOP OF NUT EL= 463.74'
41655	465.92'	TOP OF NUT EL= 465.35'	42935	466.55'	TOP OF NUT EL= 464.24'
41663	465.58'	TOP OF NUT EL= 463.57'			

INVERT TABLE

40048	SSMH RIM EL=463.92' PIC ID: 40048 IN (E) FL EL=458.37' IN (N) FL EL=458.40' OUT (S) FL EL=458.29'	42940	SSMH RIM EL=466.83' PIC ID: 42940 BOTTOM FLOOR EL=453.47'
40090	SSMH RIM EL=475.52' PIC ID: 40090 IN (E) FL EL=459.82' IN (NW) FL EL=465.12' IN (SW) FL EL=462.03' OUT (S) FL EL=459.64'	42941	SSMH RIM EL=469.87' PIC ID: 42941 IN (NE) FL EL=462.43' IN (W) FL EL=455.65' OUT (S) FL EL=455.47'
40181	SSMH RIM EL=469.88' PIC ID: 40181 BOTTOM FLOOR EL=460.20' TOP OF PIPE EL=464.87'	42942	SSMH RIM EL=469.20' PIC ID: 42942 IN (W) FL EL=451.43' BOTTOM FLOOR EL=453.50'
40182	SSMH RIM EL=469.40' PIC ID: 40182 BOTTOM FLOOR EL=460.30' TOP OF PIPE EL=464.53'	42943	SSMH RIM EL=466.87' PIC ID: 42943 TOP OF PIPE EL=463.05' BOTTOM FLOOR EL=460.04'
40183	SSMH RIM EL=468.09' PIC ID: 40183 BOTTOM FLOOR EL=459.11' TOP OF PIPE EL=463.48'	42944	SSMH RIM EL=468.37' PIC ID: 42944 IN (N) FL EL=460.45' IN (NE) FL EL=460.69' OUT (S) FL EL=460.40'
40185	SSMH RIM EL=479.01' PIC ID: 40185 IN (E) FL EL=472.72' IN (N) FL EL=461.73' OUT (W) FL EL=461.68'	42945	SSMH RIM EL=467.84' PIC ID: 42945 TOP OF PIPE EL=462.63' BOTTOM FLOOR EL=459.01'
40186	SSMH RIM EL=479.76' PIC ID: 40186 IN (E) FL EL=462.21' IN (NE) FL EL=472.69' OUT (S) FL EL=462.06'	42946	SSMH RIM EL=465.82' PIC ID: 42946 IN (E) FL EL=463.67' IN (N) FL EL=463.14' IN (SE) FL EL=463.19' OUT (W) FL EL=463.16'
40625	SSMH RIM EL=470.09' PIC ID: 40625 IN (NW) FL EL=465.15' IN (SW) FL EL=465.31' OUT (W) FL EL=462.19'	42947	SSMH RIM EL=467.41' PIC ID: 42947 IN (N) FL EL=461.18' IN (NE) FL EL=463.02' IN (S) FL EL=462.24' IN (SE) FL EL=461.74' OUT (W) FL EL=459.50'
40626	SSMH RIM EL=466.83' PIC ID: 40626 IN (E) FL EL=459.56' IN (N) FL EL=460.22' OUT (W) FL EL=459.51'	42948	SSMH RIM EL=466.95' PIC ID: 42948 IN (E) FL EL=456.34' OUT (N) FL EL=456.07'
40627	SSMH RIM EL=465.84' PIC ID: 40627 IN (E) FL EL=458.36' OUT (W) FL EL=458.28'	42949	SDMH RIM EL=466.23' PIC ID: 42949 IN (N) FL EL=459.41' OUT (W) FL EL=459.06'
40628	SSMH RIM EL=465.95' PIC ID: 40628 UNABLE TO OPEN	42950	SDMH RIM EL=467.53' PIC ID: 42950 IN (NW) FL EL=460.26' OUT (S) FL EL=459.84'
40629	SSMH RIM EL=466.00' PIC ID: 40629 BOTTOM FLOOR EL=459.02'	43463	SSMH RIM EL=467.83' PIC ID: 43463 BOTTOM FLOOR EL=453.68'

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Date 6/12/2025 4:20:18 PM

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	B. SMITH
DRAWN BY	G. MCCLINTON
CHECKED BY	K. LEISSING
APPROVED BY	K. LEISSING
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS · KARIN S. LEISSING · 143328 · LICENSED PROFESSIONAL ENGINEER · 13 June 2025

LEWISVILLE
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CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

SURVEY DATA

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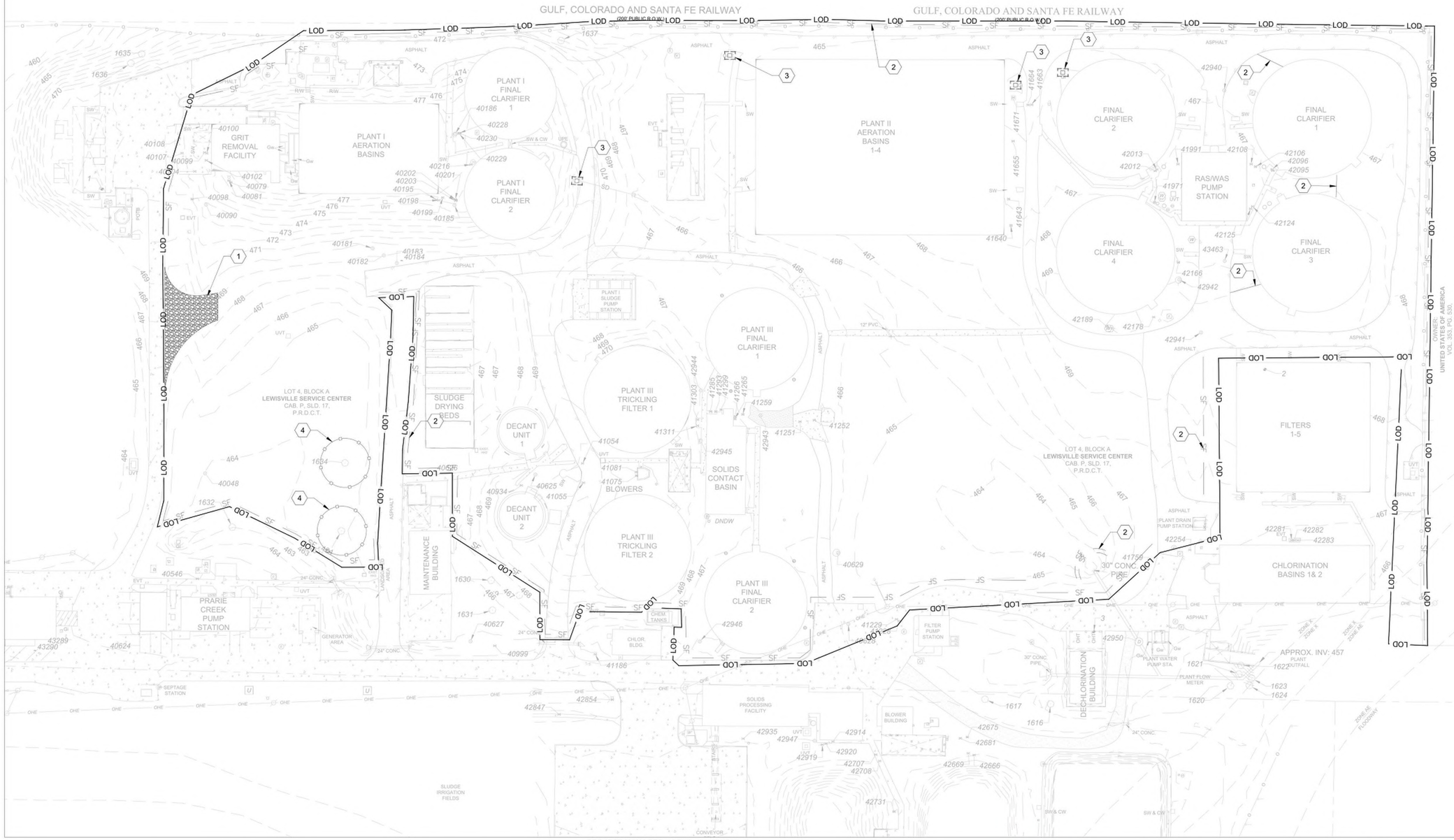
SCALE	NO SCALE
SHEET	00C102



SHEET NOTES:

1. EXISTING CONDITION AS SHOWN WAS OBTAINED FROM TOPOGRAPHIC SURVEY OF PRAIRIE CREEK WASTE WATER TREATMENT PLANT, FIELD DATE SEPTEMBER 12, 2022, PREPARED BY SPOONER & ASSOCIATES.
2. SEE SHEET 00G004 FOR SURVEY LEGEND.
3. EXISTING 12" RCP STORM PIPE FROM EAST OF PLANT I FINAL CLARIFIER 2 TO WEST OF EXISTING BLOWER BUILDING WAS OBTAINED FROM AS-BUILT PROVIDED BY THE CITY, TITLED "PROPOSED DECHLORINATION FACILITY PAVING AND DRAINAGE" BY SHIMEK, JACOBS & FINKLEA CONSULTING ENGINEERS, DATED NOVEMBER, 1991.
4. LIMIT OF DISTURBANCE IS 13.56 AC.
5. CONTRACTOR TO OBTAIN REQUIRED PERMITS PRIOR TO START OF CONSTRUCTION ACTIVITIES.
6. CONTRACTOR SHALL INSTALL A 4'X4' WEATHER PROOF SIGN (6' HEIGHT) AT THE MAIN CONSTRUCTION ENTRANCE. THE SIGN SHALL HAVE THE FOLLOWING INFORMATION:
   - 6.1. A COPY OF THE NOTICE OF COVERAGE WITH THE NPDES PERMIT NUMBER (FURNISHED BY CONSTRUCTION MANAGER).
   - 6.2. THE NAME AND TELEPHONE NUMBER OF A LOCAL CONTACT PERSON (FURNISHED BY CONSTRUCTION MANAGER).
   - 6.3. DESCRIPTION OF PROJECT (FURNISHED BY CONSTRUCTION MANAGER).
7. REFER TO 00C001 FOR ADDITIONAL EROSION AND SEDIMENTATION CONTROL NOTES

KEY NOTES:

1. STABILIZED CONSTRUCTION EXIT. SEE DETAIL 5/99C501.
2. SILT FENCE. SEE DETAIL 4/99C501.
3. INLET PROTECTION. SEE DETAIL 6/99C502.
4. TREE PROTECTION. SEE DETAIL 5/99C502.

ESC LEGEND

LIMITS OF DISTRUBANCE
LOD ——— LOD

SILT FENCE
SF — SF — SF

TREE PROTECTION

INLET PROTECTION

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Date 6/12/2025 4:20:31 PM

HDR
TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	B. SMITH
DRAWN BY	G. MCCLINTON
CHECKED BY	K. LEISSING
APPROVED BY	K. LEISSING
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS · KARIN S. LEISSING · 143328 · LICENSED PROFESSIONAL ENGINEER

LEWISVILLE
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CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

N
0 1" 2"

EROSION AND SEDIMENT CONTROL PLAN

FILENAME 00C103.dwg
SCALE 1" = 50'
SHEET 00C103

SHEET NOTES:

1. SEE GENERAL NOTES ON SHEET 00G005.
2. THIS DEMOLITION PLAN IS FOR SITE ITEMS ONLY. FOR YARD PIPING, SEE SHEETS 00CX161-00CX164.
3. EXISTING STRUCTURES TO REMAIN SHALL BE PROTECTED.
4. SEE SHEET 00G004 FOR LEGEND
5. SEE SPECIFICATION 01 14 16 - COORDINATION WITH OWNER'S OPERATIONS FOR CONSTRUCTION SEQUENCING REQUIREMENTS AND CONSTRAINTS.
6. ALL FULL DEPTH SAWCUT IS REQUIRED AT ALL EDGES OF PAVEMENT REMOVAL.
7. REMOVE ALL SIDEWALK AND PAVEMENT TO THE NEAREST JOINT LINE. REMOVAL LIMITS SHOWN ARE APPROXIMATED TO THE NEAREST JOINT LINE.
8. CONTRACTOR SHALL NOT ENTER THE RAILWAY EASEMENT NORTH OF THE PLANT PROPERTY AT ANY TIME DURING CONSTRUCTION OR FENCE WORK.

KEY NOTES:

1. SEE 10DX101 SHEETS FOR DEMOLITION AT EXISTING HEADWORKS EFFLUENT SPLITTER STRUCTURE.
2. SEE 40DX301 FOR DEMOLITION AND MODIFICATIONS TO RAS/WAS PUMP STATION.
3. EXISTING STORM PIPE TO BE REMOVED.
4. FIELD VERIFY THERE ARE NO OTHER CONNECTING PIPES THEN DEMOLISH EXISTING STORM STRUCTURES.
5. SAWCUT EXISTING ASPHALT.
6. EXISTING FENCE TO BE REMOVED. ALL FENCE DEMOLITION SHALL BE DONE WITHIN THE PROPERTY LIMITS OF PRAIRIE CREEK WASTEWATER TREATMENT PLANT.

SITE DEMOLITION LEGEND

LIMITS OF DEMOLITON

EXISTING CONCRETE TO BE REMOVED

EXISTING GRAVEL TO BE REMOVED

EXISTING ASPHALT TO BE REMOVED

File Path C:\Users\BLSMITH\DCACCDocs\HDR\10342803_COL_PCWWT_AB_Expansion_2024\Project Files\01_HDR\05_Civil_C\05.03_Sheet Files\00C104.dwg
Date 10/16/2025 9:37:05 AM

HDR
TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	OCT 16 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	B. SMITH
DRAWN BY	G. MCCLINTON
CHECKED BY	K. LEISSING
APPROVED BY	K. LEISSING
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
KARIN S. LEISSING
143328
LICENSED
PROFESSIONAL ENGINEER

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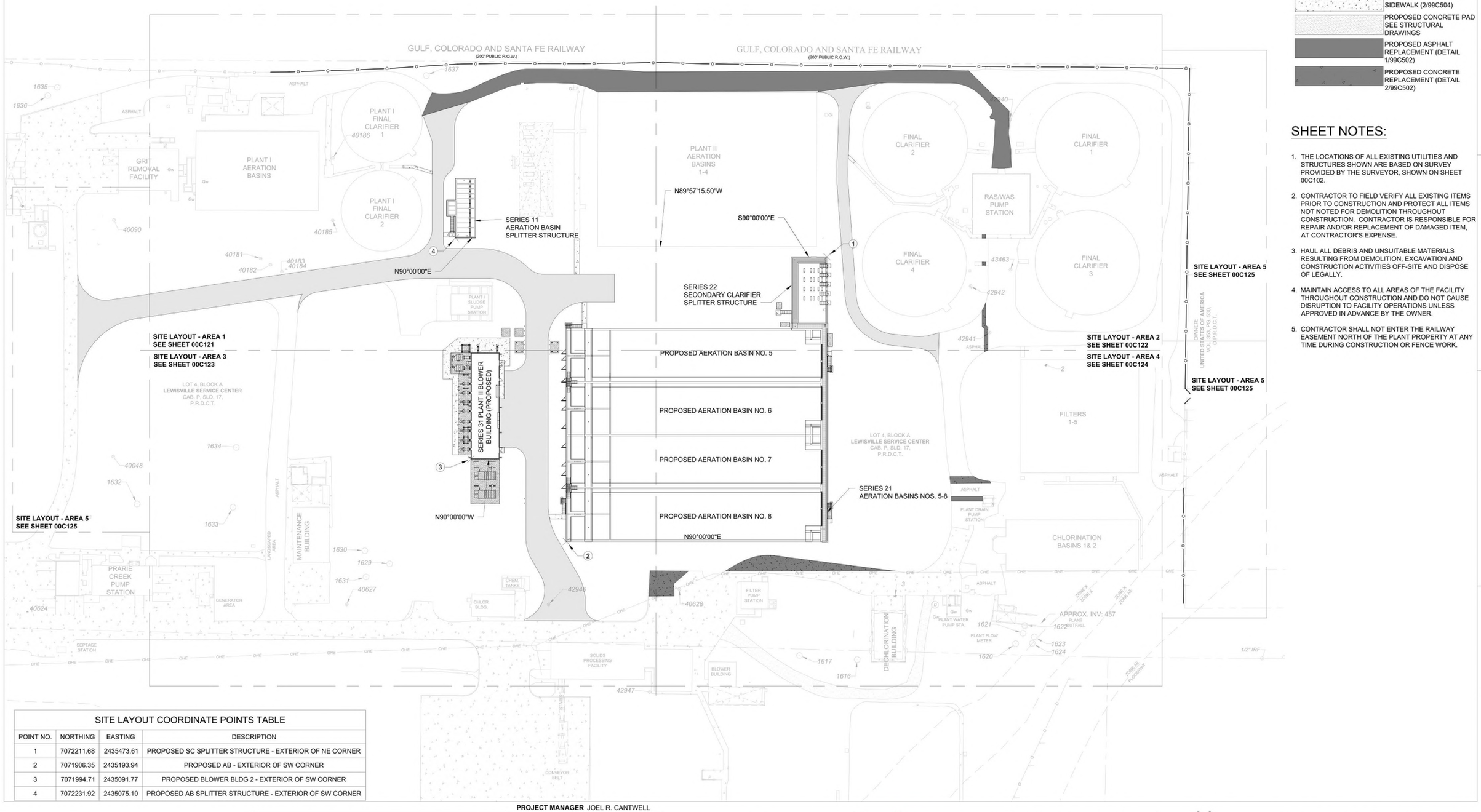
CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

N
0 1" 2"

FINAL SITE DEMOLITION PLAN

FILENAME 00C104.dwg
SCALE 1" = 50'
SHEET 00C104



SITE PLAN LEGEND

- PROPOSED ASPHALT (DETAIL 2/99C503)
- PROPOSED CONCRETE SIDEWALK (2/99C504)
- PROPOSED CONCRETE PAD SEE STRUCTURAL DRAWINGS
- PROPOSED ASPHALT REPLACEMENT (DETAIL 1/99C502)
- PROPOSED CONCRETE REPLACEMENT (DETAIL 2/99C502)

SHEET NOTES:

1. THE LOCATIONS OF ALL EXISTING UTILITIES AND STRUCTURES SHOWN ARE BASED ON SURVEY PROVIDED BY THE SURVEYOR, SHOWN ON SHEET 00C102.
2. CONTRACTOR TO FIELD VERIFY ALL EXISTING ITEMS PRIOR TO CONSTRUCTION AND PROTECT ALL ITEMS NOT NOTED FOR DEMOLITION THROUGHOUT CONSTRUCTION. CONTRACTOR IS RESPONSIBLE FOR REPAIR AND/OR REPLACEMENT OF DAMAGED ITEM, AT CONTRACTOR'S EXPENSE.
3. HAUL ALL DEBRIS AND UNSUITABLE MATERIALS RESULTING FROM DEMOLITION, EXCAVATION AND CONSTRUCTION ACTIVITIES OFF-SITE AND DISPOSE OF LEGALLY.
4. MAINTAIN ACCESS TO ALL AREAS OF THE FACILITY THROUGHOUT CONSTRUCTION AND DO NOT CAUSE DISRUPTION TO FACILITY OPERATIONS UNLESS APPROVED IN ADVANCE BY THE OWNER.
5. CONTRACTOR SHALL NOT ENTER THE RAILWAY EASEMENT NORTH OF THE PLANT PROPERTY AT ANY TIME DURING CONSTRUCTION OR FENCE WORK.

SITE LAYOUT COORDINATE POINTS TABLE

POINT NO.	NORTHING	EASTING	DESCRIPTION
1	7072211.68	2435473.61	PROPOSED SC SPLITTER STRUCTURE - EXTERIOR OF NE CORNER
2	7071906.35	2435193.94	PROPOSED AB - EXTERIOR OF SW CORNER
3	7071994.71	2435091.77	PROPOSED BLOWER BLDG 2 - EXTERIOR OF SW CORNER
4	7072231.92	2435075.10	PROPOSED AB SPLITTER STRUCTURE - EXTERIOR OF SW CORNER

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	OCT 16 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	B. SMITH
DRAWN BY	G. MCCLINTON
CHECKED BY	K. LEISSING
APPROVED BY	K. LEISSING
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

KARIN S. LEISSING 143328 LICENSED PROFESSIONAL ENGINEER

LEWISVILLE
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CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

OVERALL SITE LAYOUT AND CONTROL PLAN

N

0 1" 2"

FILENAME 00C120.dwg
SCALE 1" = 50'

SHEET 00C120

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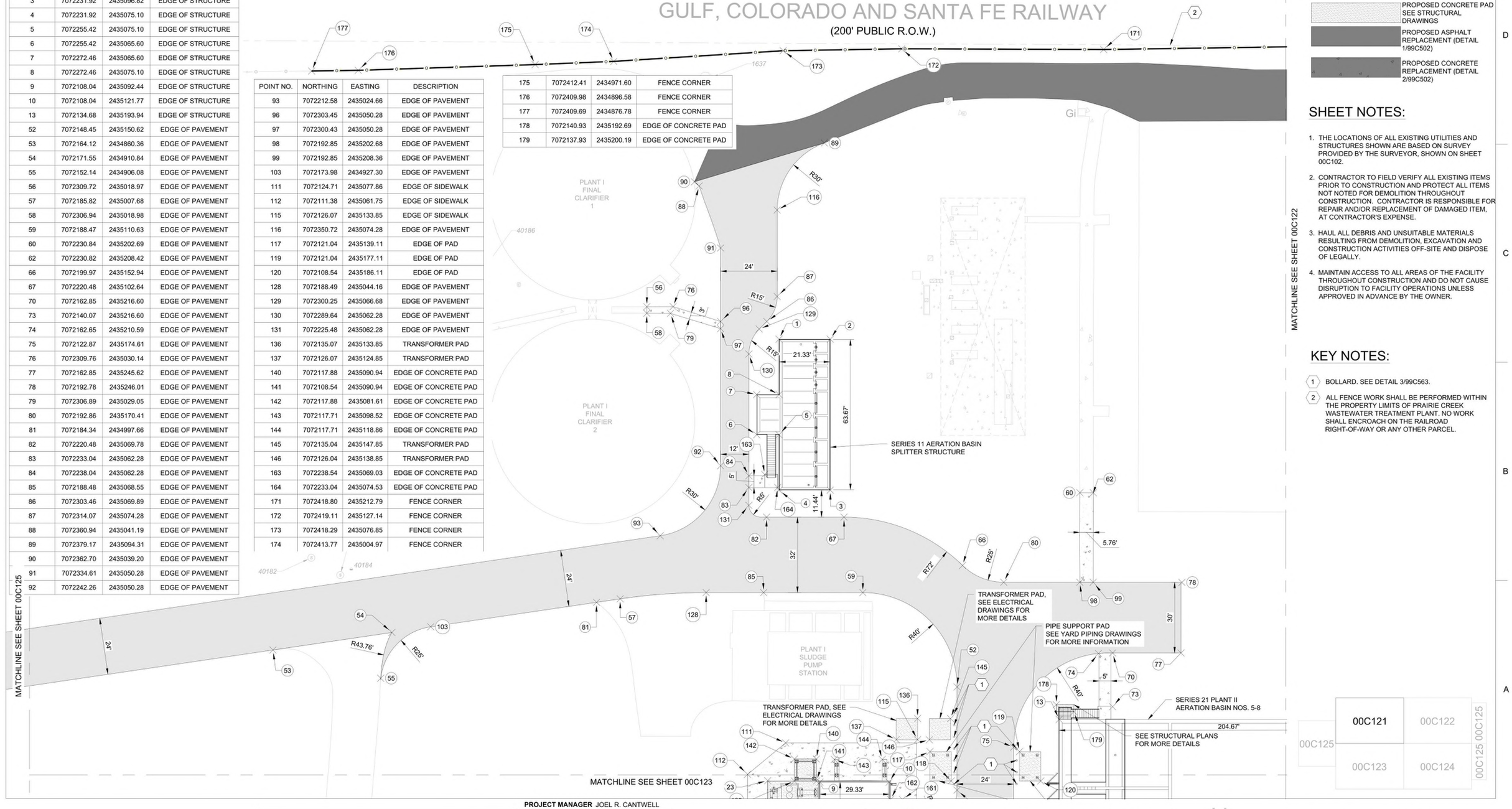
Date 10/16/2025 9:37:31 AM

SITE LAYOUT COORDINATE POINTS TABLE

POINT NO.	NORTHING	EASTING	DESCRIPTION
1	7072295.96	2435075.10	EDGE OF STRUCTURE
2	7072295.96	2435096.82	EDGE OF STRUCTURE
3	7072231.92	2435096.82	EDGE OF STRUCTURE
4	7072231.92	2435075.10	EDGE OF STRUCTURE
5	7072255.42	2435075.10	EDGE OF STRUCTURE
6	7072255.42	2435065.60	EDGE OF STRUCTURE
7	7072272.46	2435065.60	EDGE OF STRUCTURE
8	7072272.46	2435075.10	EDGE OF STRUCTURE
9	7072108.04	2435092.44	EDGE OF STRUCTURE
10	7072108.04	2435121.77	EDGE OF STRUCTURE
13	7072134.68	2435193.94	EDGE OF STRUCTURE
52	7072148.45	2435150.62	EDGE OF PAVEMENT
53	7072164.12	2434860.36	EDGE OF PAVEMENT
54	7072171.55	2434910.84	EDGE OF PAVEMENT
55	7072152.14	2434906.08	EDGE OF PAVEMENT
56	7072309.72	2435018.97	EDGE OF PAVEMENT
57	7072185.82	2435007.68	EDGE OF PAVEMENT
58	7072306.94	2435018.98	EDGE OF PAVEMENT
59	7072188.47	2435110.63	EDGE OF PAVEMENT
60	7072230.84	2435202.69	EDGE OF PAVEMENT
62	7072230.82	2435208.42	EDGE OF PAVEMENT
66	7072199.97	2435152.94	EDGE OF PAVEMENT
67	7072220.48	2435102.64	EDGE OF PAVEMENT
70	7072162.85	2435216.60	EDGE OF PAVEMENT
73	7072140.07	2435216.60	EDGE OF PAVEMENT
74	7072162.65	2435210.59	EDGE OF PAVEMENT
75	7072122.87	2435174.61	EDGE OF PAVEMENT
76	7072309.76	2435030.14	EDGE OF PAVEMENT
77	7072162.85	2435245.62	EDGE OF PAVEMENT
78	7072192.78	2435246.01	EDGE OF PAVEMENT
79	7072306.89	2435029.05	EDGE OF PAVEMENT
80	7072192.86	2435170.41	EDGE OF PAVEMENT
81	7072184.34	2434997.66	EDGE OF PAVEMENT
82	7072220.48	2435069.78	EDGE OF PAVEMENT
83	7072233.04	2435062.28	EDGE OF PAVEMENT
84	7072238.04	2435062.28	EDGE OF PAVEMENT
85	7072188.48	2435068.55	EDGE OF PAVEMENT
86	7072303.46	2435069.89	EDGE OF PAVEMENT
87	7072314.07	2435074.28	EDGE OF PAVEMENT
88	7072360.94	2435041.19	EDGE OF PAVEMENT
89	7072379.17	2435094.31	EDGE OF PAVEMENT
90	7072362.70	2435039.20	EDGE OF PAVEMENT
91	7072334.61	2435050.28	EDGE OF PAVEMENT
92	7072242.26	2435050.28	EDGE OF PAVEMENT

POINT NO.	NORTHING	EASTING	DESCRIPTION
93	7072212.58	2435024.66	EDGE OF PAVEMENT
96	7072303.45	2435050.28	EDGE OF PAVEMENT
97	7072300.43	2435050.28	EDGE OF PAVEMENT
98	7072192.85	2435202.68	EDGE OF PAVEMENT
99	7072192.85	2435208.36	EDGE OF PAVEMENT
103	7072173.98	2434927.30	EDGE OF PAVEMENT
111	7072124.71	2435077.86	EDGE OF SIDEWALK
112	7072111.38	2435061.75	EDGE OF SIDEWALK
115	7072126.07	2435133.85	EDGE OF SIDEWALK
116	7072350.72	2435074.28	EDGE OF PAVEMENT
117	7072121.04	2435139.11	EDGE OF PAD
119	7072121.04	2435177.11	EDGE OF PAD
120	7072108.54	2435186.11	EDGE OF PAD
128	7072188.49	2435044.16	EDGE OF PAVEMENT
129	7072300.25	2435066.68	EDGE OF PAVEMENT
130	7072289.64	2435062.28	EDGE OF PAVEMENT
131	7072225.48	2435062.28	EDGE OF PAVEMENT
136	7072135.07	2435133.85	TRANSFORMER PAD
137	7072126.07	2435124.85	TRANSFORMER PAD
140	7072117.88	2435090.94	EDGE OF CONCRETE PAD
141	7072108.54	2435090.94	EDGE OF CONCRETE PAD
142	7072117.88	2435081.61	EDGE OF CONCRETE PAD
143	7072117.71	2435098.52	EDGE OF CONCRETE PAD
144	7072117.71	2435118.86	EDGE OF CONCRETE PAD
145	7072135.04	2435147.85	TRANSFORMER PAD
146	7072126.04	2435138.85	TRANSFORMER PAD
163	7072238.54	2435069.03	EDGE OF CONCRETE PAD
164	7072233.04	2435074.53	EDGE OF CONCRETE PAD
171	7072418.80	2435212.79	FENCE CORNER
172	7072419.11	2435127.14	FENCE CORNER
173	7072418.29	2435076.85	FENCE CORNER
174	7072413.77	2435004.97	FENCE CORNER

175	7072412.41	2434971.60	FENCE CORNER
176	7072409.98	2434896.58	FENCE CORNER
177	7072409.69	2434876.78	FENCE CORNER
178	7072140.93	2435192.69	EDGE OF CONCRETE PAD
179	7072137.93	2435200.19	EDGE OF CONCRETE PAD



SITE PLAN LEGEND

- PROPOSED ASPHALT (DETAIL 2/99C503)
- PROPOSED CONCRETE SIDEWALK (2/99C504)
- PROPOSED CONCRETE PAD SEE STRUCTURAL DRAWINGS
- PROPOSED ASPHALT REPLACEMENT (DETAIL 1/99C502)
- PROPOSED CONCRETE REPLACEMENT (DETAIL 2/99C502)

SHEET NOTES:

1. THE LOCATIONS OF ALL EXISTING UTILITIES AND STRUCTURES SHOWN ARE BASED ON SURVEY PROVIDED BY THE SURVEYOR, SHOWN ON SHEET 00C102.
2. CONTRACTOR TO FIELD VERIFY ALL EXISTING ITEMS PRIOR TO CONSTRUCTION AND PROTECT ALL ITEMS NOT NOTED FOR DEMOLITION THROUGHOUT CONSTRUCTION. CONTRACTOR IS RESPONSIBLE FOR REPAIR AND/OR REPLACEMENT OF DAMAGED ITEM, AT CONTRACTOR'S EXPENSE.
3. HAUL ALL DEBRIS AND UNSUITABLE MATERIALS RESULTING FROM DEMOLITION, EXCAVATION AND CONSTRUCTION ACTIVITIES OFF-SITE AND DISPOSE OF LEGALLY.
4. MAINTAIN ACCESS TO ALL AREAS OF THE FACILITY THROUGHOUT CONSTRUCTION AND DO NOT CAUSE DISRUPTION TO FACILITY OPERATIONS UNLESS APPROVED IN ADVANCE BY THE OWNER.

KEY NOTES:

1. BOLLARD. SEE DETAIL 3/99C563.
2. ALL FENCE WORK SHALL BE PERFORMED WITHIN THE PROPERTY LIMITS OF PRAIRIE CREEK WASTEWATER TREATMENT PLANT. NO WORK SHALL ENCROACH ON THE RAILROAD RIGHT-OF-WAY OR ANY OTHER PARCEL.

00C125	00C121	00C122	00C125 00C125
	00C123	00C124	

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	OCT 16 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	B. SMITH
DRAWN BY	G. MCCLINTON
CHECKED BY	K. LEISSING
APPROVED BY	K. LEISSING
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS · KARIN S. LEISSING · 143328 · LICENSED PROFESSIONAL ENGINEER

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

N
0 20' 40'

SITE LAYOUT AND CONTROL PLAN - AREA 1

FILENAME 00C121.dwg
SCALE 1" = 20'
SHEET 00C121

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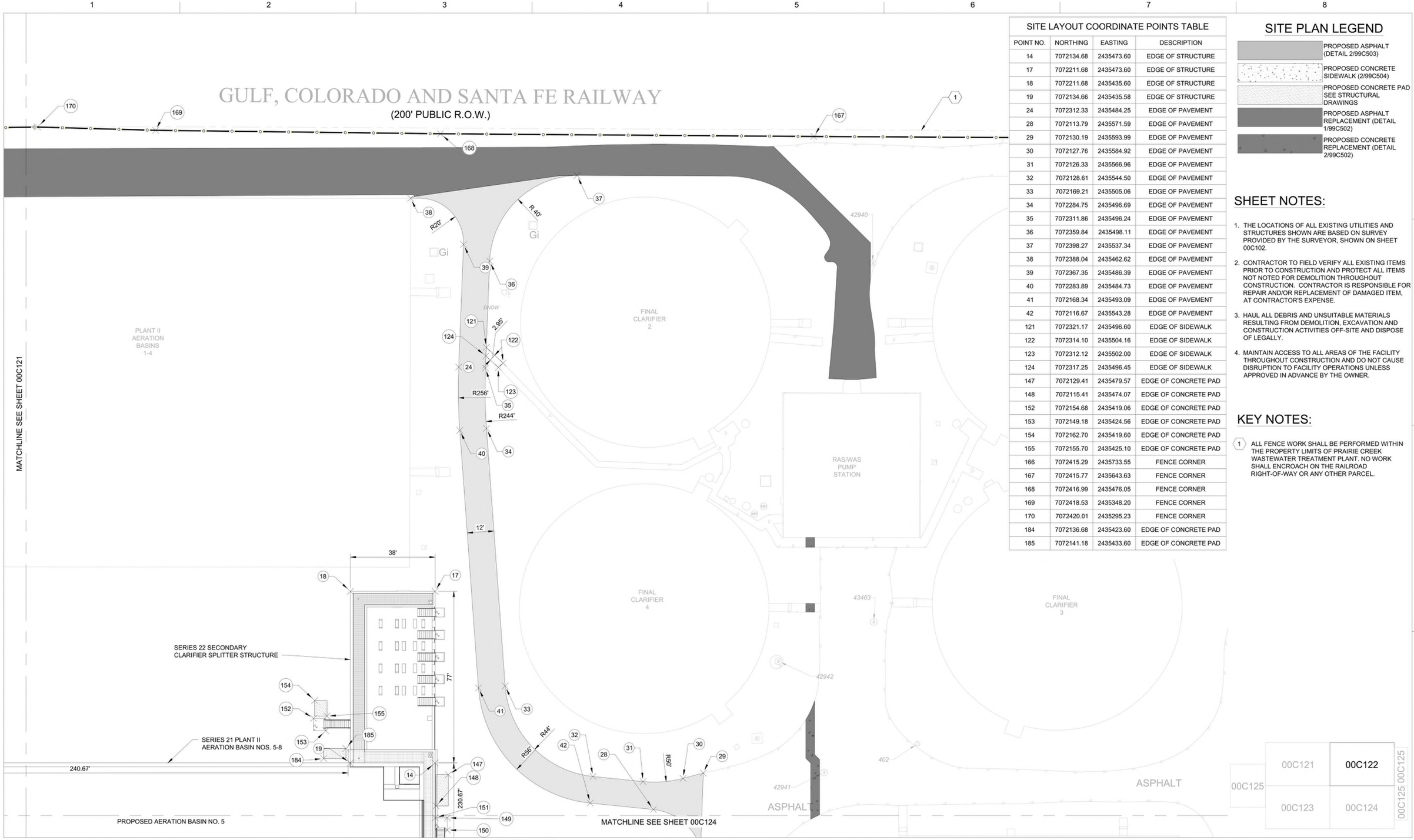

SITE LAYOUT COORDINATE POINTS TABLE			
POINT NO.	NORTHING	EASTING	DESCRIPTION
14	7072134.68	2435473.60	EDGE OF STRUCTURE
17	7072211.68	2435473.60	EDGE OF STRUCTURE
18	7072211.68	2435435.60	EDGE OF STRUCTURE
19	7072134.66	2435435.58	EDGE OF STRUCTURE
24	7072312.33	2435484.25	EDGE OF PAVEMENT
28	7072113.79	2435571.59	EDGE OF PAVEMENT
29	7072130.19	2435593.99	EDGE OF PAVEMENT
30	7072127.76	2435584.92	EDGE OF PAVEMENT
31	7072126.33	2435566.96	EDGE OF PAVEMENT
32	7072128.61	2435544.50	EDGE OF PAVEMENT
33	7072169.21	2435505.06	EDGE OF PAVEMENT
34	7072284.75	2435496.69	EDGE OF PAVEMENT
35	7072311.86	2435496.24	EDGE OF PAVEMENT
36	7072359.84	2435498.11	EDGE OF PAVEMENT
37	7072398.27	2435537.34	EDGE OF PAVEMENT
38	7072388.04	2435462.62	EDGE OF PAVEMENT
39	7072367.35	2435486.39	EDGE OF PAVEMENT
40	7072283.89	2435484.73	EDGE OF PAVEMENT
41	7072168.34	2435493.09	EDGE OF PAVEMENT
42	7072116.67	2435543.28	EDGE OF PAVEMENT
121	7072321.17	2435496.60	EDGE OF SIDEWALK
122	7072314.10	2435504.16	EDGE OF SIDEWALK
123	7072312.12	2435502.00	EDGE OF SIDEWALK
124	7072317.25	2435496.45	EDGE OF SIDEWALK
147	7072129.41	2435479.57	EDGE OF CONCRETE PAD
148	7072115.41	2435474.07	EDGE OF CONCRETE PAD
152	7072154.68	2435419.06	EDGE OF CONCRETE PAD
153	7072149.18	2435424.56	EDGE OF CONCRETE PAD
154	7072162.70	2435419.60	EDGE OF CONCRETE PAD
155	7072155.70	2435425.10	EDGE OF CONCRETE PAD
166	7072415.29	2435733.55	FENCE CORNER
167	7072415.77	2435643.63	FENCE CORNER
168	7072416.99	2435476.05	FENCE CORNER
169	7072418.53	2435348.20	FENCE CORNER
170	7072420.01	2435295.23	FENCE CORNER
184	7072136.68	2435423.60	EDGE OF CONCRETE PAD
185	7072141.18	2435433.60	EDGE OF CONCRETE PAD

SITE PLAN LEGEND

- PROPOSED ASPHALT (DETAIL 2/99C503)
- PROPOSED CONCRETE SIDEWALK (2/99C504)
- PROPOSED CONCRETE PAD SEE STRUCTURAL DRAWINGS
- PROPOSED ASPHALT REPLACEMENT (DETAIL 1/99C502)
- PROPOSED CONCRETE REPLACEMENT (DETAIL 2/99C502)

SHEET NOTES:

1. THE LOCATIONS OF ALL EXISTING UTILITIES AND STRUCTURES SHOWN ARE BASED ON SURVEY PROVIDED BY THE SURVEYOR, SHOWN ON SHEET 00C102.
2. CONTRACTOR TO FIELD VERIFY ALL EXISTING ITEMS PRIOR TO CONSTRUCTION AND PROTECT ALL ITEMS NOT NOTED FOR DEMOLITION THROUGHOUT CONSTRUCTION. CONTRACTOR IS RESPONSIBLE FOR REPAIR AND/OR REPLACEMENT OF DAMAGED ITEM, AT CONTRACTOR'S EXPENSE.
3. HAUL ALL DEBRIS AND UNSUITABLE MATERIALS RESULTING FROM DEMOLITION, EXCAVATION AND CONSTRUCTION ACTIVITIES OFF-SITE AND DISPOSE OF LEGALLY.
4. MAINTAIN ACCESS TO ALL AREAS OF THE FACILITY THROUGHOUT CONSTRUCTION AND DO NOT CAUSE DISRUPTION TO FACILITY OPERATIONS UNLESS APPROVED IN ADVANCE BY THE OWNER.

KEY NOTES:

(1) ALL FENCE WORK SHALL BE PERFORMED WITHIN THE PROPERTY LIMITS OF PRAIRIE CREEK WASTEWATER TREATMENT PLANT. NO WORK SHALL ENCROACH ON THE RAILROAD RIGHT-OF-WAY OR ANY OTHER PARCEL.

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	OCT 16 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	B. SMITH
DRAWN BY	G. MCCLINTON
CHECKED BY	K. LEISSING
APPROVED BY	K. LEISSING
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
KARIN S. LEISSING
143328
LICENSED
PROFESSIONAL ENGINEER

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

N
0 20' 40'

SITE LAYOUT AND CONTROL PLAN - AREA 2

FILENAME 00C122.dwg
SCALE 1" = 20'
SHEET 00C122

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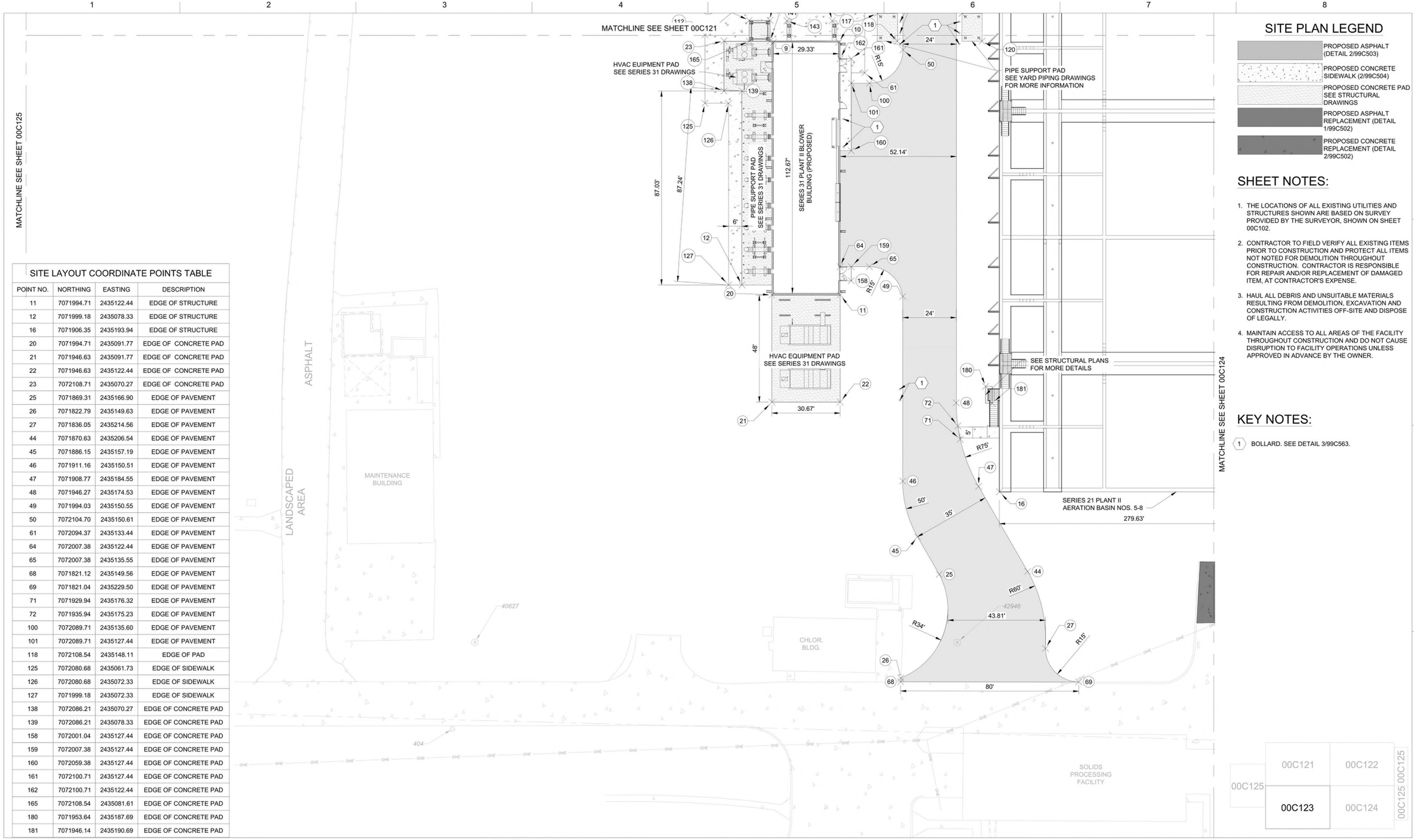

SITE LAYOUT COORDINATE POINTS TABLE

POINT NO.	NORTHING	EASTING	DESCRIPTION
11	7071994.71	2435122.44	EDGE OF STRUCTURE
12	7071999.18	2435078.33	EDGE OF STRUCTURE
16	7071906.35	2435193.94	EDGE OF STRUCTURE
20	7071994.71	2435091.77	EDGE OF CONCRETE PAD
21	7071946.63	2435091.77	EDGE OF CONCRETE PAD
22	7071946.63	2435122.44	EDGE OF CONCRETE PAD
23	7072108.71	2435070.27	EDGE OF CONCRETE PAD
25	7071869.31	2435166.90	EDGE OF PAVEMENT
26	7071822.79	2435149.63	EDGE OF PAVEMENT
27	7071836.05	2435214.56	EDGE OF PAVEMENT
44	7071870.63	2435206.54	EDGE OF PAVEMENT
45	7071886.15	2435157.19	EDGE OF PAVEMENT
46	7071911.16	2435150.51	EDGE OF PAVEMENT
47	7071908.77	2435184.55	EDGE OF PAVEMENT
48	7071946.27	2435174.53	EDGE OF PAVEMENT
49	7071994.03	2435150.55	EDGE OF PAVEMENT
50	7072104.70	2435150.61	EDGE OF PAVEMENT
61	7072094.37	2435133.44	EDGE OF PAVEMENT
64	7072007.38	2435122.44	EDGE OF PAVEMENT
65	7072007.38	2435135.55	EDGE OF PAVEMENT
68	7071821.12	2435149.56	EDGE OF PAVEMENT
69	7071821.04	2435229.50	EDGE OF PAVEMENT
71	7071929.94	2435176.32	EDGE OF PAVEMENT
72	7071935.94	2435175.23	EDGE OF PAVEMENT
100	7072089.71	2435135.60	EDGE OF PAVEMENT
101	7072089.71	2435127.44	EDGE OF PAVEMENT
118	7072108.54	2435148.11	EDGE OF PAD
125	7072080.68	2435061.73	EDGE OF SIDEWALK
126	7072080.68	2435072.33	EDGE OF SIDEWALK
127	7071999.18	2435072.33	EDGE OF SIDEWALK
138	7072086.21	2435070.27	EDGE OF CONCRETE PAD
139	7072086.21	2435078.33	EDGE OF CONCRETE PAD
158	7072001.04	2435127.44	EDGE OF CONCRETE PAD
159	7072007.38	2435127.44	EDGE OF CONCRETE PAD
160	7072059.38	2435127.44	EDGE OF CONCRETE PAD
161	7072100.71	2435127.44	EDGE OF CONCRETE PAD
162	7072100.71	2435122.44	EDGE OF CONCRETE PAD
165	7072108.54	2435081.61	EDGE OF CONCRETE PAD
180	7071953.64	2435187.69	EDGE OF CONCRETE PAD
181	7071946.14	2435190.69	EDGE OF CONCRETE PAD

SITE PLAN LEGEND

- PROPOSED ASPHALT (DETAIL 2/99C503)
- PROPOSED CONCRETE SIDEWALK (2/99C504)
- PROPOSED CONCRETE PAD SEE STRUCTURAL DRAWINGS
- PROPOSED ASPHALT REPLACEMENT (DETAIL 1/99C502)
- PROPOSED CONCRETE REPLACEMENT (DETAIL 2/99C502)

SHEET NOTES:

1. THE LOCATIONS OF ALL EXISTING UTILITIES AND STRUCTURES SHOWN ARE BASED ON SURVEY PROVIDED BY THE SURVEYOR, SHOWN ON SHEET 00C102.
2. CONTRACTOR TO FIELD VERIFY ALL EXISTING ITEMS PRIOR TO CONSTRUCTION AND PROTECT ALL ITEMS NOT NOTED FOR DEMOLITION THROUGHOUT CONSTRUCTION. CONTRACTOR IS RESPONSIBLE FOR REPAIR AND/OR REPLACEMENT OF DAMAGED ITEM, AT CONTRACTOR'S EXPENSE.
3. HAUL ALL DEBRIS AND UNSUITABLE MATERIALS RESULTING FROM DEMOLITION, EXCAVATION AND CONSTRUCTION ACTIVITIES OFF-SITE AND DISPOSE OF LEGALLY.
4. MAINTAIN ACCESS TO ALL AREAS OF THE FACILITY THROUGHOUT CONSTRUCTION AND DO NOT CAUSE DISRUPTION TO FACILITY OPERATIONS UNLESS APPROVED IN ADVANCE BY THE OWNER.

KEY NOTES:

(1) BOLLARD. SEE DETAIL 3/99C563.

00C125 | 00C121 | 00C122 | 00C125 00C125
00C123 | 00C124

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TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	OCT 16 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	B. SMITH
DRAWN BY	G. MCCLINTON
CHECKED BY	K. LEISSING
APPROVED BY	K. LEISSING
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
KARIN S. LEISSING
143328
LICENSED
PROFESSIONAL ENGINEER

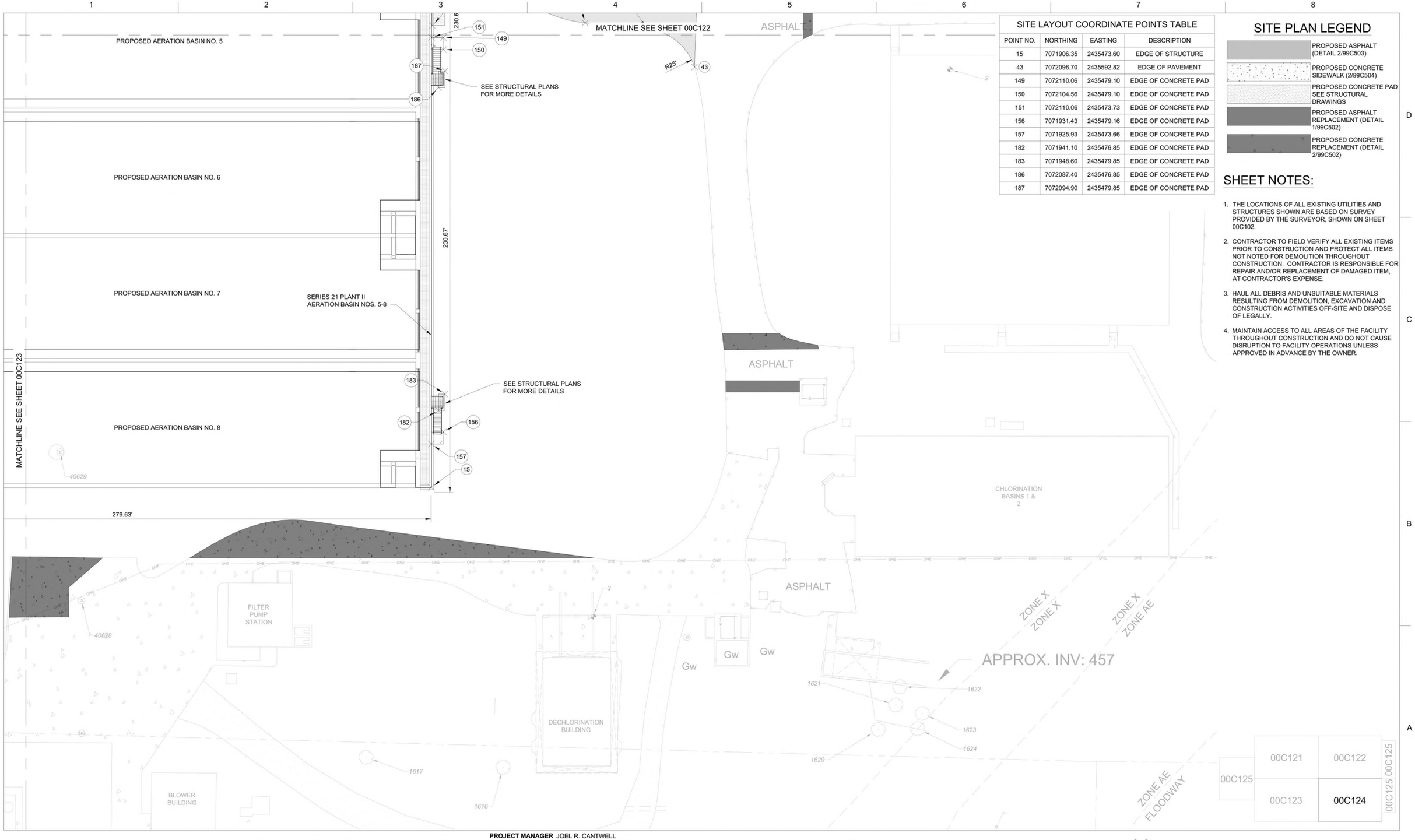
LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

N
0 20' 40'

SITE LAYOUT AND CONTROL PLAN - AREA 3

FILENAME 00C123.dwg
SCALE 1" = 20'
SHEET 00C123



SITE LAYOUT COORDINATE POINTS TABLE			
POINT NO.	NORTHING	EASTING	DESCRIPTION
15	7071906.35	2435473.60	EDGE OF STRUCTURE
43	7072096.70	2435592.82	EDGE OF PAVEMENT
149	7072110.06	2435479.10	EDGE OF CONCRETE PAD
150	7072104.56	2435479.10	EDGE OF CONCRETE PAD
151	7072110.06	2435473.73	EDGE OF CONCRETE PAD
156	7071931.43	2435479.16	EDGE OF CONCRETE PAD
157	7071925.93	2435473.66	EDGE OF CONCRETE PAD
182	7071941.10	2435476.85	EDGE OF CONCRETE PAD
183	7071948.60	2435479.85	EDGE OF CONCRETE PAD
186	7072087.40	2435476.85	EDGE OF CONCRETE PAD
187	7072094.90	2435479.85	EDGE OF CONCRETE PAD

SITE PLAN LEGEND

- PROPOSED ASPHALT (DETAIL 2/99C503)
- PROPOSED CONCRETE SIDEWALK (2/99C504)
- PROPOSED CONCRETE PAD SEE STRUCTURAL DRAWINGS
- PROPOSED ASPHALT REPLACEMENT (DETAIL 1/99C502)
- PROPOSED CONCRETE REPLACEMENT (DETAIL 2/99C502)

SHEET NOTES:

1. THE LOCATIONS OF ALL EXISTING UTILITIES AND STRUCTURES SHOWN ARE BASED ON SURVEY PROVIDED BY THE SURVEYOR, SHOWN ON SHEET 00C102.
2. CONTRACTOR TO FIELD VERIFY ALL EXISTING ITEMS PRIOR TO CONSTRUCTION AND PROTECT ALL ITEMS NOT NOTED FOR DEMOLITION THROUGHOUT CONSTRUCTION. CONTRACTOR IS RESPONSIBLE FOR REPAIR AND/OR REPLACEMENT OF DAMAGED ITEM, AT CONTRACTOR'S EXPENSE.
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4. MAINTAIN ACCESS TO ALL AREAS OF THE FACILITY THROUGHOUT CONSTRUCTION AND DO NOT CAUSE DISRUPTION TO FACILITY OPERATIONS UNLESS APPROVED IN ADVANCE BY THE OWNER.

00C125	00C121	00C122	00C125 00C125
	00C123	00C124	

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	OCT 16 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	B. SMITH
DRAWN BY	G. MCCLINTON
CHECKED BY	K. LEISSING
APPROVED BY	K. LEISSING
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
KARIN S. LEISSING
143328
LICENSED
PROFESSIONAL ENGINEER

LEWISVILLE
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CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

N

0 20' 40'

SITE LAYOUT AND CONTROL PLAN - AREA 4

FILENAME 00C124.dwg
SCALE 1" = 20'

SHEET
00C124

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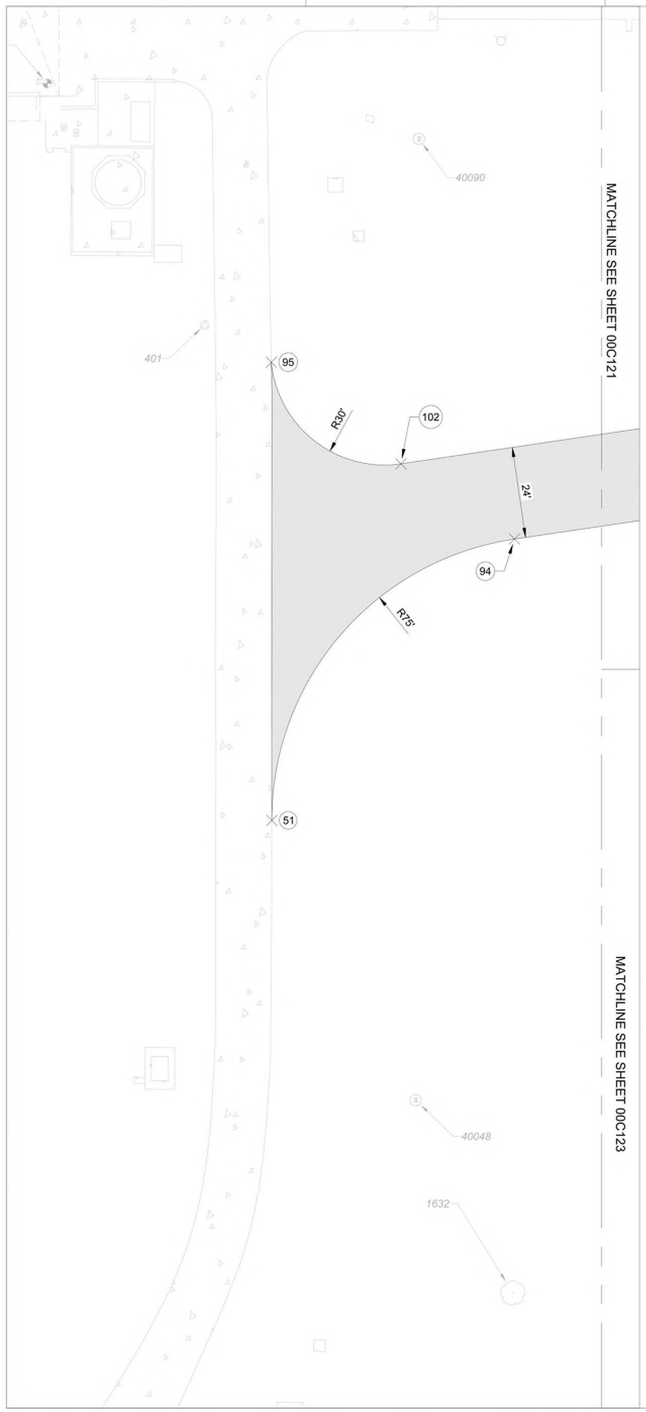
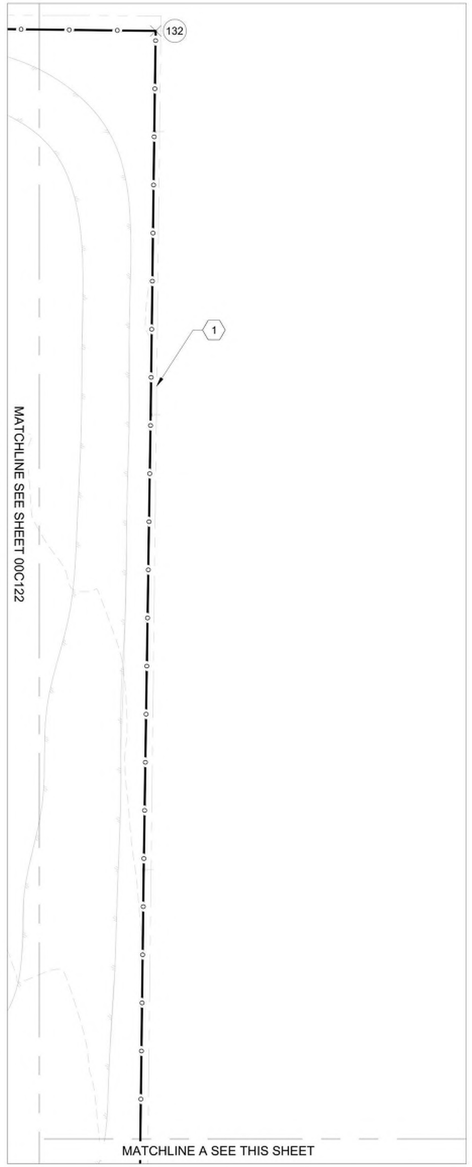
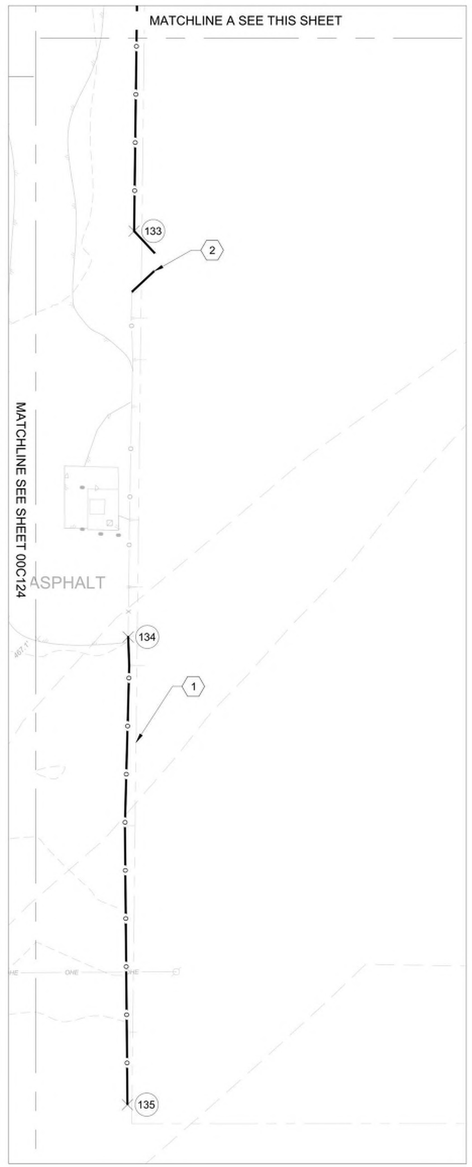






SITE LAYOUT COORDINATE POINTS TABLE			
POINT NO.	NORTHING	EASTING	DESCRIPTION
51	7072071.27	2434670.01	EDGE OF PAVEMENT
94	7072145.52	2434734.08	EDGE OF PAVEMENT
95	7072192.19	2434669.88	EDGE OF PAVEMENT
102	7072165.36	2434704.12	EDGE OF PAVEMENT
133	7072070.39	2435857.84	FENCE CORNER
134	7071963.25	2435856.26	FENCE CORNER
135	7071839.80	2435856.08	FENCE CORNER

SITE PLAN LEGEND

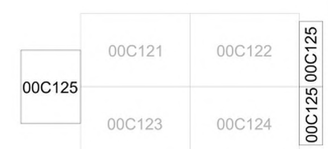
- PROPOSED ASPHALT (DETAIL 2/99C503)
- PROPOSED CONCRETE SIDEWALK (2/99C504)
- PROPOSED CONCRETE PAD SEE STRUCTURAL DRAWINGS
- PROPOSED ASPHALT REPLACEMENT (DETAIL 1/99C502)
- PROPOSED CONCRETE REPLACEMENT (DETAIL 2/99C502)

SHEET NOTES:

1. THE LOCATIONS OF ALL EXISTING UTILITIES AND STRUCTURES SHOWN ARE BASED ON SURVEY PROVIDED BY THE SURVEYOR, SHOWN ON SHEET 00C102.
2. CONTRACTOR TO FIELD VERIFY ALL EXISTING ITEMS PRIOR TO CONSTRUCTION AND PROTECT ALL ITEMS NOT NOTED FOR DEMOLITION THROUGHOUT CONSTRUCTION. CONTRACTOR IS RESPONSIBLE FOR REPAIR AND/OR REPLACEMENT OF DAMAGED ITEM, AT CONTRACTOR'S EXPENSE.
3. HAUL ALL DEBRIS AND UNSUITABLE MATERIALS RESULTING FROM DEMOLITION, EXCAVATION AND CONSTRUCTION ACTIVITIES OFF-SITE AND DISPOSE OF LEGALLY.
4. MAINTAIN ACCESS TO ALL AREAS OF THE FACILITY THROUGHOUT CONSTRUCTION AND DO NOT CAUSE DISRUPTION TO FACILITY OPERATIONS UNLESS APPROVED IN ADVANCE BY THE OWNER.

KEY NOTES:

1. ALL FENCE WORK SHALL BE PERFORMED WITHIN THE PROPERTY LIMITS OF PRAIRIE CREEK WASTEWATER TREATMENT PLANT. NO WORK SHALL ENCROACH ON THE RAILROAD RIGHT-OF-WAY OR ANY OTHER PARCEL.
2. 16' DOUBLE SWING GATE. SEE DETAIL 5/99C503.



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TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	OCT 16 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	B. SMITH
DRAWN BY	G. MCCLINTON
CHECKED BY	K. LEISSING
APPROVED BY	K. LEISSING
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS · KARIN S. LEISSING · 143328 · LICENSED PROFESSIONAL ENGINEER

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

N
0 20' 40'

SITE LAYOUT AND CONTROL PLAN - AREA 5

FILENAME 00C125.dwg
SCALE 1" = 20'

SHEET **00C125**

GRADING PLAN LEGEND

EXISTING CONTOUR
468

PROPOSED CONTOUR
468

SHEET NOTES:

1. SEE GENERAL NOTES ON SHEET 00G005.
2. SEE SHEET 00G004 FOR LEGEND.
3. THE LOCATIONS OF ALL EXISTING UTILITIES AND STRUCTURES SHOWN ARE BASED ON SURVEY PROVIDED BY THE SURVEYOR, SHOWN ON SHEET 00C102.

GULF, COLORADO AND SANTA FE RAILWAY (200' PUBLIC R.O.W.)

GULF, COLORADO AND SANTA FE RAILWAY (200' PUBLIC R.O.W.)

PLANT I FINAL CLARIFIER 1

PLANT I AERATION BASINS

GRIT REMOVAL FACILITY

PLANT II AERATION BASINS 1-4

FINAL CLARIFIER 2

FINAL CLARIFIER 1

FINAL CLARIFIER 4

FINAL CLARIFIER 3

RAS/WAS PUMP STATION

FILTERS 1-5

CHLORINATION BASINS 1 & 2

FILTER PUMP STATION

PRAIRIE CREEK PUMP STATION

GENERATOR AREA

LOT 4, BLOCK A LEWISVILLE SERVICE CENTER CAB. P, SLD. 17, P.R.D.C.T.

OWNER: UNITED STATES OF AMERICA VOL. 383, PG. 530, O.P.R.D.C.T.

FES-B101

FES-B100

FES-A100

CB-A107.1

CB-A107.2

MH-A107

CB-A106.1

CB-A106

CB-A105

CB-A104

MH-A103

MH-A102

MH-A101

CB-A102.2

CB-A102.1

30" CONC. PIPE

APPROX. INV: 457

GRADING AND DRAINAGE - AREA 1
SEE SHEET 00C141

GRADING AND DRAINAGE - AREA 3
SEE SHEET 00C143

GRADING AND DRAINAGE - AREA 2
SEE SHEET 00C142

GRADING AND DRAINAGE - AREA 4
SEE SHEET 00C144

GRADING AND DRAINAGE - AREA 5
SEE SHEET 00C145

SEE YARD PIPING SHEETS FOR RIM ADJUSTMENTS

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TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	OCT 16 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	B. SMITH
DRAWN BY	G. MCCLINTON
CHECKED BY	K. LEISSING
APPROVED BY	K. LEISSING
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
KARIN S. LEISSING
143328
LICENSED PROFESSIONAL ENGINEER

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

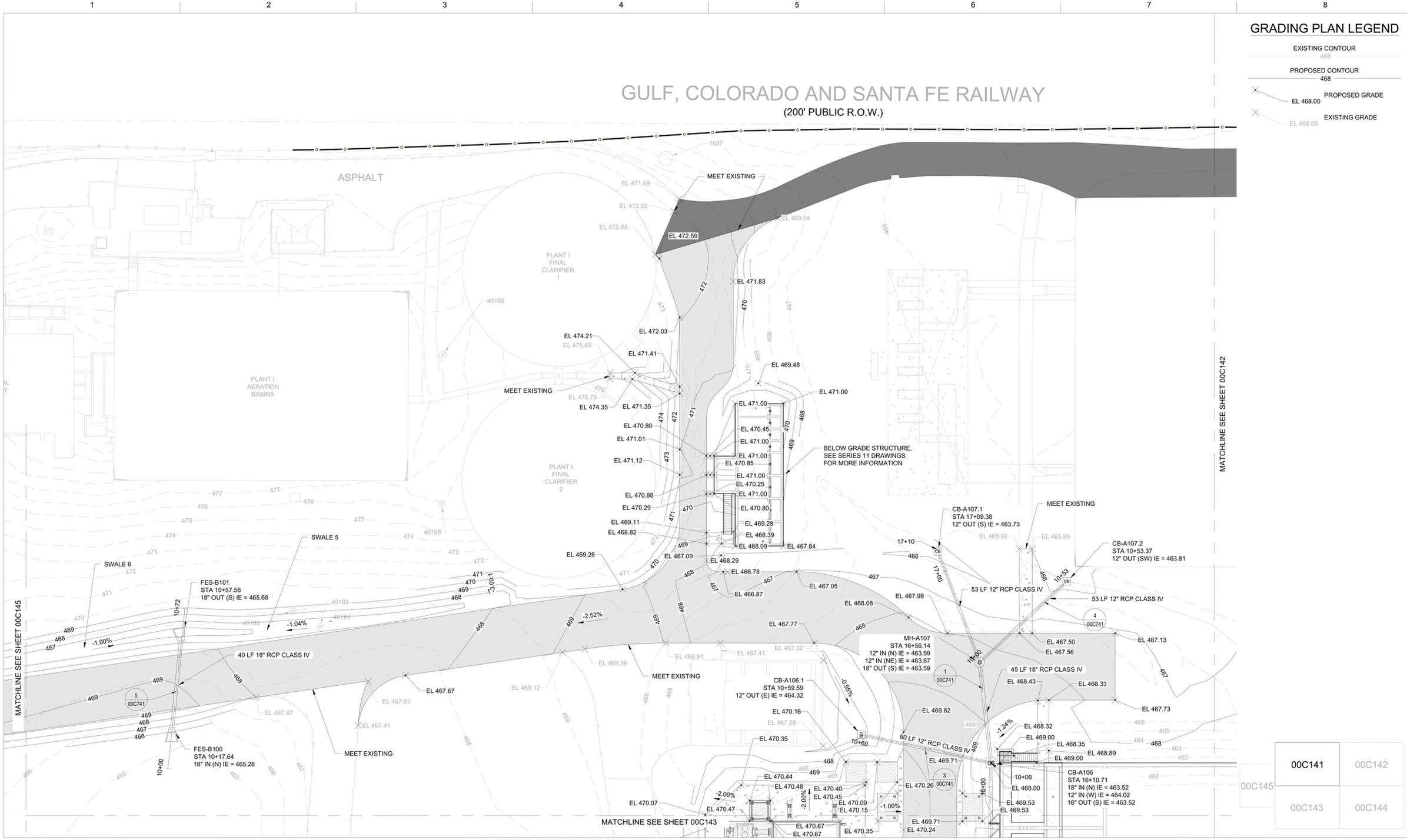
N

0 1" 2"

OVERALL GRADING AND DRAINAGE PLAN

FILENAME 00C140.dwg
SCALE 1" = 50'

SHEET
00C140



GRADING PLAN LEGEND

- EXISTING CONTOUR 468
- PROPOSED CONTOUR 468
- EL 468.00 PROPOSED GRADE
- EL 468.00 EXISTING GRADE

00C145	00C141	00C142	
	00C143	00C144	

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TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	OCT 16 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	B. SMITH
DRAWN BY	G. MCCLINTON
CHECKED BY	K. LEISSING
APPROVED BY	K. LEISSING
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
KARIN S. LEISSING
143328
LICENSED
PROFESSIONAL ENGINEER

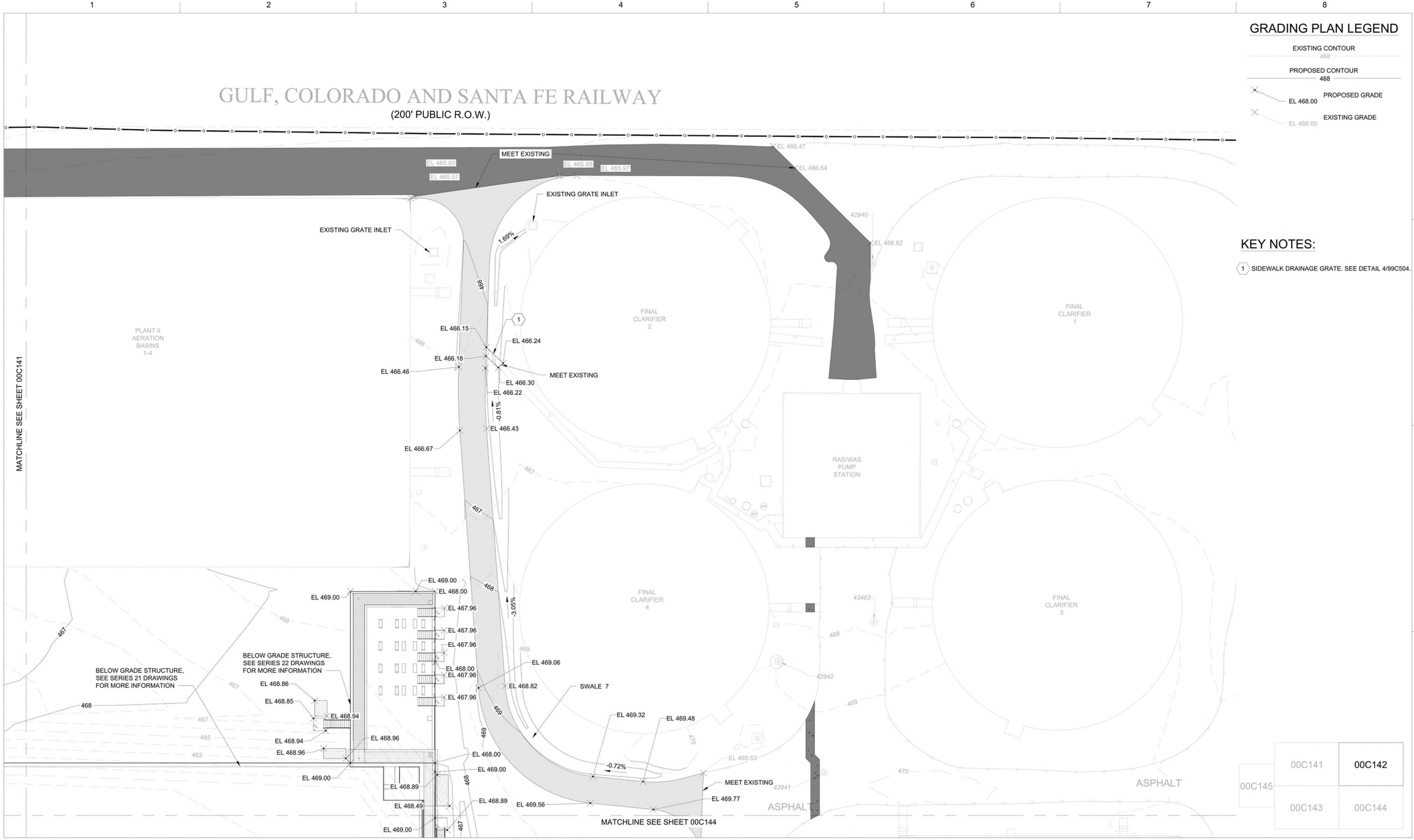
LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

N
0 20' 40'

GRADING AND DRAINAGE PLAN - AREA 1

FILENAME	00C141.dwg
SCALE	1" = 20'
SHEET	00C141



GRADING PLAN LEGEND

EXISTING CONTOUR 468

PROPOSED CONTOUR 468

EL 468.00 PROPOSED GRADE

EL 468.00 EXISTING GRADE

KEY NOTES:

1. SIDEWALK DRAINAGE GRATE. SEE DETAIL 4/99C504.

100%	OCT 16 2025	ISSUED FOR BID
ISSUE	DATE	DESCRIPTION

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	B. SMITH
DRAWN BY	G. MCCLINTON
CHECKED BY	K. LEISSING
APPROVED BY	K. LEISSING
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

TEXAS P.E. FIRM
Registration No. F-754

KARIN S. LEISSING
143328
LICENSED
PROFESSIONAL ENGINEER
STATE OF TEXAS

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

GRADING AND DRAINAGE PLAN - AREA 2

0 20' 40'

FILENAME 00C142.dwg
SCALE 1" = 20'

SHEET 00C142

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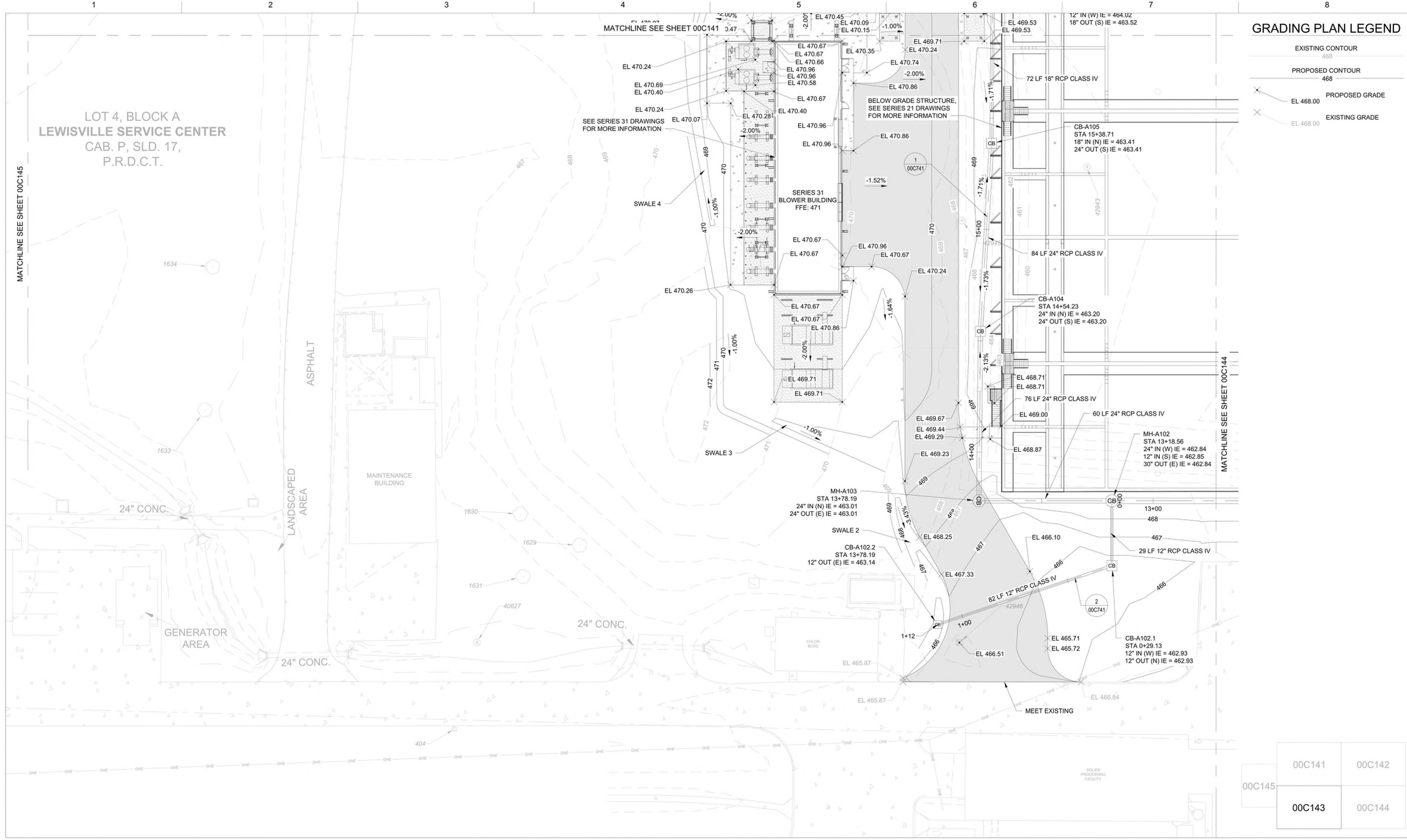

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TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
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DESIGNED BY	B. SMITH
DRAWN BY	G. MCCLINTON
CHECKED BY	K. LEISSING
APPROVED BY	K. LEISSING
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS · KARIN S. LEISSING · 143328 · LICENSED PROFESSIONAL ENGINEER

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

GRADING AND DRAINAGE PLAN - AREA 3

0 20' 40'

FILENAME 00C143.dwg
SCALE 1" = 20'

SHEET 00C143

GRADING PLAN LEGEND

EXISTING CONTOUR 468

PROPOSED CONTOUR 468

EL 468.00 PROPOSED GRADE

EL 468.00 EXISTING GRADE

EL 468.49
EL 468.89
EL 469.56
EL 469.77
MATCHLINE SEE SHEET 00C142
EL 469.00
EL 468.65
EL 468.65
EL 469.36
MEET EXISTING
ASPHALT
FILTERS 1-5
BELOW GRADE STRUCTURE, SEE SERIES 21 DRAWINGS FOR MORE INFORMATION
SWALE 1
GROUTED IN PLACE RIP RAP PROTECTION. SEE DETAIL 3/99C502
EL 468.87
EL 468.87
EL 469.00
EL 468.89
EL 469.00
MATCHLINE SEE SHEET 00C143
236 LF 30" RCP CLASS IV
50 LF 30" RCP CLASS IV
12+00
11+00
10+00
30" CONC. PIPE
CHLORINATION BASINS 1 & 2
FES-A100
STA 10+31.73
30" IN (W) IE = 462.55
MH-A101
STA 10+82.17
30" IN (W) IE = 462.60
30" OUT (E) IE = 462.60
FILTER PUMP STATION
ASPHALT
ZONE X
ZONE X
ZONE X
ZONE AE
APPROX. INV: 457
30" CONC. PIPE
DECHLORINATION BUILDING
BLOWER BUILDING
ZONE AE FLOODWAY
24" CONC

00C141	00C142	
00C145	00C143	00C144

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	B. SMITH
DRAWN BY	G. MCCLINTON
CHECKED BY	K. LEISSING
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CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

ISSUE	DATE	DESCRIPTION
100%	OCT 16 2025	ISSUED FOR BID

TEXAS P.E. FIRM Registration No. F-754

STATE OF TEXAS KARIN S. LEISSING 143328 LICENSED PROFESSIONAL ENGINEER

LEWISVILLE Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

GRADING AND DRAINAGE PLAN - AREA 4

N

0 20' 40'

FILENAME 00C144.dwg

SCALE 1" = 20'

SHEET 00C144

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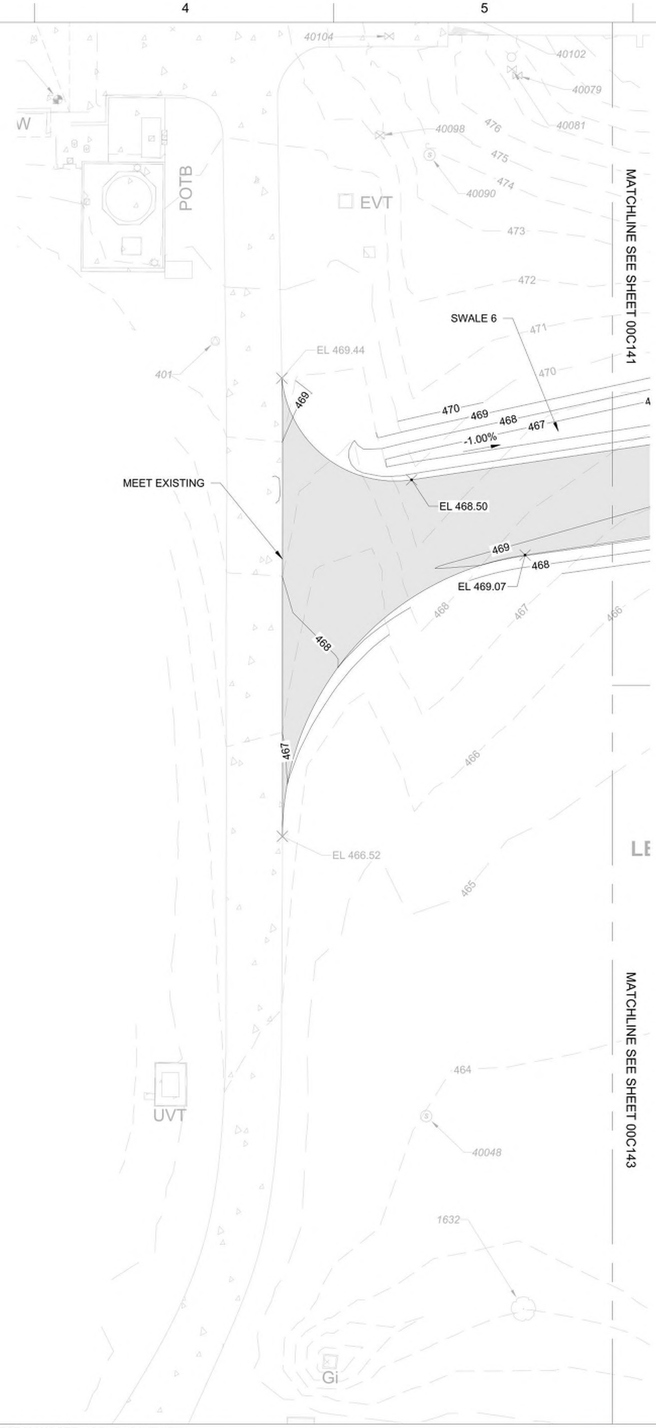

GRADING PLAN LEGEND

EXISTING CONTOUR 468

PROPOSED CONTOUR 468

EL 468.00 PROPOSED GRADE

EL 468.00 EXISTING GRADE

	00C141	00C142
00C145		
	00C143	00C144

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TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	B. SMITH
DRAWN BY	G. MCCLINTON
CHECKED BY	K. LEISSING
APPROVED BY	K. LEISSING
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS · KARIN S. LEISSING · 143328 · LICENSED · PROFESSIONAL ENGINEER

LEWISVILLE
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CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

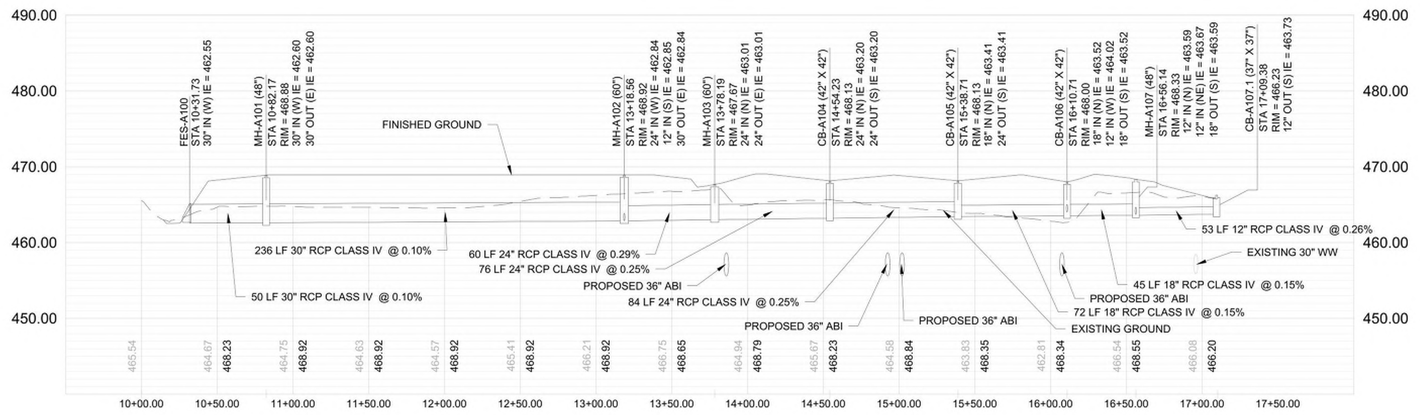
N

0 20' 40'

GRADING AND DRAINAGE PLAN - AREA 5

FILENAME 00C145.dwg
SCALE 1" = 20'

SHEET **00C145**



1 / 00C741 STORM DRAIN PROFILE FES-A100 TO CB-A107.1

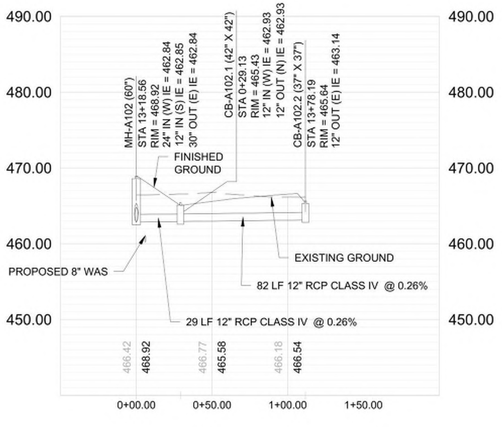
HORIZONTAL SCALE: 1" = 50'
VERTICAL SCALE: 1" = 10'

STRUCTURE TABLE				
NAME	STATION	OFFSET	RIM	CONNECTED PIPES
CB-A102.1	0+29.13	0.00	465.43	12" IN (W) = 462.93 12" OUT (N) = 462.93
CB-A102.2	13+78.19	58.54 L	465.64	12" OUT (E) = 463.14
CB-A104	14+54.23	0.00	468.13	24" IN (N) = 463.20 24" OUT (S) = 463.20
CB-A105	15+38.71	0.00	468.13	18" IN (N) = 463.41 24" OUT (S) = 463.41
CB-A106	16+10.71	0.00	468.00	18" IN (N) = 463.52 12" IN (W) = 464.02 18" OUT (S) = 463.52
CB-A106.1	10+59.59	0.00	466.99	12" OUT (E) = 464.32
CB-A107.1	17+09.38	0.02 L	466.23	12" OUT (S) = 463.73
CB-A107.2	10+53.37	0.00	466.31	12" OUT (SW) = 463.81
FES-A100	10+31.73	0.01 R	465.14	30" IN (W) = 462.55
FES-B100	10+17.64	0.00	467.07	18" IN (N) = 465.28
FES-B101	10+57.56	0.18 L	467.47	18" OUT (S) = 465.68
MH-A101	10+82.17	0.00	468.88	30" IN (W) = 462.60 30" OUT (E) = 462.60
MH-A102	13+18.56	0.00 L	468.92	24" IN (W) = 462.84 12" IN (S) = 462.85 30" OUT (E) = 462.84
MH-A103	13+78.19	0.00	467.67	24" IN (N) = 463.01 24" OUT (E) = 463.01
MH-A107	16+56.14	0.00	468.33	12" IN (N) = 463.59 12" IN (NE) = 463.67 18" OUT (S) = 463.59

PIPE TABLE			
PIPE NAME	SIZE	LENGTH	SLOPE
A100-A101	30"	50'	0.10%
A101-A102	30"	236'	0.10%
A102-A102.1	12"	29'	0.26%
A102-A103	24"	60'	0.29%
A102.1-A102.2	12"	82'	0.26%
A103-A104	24"	76'	0.25%
A104-A105	24"	84'	0.25%
A105-A106	18"	72'	0.15%
A106-A106.1	12"	60'	0.50%
A106-A107	18"	45'	0.15%
A107-A107.1	12"	53'	0.26%
A107-A107.2	12"	53'	0.26%
B100-B101	18"	40'	1.00%

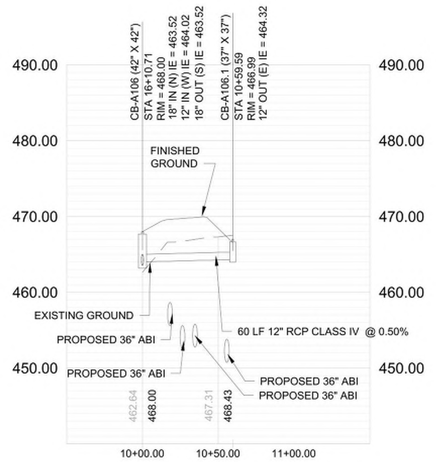
ABBREVIATIONS FOR STRUCTURE NAMES:

MH - MANHOLE, SEE DETAIL 1/99C564
CB - CATCH BASIN, SEE DETAIL 1/99C505
FES - FLARED END STRUCTURE, SEE DETAIL 2/C99505



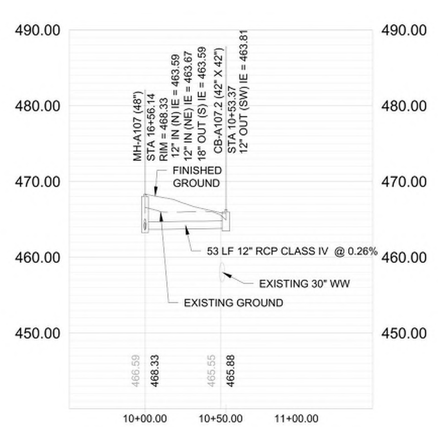
2 / 00C741 STORM DRAIN PROFILE MH-A102 TO CB-A102.2

HORIZONTAL SCALE: 1" = 50'
VERTICAL SCALE: 1" = 10'



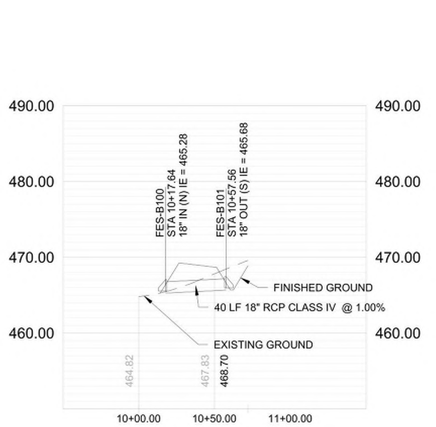
3 / 00C741 STORM DRAIN PROFILE CB-A106 TO CB-A106.1

HORIZONTAL SCALE: 1" = 50'
VERTICAL SCALE: 1" = 10'



4 / 00C741 STORM DRAIN PROFILE CB-A107 TO CB-A107.2

HORIZONTAL SCALE: 1" = 50'
VERTICAL SCALE: 1" = 10'



5 / 00C741 STORM DRAIN PROFILE FES-B100 TO FES-B101

HORIZONTAL SCALE: 1" = 50'
VERTICAL SCALE: 1" = 10'

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Date 6/12/2025 4:23:31 PM

HDR
TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	B. SMITH
DRAWN BY	G. MCCLINTON
CHECKED BY	K. LEISSING
APPROVED BY	K. LEISSING
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS · KARIN S. LEISSING · 143328 · LICENSED PROFESSIONAL ENGINEER

LEWISVILLE
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CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

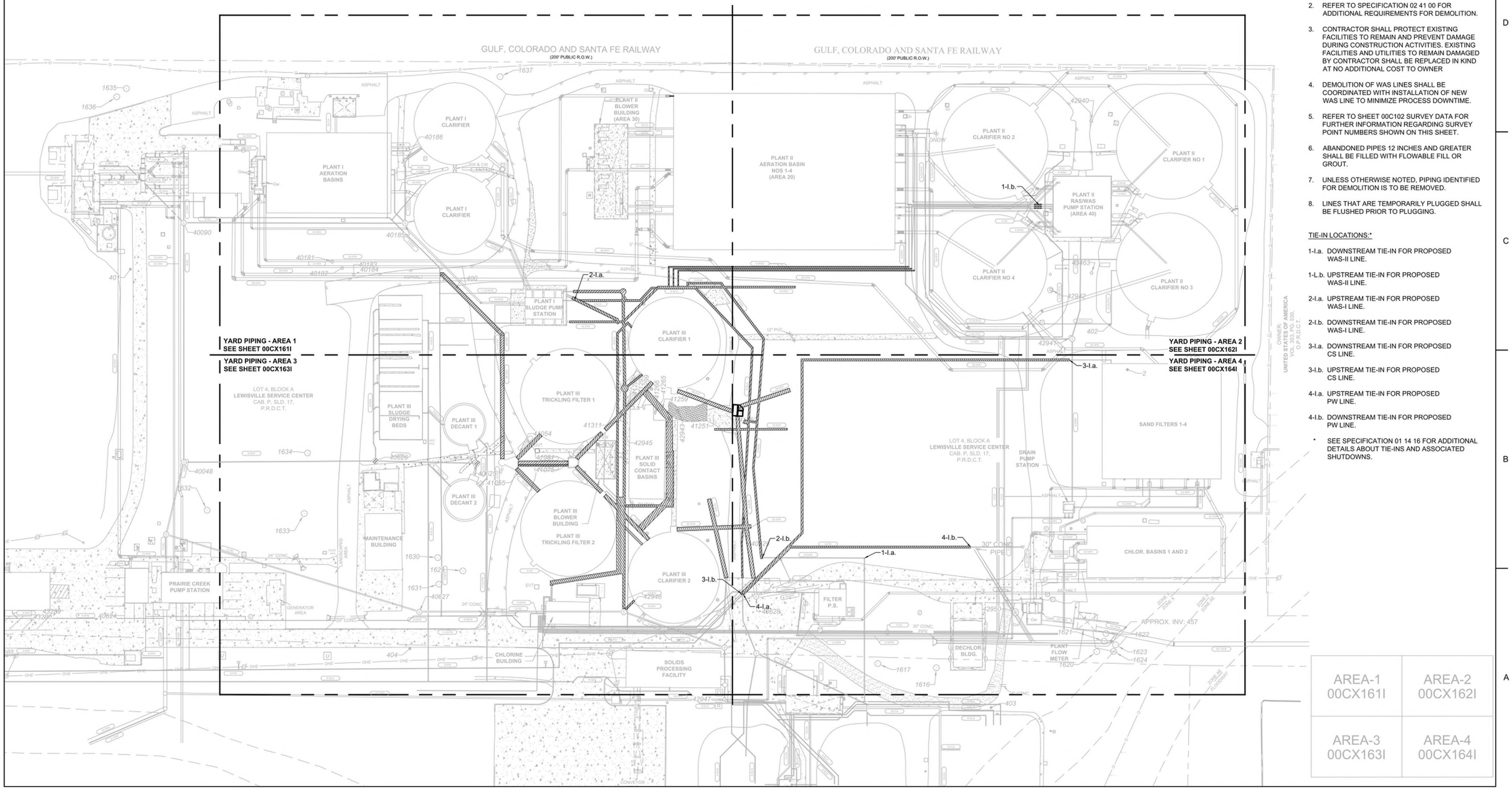
N

0

STORM DRAIN PROFILES

FILENAME 00C741.dwg
SCALE

SHEET 00C741



GENERAL NOTES:

1. REFER TO SPECIFICATION 01 14 16 FOR SEQUENCING OF WORK INFORMATION.
2. REFER TO SPECIFICATION 02 41 00 FOR ADDITIONAL REQUIREMENTS FOR DEMOLITION.
3. CONTRACTOR SHALL PROTECT EXISTING FACILITIES TO REMAIN AND PREVENT DAMAGE DURING CONSTRUCTION ACTIVITIES. EXISTING FACILITIES AND UTILITIES TO REMAIN DAMAGED BY CONTRACTOR SHALL BE REPLACED IN KIND AT NO ADDITIONAL COST TO OWNER
4. DEMOLITION OF WAS LINES SHALL BE COORDINATED WITH INSTALLATION OF NEW WAS LINE TO MINIMIZE PROCESS DOWNTIME.
5. REFER TO SHEET 00C102 SURVEY DATA FOR FURTHER INFORMATION REGARDING SURVEY POINT NUMBERS SHOWN ON THIS SHEET.
6. ABANDONED PIPES 12 INCHES AND GREATER SHALL BE FILLED WITH FLOWABLE FILL OR GROUT.
7. UNLESS OTHERWISE NOTED, PIPING IDENTIFIED FOR DEMOLITION IS TO BE REMOVED.
8. LINES THAT ARE TEMPORARILY PLUGGED SHALL BE FLUSHED PRIOR TO PLUGGING.

TIE-IN LOCATIONS:*

1-I.a. DOWNSTREAM TIE-IN FOR PROPOSED WAS-II LINE.

1-L.b. UPSTREAM TIE-IN FOR PROPOSED WAS-II LINE.

2-I.a. UPSTREAM TIE-IN FOR PROPOSED WAS-I LINE.

2-I.b. DOWNSTREAM TIE-IN FOR PROPOSED WAS-I LINE.

3-I.a. DOWNSTREAM TIE-IN FOR PROPOSED CS LINE.

3-I.b. UPSTREAM TIE-IN FOR PROPOSED CS LINE.

4-I.a. UPSTREAM TIE-IN FOR PROPOSED PW LINE.

4-I.b. DOWNSTREAM TIE-IN FOR PROPOSED PW LINE.

* SEE SPECIFICATION 01 14 16 FOR ADDITIONAL DETAILS ABOUT TIE-INS AND ASSOCIATED SHUTDOWNS.

AREA-1 00CX161I	AREA-2 00CX162I
AREA-3 00CX163I	AREA-4 00CX164I

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TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUN 13/2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	J. THOMPSON
DRAWN BY	T. SCHLOTTMAN
CHECKED BY	S. BEROSET
APPROVED BY	J. THOMPSON
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
JONATHAN D. THOMPSON
147189
LICENSED PROFESSIONAL ENGINEER
06/13/2025

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

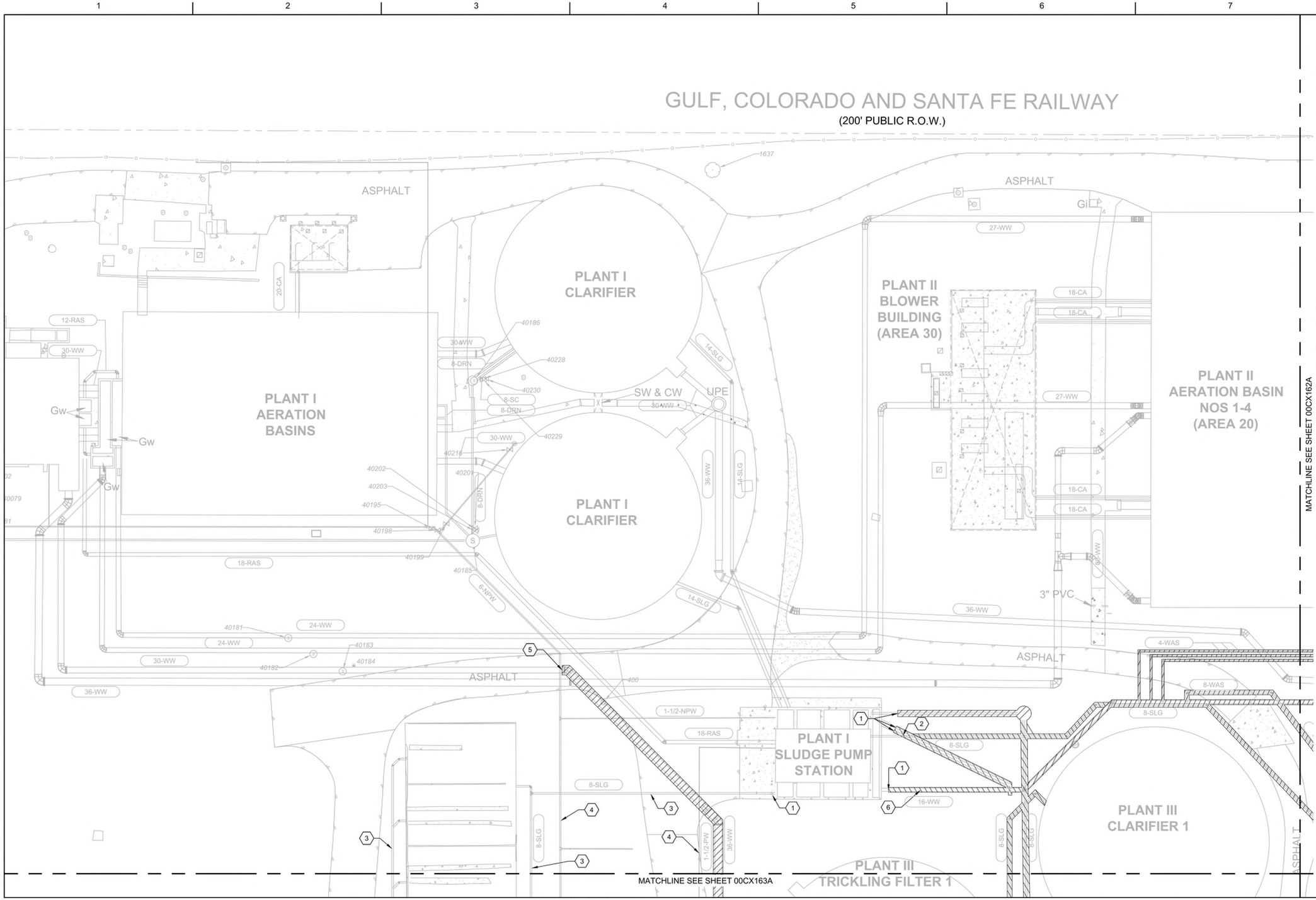
CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

N
0 50' 100'

CIVIL
INTERIM OVERALL YARD PIPING DEMOLITION PLAN

FILENAME 00CX160I.dwg
SCALE 1" = 50'

SHEET **00CX160I**



GENERAL NOTES:

1. REFER TO SPECIFICATION 01 14 16 FOR SEQUENCING OF WORK INFORMATION.
2. REFER TO SPECIFICATION 02 41 00 FOR ADDITIONAL REQUIREMENTS FOR DEMOLITION.
3. CONTRACTOR SHALL PROTECT EXISTING FACILITIES TO REMAIN AND PREVENT DAMAGE DURING CONSTRUCTION ACTIVITIES. EXISTING FACILITIES AND UTILITIES TO REMAIN DAMAGED BY CONTRACTOR SHALL BE REPLACED IN KIND AT NO ADDITIONAL COST TO OWNER
4. DEMOLITION OF WAS LINES SHALL BE COORDINATED WITH INSTALLATION OF NEW WAS LINE TO MINIMIZE PROCESS DOWNTIME.
5. REFER TO SHEET 00C102 SURVEY DATA FOR FURTHER INFORMATION REGARDING SURVEY POINT NUMBERS SHOWN ON THIS SHEET.

KEYNOTES:

1. CUT AND PLUG
2. PREPARE FOR CONNECTION TO PROPOSED PIPING
3. ABANDON IN PLACE
4. EXISTING UTILITIES TO REMAIN IN SERVICE - PROTECT DURING DEMOLITION
5. INSTALL TEMPORARY PLUG TO BE REMOVED BY OTHERS FOR FUTURE REUSE OF PIPE TO REMAIN
6. PREVIOUSLY ABANDONED 16" CAST IRON PIPE.

AREA-1 00CX161I	AREA-2 00CX162I
AREA-3 00CX163I	AREA-4 00CX164I

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
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STATE OF TEXAS
JONATHAN D. THOMPSON
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06/13/2025

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

N
20' 40'

CIVIL
INTERIM YARD PIPING DEMO PLAN
AREA - 1

FILENAME 00CX161I.dwg
SCALE 1" = 20'

SHEET
00CX161I

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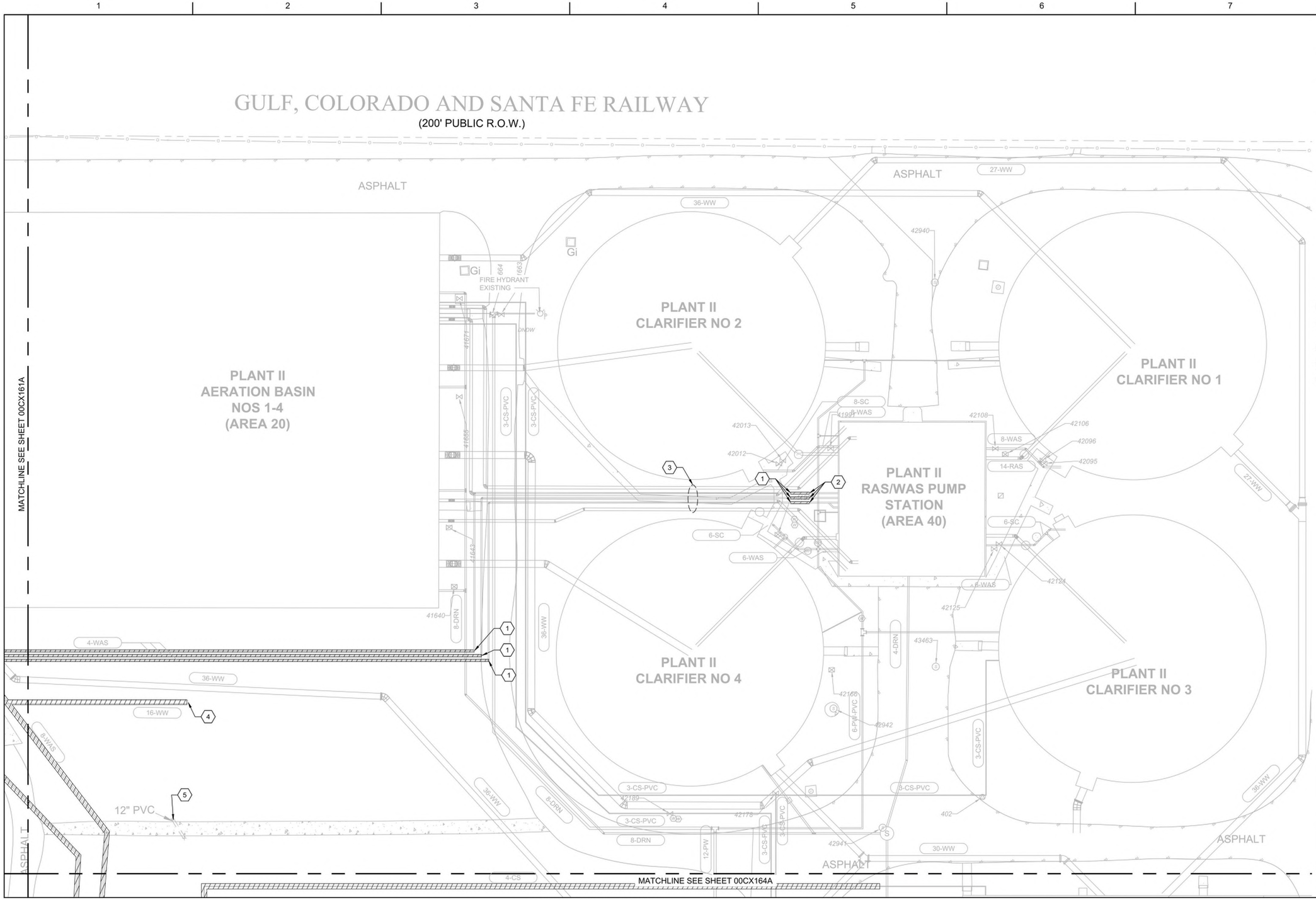

GENERAL NOTES:

1. REFER TO SPECIFICATION 01 14 16 FOR SEQUENCING OF WORK INFORMATION.
2. REFER TO SPECIFICATION 02 41 00 FOR ADDITIONAL REQUIREMENTS FOR DEMOLITION.
3. CONTRACTOR SHALL PROTECT EXISTING FACILITIES TO REMAIN AND PREVENT DAMAGE DURING CONSTRUCTION ACTIVITIES. EXISTING FACILITIES AND UTILITIES TO REMAIN DAMAGED BY CONTRACTOR SHALL BE REPLACED IN KIND AT NO ADDITIONAL COST TO OWNER
4. DEMOLITION OF WAS LINES SHALL BE COORDINATED WITH INSTALLATION OF NEW WAS LINE TO MINIMIZE PROCESS DOWNTIME.
5. REFER TO SHEET 00C102 SURVEY DATA FOR FURTHER INFORMATION REGARDING SURVEY POINT NUMBERS SHOWN ON THIS SHEET.

KEYNOTES:

1. CUT AND PLUG
2. PREPARE FOR CONNECTION TO PROPOSED PIPING
3. ABANDON WAS LINES IN PLACE
4. PREVIOUSLY ABANDONED 16" CAST IRON PIPE
5. 12"-PVC DRAINAGE PIPE TO BE DEMOLISHED. SEE SHEET 00C104I.

AREA-1 00CX161I	AREA-2 00CX162I
AREA-3 00CX163I	AREA-4 00CX164I

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TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
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PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	J. THOMPSON
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APPROVED BY	J. THOMPSON
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
JONATHAN D. THOMPSON
147189
LICENSED
PROFESSIONAL ENGINEER
06/13/2025

LEWISVILLE
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CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

N
20' 40'

CIVIL
INTERIM YARD PIPING DEMO PLAN
AREA - 2

FILENAME 00CX162I.dwg
SCALE 1" = 20'

SHEET
00CX162I

MATCHLINE SEE SHEET 00CX161A

LOT 4, BLOCK A
LEWISVILLE SERVICE CENTER
CAB. P, SLD. 17,
P.R.D.C.T.

PLANT III
SLUDGE DRYING
BEDS

PLANT III
DECANT 1

PLANT III
DECANT 2

PLANT III
TRICKLING FILTER 1

PLANT III
TRICKLING FILTER 2

PLANT III
CLARIFIER 1

PLANT III
CLARIFIER 2

PLANT III
SOLID
CONTACT
BASINS

MAINTENANCE
BUILDING

GENERATOR
AREA

CHLORINE
BUILDING

SOLIDS
PROCESSING
FACILITY

LANDSCAPED
AREA

ASPHALT

EXIST.
HH2

EXIST.
HH3

FIRE HYDRANT
EXISTING

EVT

UVT

SW

24" CONC.

MATCHLINE SEE SHEET 00CX164A

GENERAL NOTES:

1. REFER TO SPECIFICATION 01 14 16 FOR SEQUENCING OF WORK INFORMATION.
2. REFER TO SPECIFICATION 02 41 00 FOR ADDITIONAL REQUIREMENTS FOR DEMOLITION.
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4. DEMOLITION OF WAS LINES SHALL BE COORDINATED WITH INSTALLATION OF NEW WAS LINE TO MINIMIZE PROCESS DOWNTIME.
5. REFER TO SHEET 00C102 SURVEY DATA FOR FURTHER INFORMATION REGARDING SURVEY POINT NUMBERS SHOWN ON THIS SHEET.

KEYNOTES:

1. CUT AND PLUG
2. ABANDONED
3. ABANDON IN PLACE
4. EXISTING UTILITIES TO REMAIN IN SERVICE - PROTECT DURING DEMOLITION

AREA-1 00CX161I	AREA-2 00CX162I
AREA-3 00CX163I	AREA-4 00CX164I

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HDR
TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
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DESIGNED BY	J. THOMPSON
DRAWN BY	T. SCHLOTTMAN
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APPROVED BY	J. THOMPSON
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
JONATHAN D. THOMPSON
147189
LICENSED
PROFESSIONAL ENGINEER
06/13/2025

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

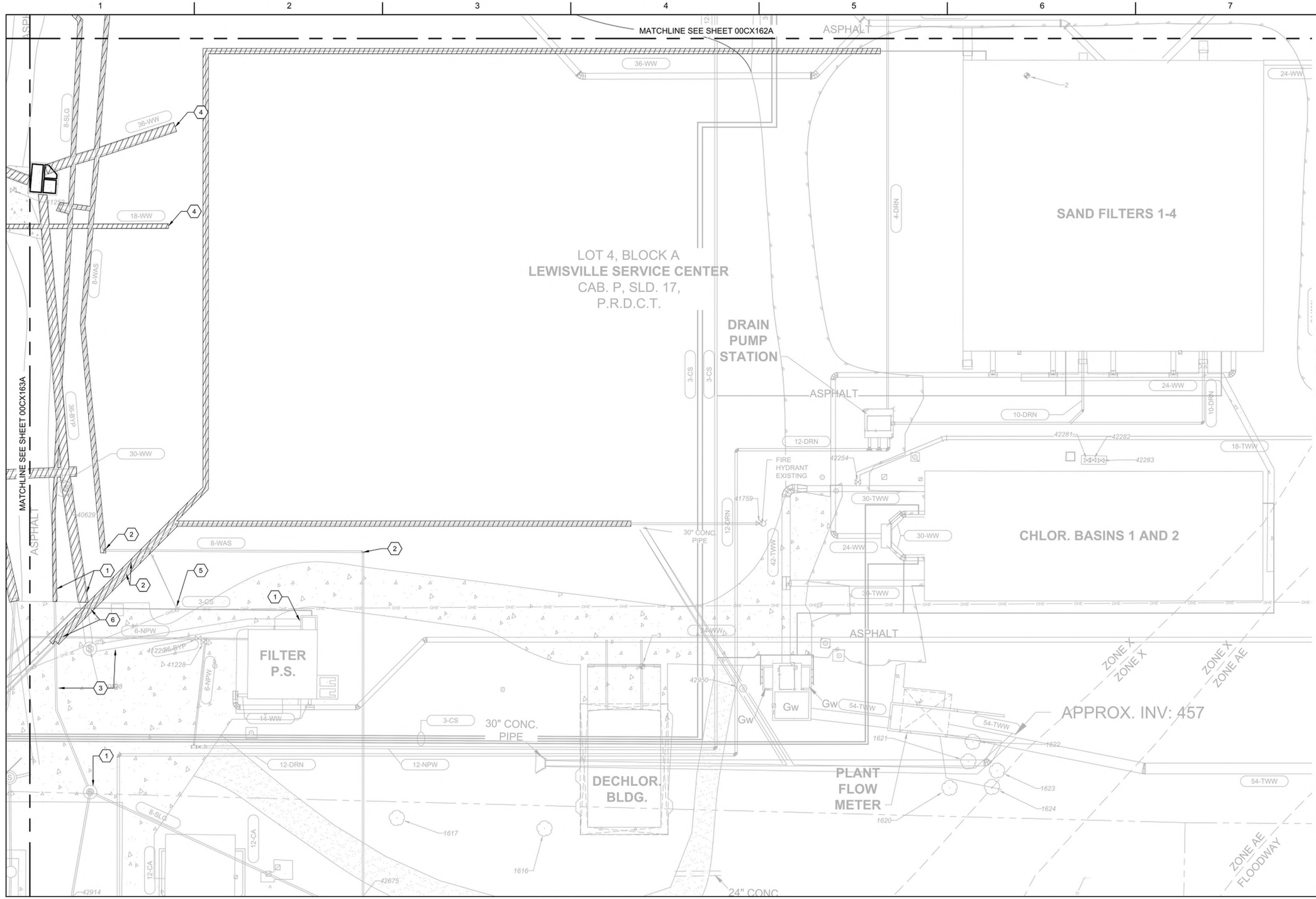
CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

N
20' 40'

CIVIL
INTERIM YARD PIPING DEMO PLAN
AREA - 3

FILENAME 00CX163I.dwg
SCALE 1" = 20'

SHEET
00CX163I



GENERAL NOTES:

1. REFER TO SPECIFICATION 01 14 16 FOR SEQUENCING OF WORK INFORMATION.
2. REFER TO SPECIFICATION 02 41 00 FOR ADDITIONAL REQUIREMENTS FOR DEMOLITION.
3. CONTRACTOR SHALL PROTECT EXISTING FACILITIES TO REMAIN AND PREVENT DAMAGE DURING CONSTRUCTION ACTIVITIES. EXISTING FACILITIES AND UTILITIES TO REMAIN DAMAGED BY CONTRACTOR SHALL BE REPLACED IN KIND AT NO ADDITIONAL COST TO OWNER
4. DEMOLITION OF WAS LINES SHALL BE COORDINATED WITH INSTALLATION OF NEW WAS LINE TO MINIMIZE PROCESS DOWNTIME.
5. REFER TO SHEET 00C102 SURVEY DATA FOR FURTHER INFORMATION REGARDING SURVEY POINT NUMBERS SHOWN ON THIS SHEET.

KEYNOTES:

1. CUT AND PLUG
2. PREPARE FOR CONNECTION TO PROPOSED PIPING
3. ABANDON IN PLACE
4. APPROXIMATE TERMINATION POINT OF PREVIOUSLY ABANDONED LINE.
5. EXISTING POWER POLE. CONTRACTOR TO COORDINATE DEMOLITION WITH THE POWER COMPANY. CONTRACTOR TO COORDINATE DEMOLITION WITH GUY WIRE RELOCATION.
6. PROTECT IN PLACE THE 6-NPW AND 3-CS.

AREA-1 00CX161I	AREA-2 00CX162I
AREA-3 00CX163I	AREA-4 00CX164I

HDR
TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUN 13/2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	J. THOMPSON
DRAWN BY	T. SCHLOTTMAN
CHECKED BY	S. BEROSET
APPROVED BY	J. THOMPSON
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
JONATHAN D. THOMPSON
147189
LICENSED
PROFESSIONAL ENGINEER
06/13/2025

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

N
20' 40'

CIVIL
INTERIM YARD PIPING DEMO PLAN
AREA - 4

FILENAME	00CX164I.dwg
SCALE	1" = 20'

SHEET
00CX164I

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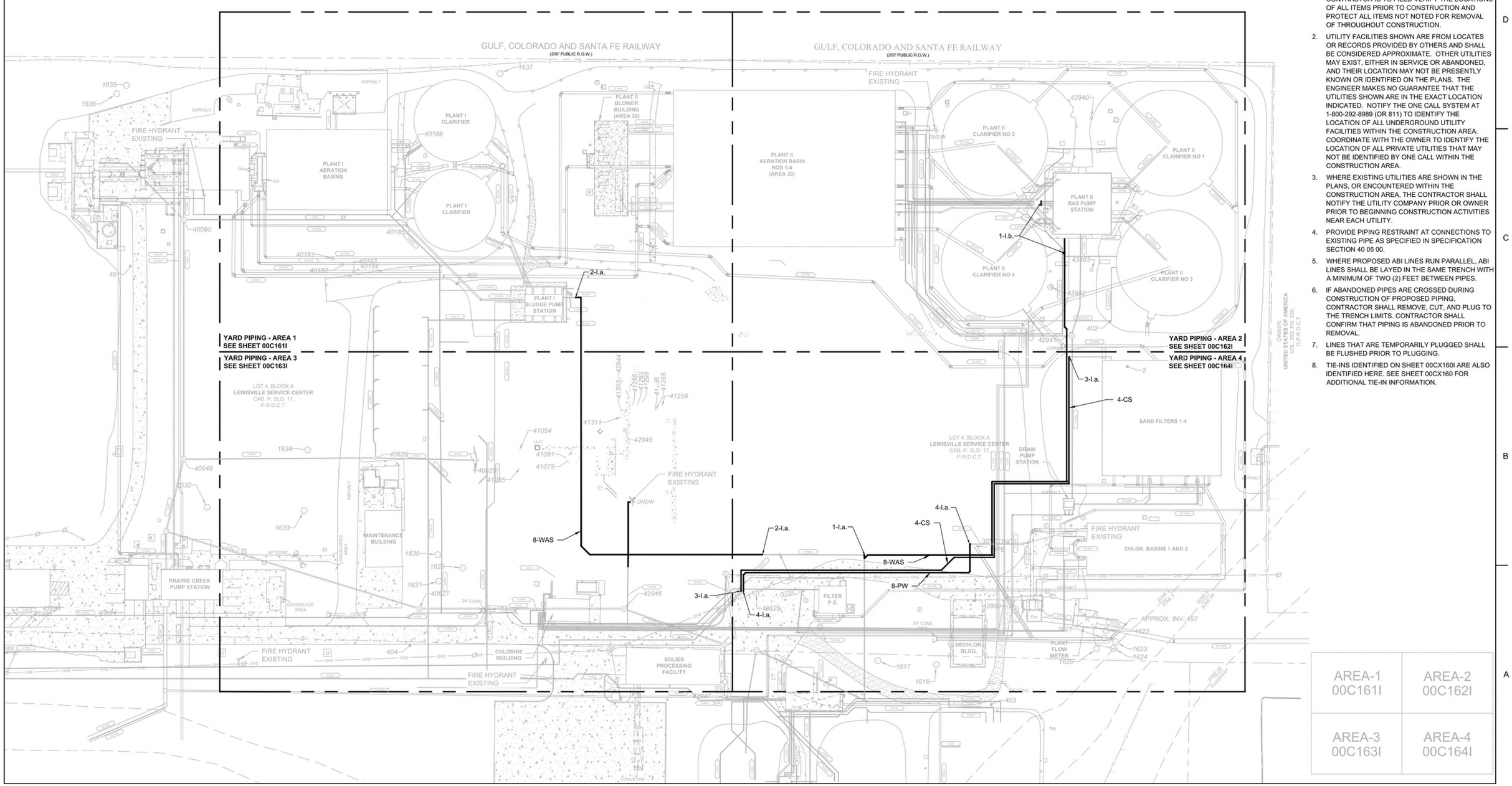

GENERAL NOTES:

1. THE LOCATIONS OF ALL EXISTING UTILITIES AND STRUCTURES SHOWN ARE APPROXIMATE OR MAY NOT BE LOCATED ON THESE PLANS. THE CONTRACTOR IS TO FIELD VERIFY THE LOCATIONS OF ALL ITEMS PRIOR TO CONSTRUCTION AND PROTECT ALL ITEMS NOT NOTED FOR REMOVAL OF THROUGHOUT CONSTRUCTION.
2. UTILITY FACILITIES SHOWN ARE FROM LOCATES OR RECORDS PROVIDED BY OTHERS AND SHALL BE CONSIDERED APPROXIMATE. OTHER UTILITIES MAY EXIST, EITHER IN SERVICE OR ABANDONED, AND THEIR LOCATION MAY NOT BE PRESENTLY KNOWN OR IDENTIFIED ON THE PLANS. THE ENGINEER MAKES NO GUARANTEE THAT THE UTILITIES SHOWN ARE IN THE EXACT LOCATION INDICATED. NOTIFY THE ONE CALL SYSTEM AT 1-800-292-8989 (OR 811) TO IDENTIFY THE LOCATION OF ALL UNDERGROUND UTILITY FACILITIES WITHIN THE CONSTRUCTION AREA. COORDINATE WITH THE OWNER TO IDENTIFY THE LOCATION OF ALL PRIVATE UTILITIES THAT MAY NOT BE IDENTIFIED BY ONE CALL WITHIN THE CONSTRUCTION AREA.
3. WHERE EXISTING UTILITIES ARE SHOWN IN THE PLANS, OR ENCOUNTERED WITHIN THE CONSTRUCTION AREA, THE CONTRACTOR SHALL NOTIFY THE UTILITY COMPANY PRIOR OR OWNER PRIOR TO BEGINNING CONSTRUCTION ACTIVITIES NEAR EACH UTILITY.
4. PROVIDE PIPING RESTRAINT AT CONNECTIONS TO EXISTING PIPE AS SPECIFIED IN SPECIFICATION SECTION 40 05 00.
5. WHERE PROPOSED ABI LINES RUN PARALLEL, ABI LINES SHALL BE LAYED IN THE SAME TRENCH WITH A MINIMUM OF TWO (2) FEET BETWEEN PIPES.
6. IF ABANDONED PIPES ARE CROSSED DURING CONSTRUCTION OF PROPOSED PIPING, CONTRACTOR SHALL REMOVE, CUT, AND PLUG TO THE TRENCH LIMITS. CONTRACTOR SHALL CONFIRM THAT PIPING IS ABANDONED PRIOR TO REMOVAL.
7. LINES THAT ARE TEMPORARILY PLUGGED SHALL BE FLUSHED PRIOR TO PLUGGING.
8. TIE-INS IDENTIFIED ON SHEET 00CX160I ARE ALSO IDENTIFIED HERE. SEE SHEET 00CX160 FOR ADDITIONAL TIE-IN INFORMATION.

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CITY PROJECT NO.	U2100
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STATE OF TEXAS
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06/13/2025

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

CIVIL
INTERIM OVERALL YARD PIPING PLAN

N
0 50' 100'

FILENAME 00C160I.dwg
SCALE 1" = 50'

SHEET
00C160I

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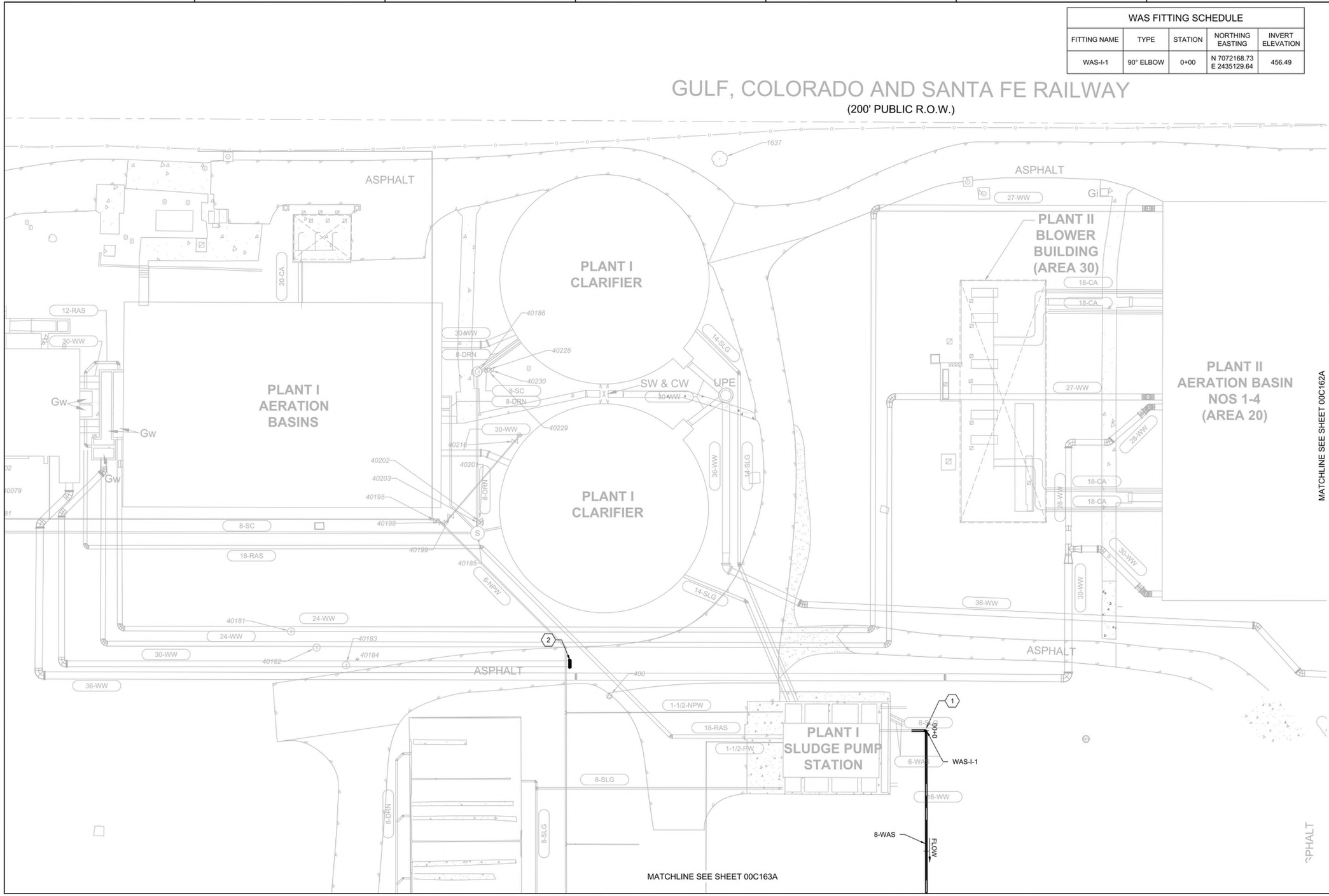
WAS FITTING SCHEDULE				
FITTING NAME	TYPE	STATION	NORTHING EASTING	INVERT ELEVATION
WAS-I-1	90° ELBOW	0+00	N 7072168.73 E 2435129.64	456.49



GENERAL NOTES:

1. REFER TO SPECIFICATION 01 14 16 FOR SEQUENCING OF WORK INFORMATION.
2. REFER TO SPECIFICATION 02 41 00 FOR ADDITIONAL REQUIREMENTS FOR DEMOLITION.
3. CONTRACTOR SHALL PROTECT EXISTING FACILITIES TO REMAIN AND PREVENT DAMAGE DURING CONSTRUCTION ACTIVITIES. EXISTING FACILITIES AND UTILITIES TO REMAIN DAMAGED BY CONTRACTOR SHALL BE REPLACED IN KIND AT NO ADDITIONAL COST TO OWNER
4. DEMOLITION OF WAS LINES SHALL BE COORDINATED WITH INSTALLATION OF NEW WAS LINE TO MINIMIZE PROCESS DOWNTIME.
5. REFER TO SHEET 00C102 SURVEY DATA FOR FURTHER INFORMATION REGARDING SURVEY POINT NUMBERS SHOWN ON THIS SHEET.

KEYNOTES:

1. 8" WAS CLEAN OUT. SEE DETAIL 01/00C561
2. INSTALL TEMPORARY MECHANICAL PLUG WITH MINIMUM PRESSURE RATING OF 100 PSI

AREA-1 00C161I	AREA-2 00C162I
AREA-3 00C163I	AREA-4 00C164I

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CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

CIVIL
INTERIM YARD PIPING PLAN
AREA - 1

FILENAME 00C161I.dwg
SCALE 1" = 20'

SHEET **00C161I**

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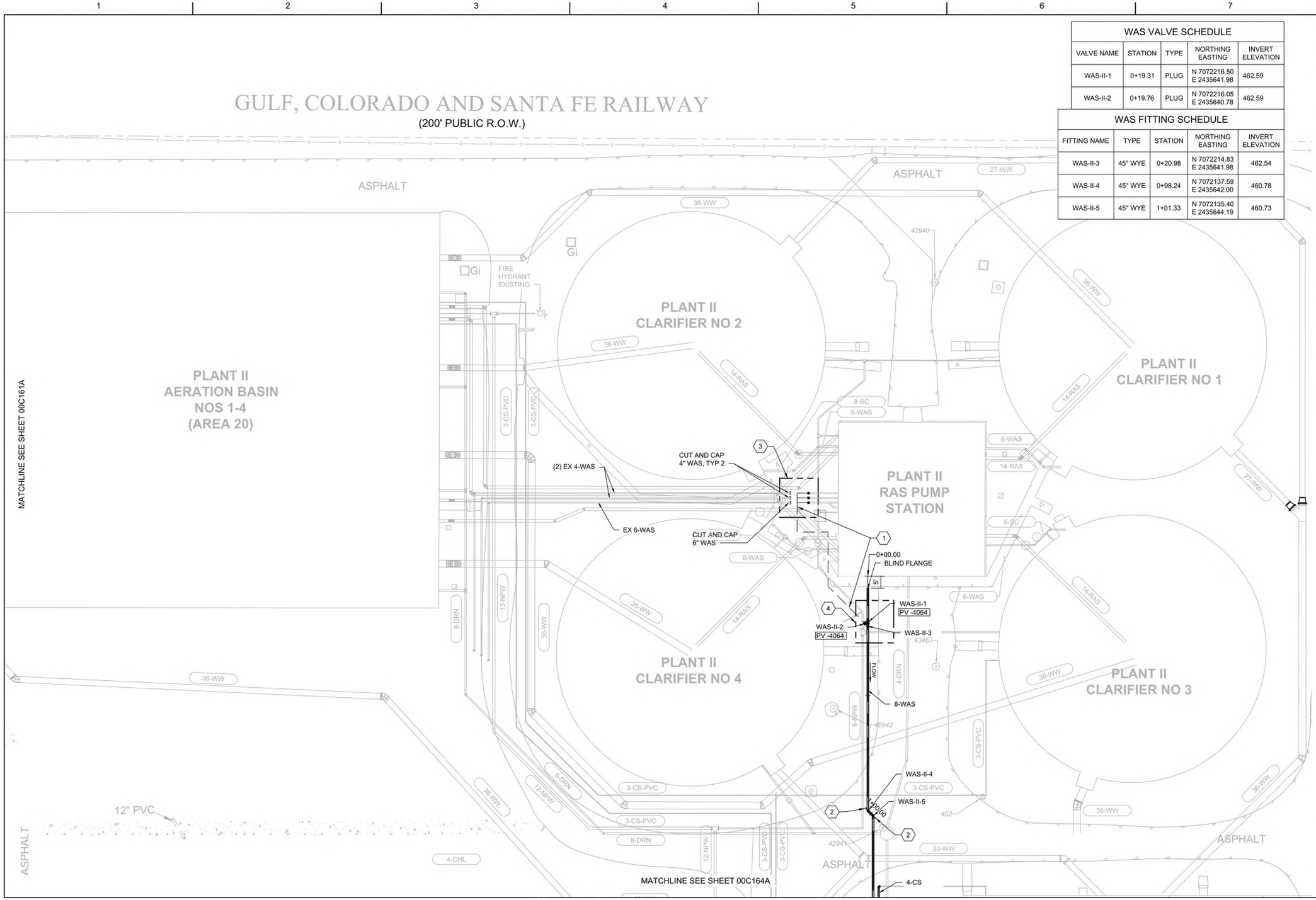

WAS VALVE SCHEDULE				
VALVE NAME	STATION	TYPE	NORTHING EASTING	INVERT ELEVATION
WAS-II-1	0+19.31	PLUG	N 7072216.50 E 2435641.98	462.59
WAS-II-2	0+19.76	PLUG	N 7072216.05 E 2435640.78	462.59

WAS FITTING SCHEDULE				
FITTING NAME	TYPE	STATION	NORTHING EASTING	INVERT ELEVATION
WAS-II-3	45° WYE	0+20.98	N 7072214.83 E 2435641.98	462.54
WAS-II-4	45° WYE	0+98.24	N 7072137.59 E 2435642.00	460.78
WAS-II-5	45° WYE	1+01.33	N 7072135.40 E 2435644.19	460.73

GENERAL NOTES:

1. REFER TO SPECIFICATION 01 14 16 FOR SEQUENCING OF WORK INFORMATION.
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3. CONTRACTOR SHALL PROTECT EXISTING FACILITIES TO REMAIN AND PREVENT DAMAGE DURING CONSTRUCTION ACTIVITIES. EXISTING FACILITIES AND UTILITIES TO REMAIN DAMAGED BY CONTRACTOR SHALL BE REPLACED IN KIND AT NO ADDITIONAL COST TO OWNER
4. DEMOLITION OF WAS LINES SHALL BE COORDINATED WITH INSTALLATION OF NEW WAS LINE TO MINIMIZE PROCESS DOWNTIME.
5. REFER TO SHEET 00C102 SURVEY DATA FOR FURTHER INFORMATION REGARDING SURVEY POINT NUMBERS SHOWN ON THIS SHEET.
6. WHERE PROPOSED WAS AND CS LINES RUN PARALLEL, LINES SHALL BE LAYED IN THE SAME TRENCH WITH A MINIMUM OF ONE (1) FOOT BETWEEN PIPES.

KEYNOTES:

1. FIELD ROUTE ONE BURIED 8" WAS PIPE FROM THREE EXISTING WAS PIPES (4", 4", 6") TO NEW 8" WAS PIPE. PROVIDE AT LEAST 12" COVER AT ALL POINTS.
2. 8" WAS PRESSURE PIPE CLEANOUT. SEE DETAIL 01/00C561
3. CONNECTION DETAIL. SEE DETAIL 02/00C561
4. CONNECTION DETAIL. SEE DETAIL 03/00C561

AREA-1 00C161I	AREA-2 00C162I
AREA-3 00C163I	AREA-4 00C164I

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CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
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LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

CIVIL
INTERIM YARD PIPING PLAN
AREA - 2

N
20' 40'

FILENAME 00C162I.dwg
SCALE 1" = 20'

SHEET **00C162I**

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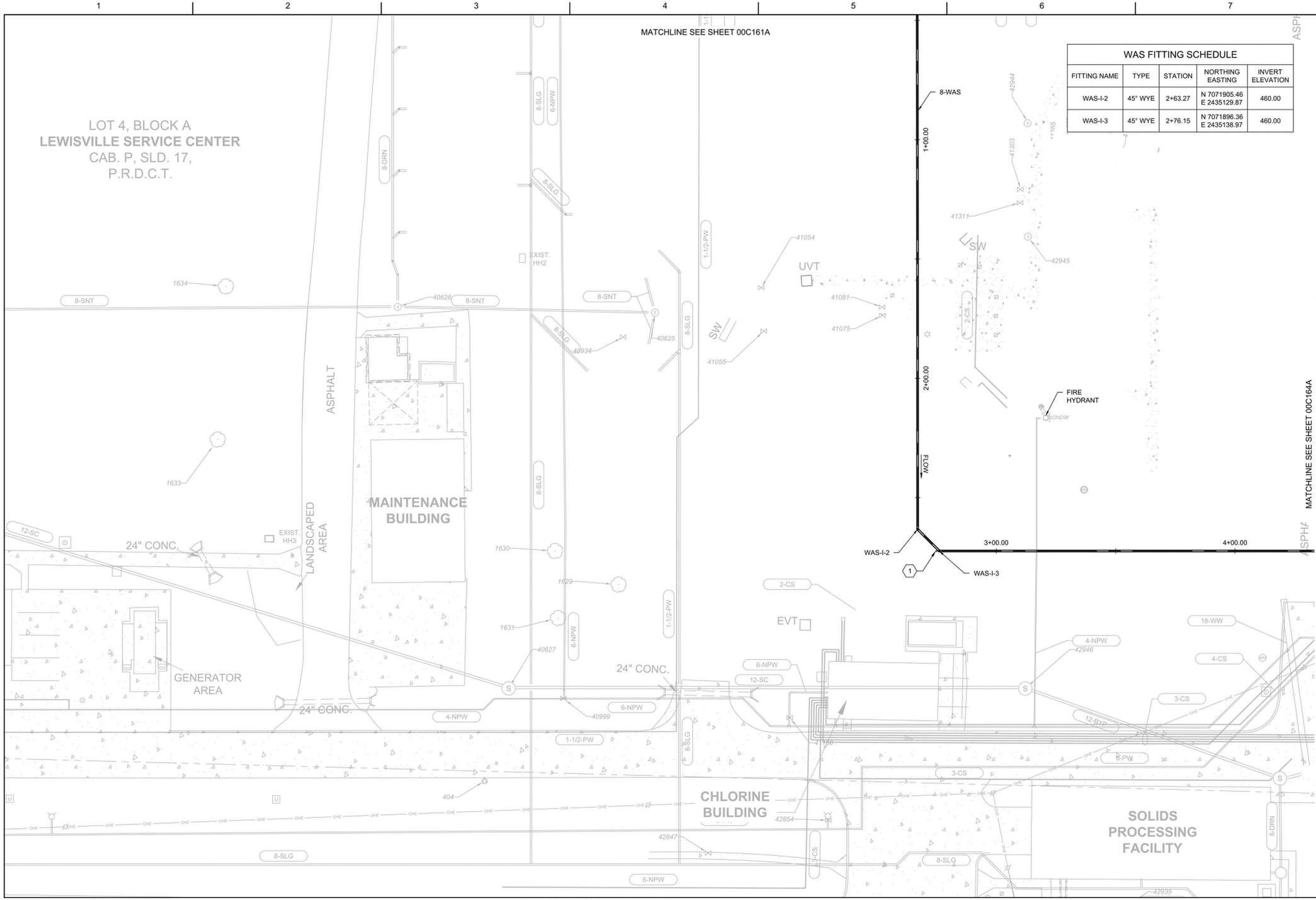

WAS FITTING SCHEDULE				
FITTING NAME	TYPE	STATION	NORTHING EASTING	INVERT ELEVATION
WAS-I-2	45° WYE	2+63.27	N 7071905.46 E 2435129.87	460.00
WAS-I-3	45° WYE	2+76.15	N 7071896.36 E 2435138.97	460.00

GENERAL NOTES:

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4. DEMOLITION OF WAS LINES SHALL BE COORDINATED WITH INSTALLATION OF NEW WAS LINE TO MINIMIZE PROCESS DOWNTIME.
5. REFER TO SHEET 00C102 SURVEY DATA FOR FURTHER INFORMATION REGARDING SURVEY POINT NUMBERS SHOWN ON THIS SHEET.

KEYNOTES:

(1) 8" WAS PRESSURE PIPE CLEAN OUT. SEE DETAIL 01/00C561

AREA-1 00CX161I	AREA-2 00CX162I
AREA-3 00CX163I	AREA-4 00CX164I

TEXAS P.E. FIRM
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STATE OF TEXAS
JONATHAN D. THOMPSON
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06/13/2025

LEWISVILLE
Deep Roots. Broad Wings. Bright Future

CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

N
20' 40'

CIVIL
INTERIM YARD PIPING PLAN
AREA - 3

FILENAME 00C163I.dwg
SCALE 1" = 20'

SHEET
00C163I

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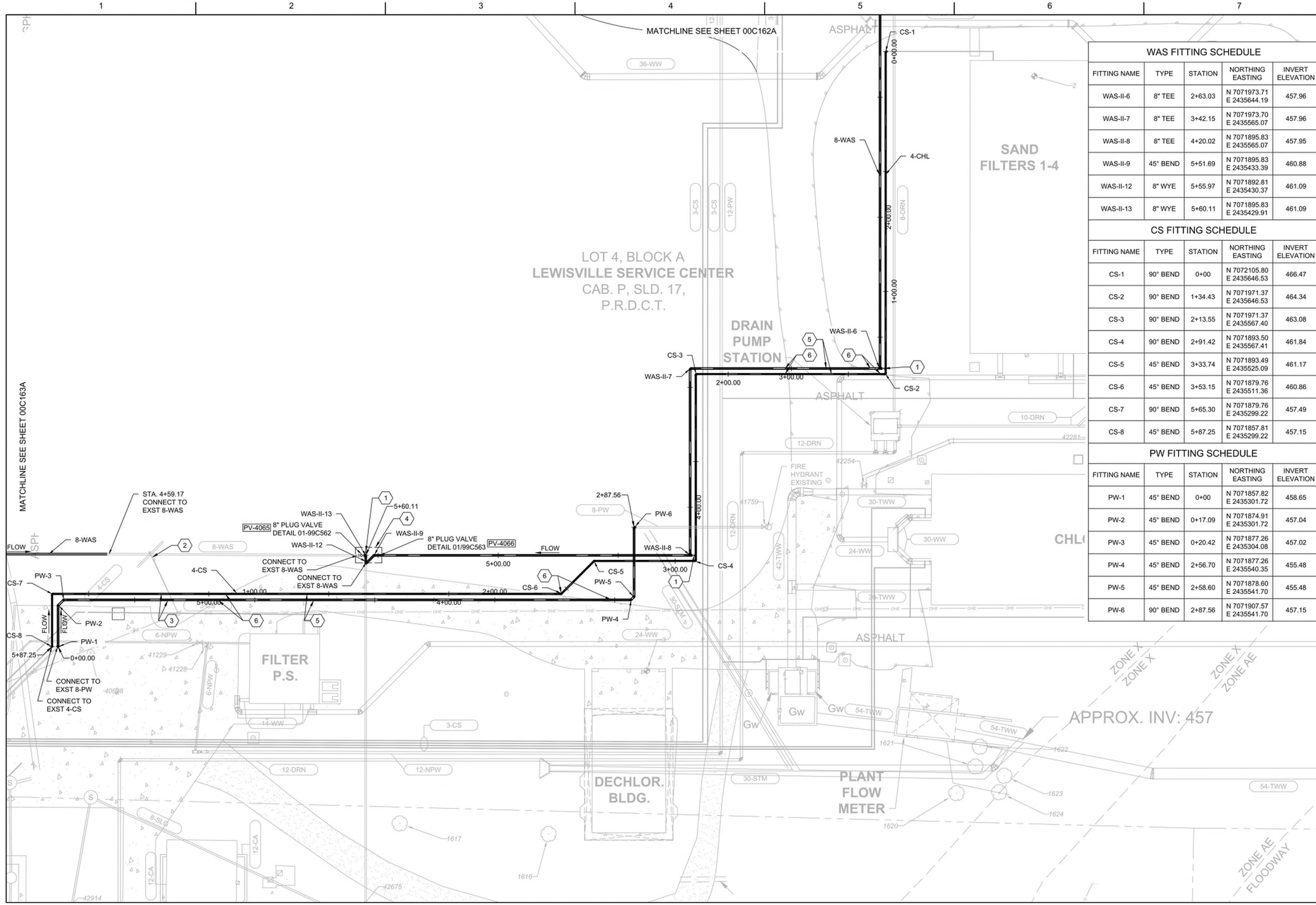

WAS FITTING SCHEDULE

FITTING NAME	TYPE	STATION	NORTHING EASTING	INVERT ELEVATION
WAS-II-6	8" TEE	2+63.03	N 7071973.71 E 2435644.19	457.96
WAS-II-7	8" TEE	3+42.15	N 7071973.70 E 2435565.07	457.96
WAS-II-8	8" TEE	4+20.02	N 7071895.83 E 2435565.07	457.95
WAS-II-9	45° BEND	5+51.69	N 7071895.83 E 2435433.39	460.88
WAS-II-12	8" WYE	5+55.97	N 7071892.81 E 2435430.37	461.09
WAS-II-13	8" WYE	5+60.11	N 7071895.83 E 2435429.91	461.09

CS FITTING SCHEDULE

FITTING NAME	TYPE	STATION	NORTHING EASTING	INVERT ELEVATION
CS-1	90° BEND	0+00	N 7072105.80 E 2435646.53	466.47
CS-2	90° BEND	1+34.43	N 7071971.37 E 2435646.53	464.34
CS-3	90° BEND	2+13.55	N 7071971.37 E 2435567.40	463.08
CS-4	90° BEND	2+91.42	N 7071893.50 E 2435567.41	461.84
CS-5	45° BEND	3+33.74	N 7071893.49 E 2435525.09	461.17
CS-6	45° BEND	3+53.15	N 7071879.76 E 2435511.36	460.86
CS-7	90° BEND	5+65.30	N 7071879.76 E 2435299.22	457.49
CS-8	45° BEND	5+87.25	N 7071857.81 E 2435299.22	457.15

PW FITTING SCHEDULE

FITTING NAME	TYPE	STATION	NORTHING EASTING	INVERT ELEVATION
PW-1	45° BEND	0+00	N 7071857.82 E 2435301.72	458.65
PW-2	45° BEND	0+17.09	N 7071874.91 E 2435301.72	457.04
PW-3	45° BEND	0+20.42	N 7071877.26 E 2435304.08	457.02
PW-4	45° BEND	2+56.70	N 7071877.26 E 2435540.35	455.48
PW-5	45° BEND	2+58.60	N 7071878.60 E 2435541.70	455.48
PW-6	90° BEND	2+87.56	N 7071907.57 E 2435541.70	457.15

GENERAL NOTES:

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5. REFER TO SHEET 00C102 SURVEY DATA FOR FURTHER INFORMATION REGARDING SURVEY POINT NUMBERS SHOWN ON THIS SHEET.
6. WHERE PROPOSED WAS AND CS LINES RUN PARALLEL, LINES SHALL BE LAYED IN THE SAME TRENCH WITH A MINIMUM OF ONE (1) FOOT BETWEEN PIPES.

KEYNOTES:

1. 8" WAS PRESSURE PIPE CLEAN OUT. SEE DETAIL 01/00C561
2. APPROXIMATE LOCATION OF THE EXISTING OVERHEAD ELECTRICAL POLE GUY WIRES. THE ELECTRICAL COMPANY HAS INDICATED THAT THE LOCATION OF GUY WIRE CONNECTION WILL CHANGE. CONTRACTOR TO CONFIRM LOCATIONS OF GUY WIRE CONNECTION.
3. CONTRACTOR TO COORDINATE WORK WITH THE ELECTRICAL COMPANY. THE ELECTRICAL COMPANY HAS INDICATED THAT THE LOCATION OF GUY WIRE CONNECTION WILL CHANGE, THE CONTRACTOR SHALL RE-ROUTE ALIGNMENTS BY ADJUSTING THE HORIZONTAL ALIGNMENT BY ADDING 45 DEGREE BENDS. ALIGNMENTS SHALL BE A MINIMUM OF 5' FROM GUY WIRE CONNECTIONS AND SHALL BE SOUTH OF NORTHING 7071895.83.
4. CONNECTION DETAIL. SEE DETAIL 4/00C561
5. FIRE LANE ACCESS SHALL NOT BE DISRUPTED DURING CONSTRUCTION OF CS AND PW LINES. CONTRACTOR TO COORDINATE WITH THE FIRE MARSHALL. CS AND PW LINES SHALL BE INSTALLED BY OPEN CUT OR TUNNELING, AS SPECIFIED.
6. APPROXIMATE EXTENT OF FIRE LANE ALONG ALIGNMENT.

AREA-1 00CX161I	AREA-2 00CX162I
AREA-3 00CX163I	AREA-4 00CX164I

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Date 6/13/2025 7:12:23 AM

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TEXAS P.E. FIRM
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06/13/2025

LEWISVILLE
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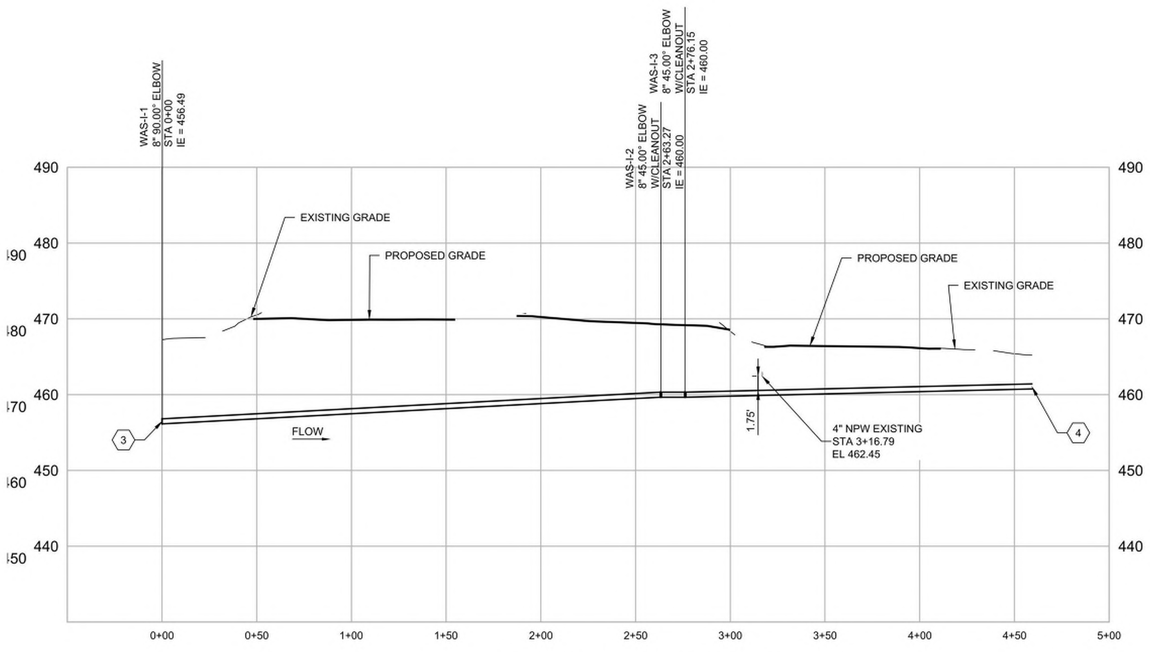
CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

N
20' 40'

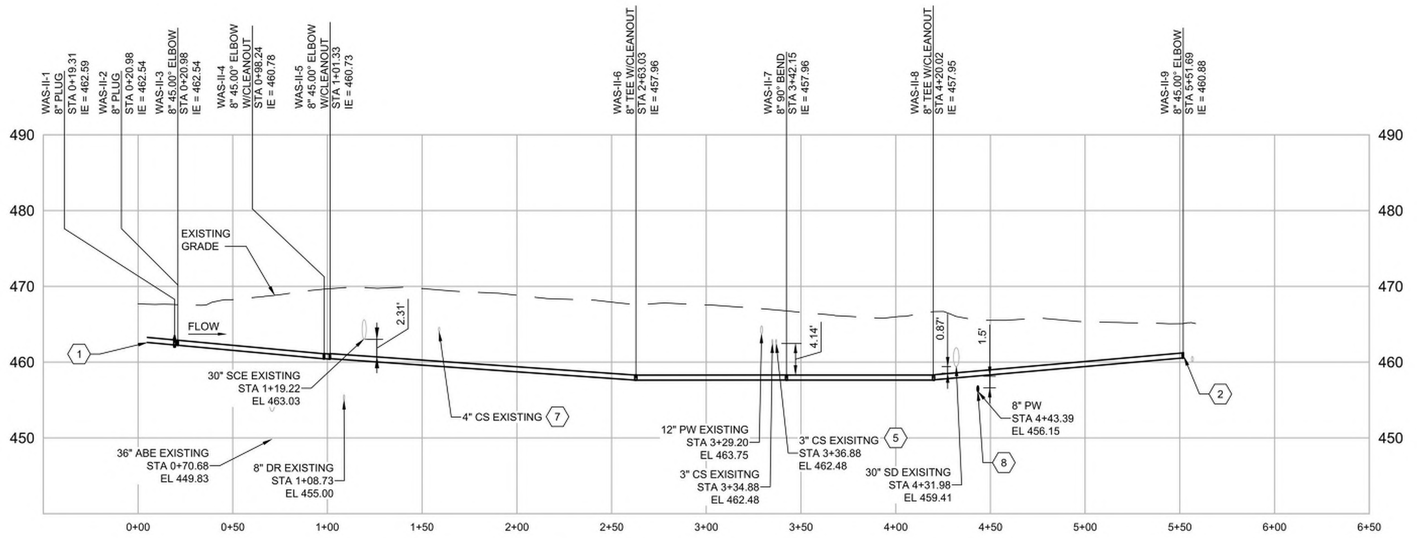
CIVIL
INTERIM YARD PIPING PLAN
AREA - 4

FILENAME 00C164I.dwg
SCALE 1" = 20'

SHEET **00C164I**



1 - PLANT I - WAS PIPING
HZ: 1"=40' VT: 1"=10'



2 - PLANT II - WAS PIPING
HZ: 1"=40' VT: 1"=10'

GENERAL NOTES:

1. THE LOCATIONS OF ALL EXISTING UTILITIES AND STRUCTURES SHOWN ARE APPROXIMATE OR MAY NOT BE LOCATED ON THESE PLANS. THE CONTRACTOR IS TO FIELD VERIFY THE LOCATIONS OF ALL ITEMS PRIOR TO CONSTRUCTION AND PROTECT ALL ITEMS NOT NOTED FOR REMOVAL OF THROUGHOUT CONSTRUCTION.
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4. PROVIDE PIPING RESTRAINT AT CONNECTIONS TO EXISTING PIPE AS SPECIFIED IN SPECIFICATION SECTION 40 05 00.

KEYNOTES:

1. END 5' FROM THE RAS/WAS PUMP STATION STRUCTURE AT INVERT ELEVATION 463.00FT. PROVIDE BLIND FLANGE FOR FUTURE CONNECTION WITH PROCESS PIPING.
2. CONNECT TO EXISTING 8" WAS AT APPROXIMATE INVERT ELEVATION OF 460.50FT. SEE CONNECTION DETAIL
3. CONNECT 8"X6" REDUCER TO EXISTING 6" WAS AT APPROXIMATE INVERT ELEVATION OF 456.35FT. SEE CONNECTION DETAIL.
4. CONNECT TO EXISTING 8" WAS AT APPROXIMATE INVERT ELEVATION OF 461.09FT.
5. PIPE ELEVATION ESTIMATED FOR FIELD ROUTED LINES.
6. EXISTING DRAIN IS ABANDONED IN PLACE. CONTRACTOR TO VERIFY FIELD ELEVATION. CONTRACTOR TO DEMOLISH ABANDONED DRAIN TO THE EXTENT NECESSARY TO INSTALL PROPOSED WAS LINE.
7. APPROXIMATE LOCATION OF 4" CHLORINE SOLUTION LINE THAT FEEDS THE FILTER COMPLEX. LINE NOT IDENTIFIED ON PLANS.
8. SEE DETAIL 05/99C561

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PROFESSIONAL ENGINEER
06/13/2025

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

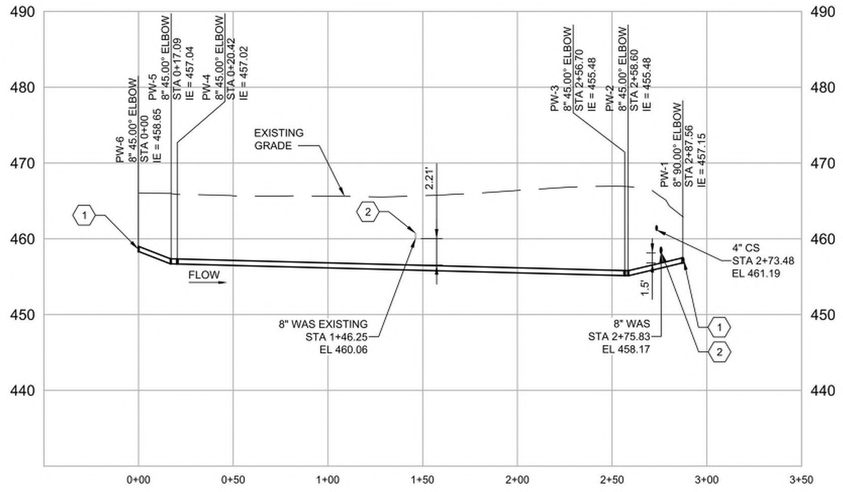
CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

N

CIVIL
INTERIM YARD PIPING PROFILES I

FILENAME 00C761I.dwg
SCALE

SHEET
00C761I



1
-
PW PIPING
HZ: 1"=40' VT: 1"=10'

GENERAL NOTES:

1. THE LOCATIONS OF ALL EXISTING UTILITIES AND STRUCTURES SHOWN ARE APPROXIMATE OR MAY NOT BE LOCATED ON THESE PLANS. THE CONTRACTOR IS TO FIELD VERIFY THE LOCATIONS OF ALL ITEMS PRIOR TO CONSTRUCTION AND PROTECT ALL ITEMS NOT NOTED FOR REMOVAL OF THROUGHOUT CONSTRUCTION.
2. UTILITY FACILITIES SHOWN ARE FROM LOCATES OR RECORDS PROVIDED BY OTHERS AND SHALL BE CONSIDERED APPROXIMATE. OTHER UTILITIES MAY EXIST, EITHER IN SERVICE OR ABANDONED, AND THEIR LOCATION MAY NOT BE PRESENTLY KNOWN OR IDENTIFIED ON THE PLANS. THE ENGINEER MAKES NO GUARANTEE THAT THE UTILITIES SHOWN ARE IN THE EXACT LOCATION INDICATED. NOTIFY THE ONE CALL SYSTEM AT 1-800-292-8989 (OR 811) TO IDENTIFY THE LOCATION OF ALL UNDERGROUND UTILITY FACILITIES WITHIN THE CONSTRUCTION AREA. COORDINATE WITH THE OWNER TO IDENTIFY THE LOCATION OF ALL PRIVATE UTILITIES THAT MAY NOT BE IDENTIFIED BY ONE CALL WITHIN THE CONSTRUCTION AREA.
3. WHERE EXISTING UTILITIES ARE SHOWN IN THE PLANS, OR ENCOUNTERED WITHIN THE CONSTRUCTION AREA, THE CONTRACTOR SHALL NOTIFY THE UTILITY COMPANY PRIOR OR OWNER PRIOR TO BEGINNING CONSTRUCTION ACTIVITIES NEAR EACH UTILITY.
4. PROVIDE PIPING RESTRAINT AT CONNECTIONS TO EXISTING PIPE AS SPECIFIED IN SPECIFICATION SECTION 40 05 00.

KEYNOTES:

1. CONNECTION ELEVATIONS ARE PROVIDED BASED ON HISTORICAL DESIGN DRAWINGS AND SUE DATA OBTAINED DURING DESIGN. CONTRACTOR TO FIELD VERIFY.
2. SEE DETAIL 05-99C561

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Date 6/13/2025 7:12:59 AM

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUN 13/2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	J. THOMPSON
DRAWN BY	T. SCHLOTTMAN
CHECKED BY	S. BEROSET
APPROVED BY	J. THOMPSON
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
JONATHAN D. THOMPSON
147189
LICENSED
PROFESSIONAL ENGINEER
06/13/2025

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

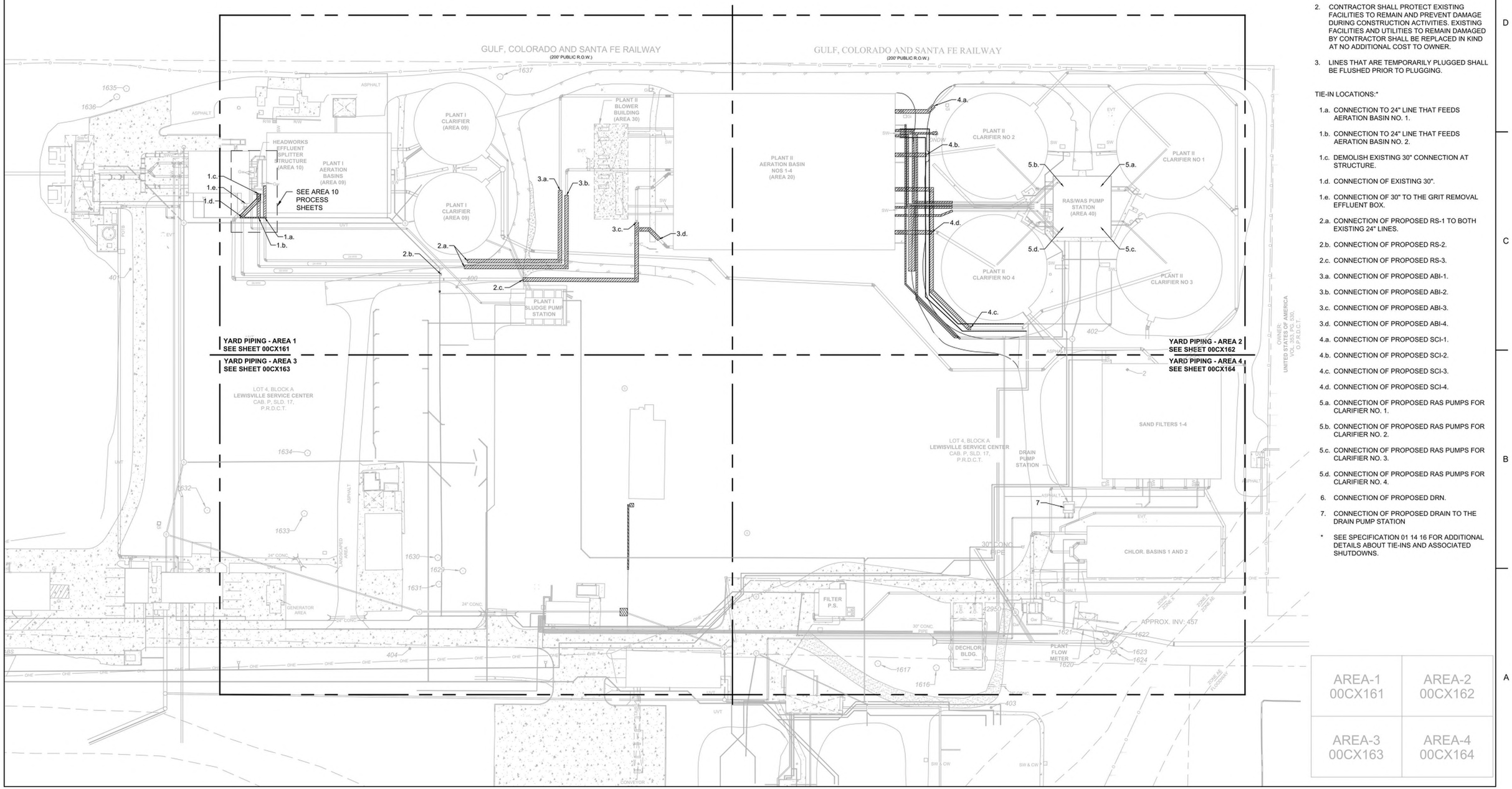
CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

N

CIVIL
INTERIM YARD PIPING PROFILES II

FILENAME 00C762l.dwg
SCALE

SHEET
00C762l



GENERAL NOTES:

1. REFER TO SEQUENCE OF CONSTRUCTION FOR DEMOLITION OF EXISTING FACILITIES IN SPECIFICATION 02 41 00.
2. CONTRACTOR SHALL PROTECT EXISTING FACILITIES TO REMAIN AND PREVENT DAMAGE DURING CONSTRUCTION ACTIVITIES. EXISTING FACILITIES AND UTILITIES TO REMAIN DAMAGED BY CONTRACTOR SHALL BE REPLACED IN KIND AT NO ADDITIONAL COST TO OWNER.
3. LINES THAT ARE TEMPORARILY PLUGGED SHALL BE FLUSHED PRIOR TO PLUGGING.

TIE-IN LOCATIONS:*

1.a. CONNECTION TO 24" LINE THAT FEEDS AERATION BASIN NO. 1.

1.b. CONNECTION TO 24" LINE THAT FEEDS AERATION BASIN NO. 2.

1.c. DEMOLISH EXISTING 30" CONNECTION AT STRUCTURE.

1.d. CONNECTION OF EXISTING 30".

1.e. CONNECTION OF 30" TO THE GRIT REMOVAL EFFLUENT BOX.

2.a. CONNECTION OF PROPOSED RS-1 TO BOTH EXISTING 24" LINES.

2.b. CONNECTION OF PROPOSED RS-2.

2.c. CONNECTION OF PROPOSED RS-3.

3.a. CONNECTION OF PROPOSED ABI-1.

3.b. CONNECTION OF PROPOSED ABI-2.

3.c. CONNECTION OF PROPOSED ABI-3.

3.d. CONNECTION OF PROPOSED ABI-4.

4.a. CONNECTION OF PROPOSED SCI-1.

4.b. CONNECTION OF PROPOSED SCI-2.

4.c. CONNECTION OF PROPOSED SCI-3.

4.d. CONNECTION OF PROPOSED SCI-4.

5.a. CONNECTION OF PROPOSED RAS PUMPS FOR CLARIFIER NO. 1.

5.b. CONNECTION OF PROPOSED RAS PUMPS FOR CLARIFIER NO. 2.

5.c. CONNECTION OF PROPOSED RAS PUMPS FOR CLARIFIER NO. 3.

5.d. CONNECTION OF PROPOSED RAS PUMPS FOR CLARIFIER NO. 4.

6. CONNECTION OF PROPOSED DRN.

7. CONNECTION OF PROPOSED DRAIN TO THE DRAIN PUMP STATION

* SEE SPECIFICATION 01 14 16 FOR ADDITIONAL DETAILS ABOUT TIE-INS AND ASSOCIATED SHUTDOWNS.

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HDR
TEXAS P.E. FIRM
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LEWISVILLE
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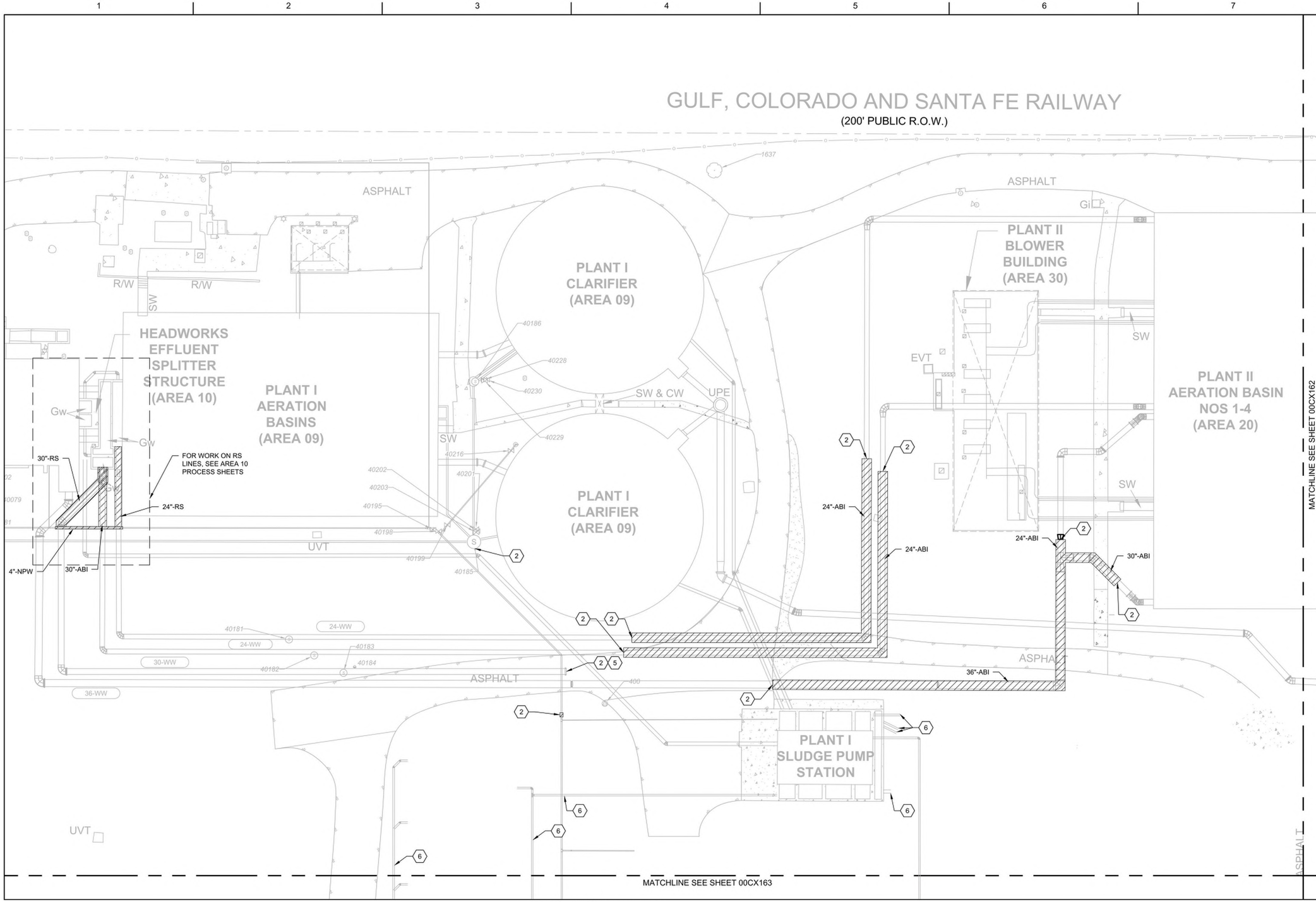
CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

N
0 50' 100'

CIVIL
OVERALL YARD PIPING DEMOLITION PLAN

FILENAME 00CX160.dwg
SCALE 1" = 50'

SHEET **00CX160**



GENERAL NOTES:

1. REFER TO SEQUENCE OF CONSTRUCTION FOR DEMOLITION OF EXISTING FACILITIES IN SPECIFICATION 02 41 00.
2. CONTRACTOR SHALL PROTECT EXISTING FACILITIES TO REMAIN AND PREVENT DAMAGE DURING CONSTRUCTION ACTIVITIES. EXISTING FACILITIES AND UTILITIES TO REMAIN DAMAGED BY CONTRACTOR SHALL BE REPLACED IN KIND AT NO ADDITIONAL COST TO OWNER

KEYNOTES:

1. CUT AND PLUG
2. PREPARE FOR CONNECTION TO PROPOSED PIPING
3. ABANDON IN PLACE
4. EXISTING UTILITIES TO REMAIN IN SERVICE - PROTECT DURING DEMOLITION
5. REMOVE TEMPORARY MECHANICAL PLUG.
6. PREVIOUSLY ABANDONED PIPE

AREA-1 00CX161	AREA-2 00CX162
AREA-3 00CX163	AREA-4 00CX164

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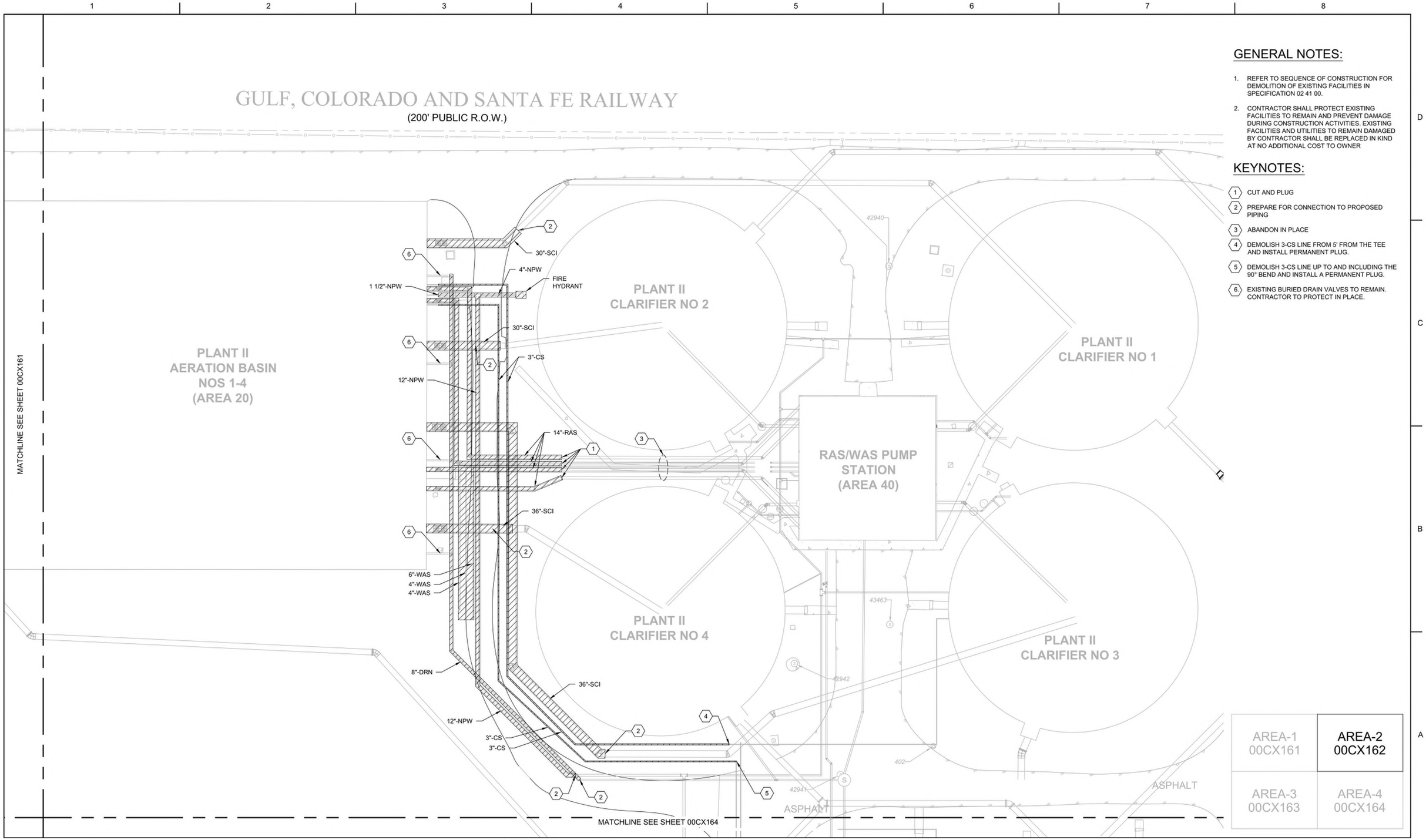
PRAIRIE CREEK
AERATION BASIN EXPANSION

N
20' 40'

CIVIL
YARD PIPING DEMO PLAN
AREA - 1

FILENAME 00CX161.dwg
SCALE 1" = 20'

SHEET
00CX161



GENERAL NOTES:

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KEYNOTES:

1. CUT AND PLUG
2. PREPARE FOR CONNECTION TO PROPOSED PIPING
3. ABANDON IN PLACE
4. DEMOLISH 3-CS LINE FROM 5' FROM THE TEE AND INSTALL PERMANENT PLUG.
5. DEMOLISH 3-CS LINE UP TO AND INCLUDING THE 90° BEND AND INSTALL A PERMANENT PLUG.
6. EXISTING BURIED DRAIN VALVES TO REMAIN. CONTRACTOR TO PROTECT IN PLACE.

AREA-1 00CX161	AREA-2 00CX162
AREA-3 00CX163	AREA-4 00CX164

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CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

N
20' 40'

CIVIL
YARD PIPING DEMO PLAN
AREA - 2

FILENAME 00CX162.dwg
SCALE 1" = 20'

SHEET 00CX162

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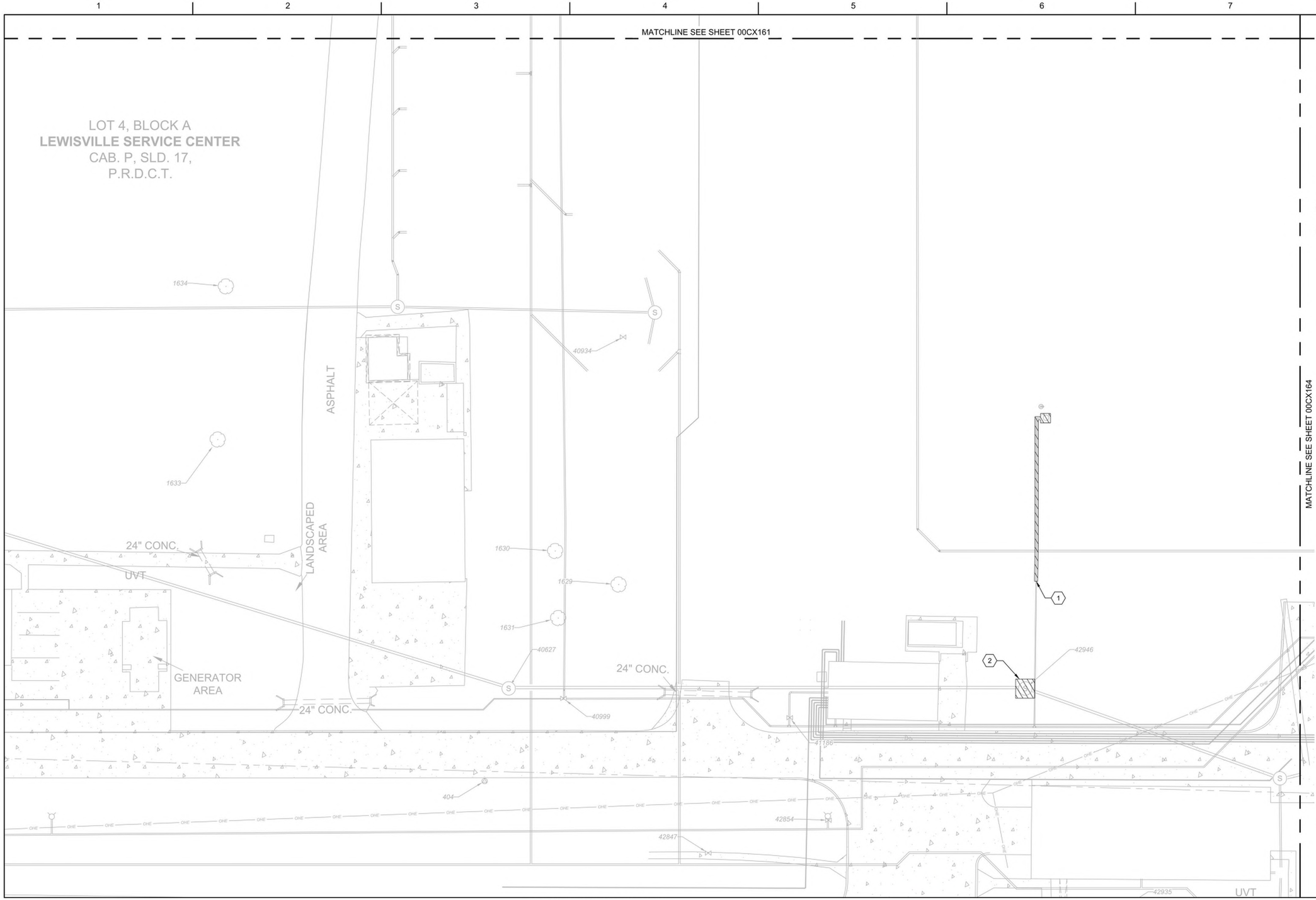

GENERAL NOTES:

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2. CONTRACTOR SHALL PROTECT EXISTING FACILITIES TO REMAIN AND PREVENT DAMAGE DURING CONSTRUCTION ACTIVITIES. EXISTING FACILITIES AND UTILITIES TO REMAIN DAMAGED BY CONTRACTOR SHALL BE REPLACED IN KIND AT NO ADDITIONAL COST TO OWNER

KEYNOTES:

1. PREPARE FOR CONNECTION TO PROPOSED PIPING.
2. DEMOLITION MANHOLE LID, FRAME, GRADE RINGS AND PREPARE FOR PROPOSED TO MEET THE GRADE OF THE PROPOSED ROADWAY.

AREA-1 00CX161	AREA-2 00CX162
AREA-3 00CX163	AREA-4 00CX164

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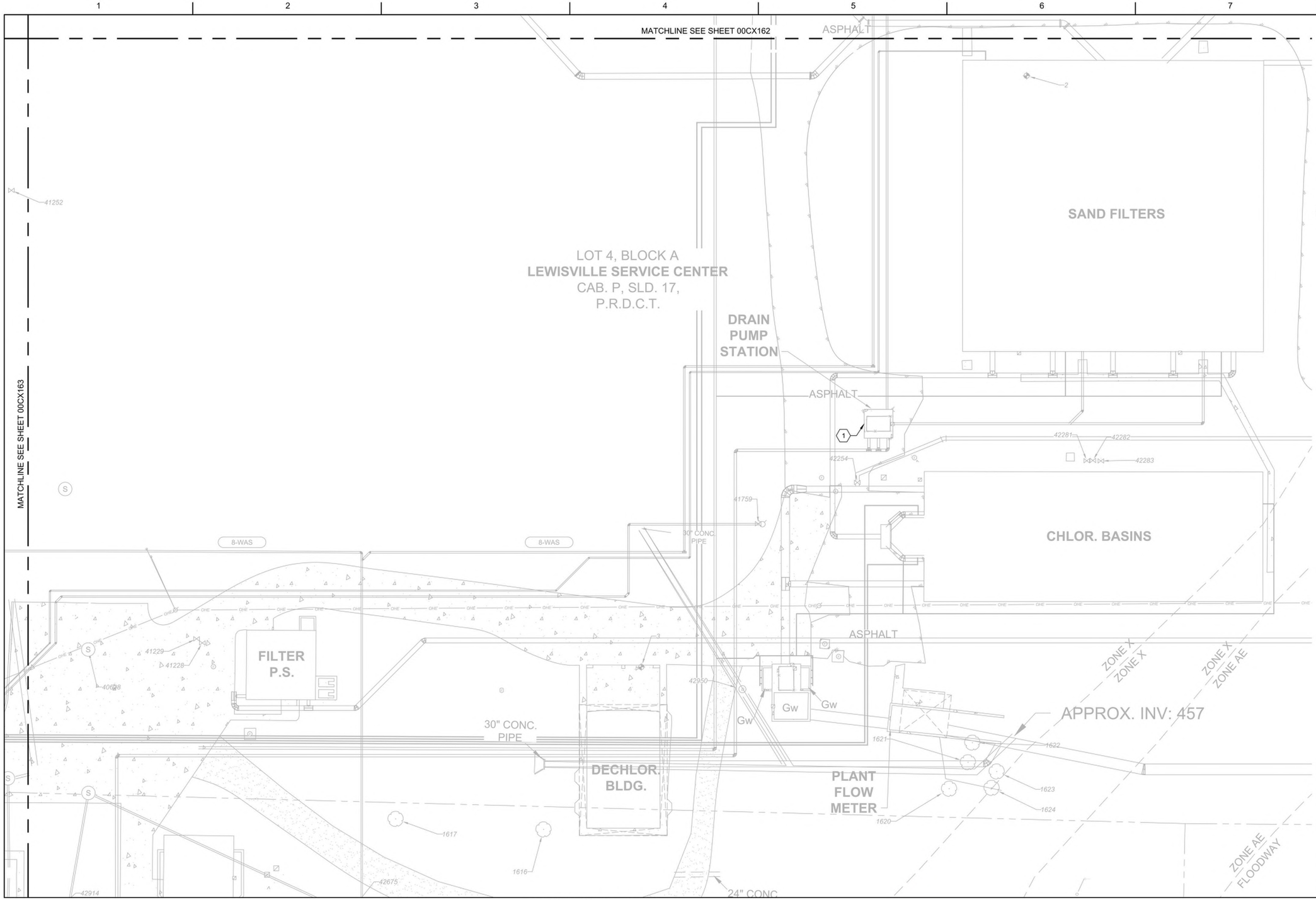
PRAIRIE CREEK
AERATION BASIN EXPANSION

N
20' 40'

CIVIL
YARD PIPING DEMO PLAN
AREA - 3

FILENAME 00CX163.dwg
SCALE 1" = 20'

SHEET
00CX163



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KEYNOTES:

(1) PREPARE FOR CONNECTION TO PROPOSED PIPING

AREA-1 00CX161	AREA-2 00CX162
AREA-3 00CX163	AREA-4 00CX164

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CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

N
20' 40'

CIVIL
YARD PIPING DEMO PLAN
AREA - 4

FILENAME 00CX164.dwg
SCALE 1" = 20'

SHEET
00CX164

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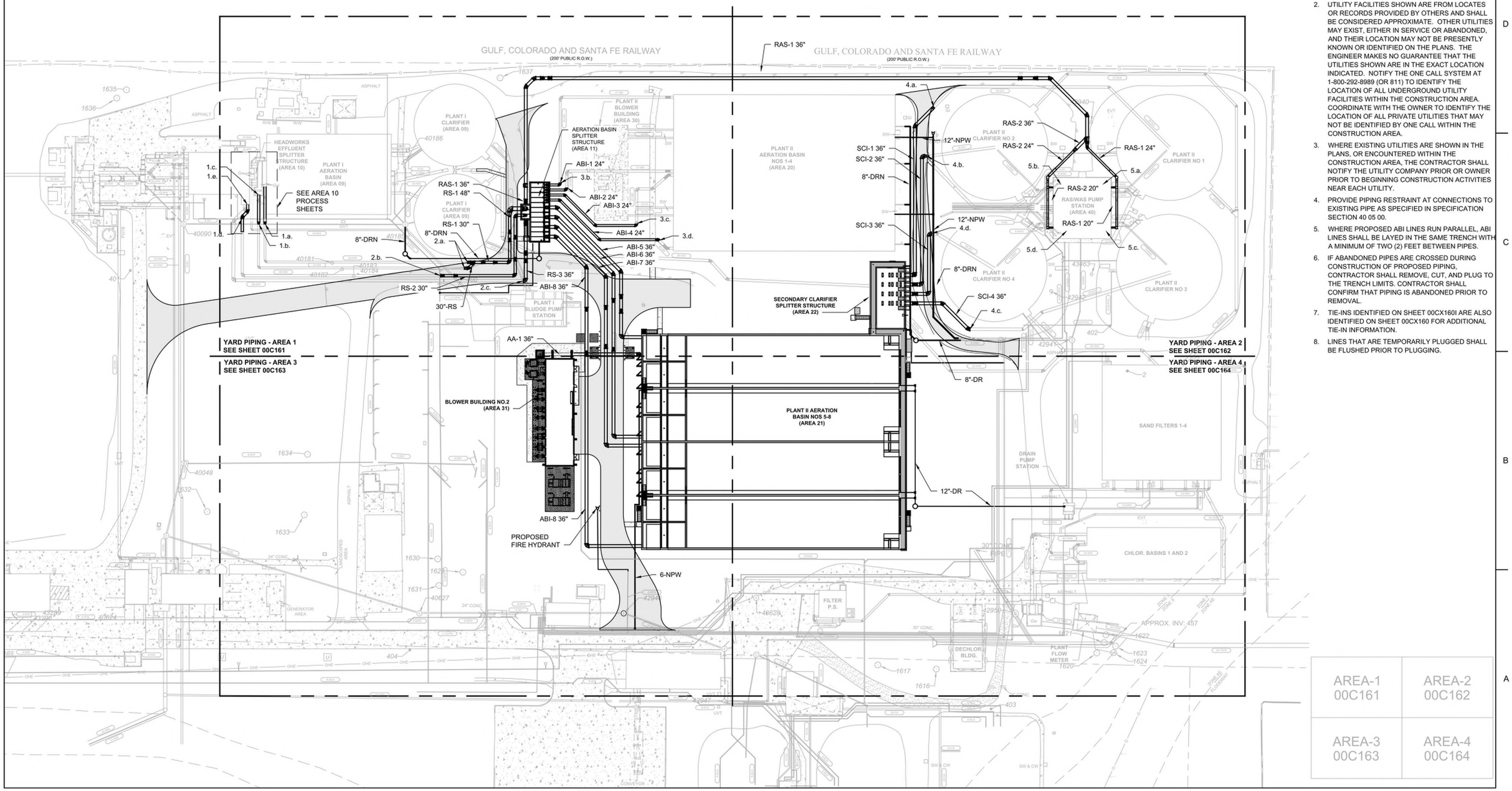

GENERAL NOTES:

1. THE LOCATIONS OF ALL EXISTING UTILITIES AND STRUCTURES SHOWN ARE APPROXIMATE OR MAY NOT BE LOCATED ON THESE PLANS. THE CONTRACTOR IS TO FIELD VERIFY THE LOCATIONS OF ALL ITEMS PRIOR TO CONSTRUCTION AND PROTECT ALL ITEMS NOT NOTED FOR REMOVAL OF THROUGHOUT CONSTRUCTION.
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3. WHERE EXISTING UTILITIES ARE SHOWN IN THE PLANS, OR ENCOUNTERED WITHIN THE CONSTRUCTION AREA, THE CONTRACTOR SHALL NOTIFY THE UTILITY COMPANY PRIOR OR OWNER PRIOR TO BEGINNING CONSTRUCTION ACTIVITIES NEAR EACH UTILITY.
4. PROVIDE PIPING RESTRAINT AT CONNECTIONS TO EXISTING PIPE AS SPECIFIED IN SPECIFICATION SECTION 40 05 00.
5. WHERE PROPOSED ABI LINES RUN PARALLEL, ABI LINES SHALL BE LAYED IN THE SAME TRENCH WITH A MINIMUM OF TWO (2) FEET BETWEEN PIPES.
6. IF ABANDONED PIPES ARE CROSSED DURING CONSTRUCTION OF PROPOSED PIPING, CONTRACTOR SHALL REMOVE, CUT, AND PLUG TO THE TRENCH LIMITS. CONTRACTOR SHALL CONFIRM THAT PIPING IS ABANDONED PRIOR TO REMOVAL.
7. TIE-INS IDENTIFIED ON SHEET 00CX160I ARE ALSO IDENTIFIED ON SHEET 00CX160 FOR ADDITIONAL TIE-IN INFORMATION.
8. LINES THAT ARE TEMPORARILY PLUGGED SHALL BE FLUSHED PRIOR TO PLUGGING.

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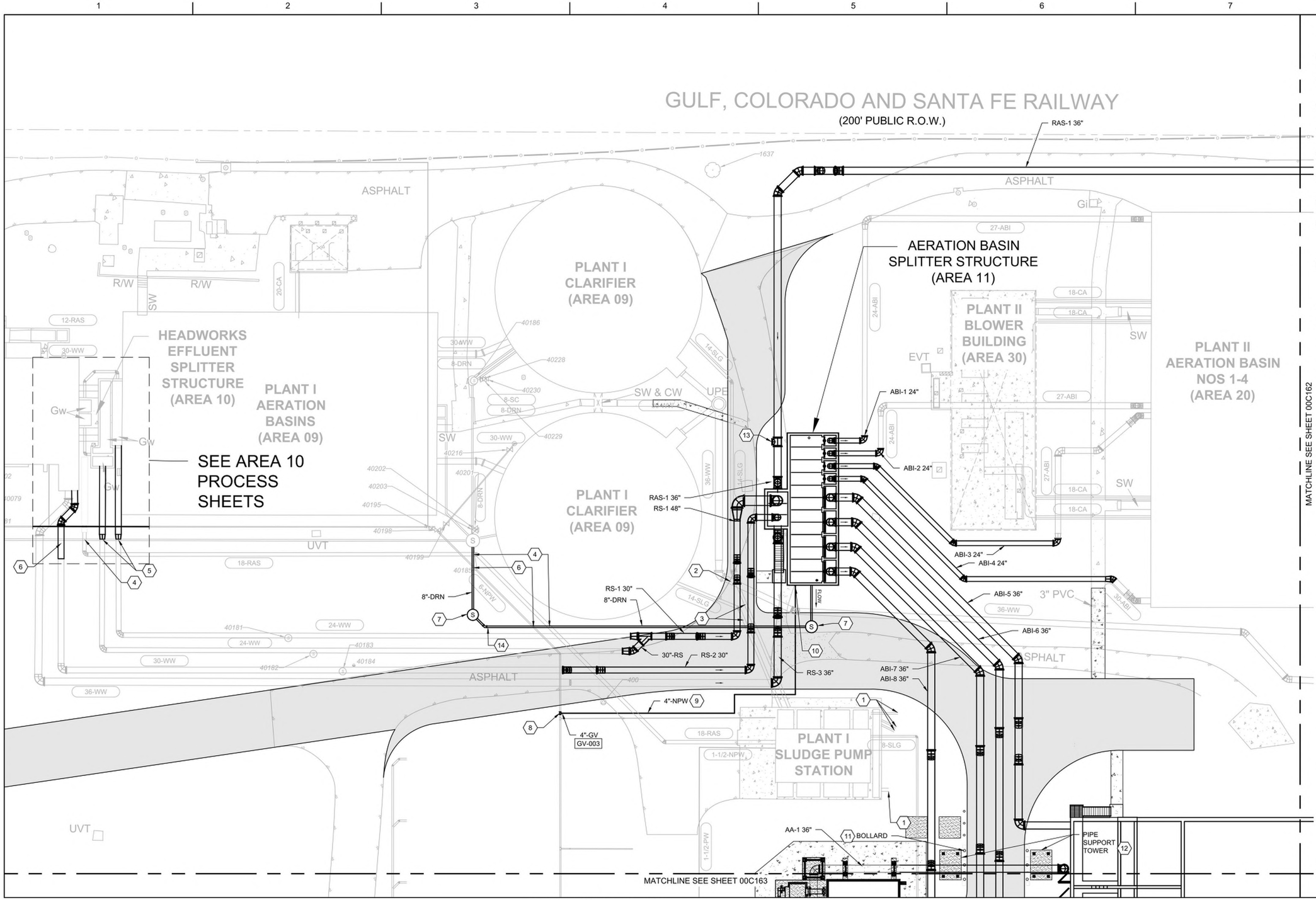
PRAIRIE CREEK
AERATION BASIN EXPANSION

N
0 50' 100'

CIVIL
OVERALL YARD PIPING PLAN

FILENAME 00C160.dwg
SCALE 1" = 50'

SHEET 00C160



KEYNOTES:

1. EXISTING PIPE WAS ABANDONED AND PLUGGED AS PART OF A PREVIOUS WORK.
2. CONTRACTOR TO PROTECT EXISTING 36" PLANT I EFFLUENT DURING CONSTRUCTION.
3. CONTRACTOR TO PROTECT EXISTING 14" SLUDGE LINES DURING CONSTRUCTION.
4. CONTRACTOR TO PROTECT EXISTING 18" RAS LINE DURING CONSTRUCTION.
5. CONTRACTOR TO PROTECT EXISTING 8" DRAIN DURING CONSTRUCTION.
6. CONTRACTOR TO PROTECT EXISTING 4" NPW DURING CONSTRUCTION.
7. PROPOSED 4' MANHOLE. SEE DETAILS ON 99C564
8. INSTALL 6"X6"X4" REDUCING TEE CONNECTION TO EXISTING 6"-NPW LINE TO PROVIDE NPW SERVICE TO A HYDRANT AT THE PROPOSED SPLITTER STRUCTURE.
9. CONTRACTOR TO FIELD ROUTE 4" NPW TO A PROPOSED YARD HYDRANT AT THE SPLITTER STRUCTURE. REDUCE TO 2" PRIOR TO YARD HYDRANT.
10. PROPOSED 2" NPW YARD HYDRANT. SEE DETAIL 07/99C564.
11. PROVIDED BOLLARDS TO PROTECT PIPE SUPPORTS BESIDE THE ROADWAY. LOCATE BOLLARDS AS SHOWN ON 00C121. SEE DETAIL 3/99C563.
12. STRUCTURAL SUPPORT FOR THE PROPOSED AIR PIPE AND FUTURE AIR PIPE. SEE STRUCTURAL DETAILS ON 99S507.
13. TEMPORARY PLUG FOR FUTURE RAS CONNECTION.
14. SEE CLEANOUT DETAIL 6/99C562.

NPW FITTING TABLE

FITTING	NORTHING	EASTING
TEE	7702178.33	2434980.03
90° BEND	7072178.40	2435053.10
90° BEND	7072186.20	2435053.10
90° BEND	7072186.20	2435078.59

MANHOLE TABLE

NAME	RIM	CONNECTED PIPES
DRN-1	471.31	8" OUT (N) = 460.80 8" OUT (SE) = 461.00
DRN-2	467.00	8" IN (W) = 461.55 8" OUT (N) = 461.75

AREA-1 00C161	AREA-2 00C162
AREA-3 00C163	AREA-4 00C164

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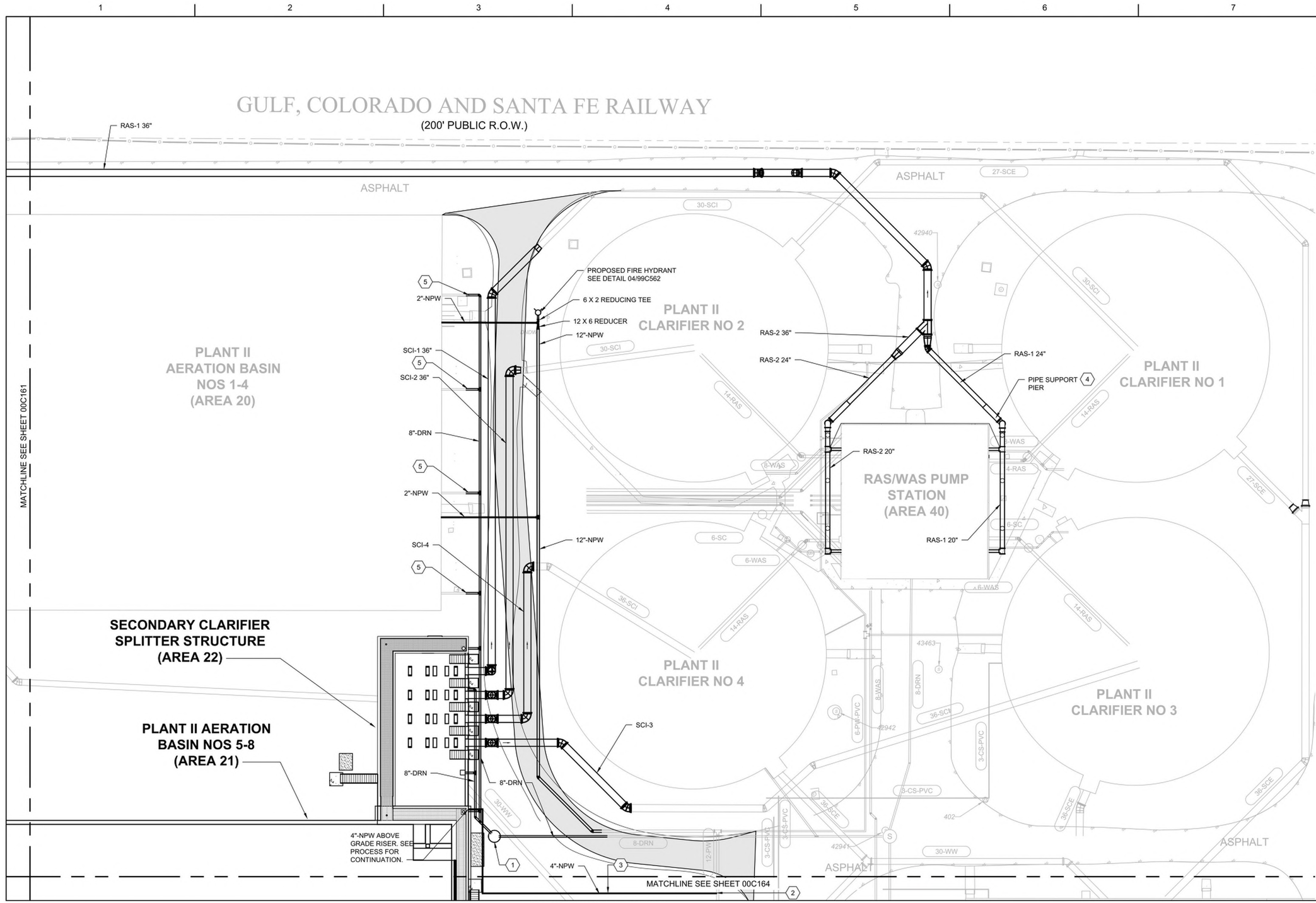
PRAIRIE CREEK
AERATION BASIN EXPANSION

N
20' 40'

CIVIL
YARD PIPING PLAN
AREA - 1

FILENAME 00C161.dwg
SCALE 1" = 20'

SHEET **00C161**



KEYNOTES:

1. PROPOSED 4' MANHOLE. PRECAST WITH BOLT DOWN COVER. SEE DETAILS ON 99C564
2. INSTALL A 12"X12"X4" TEE CONNECTION TO EXISTING 12"-NPW LINE TO PROVIDE NPW SERVICE TO THE PROPOSED BASINS.
3. CONTRACTOR TO FIELD ROUTE NPW LINE FROM 12" EXISTING LINE TO PROVIDE SERVICE TO THE SPLITTER STRUCTURE.
4. RAS DISCHARGE HEADER TEE SUPPORT. SEE STRUCTURAL DETAILS.
5. PROTECT IN PLACE EXISTING BURIED DRAIN VALVES.

NPW FITTING TABLE

FITTING	NORTHING EASTING	EASTING
45° BEND	7072152.75	2435502.88
45° BEND	7072130.16	2435525.49
REDUCER	7072341.30	2435502.79
TEE	7072261.54	2435502.86
TEE	7072342.96	2435502.79

DRN FITTING TABLE

FITTING	NORTHING EASTING	EASTING
45° BEND	7072134.05	2435478.48
90° BEND	7072354.56	2435478.48
TEE	7072315.07	2435478.48
TEE	7072271.74	2435478.48
TEE	7072206.68	2435478.48
TEE	7072138.68	2435478.48

MANHOLE TABLE

NAME	RIM	CONNECTED PIPES
DRN-MH-3	467.41	

AREA-1 00C161	AREA-2 00C162
AREA-3 00C163	AREA-4 00C164

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DESIGNED BY	J. THOMPSON
DRAWN BY	T. SCHLOTTMAN
CHECKED BY	S. BEROSET
APPROVED BY	J. THOMPSON
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
JONATHAN D. THOMPSON
147189
LICENSED PROFESSIONAL ENGINEER
06/13/2025

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

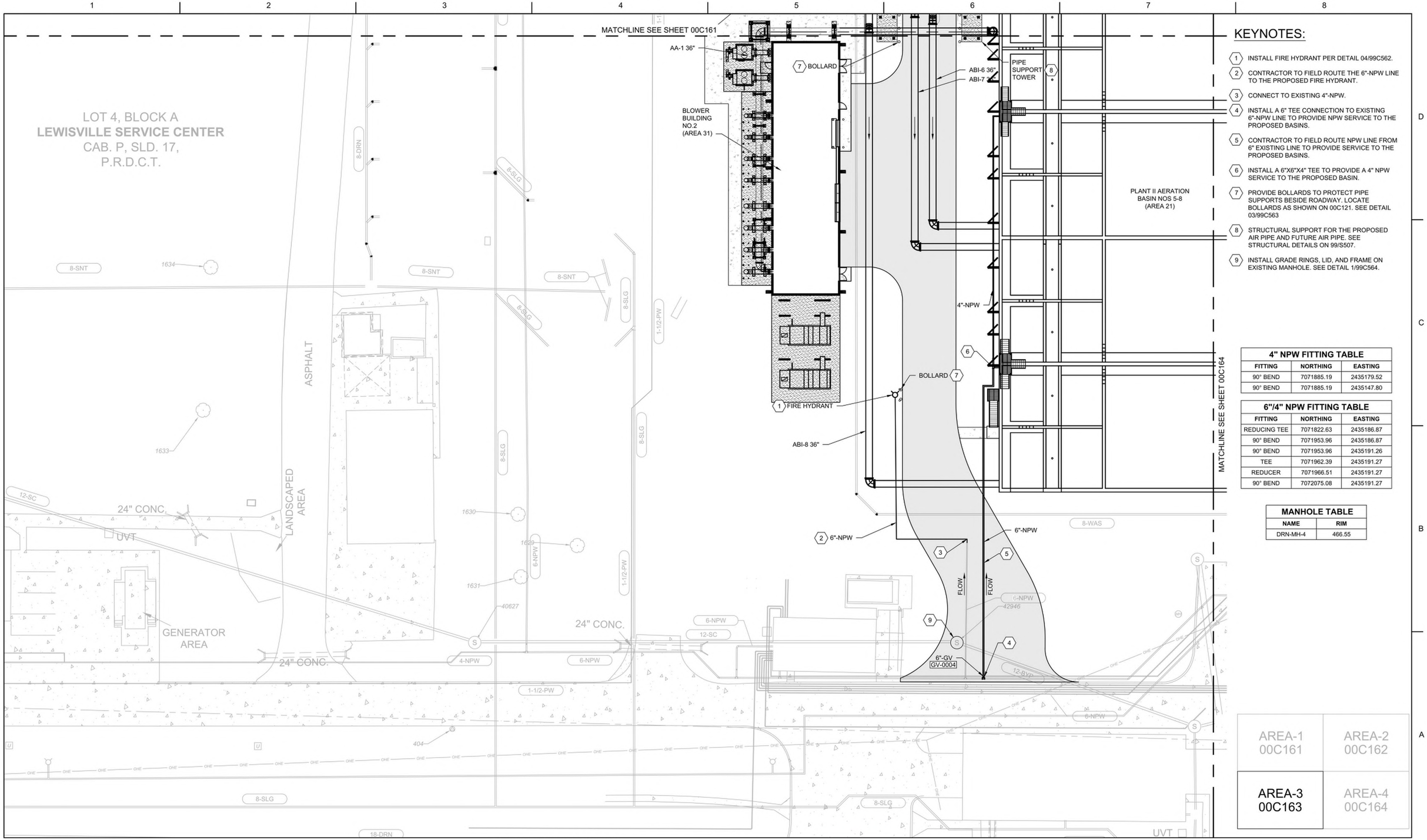
CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

N
20' 40'

CIVIL
YARD PIPING PLAN
AREA - 2

FILENAME 00C162.dwg
SCALE 1" = 20'

SHEET **00C162**



KEYNOTES:

1. INSTALL FIRE HYDRANT PER DETAIL 04/99C562.
2. CONTRACTOR TO FIELD ROUTE THE 6"-NPW LINE TO THE PROPOSED FIRE HYDRANT.
3. CONNECT TO EXISTING 4"-NPW.
4. INSTALL A 6" TEE CONNECTION TO EXISTING 6"-NPW LINE TO PROVIDE NPW SERVICE TO THE PROPOSED BASINS.
5. CONTRACTOR TO FIELD ROUTE NPW LINE FROM 6" EXISTING LINE TO PROVIDE SERVICE TO THE PROPOSED BASINS.
6. INSTALL A 6"X6"X4" TEE TO PROVIDE A 4" NPW SERVICE TO THE PROPOSED BASIN.
7. PROVIDE BOLLARDS TO PROTECT PIPE SUPPORTS BESIDE ROADWAY. LOCATE BOLLARDS AS SHOWN ON 00C121. SEE DETAIL 03/99C563
8. STRUCTURAL SUPPORT FOR THE PROPOSED AIR PIPE AND FUTURE AIR PIPE. SEE STRUCTURAL DETAILS ON 99/S507.
9. INSTALL GRADE RINGS, LID, AND FRAME ON EXISTING MANHOLE. SEE DETAIL 1/99C564.

4" NPW FITTING TABLE

FITTING	NORTHING	EASTING
90° BEND	7071885.19	2435179.52
90° BEND	7071885.19	2435147.80

6"/4" NPW FITTING TABLE

FITTING	NORTHING	EASTING
REDUCING TEE	7071822.63	2435186.87
90° BEND	7071953.96	2435186.87
90° BEND	7071953.96	2435191.26
TEE	7071962.39	2435191.27
REDUCER	7071966.51	2435191.27
90° BEND	7072075.08	2435191.27

MANHOLE TABLE

NAME	RIM
DRN-MH-4	466.55

AREA-1 00C161	AREA-2 00C162
AREA-3 00C163	AREA-4 00C164

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Date 6/13/2025 7:16:08 AM

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUN 13/2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	J. THOMPSON
DRAWN BY	T. SCHLOTTMAN
CHECKED BY	S. BEROSET
APPROVED BY	J. THOMPSON
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
JONATHAN D. THOMPSON
147189
LICENSED
PROFESSIONAL ENGINEER
06/13/2025

LEWISVILLE
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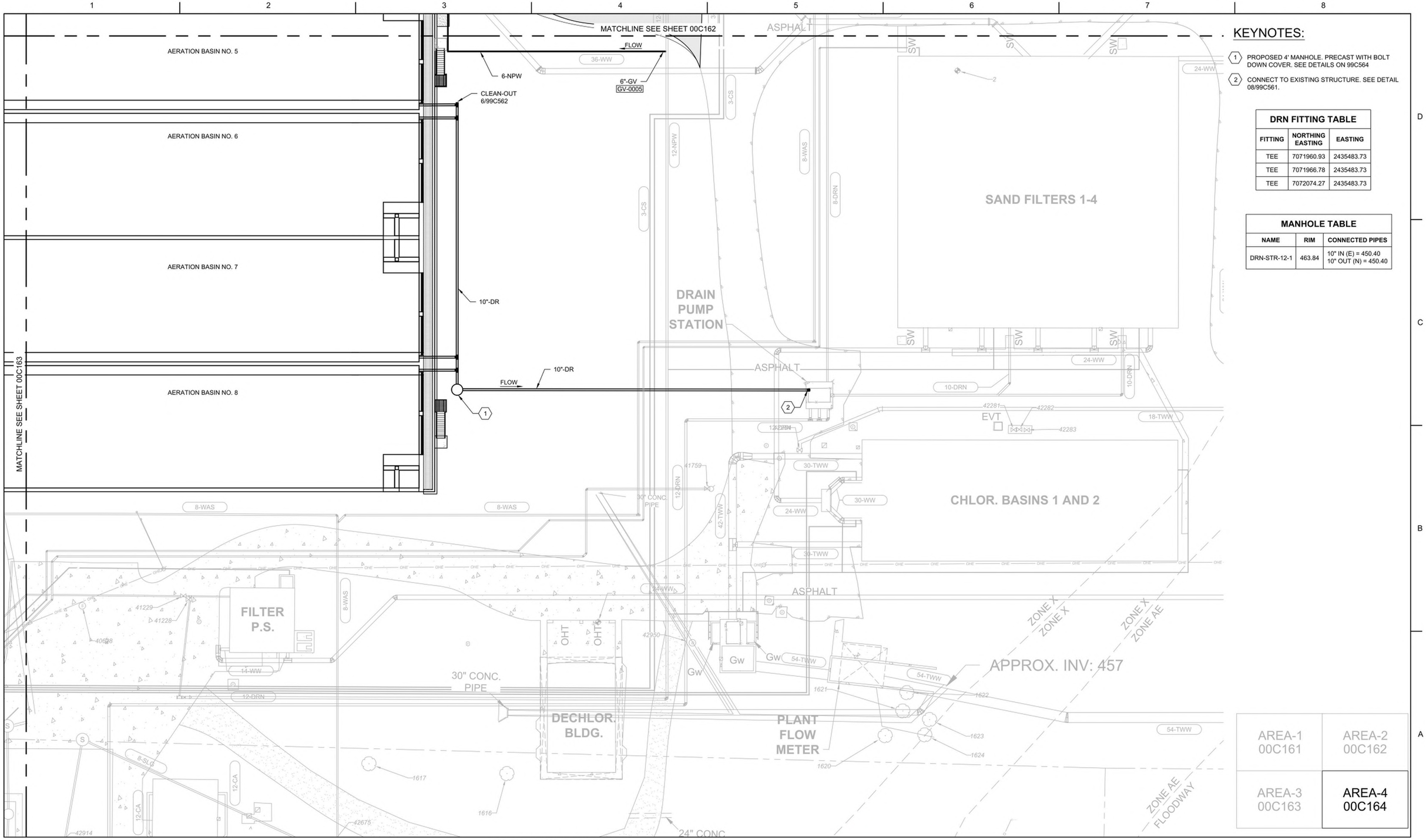
CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

N
20' 40'

CIVIL
YARD PIPING PLAN
AREA - 3

FILENAME 00C163.dwg
SCALE 1" = 20'

SHEET **00C163**



KEYNOTES:

1. PROPOSED 4' MANHOLE. PRECAST WITH BOLT DOWN COVER. SEE DETAILS ON 99C564
2. CONNECT TO EXISTING STRUCTURE. SEE DETAIL 08/99C561.

DRN FITTING TABLE

FITTING	NORTHING EASTING	EASTING
TEE	7071960.93	2435483.73
TEE	7071966.78	2435483.73
TEE	7072074.27	2435483.73

MANHOLE TABLE

NAME	RIM	CONNECTED PIPES
DRN-STR-12-1	463.84	10" IN (E) = 450.40 10" OUT (N) = 450.40

AREA-1 00C161	AREA-2 00C162
AREA-3 00C163	AREA-4 00C164

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CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

N
20' 40'

CIVIL
YARD PIPING PLAN
AREA - 4

FILENAME 00C164.dwg
SCALE 1" = 20'

SHEET **00C164**

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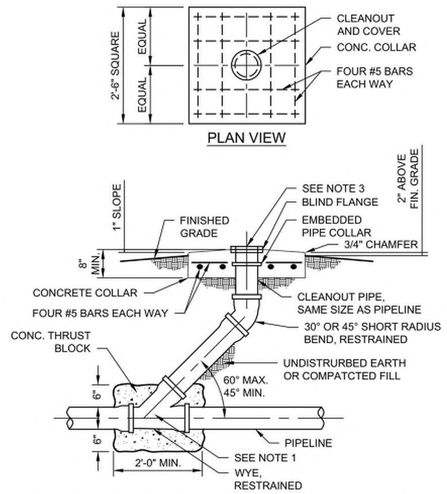
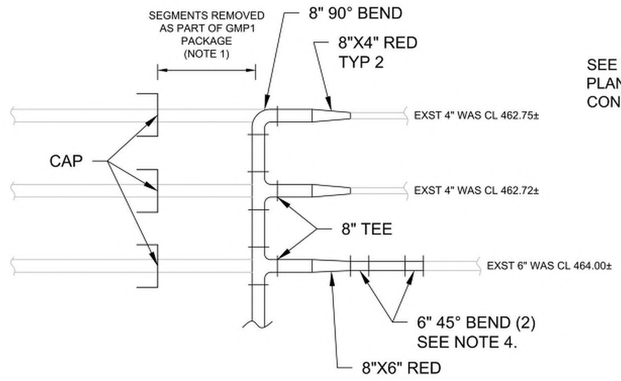


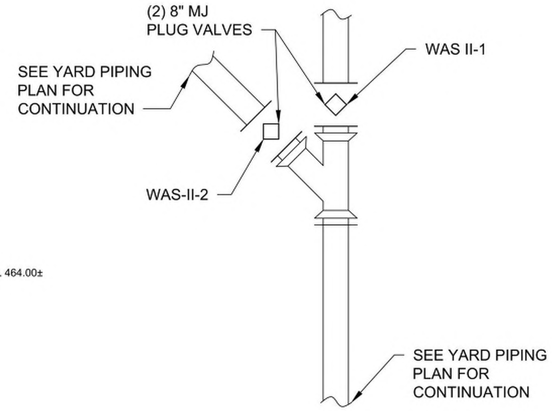
NOTES
1. THE WYE FITTING IS REPLACED BY A 45 DEG BEND AT TERMINALLY LOCATED CLEANOUTS.
2. CLEANOUT PIPE DIAMETER SHALL MATCH THE SERVICE LINE DIAMETER TO WHICH IT IS CONNECTING.
3. PROVIDE A 2" NPT CONNECTION WITH A REMOVABLE PLUG.

1 - PRESSURE PIPE CLEANOUT
NO SCALE



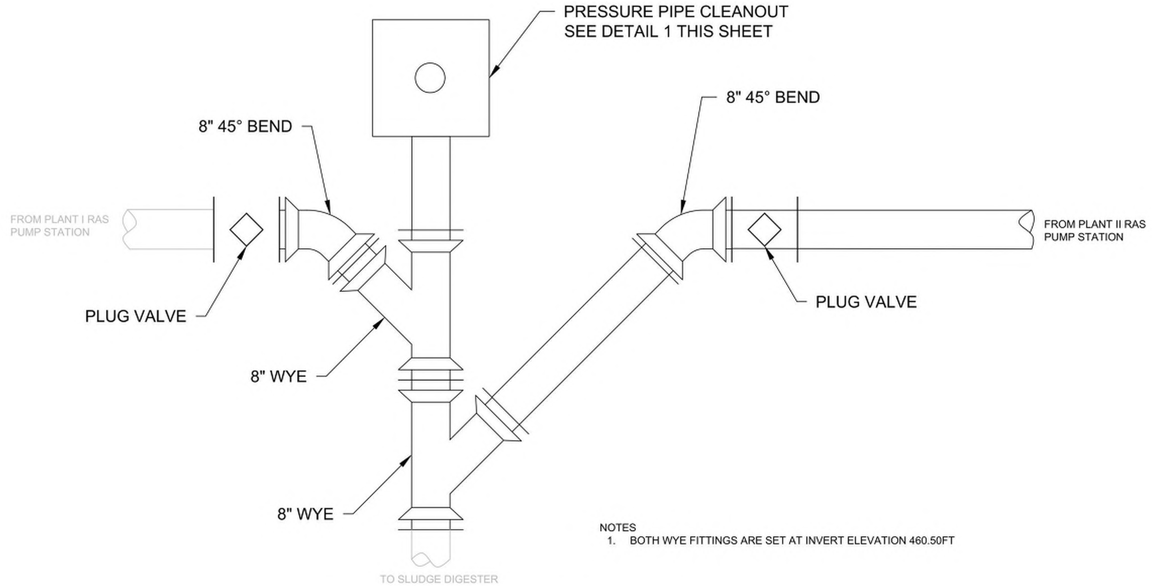
NOTES
1. MINIMUM OF 2' BETWEEN THE FINISHED CAPS AND THE EDGE OF THE PROPOSED 8" PIPE.
2. THIS CONNECTION IS IMMEDIATELY WEST OF PLANT II PUMP STATION.
3. THIS CONNECTION DETAIL IS DEVELOPED FOR THE GMP1 PACKAGE OF THIS DESIGN CONTRACT.
4. USE BENDS TO BRING ELEVATION TO A COMMON CENTERLINE ELEVATION OF 462.75±

2 - WAS PIPING CONNECTION TO EXISTING
NO SCALE



NOTES
1. THIS CONNECTION IS SOUTH OF PLANT II RAS PUMP STATION.
2. THIS CONNECTION DETAIL IS DEVELOPED FOR THE GMP1 PACKAGE OF THIS DESIGN CONTRACT.

3 - WAS PIPING WYE CONNECTION
NO SCALE



NOTES
1. BOTH WYE FITTINGS ARE SET AT INVERT ELEVATION 460.50FT

4 - PLANT I WAS AND PLANT II WAS CONNECTION
NO SCALE

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Date 6/13/2025 7:16:42 AM

HDR
TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUN 13/2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	J. THOMPSON
DRAWN BY	T. SCHLOTTMAN
CHECKED BY	S. BEROSET
APPROVED BY	J. THOMPSON
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
JONATHAN D. THOMPSON
147189
LICENSED
PROFESSIONAL ENGINEER
06/13/2025

LEWISVILLE
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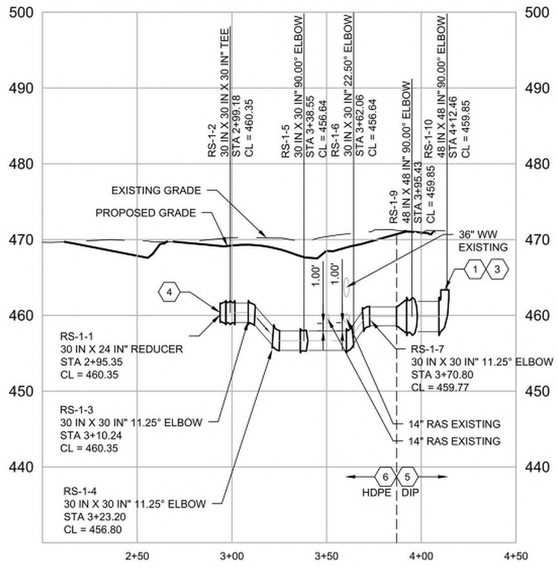
PRAIRIE CREEK
AERATION BASIN EXPANSION

N

CIVIL
YARD PIPING DETAILS
SHEET 1

FILENAME 00C561.dwg
SCALE

SHEET
00C561



1 - RS-1 RAW SEWAGE
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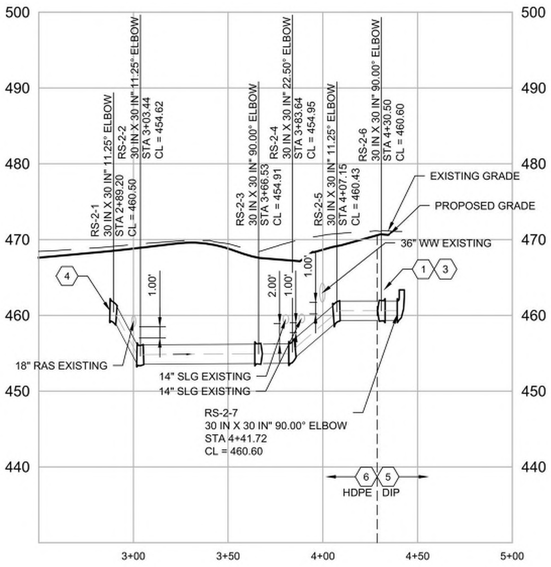

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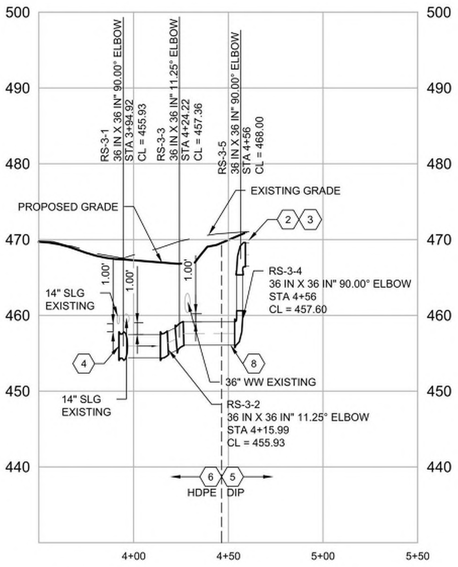

3 - RS-3 RAW SEWAGE
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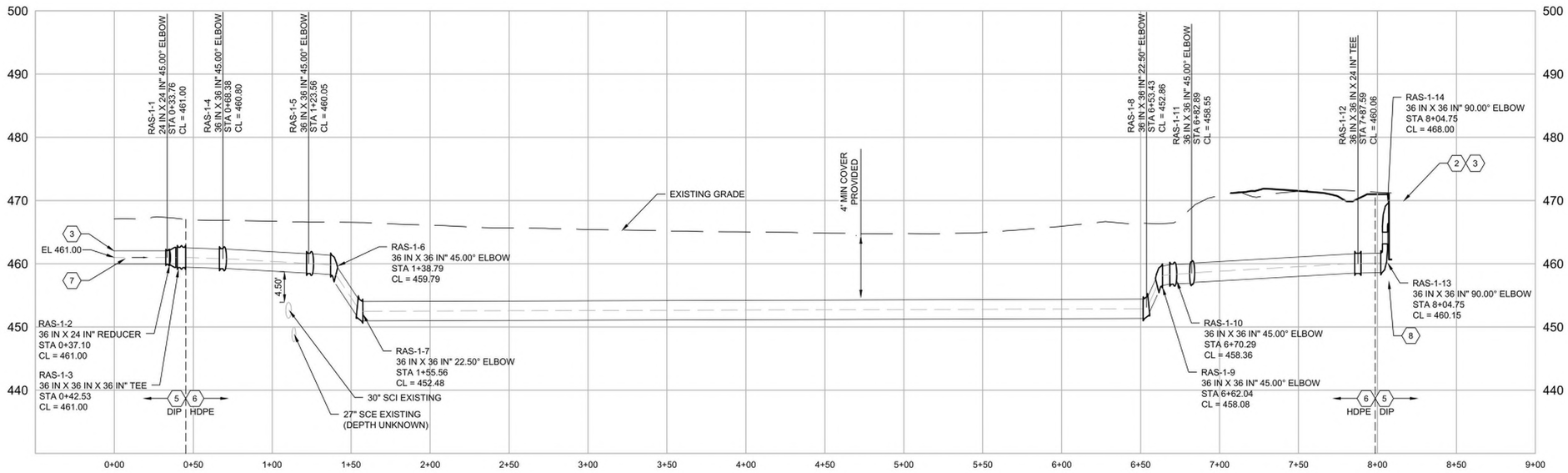

4 - RAS-1 PLANT II NORTH RAS
HZ: 1"=40' VT: 1"=10'

GENERAL NOTES:

1. SEE GENERAL NOTES ON SHEET 00C160
2. PROFILE VIEW CALLOUTS CORRESPOND TO PIPE CALLOUTS ON THE YARD PIPING PLANS.

KEYNOTES:

1. PIPE TERMINATES AT THE TOP OF SLAB.
2. PIPE TERMINATES AT THE INSIDE WALL OF THE STRUCTURE.
3. SEE PROCESS SHEETS FOR CONTINUATION.
4. SEE YARD PIPING PLAN FOR CONTINUATION.
5. DUCTILE IRON PIPE CONTINUED TO THIS POINT FROM THE RESPECTIVE PROCESS. PROVIDE TR FLEX JOINTS, AS SPECIFIED IN 40 05 00 AND 40 05 33.
6. TRANSITION YARD PIPING TO HDPE PIPE. PROVIDE FITTINGS AND JOINTS AS SPECIFIED IN 40 05 00 AND 40 05 33.
7. ADJACENT TO THE UPSTREAM 90° BEND, PROVIDE JOINTS AS SHOWN ON PROCESS SHEETS AND AS DETAILED IN 07/99C561.
8. ADJACENT TO THE DOWNSTREAM 90° BEND, PROVIDE JOINTS AS DETAILED IN 07/99C561.

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Date 6/13/2025 7:17:02 AM

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
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DESIGNED BY	J. THOMPSON
DRAWN BY	T. SCHLOTTMAN
CHECKED BY	S. BEROSET
APPROVED BY	J. THOMPSON
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
JONATHAN D. THOMPSON
147189
LICENSED
PROFESSIONAL ENGINEER
06/13/2025

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

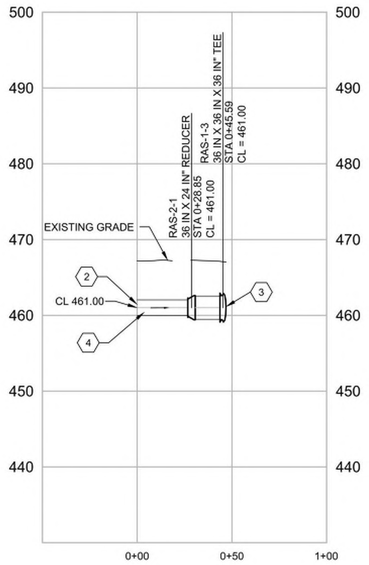
CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

N
40' 80'

CIVIL
YARD PIPING PROFILES 1

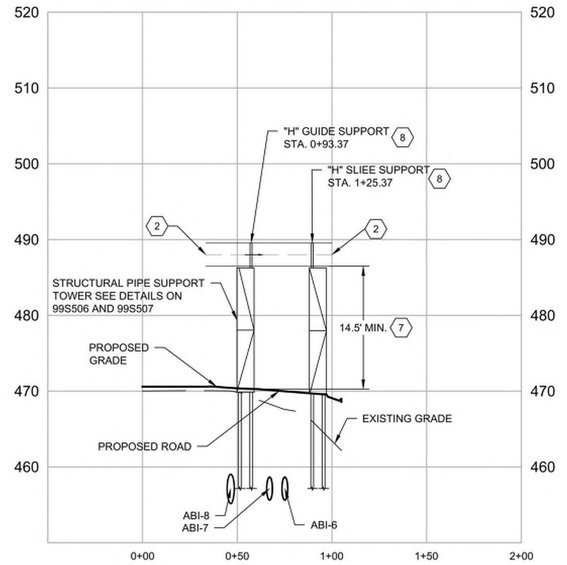
FILENAME 00C761.dwg
SCALE HZ: 1"=40' VT: 1"=10'

SHEET
00C761



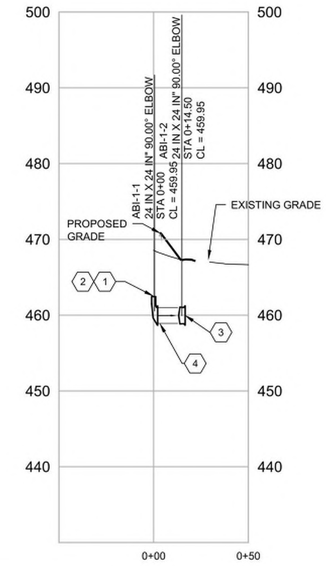
1 - RAS-2 PLANT II SOUTH RAS

HZ: 1"=40' VT: 1"=10'



2 - AA-1 AERATION AIR

HZ: 1"=40' VT: 1"=10'



3 - ABI-1 BASIN NO 1 INFLUENT

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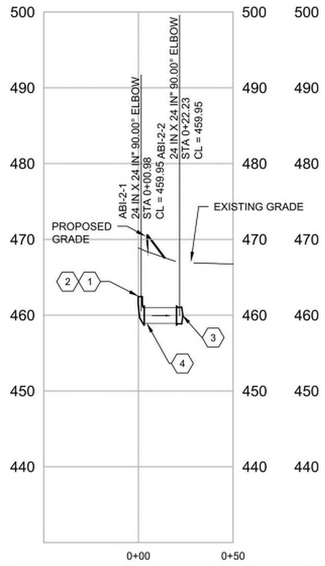

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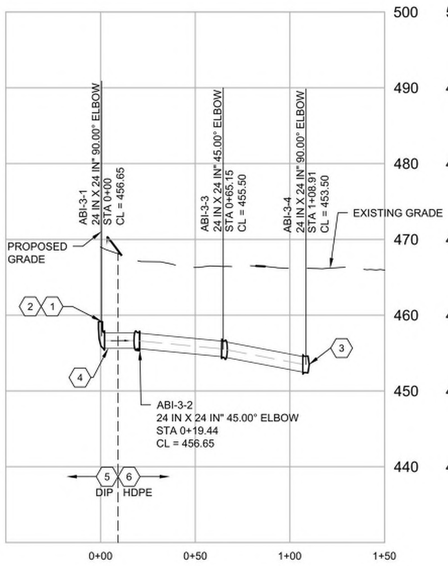

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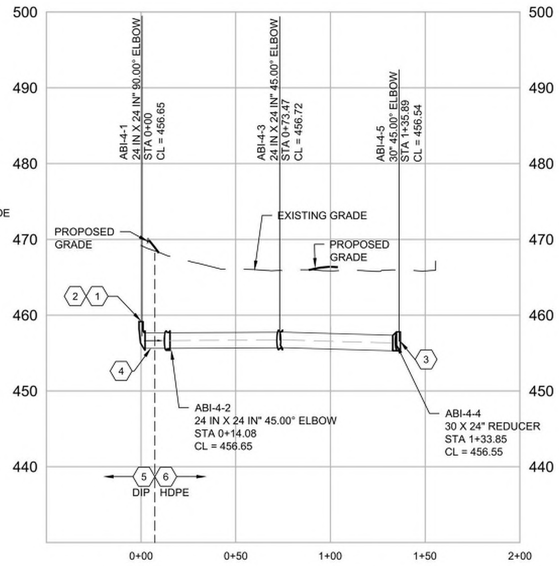

6 - ABI-4 BASIN NO 4 INFLUENT

HZ: 1"=40' VT: 1"=10'

GENERAL NOTES:

1. SEE GENERAL NOTES ON SHEET 00C160
2. PROFILE VIEW CALLOUTS CORRESPOND TO PIPE CALLOUTS ON THE YARD PIPING PLANS

KEYNOTES:

1. PIPE TERMINATES AT THE TOP OF SLAB.
2. SEE PROCESS SHEETS FOR CONTINUATION.
3. SEE YARD PIPING PLAN FOR CONTINUATION.
4. ADJACENT TO THE UPSTREAM 90° BEND, PROVIDE JOINTS AS DETAILED IN 07/99C561.
5. DUCTILE IRON PIPE CONTINUED TO THIS POINT FROM THE RESPECTIVE PROCESS. PROVIDE TR FLEX JOINTS, AS SPECIFIED IN 40 05 00 AND 40 05 33.
6. TRANSITION YARD PIPING TO HDPE PIPE. PROVIDE FITTINGS AND JOINTS AS SPECIFIED IN 40 05 00 AND 40 05 33.
7. THE MINIMUM DISTANCE FROM ROADWAY TO BOTTOM OF PIPE TO PROVIDE VEHICLE CLEARANCE FOR FIRE LANE.
8. SEE PROCESS STANDARD DETAILS FOR THE "H" GUIDE SUPPORT AND THE "H" SLIDE SUPPORT DETAILS.

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Date 6/13/2025 7:17:20 AM

TEXAS P.E. FIRM
Registration No. F-754

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DESIGNED BY	J. THOMPSON
DRAWN BY	T. SCHLOTTMAN
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CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
JONATHAN D. THOMPSON
147189
LICENSED
PROFESSIONAL ENGINEER
06/13/2025

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

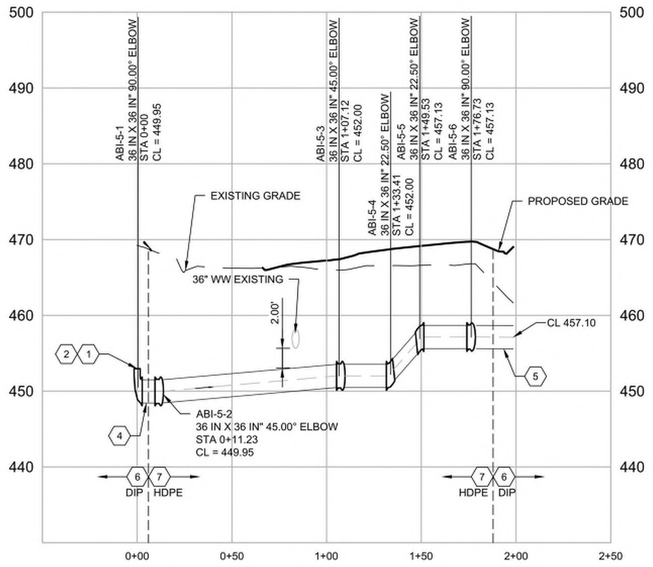
CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

N
40' 80'

CIVIL
YARD PIPING PROFILES 2

FILENAME 00C762.dwg
SCALE HZ: 1"=40' VT: 1"=10'

SHEET 00C762



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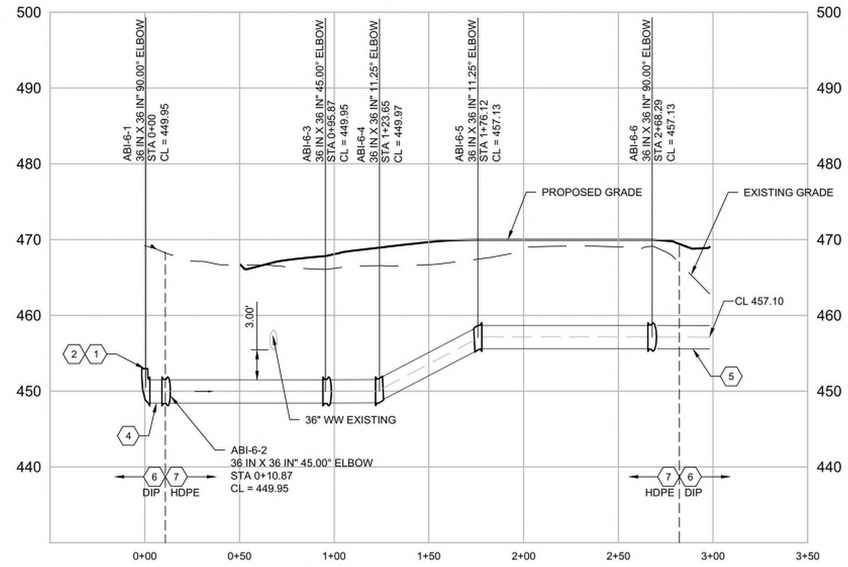

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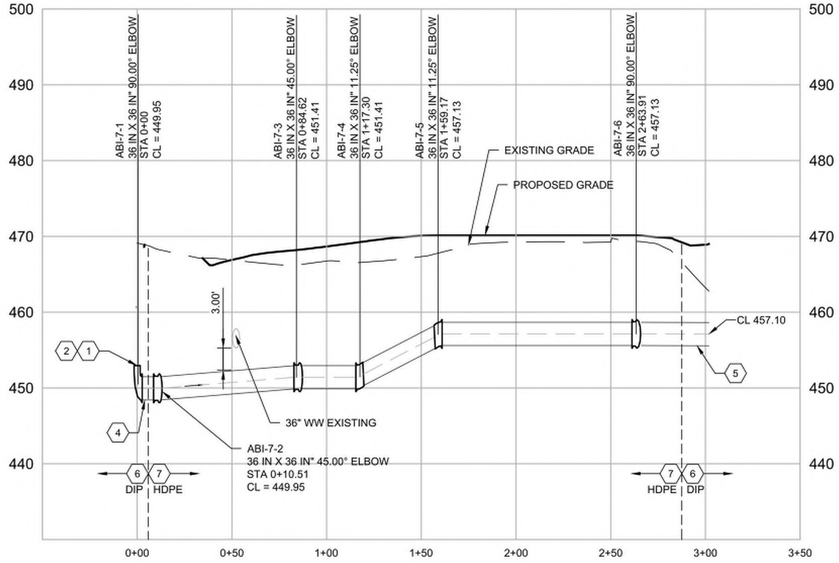

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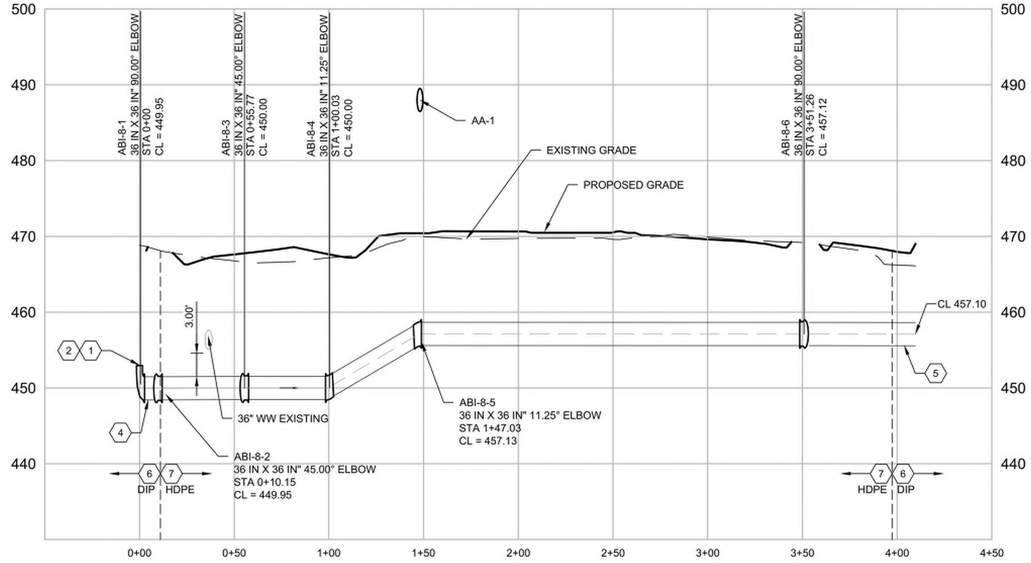

4 - ABI-8 BASIN NO 8 INFLUENT

HZ: 1"=40' VT: 1"=10'

GENERAL NOTES:

1. SEE GENERAL NOTES ON SHEET 00C160.
2. PROFILE VIEW CALLOUTS CORRESPOND TO PIPE CALLOUTS ON THE YARD PIPING PLANS.

KEYNOTES:

1. PIPE TERMINATES AT THE TOP OF SLAB.
2. SEE PROCESS SHEETS FOR CONTINUATION.
3. SEE YARD PIPING PLAN FOR CONTINUATION.
4. ADJACENT TO THE UPSTREAM 90° BEND, PROVIDE JOINTS AS DETAILED IN 7/99C561.
5. ADJACENT TO THE AERATION BASIN, PROVIDE JOINTS AS DETAILED IN 7/99C561.
6. DUCTILE IRON PIPE CONTINUED TO THIS POINT FROM THE RESPECTIVE PROCESS. PROVIDE TR FLEX JOINTS, AS SPECIFIED IN 40 05 00 AND 40 05 33.
7. TRANSITION YARD PIPING TO HDPE PIPE. PROVIDE FITTINGS AND JOINTS AS SPECIFIED IN 40 05 00 AND 40 05 33.

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Date 6/13/2025 7:17:36 AM

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PROFESSIONAL ENGINEER
06/13/2025

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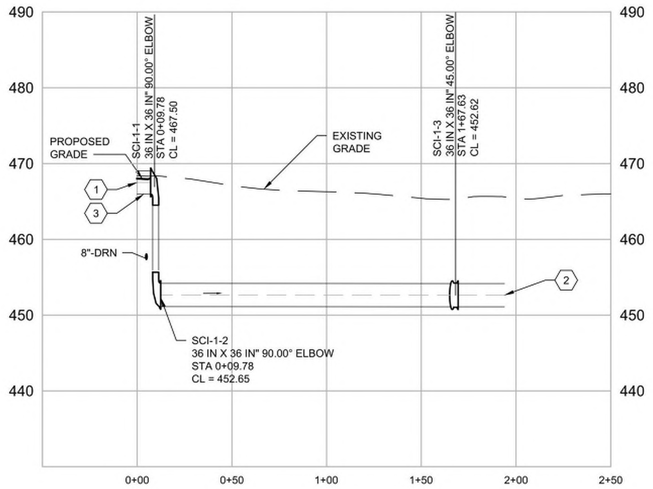
PRAIRIE CREEK
AERATION BASIN EXPANSION

N
40' 80'

CIVIL
YARD PIPING PROFILES 3

FILENAME 00C763.dwg
SCALE HZ: 1"=40' VT: 1"=10'

SHEET
00C763



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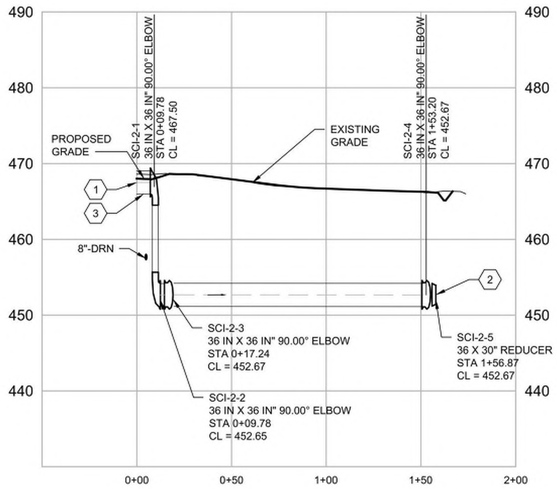

2 - SCI-2 CLARIFIER INFLUENT

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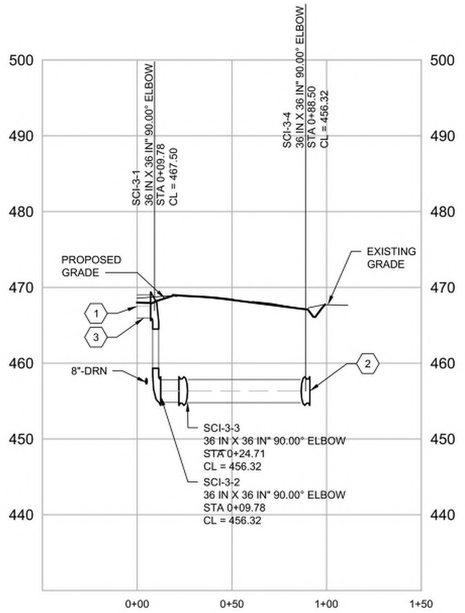

3 - SCI-3 CLARIFIER INFLUENT

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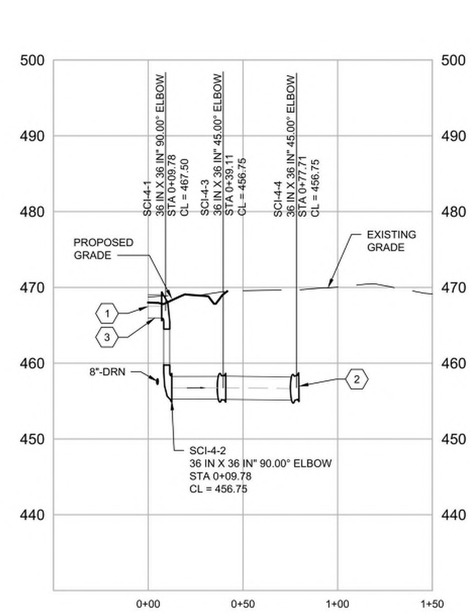

4 - SCI-4 CLARIFIER INFLUENT

HZ: 1"=40' VT: 1"=10'

GENERAL NOTES:

1. SEE GENERAL NOTES ON SHEET 00C160
2. PROFILE VIEW CALLOUTS CORRESPOND TO PIPE CALLOUTS ON THE YARD PIPING PLANS.

KEYNOTES:

1. SEE PROCESS SHEETS FOR CONTINUATION.
2. SEE YARD PIPING PLAN FOR CONTINUATION.
3. ADJACENT TO THE UPSTREAM 90° BEND, PROVIDE JOINTS AS DETAILED IN 07/99C561.

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Date 6/13/2025 7:17:52 AM

HDR
TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUN 13/2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	J. THOMPSON
DRAWN BY	T. SCHLOTTMAN
CHECKED BY	S. BEROSET
APPROVED BY	J. THOMPSON
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
JONATHAN D. THOMPSON
147189
LICENSED
PROFESSIONAL ENGINEER
06/13/2025

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

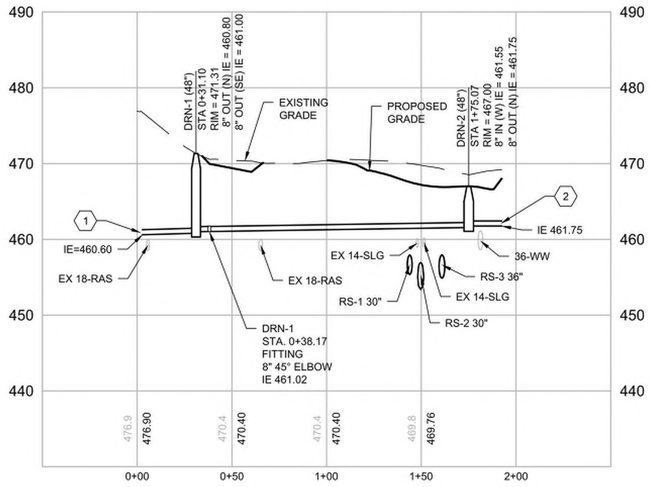
CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

N
40' 80'

CIVIL
YARD PIPING PROFILES 4

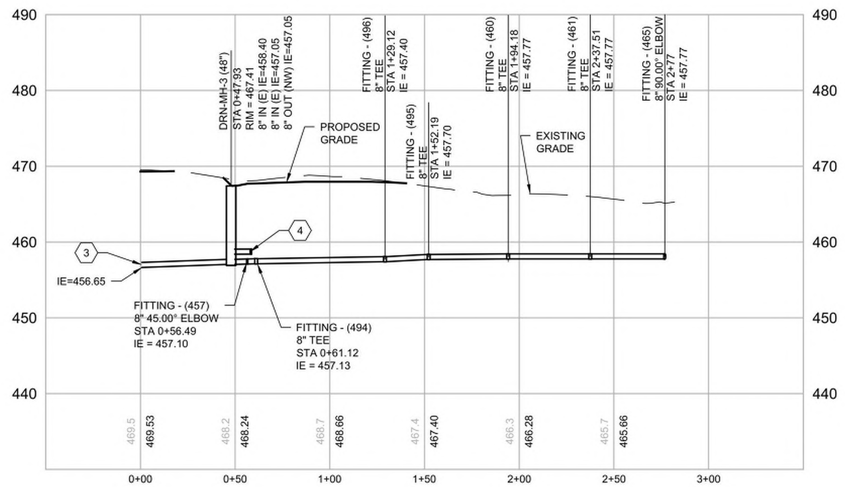
FILENAME 00C764.dwg
SCALE HZ: 1"=40' VT: 1"=10'

SHEET **00C764**



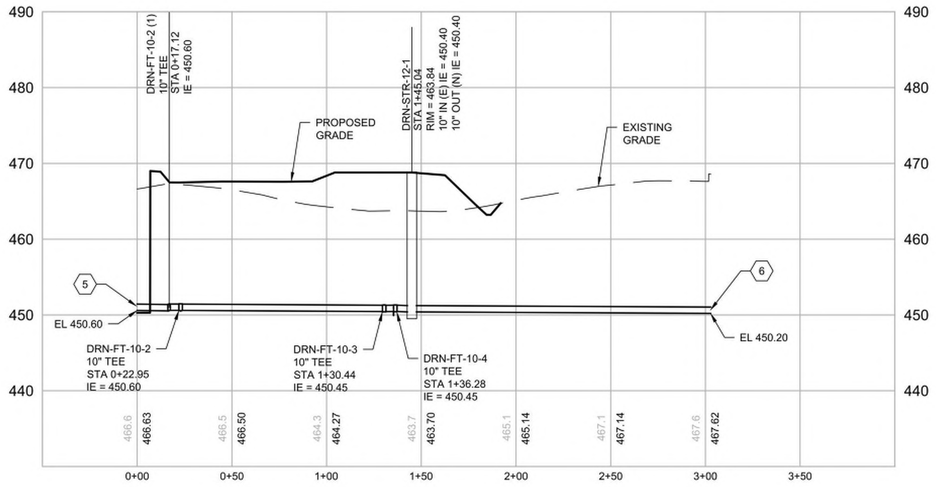
1 - DRAIN- AERATION BASIN SPLITTER STRUCTURE

HZ: 1"=40' VT: 1"=10'



1 - DRAIN- EXISTING BASINS & SC SPLITTER STRUCTURE

HZ: 1"=40' VT: 1"=10'



1 - DRAIN - PROPOSED BASINS

HZ: 1"=40' VT: 1"=10'

GENERAL NOTES:

1. SEE GENERAL NOTES ON SHEET 00C160.
2. PROFILE VIEW CALLOUTS CORRESPOND TO PIPE CALLOUTS ON THE YARD PIPING PLANS.

KEYNOTES:

1. CONNECT TO EXISTING MANHOLE. SEE DETAIL 6/99C563.
2. CONNECT TO PROPOSED AERATION BASIN SPLITTER STRUCTURE. SEE PROCESS SHEETS FOR CONTINUATION.
3. CONNECT TO EXISTING DRAIN LINE. CONNECTION POINT ELEVATION IS BASED ON HISTORICAL DRAWINGS AND SUE DATA OBTAINED DURING DESIGN. CONTRACTOR TO FIELD VERIFY.
4. DRAIN CONNECTION FROM FLOOR DRAINS IN SECONDARY CLARIFIER SPLITTER STRUCTURE. PROVIDE A DUCKBILL CV IN THE MANHOLE AS DETAILED. SEE YARD PIPING PLAN FOR CONTINUATION OF ALIGNMENT.
5. CONNECT TO PROPOSED BASIN DRAIN. ADDITIONAL CONNECTIONS TO PROPOSED BASINS ARE NOT PROFILED AND CAN BE SEEN ON YARD PIPING PLANS. SEE PROCESS SHEETS FOR CONTINUATION.
6. CONNECT TO EXISTING DRAIN PUMP STATION. SEE DETAIL 8/99C561.

File Path C:\Users\rgentry\DC\ACCDocs\HDR\10342803_COL_PCWWT_AB_Expansion_2024\Project Files\01_HDR\05_Civil_C\05.03_Sheet Files\00C765.dwg
Date 6/13/2025 7:18:06 AM

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUN 13/2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	J. THOMPSON
DRAWN BY	T. SCHLOTTMAN
CHECKED BY	S. BEROSET
APPROVED BY	J. THOMPSON
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
JONATHAN D. THOMPSON
147189
LICENSED PROFESSIONAL ENGINEER
06/13/2025

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

N
0 50' 100'

CIVIL
YARD PIPING PROFILES 5

FILENAME 00C765.dwg
SCALE 1" = 50'

SHEET 00C765

STRUCTURAL GENERAL NOTES

GENERAL

1. SCOPE
THE NOTES ON THIS SHEET AND THE STANDARD STRUCTURAL DETAILS ARE GENERAL AND APPLY TO THE ENTIRE PROJECT WHETHER SPECIFICALLY CALLED OUT OR NOT, EXCEPT WHERE THERE ARE SPECIFIC INDICATIONS TO THE CONTRARY ON STRUCTURAL SHEETS. IF THERE ARE QUESTIONS, THEY SHALL BE SUBMITTED TO THE STRUCTURAL ENGINEER AND ANSWERED IN WRITING PRIOR TO CONSTRUCTION.

2. APPLICABLE SPECIFICATIONS AND CODES
   A. INTERNATIONAL BUILDING CODE, IBC 2021 WITH APPLICABLE EDITIONS OF THE CODE REFERENCED STANDARDS.
   B. AMERICAN CONCRETE INSTITUTE, ACI 318-19 & ACI 350-20
   C. AMERICAN INSTITUTE OF STEEL CONSTRUCTION, AISC 360-16
   D. ALUMINUM ASSOCIATION, AA ADM-2020
   E. THE MASONRY SOCIETY, TMS 402/602-16
   F. LOCAL JURISDICTION AMENDMENTS

3. DESIGN CRITERIA
   A. DEAD LOAD:
      · ACTUAL TRIBUTARY STRUCTURE WEIGHT
      · BLOWER BUILDING ROOF: 10 PSF
   B. LIVE LOAD:
      · ELEVATED AND ACCESS FLOORS: 100 PSF
      · WALKWAYS, STAIRS, GRATING: 100 PSF
      · BLOWER ROOM: 250 PSF (UNIFORM) 2,000LB (CONCENTRATED) EQUIP WT (CONCENTRATED)
      · ELECTRICAL ROOM: 250 PSF (UNIFORM) 2,000LB (CONCENTRATED) EQUIP WT (CONCENTRATED)
      · SLAB ON GRADE: 250 PSF
      · ROOF 20 PSF (NOT REDUCIBLE)
   C. WIND:
      · BASIC DESIGN WIND SPEED, V: 111 MPH
      · ALLOWABLE STRESS DESIGN WIND SPEED, V_{ASD}: 86 MPH
      · RISK CATEGORY: III
      · EXPOSURE, I_E: C
      · INTERNAL PRESURRE COEFFICIENT, GC_{pi}: ±0.18
   D. SEISMIC:
      · RISK CATEGORY: III
      · IMPORTANCE FACTOR, I_E: 1.25
      · SPECTRAL RESPONSE ACCELERATION, S_S: 0.110g
      · SPECTRAL RESPONSE ACCELERATION, S_1: 0.056g
      · SITE CLASS: C
      · SEISMIC DESIGN CATEGORY: A
      · SPECTRAL RESPONSE COEFFICIENT, S_{DS}: 0.095g
      · SPECTRAL RESPONSE COEFFICIENT, S_{D1}: 0.056g
      · ANALYSIS PROCEDURE: GENERAL STRUCTURAL INTEGRITY PER ASCE 7-16 SECTION 1.4
   E. SNOW LOAD:
      · GROUND SNOW LOAD; P_G: 5 PSF

4. THE FOLLOWING NON-CONTRACTUAL GEOTECHNICAL REPORT WAS DEVELOPED FOR THIS PROJECT AND IS THE BASIS OF THIS STRUCTURAL DESIGN:
   GEOTECHNICAL FIRM NAME: KLEINFELDER, INC
   ADDRESS: 7805 MESQUITE BEND DRIVE SUITE 100 IRVING, TEXAS 75063
   REPORT NUMBER: 20233850.001A
   REPORT DATE: JULY 17, 2024

   NET ALLOWABLE SOIL BEARING PRESSURES ARE AS FOLLOWS:
   ALL STRUCTURES: 2,500 PSF

5. SAFETY
SAFETY AND STRUCTURE STABILITY DURING CONSTRUCTION ARE THE SOLE RESPONSIBILITY OF THE CONTRACTOR. STRUCTURES HAVE BEEN DESIGNED TO RESIST THE DESIGN LIVE LOADS ONLY AS A COMPLETED STRUCTURE.

6. OPENINGS
OPENINGS FOR PIPES, DUCTS, CONDUITS, ETC. ARE NOT ALL SHOWN ON THE STRUCTURAL DRAWINGS. COORDINATE AND PROVIDE OPENINGS AS REQUIRED TO ACCOMMODATE ALL WORK SHOWN OR SPECIFIED IN THE CONTRACT DOCUMENTS AND OTHERWISE REQUIRED FOR THE FURNISHING OF A FUNCTIONALLY COMPLETE PROJECT. REINFORCE AROUND OPENINGS PER STANDARD STRUCTURAL DETAILS UNLESS OTHERWISE SHOWN.

7. STANDARD DETAILS
THE STANDARD DETAILS DEPICT TYPICAL DETAILING TO BE USED ON THIS PROJECT. IF CONDITIONS ARE NOT EXPLICITLY SHOWN ON THE DRAWINGS THEY SHALL BE MADE SIMILAR TO THE STANDARD DETAILS. OBTAIN APPROVAL OF ENGINEER IN WRITING FOR SIMILAR CONDITIONS PRIOR TO CONSTRUCTION.

8. THE CONTRACTOR SHALL FIELD VERIFY ALL DIMENSIONS AND ELEVATIONS OF EXISTING CONSTRUCTION AS REQUIRED TO COORDINATE NEW CONSTRUCTION. SUBMIT REQUIRED CHANGES FOR APPROVAL.

9. CONTRACTOR TO SUBMIT FOR REVIEW ALL EQUIPMENT SIZES, OPERATING WEIGHTS, VIBRATION FORCES, SUPPORT LOCATIONS, ALONG WITH ANY FLOOR OPENINGS, NOTCHES, AND RECESSES REQUIRED BY SUCH EQUIPMENT. CONCRETE SUPPORT PADS AND/OR FRAMING REQUIRED TO SUPPORT SAID EQUIPMENT SHALL NOT BE FABRICATED AND PLACED UNTIL THE CONCRETE SUPPORT PADS AND/OR FRAMING IS APPROVED TO SUPPORT THE EQUIPMENT.

CONCRETE

1. DESIGN STRENGTHS
   F'c = 3,000 PSI (CONCRETE FILL AND LEAN CONCRETE)
   F'c = 4,000 PSI (ALL OTHER CONCRETE)
   F'c = 4,500 PSI W/ CRYSTALLINE WATERPROOFING (DRILLED PIER CONCRETE)
   F'c = 5,000 PSI W/ CRYSTALLINE WATERPROOFING (ALL CONCRETE IN CONTACT WITH PROCESS LIQUIDS)
   Fy = 60,000 PSI

2. CONCRETE COVER
   UNLESS OTHERWISE NOTED, PROVIDE CONCRETE COVER FOR REINFORCING AS FOLLOWS:
   REINFORCEMENT AT WATERSTOPS: 3 1/2"
   CONCRETE DEPOSITED AGAINST EARTH: 3"
   ALL OTHER: 2"
   SEE DRAWINGS FOR EXCEPTIONS

3. SEE SPECIFICATIONS FOR REINFORCING PLACEMENT REQUIREMENTS.

4. REFER TO OTHER DISCIPLINE DRAWINGS PRIOR TO CONSTRUCTION FOR EMBEDDED ITEMS AND PENETRATIONS NOT SHOWN ON STRUCTURAL DRAWINGS. REINFORCE AROUND OPENINGS PER STANDARD STRUCTURAL DETAILS UNLESS OTHERWISE SHOWN.

5. PROVIDE 3/4" CHAMFERS AT ALL EXPOSED EDGES AND 1/2" CHAMFERS AT JOINTS AS SHOWN. NOT ALL CHAMFERS MAY BE SHOWN ON DRAWINGS.

6. FIELD ADJUST REINFORCING AT OPENINGS AND EMBEDDED ITEMS AS INDICATED.

7. ANCHOR BOLTS NOT SPECIFIED BY ENGINEER SHALL BE DESIGNED AND CERTIFIED BY A REGISTERED PROFESSIONAL ENGINEER, RETAINED BY THE CONTRACTOR, IN ACCORDANCE WITH APPLICABLE PROJECT AND CODE REQUIREMENTS. SUBMIT AS A SHOP DRAWING FOR REVIEW AND APPROVAL BY THE ENGINEER. COORDINATE LOCATION, SIZE AND EMBEDMENT PRIOR TO CASTING CONCRETE.

8. CONTINUOUS WATERSTOP SHALL BE INSTALLED IN JOINTS SUBJECT TO STATIC WATER PRESSURE. ALL WATERSTOPS SHALL BE PVC, UNLESS NOTED OTHERWISE, SEE SPECIFICATIONS FOR ADDITIONAL INFORMATION. THE CONTRACTOR SHALL BE RESPONSIBLE TO MAKE ALL WATERSTOPS CONTINUOUS AND ALL JOINTS LEAK-FREE AS REQUIRED.

9. ABSOLUTELY NO WELDING OF REINFORCING BARS OR TORCHING TO BEND REINFORCING BARS SHALL BE ALLOWED WITHOUT SPECIFIC APPROVAL FROM THE STRUCTURAL ENGINEER.

10. CONTRACTOR SHALL SUBMIT A CONCRETE PLACEMENT PLAN PER SPECIFICATION (03 31 31) IDENTIFYING JOINT TYPES, JOINT LOCATIONS AND CONCRETE PLACEMENT SEQUENCE. FORMED CONSTRUCTION JOINTS SHALL BE KEYED, CONSTRUCTION JOINTS AT UNFORMED SURFACES SHALL BE ROUGHENED, SEE STANDARD DETAILS. A MINIMUM 72 HOURS SHALL ELAPSE BETWEEN PLACEMENTS OF ADJACENT CONCRETE CONSTRUCTION AT JOINTS WHERE PLACEMENT IS INTERRUPTED.

11. ALL CAST-IN-PLACE AND POST-INSTALLED ANCHORS INDICATED IN THE STRUCTURAL DOCUMENTS SHALL COMPLY WITH ACI 318 (CHAPTER 17), AND APPENDIX E OF ACI 350 AND CHAPTER 19 OF THE IBC. ALL EXPANSION AND ADHESIVE ANCHORS SHALL HAVE THE ICC REPORT SHOWING EQUIVALENT LOAD CAPACITY. SUBMIT AND INSTALL PER THE ICC EVALUATION REPORT.

12. PRIOR TO INSTALLING POST INSTALLED ANCHORS INTO CONCRETE, THE CONTRACTOR SHALL LOCATE REINFORCING. DO NOT DAMAGE CONCRETE REINFORCING.

13. SEE CIVIL DRAWINGS FOR ALL EXTERIOR PAVING AND FLATWORK.

14. DETAIL ALL STIRRUPS, HOOKS, AND BENDS PER CRSI MANUAL OF STANDARD PRACTICE, UNLESS NOTED OTHERWISE.

MASONRY

1. DESIGN STRENGTHS:
   F'm = 2,000 PSI
   Fy = 60,000 PSI

2. GROUT FOR FILLING MASONRY CAVITIES TO BE COARSE GROUT UNO, MAXIMUM COARSE AGGREGATE SIZE IS 3/8 INCH.

3. GROUT POURS SHALL NOT EXCEED 4 FEET IN HEIGHT UNLESS CLEANOUTS ARE PROVIDED IN THE BOTTOM COURSE OF THE CELL(S) TO BE GROUTED AND WRITTEN PERMISSION IS OBTAINED FOR HIGH LIFT GROUTING.

4. RESTRICTED BAR ANCHORAGE:
IN CASES WHERE REINFORCING BARS CANNOT BE EXTENDED AS FAR AS REQUIRED, THE BARS SHALL EXTEND AS FAR AS POSSIBLE AND TERMINATE WITH A STANDARD HOOK. SHOW ON SHOP DRAWINGS AND HIGHLIGHT WITH A BOX TO BRING TO ENGINEER'S ATTENTION.

5. ANCHOR BOLTS:
ALL EXPANSION AND ADHESIVE ANCHORS SHALL HAVE THE ICC REPORT SHOWING EQUIVALENT LOAD CAPACITY. SUBMIT AND INSTALL PER THE ICC EVALUATION REPORT.

6. IF BOND BEAMS AT INTERSECTING WALLS ARE SHOWN ON THE DRAWINGS TO MEET AT DIFFERENT ELEVATIONS, EXTEND REINFORCING OF BOTH BOND BEAMS AROUND INTERSECTING CORNER NOT LESS THAN 4 FEET IN EACH DIRECTION.

7. LINTEL BLOCKS SHALL NOT BE USED AS BOND BEAM BLOCKS EXCEPT AT OPENINGS WHERE BOND BEAMS AND LINTELS COINCIDE.

STEEL

1. DESIGN STRENGTHS:
   WIDE FLANGE AND TEES: Fy=50 KSI
   PIPES: Fy=35 KSI
   STAINLESS STEEL: Fy=30 KSI
   HSS ROUND: Fy=50 KSI
   HSS SQUARE OR RECTANGULAR: Fy=50 KSI
   ALL OTHER PLATES AND SHAPES: Fy=36 KSI

2. DIMENSIONS:
TO CENTERLINES OF COLUMNS AND BEAMS, TOP SURFACES OF BEAMS AND TUBES AND BACKS OF CHANNELS AND ANGLES UNO.

3. ELEVATIONS:
TOP OF STEEL REFERS TO TOP SURFACE OF MEMBER OR FLANGE UNO.

4. WHEN FILLET WELD SIZE IS NOT INDICATED, PROVIDE MAXIMUM WELD SIZE BASED ON MATERIAL THICKNESS IN ACCORDANCE WITH AISC SPECIFICATIONS.

5. ALL BOLTED STRUCTURAL CONNECTIONS ARE BEARING TYPE CONNECTIONS UNLESS OTHERWISE SPECIFIED TO BE SLIP-CRITICAL. PROVIDE LOAD INDICATING WASHERS AT SLIP-CRITICAL CONNECTIONS.

ALUMINUM

1. DESIGN STRENGTHS
   Fy=35 KSI
   ALLOY: SEE SPECIFICATIONS

2. DIMENSIONS
TO CENTERLINES OF COLUMNS AND BEAMS, TOP SURFACES OF BEAMS AND TUBES AND BACKS OF CHANNELS AND ANGLES UNO.

3. ELEVATIONS
TOP OF ALUMINUM REFERS TO TOP SURFACE OR FLANGE OF MEMBER UNO.

4. WHEN FILLET WELD SIZE IS NOT INDICATED, PROVIDE MAXIMUM WELD SIZE FOR THE MATERIAL THICKNESS IN ACCORDANCE WITH THE LATEST EDITION OF THE "ALUMINUM DESIGN MANUAL" BY THE ALUMINUM ASSOCIATION.

5. ALUMINUM IN CONTACT WITH DISSIMILAR MATERIALS OR CONCRETE:
CONTACT SURFACES SHALL BE PROVIDED WITH GALVANIC SEPARATION PER SPECIFICATIONS.

STEEL BAR JOIST:

1. STEEL JOISTS ARE SIZED AS SHOWN ON THE DRAWINGS AND DESIGNED BY THE CONTRACTOR FOR THE LOADINGS INDICATED.

2. STEEL JOISTS AND BRIDGING SHALL BE DESIGNED BY THE MANUFACTURER TO RESIST UPLIFT LOADS INDICATED ON THE DRAWINGS.

3. CONCENTRATED LOADS SHALL BE LOCATED WITHIN 4 INCHES OF A PANEL POINT OR SPECIAL REINFORCEMENT MUST BE ADDED PER STANDARD DETAILS.

4. ADJUST JOIST BRIDGING DESIGN AND DETAILING WHERE MECHANICAL DUCTS OR OTHER OBSTRUCTIONS RUN BETWEEN THE JOISTS. SEE STANDARD DETAILS.

STEEL DECK:

1. THE DESIGN, FABRICATION, AND ERECTION OF METAL DECKING SHALL BE IN ACCORDANCE WITH THE CURRENT EDITION OF THE SDI SPECIFICATIONS AND THE SDI DIAPHRAGM MANUAL

2. STEEL ROOF DECK IS 1-1/2 INCH AS SHOWN ON THE PLANS AND DESIGNED FOR THE DEAD AND LIVE LOADS INDICATED.

3. STEEL ROOF DECK IS TO BE A STRUCTURAL DIAPHRAGM AND SHALL BE FASTENED AS INDICATED IN THE DRAWINGS.

4. THE PLANS INDICATE DECK SPAN DIRECTION.

5. SUSPENDED CEILINGS, LIGHT FIXTURES, DUCTS, AND OTHER UTILITIES SHALL NOT BE SUPPORTED FROM THE STEEL DECK.

DEFERRED SUBMITTALS

1. DEFINED
DEFERRED SUBMITTALS ARE THOSE PORTIONS OF THE DESIGN WHICH ARE NOT SUBMITTED AT THE TIME OF PERMIT APPLICATION AND WHICH ARE TO BE SUBMITTED TO THE PERMITTING AGENCY FOR ACCEPTANCE PRIOR TO INSTALLATION OF THAT PORTION OF THE WORK.

2. DEFERRED LIST
THE FOLLOWING IS A LIST OF DEFERRED SUBMITTALS PER IBC SECTION 107.3.4.1 THAT ARE EXPECTED TO CONTAIN STRUCTURAL CALCULATIONS OF SAFETY RELATED SYSTEM INFORMATION FOR REVIEW TO MEET BUILDING PERMITTING REQUIREMENTS FOR DESIGNED SYSTEMS PRIOR TO INSTALLATION OF THE INDICATED STRUCTURAL ELEMENT, EQUIPMENT, DISTRIBUTION SYSTEM, COMPONENT OR ITS ANCHORAGE. THE CONTRACTOR SHALL SUBMIT THE REQUIRED ENGINEER CERTIFICATION SUPPORTING DATA AND DRAWINGS FOR REVIEW AND ACCEPTANCE BY THE ENGINEER. ADDITIONALLY, ACCEPTANCE INDICATED ON THE ENGINEER'S COMMENT FORM, ALONG WITH THE COMPLETED FINAL SUBMITTAL SHALL THEN BE FILED BY THE CONTRACTOR AND ACKNOWLEDGED AS ACCEPTED BY THE PERMITTING AGENCY PRIOR TO INSTALLATION OF THESE ITEMS.

DEFERRED SUBMITTALS	
SPEC SECTIONS	DESCRIPTION
03 15 19	ANCHORAGE TO CONCRETE
05 21 00	STEEL JOISTS
05 50 00	METAL FABRICATIONS
05 52 46	MECHANICALLY FASTENED ALUMINUM RAILINGS
40 05 07	PIPE SUPPORT SYSTEMS
OTHER	ANY EQUIPMENT OR COMPONENT IN WHICH A TECHNICAL SPECIFICATION REQUIRES SUBMITTAL OF EQUIPMENT OR ANCHORAGE SYSTEM CALCULATIONS

SPECIAL INSPECTION

1. THE OWNER MUST EMPLOY ONE OR MORE APPROVED AGENCIES TO PERFORM INSPECTIONS DURING CONSTRUCTION ON THE TYPES OF WORK LISTED UNDER SECTION 1705 OF THE IBC REQUIRING VERIFICATION AND INSPECTION. THESE INSPECTIONS ARE IN ADDITION TO THE INSPECTIONS DEFINED IN SECTION 110. THE INSPECTING AGENCY MUST PROVIDE REPORTS OF THE SPECIAL INSPECTIONS DIRECTLY TO THE OWNER.

   THE FOLLOWING IS A LIST OF INSPECTIONS THAT SHALL BE PERFORMED IN ACCORDANCE WITH CHAPTER 17 OF THE IBC.
   · STEEL CONSTRUCTION: 1705.2
   · CONCRETE CONSTRUCTION: 1705.3
   · MASONRY CONSTRUCTION: 1705.4
   · SOILS: 1705.6
   · CAST-IN-PLACE DEEP FOUNDATIONS: 1705.8

STRUCTURAL OBSERVATIONS:

1. STRUCTURAL OBSERVATIONS SHALL BE PERFORMED IN ACCORDANCE WITH IBC SECTION 1704.6 AND SPECIFICATION SECTION 01 45 33.

2. STRUCTURAL OBSERVATIONS SHALL BE PERFORMED BY A REGISTERED PROJECT DESIGN PROFESSIONAL FOR GENERAL CONFORMANCE TO THE APPROVED CONSTRUCTION DOCUMENTS. STRUCTURAL OBSERVATIONS DOES NOT INCLUDE OR WAIVE THE RESPONSIBILITY FOR ANY REQUIRED SPECIAL INSPECTIONS OR INSPECTIONS BY THE BUILDING OFFICIAL.

3. PRIOR TO COMMENCING STRUCTURAL OBSERVATIONS, STRUCTURAL OBSERVER SHALL SUBMIT TO BUILDING OFFICIAL WRITTEN STATEMENT IDENTIFYING FREQUENCY AND EXTENT OF ANTICIPATED STRUCTURAL OBSERVATIONS.

4. AT THE CONCLUSION OF THE WORK, A WRITTEN STATEMENT SHALL BE PROVIDED TO THE BUILDING OFFICIAL TO VERIFY THAT THE STRUCTURAL OBSERVATION SITE VISITS WERE MADE AND WHETHER THERE REMAIN ANY STRUCTURAL DEFICIENCIES THAT, TO THE BEST OF THE STRUCTURAL OBSERVER'S KNOWLEDGE, HAVE NOT BEEN RESOLVED.

5. STRUCTURAL OBSERVATIONS SHALL INCLUDE VISUAL OBSERVATION OF THE STRUCTURAL SYSTEM AT SIGNIFICANT CONSTRUCTION STAGES AND AT COMPLETION OF THE STRUCTURAL SYSTEM FOR EACH STRUCTURE CONTAINED IN THE WORK. THE CONTRACTOR SHALL SCHEDULE AND FACILITATE STRUCTURAL OBSERVATIONS FOR THE FOLLOWING:
   A. CONCRETE REINFORCING STEEL, WATERSTOPS, EMBEDS, AND SIMILAR ITEMS PRIOR TO FIRST CONCRETE PLACEMENT.
   B. MASONRY WALL REINFORCING STEEL PRIOR TO GROUTING OF FIRST LIFT.
   C. SYSTEM CONNECTION EMBEDS PRIOR TO GROUT OR CONCRETE PLACEMENT.

HDR
TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	OCT 16/2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	W. DONELAN
DRAWN BY	H. GARCIA
CHECKED BY	C. ZIMMERMAN
APPROVED BY	J. NAVE
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
JASON C. NAVE
130766
10/16/25

LEWISVILLE
Deep Roots. Broad Wings. Bright Future

CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

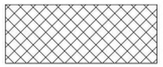
GENERAL STRUCTURAL GENERAL NOTES

FILENAME: Structural Standard Details
SCALE: NONE (0, 1", 2")
SHEET: 00S001

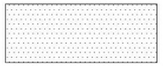
GENERAL STRUCTURAL ABBREVIATIONS

A/E	ARCHITECT/ENGINEER
AB	ANCHOR BOLT
ADDL	ADDITIONAL
ADH	ADHESIVE
AFF	ABOVE FINISH FLOOR
AFG	ABOVE FINISH GRADE
ALUM	ALUMINUM
ANC	ANCHOR
APRX	APPROXIMATE
APVD	APPROVED
ARCH	ARCHITECTURAL
BC	BOTTOM CHORD
BLDG	BUILDING
BLKG	BLOCKING
BM	BEAM
BOL	BOLLARD
BOT	BOTTOM
BP	BASE PLATE
BRG	BEARING
BTB	BACK TO BACK
BTW	BETWEEN
C	CHANNEL SHAPE
CHD	CHORD
CHKD	CHECKERED
CIP	CAST-IN-PLACE
CJ	CONSTRUCTION JOINT
CL	CENTERLINE
CLJ	CONTROL JOINT
CLR	CLEAR
CMU	CONCRETE MASONRY UNIT
COL	COLUMN
CONC	CONCRETE
CONN	CONNECTION
CONST	CONSTRUCTION
CONT	CONTINUOUS
CTC	CENTER TO CENTER
CTR	CENTER
CY	CUBIC YARD
D	DEEP
DBA	DEFORMED BAR ANCHOR
DBL	DOUBLE
DEMO	DEMOLITION
DET	DETAIL
DIA	DIAMETER
DIAG	DIAGONAL
DIM	DIMENSION
DIST	DISTANCE
DL	DEAD LOAD
DT	DOUBLE TEE
DWG	DRAWING
DWL	DOWEL
E	EAST
EA	EACH
ECC	ECCENTRIC
EF	EACH FACE
EJ	EXPANSION JOINT
EL	ELEVATION
ELEC	ELECTRICAL
ENGR	ENGINEER
EQ	EQUAL
EQUIP	EQUIPMENT
ES	EACH SIDE
EW	EACH WAY
EWEF	EACH WAY, EACH FACE
EWTB	EACH WAY, TOP AND BOTTOM
EXP	EXPANSION
EXST	EXISTING
FAB	FABRICATOR
FD	FLOOR DRAIN
FDTN	FOUNDATION
FG	FINISHED GRADE
FIG	FIGURE
FIN	FINISH
FLR	FLOOR
FOC	FACE OF CONCRETE, FACE OF CURB
FR	FRAME
FRP	FIBERGLASS REINFORCED PLASTIC
FT	FEET, FOOT
FTG	FOOTING
FV	FIELD VERIFY
GA	GAGE (METAL THICKNESS)
GALV	GALVANIZED
GEN	GENERAL
GR	GRADE
GRTG	GRATING
HC	HOLLOW CORE
HDR	HEADER
HK	HOOK
HORIZ	HORIZONTAL
HP	HIGH POINT
HS	HEADED STUD
HSS	HOLLOW STRUCTURAL SHAPE
HT	HEIGHT
ID	INSIDE DIAMETER
IF	INSIDE FACE
IN	INCH
INFO	INFORMATION
INT	INTERIOR, INTERSECTION
INV	INVERT
JF	JOINT FILLER
JST	JOIST
JT	JOINT
K	KIP
KB	KNEE BRACE
KLF	KIPS PER LINEAR FOOT
KSI	KIPS PER SQUARE INCH
L	ANGLE, LENGTH
LAD	LADDER
LB	POUND
LF	LINEAR FOOT
LG	LONG
LIN	LINEAR
LLH	LONG LEG HORIZONTAL
LLV	LONG LEG VERTICAL
LNG	LONGITUDINAL
LOC	LOCATION
LP	LOW POINT
LWC	LIGHTWEIGHT CONCRETE
MAX	MAXIMUM
MBR	MEMBER
MC	MOMENT CONNECTION
MCJ	MASONRY CONTROL JOINT
MECH	MECHANICAL
MFR	MANUFACTURER
MIN	MINIMUM
MISC	MISCELLANEOUS
ML	MASONRY LINTEL
N	NORTH
NIC	NOT IN CONTRACT
NOM	NOMINAL
NTS	NOT TO SCALE
OC	ON CENTER
OD	OUTSIDE DIAMETER
OF	OUTSIDE FACE
OH	OVERHEAD
OPNG	OPENING
OPP	OPPOSITE
OVHG	OVERHANG
PAR	PARALLEL
PCF	POUNDS PER CUBIC FOOT
PCLJ	PARTIAL CONTROL JOINT
PEN	PENETRATION
PEMB	PRE-ENGINEERED METAL BUILDING
PL	PLATE
PLBG	PLUMBING
PLF	POUNDS PER LINEAR FOOT
PREFAB	PREFABRICATED
PRELIM	PRELIMINARY
PS	PIPE SUPPORT, PUMP STATION
PSF	POUNDS PER SQUARE FOOT
PSI	POUNDS PER SQUARE INCH
PT	POINT
PVC	POLYVINYL CHLORIDE
QTY	QUANTITY
RECT	RECTANGULAR
REF	REFERENCE
REINF	REINFORCING
REQD	REQUIRED
REV	REVISION
RO	ROUGH OPENING
RTW	RETAINING WALL
S	SOUTH
SCH	SCHEDULE
SECT	SECTION
SF	SQUARE FOOT
SHT	SHEET
SIM	SIMILAR
SL	SLOPE
SLTD	SLOTTED
SOG	SLAB ON GRADE
SPA	SPACING
SPEC	SPECIFICATION
SQ	SQUARE
SST	STAINLESS STEEL
STD	STANDARD
STIR	STIRRUP
STL	STEEL
STR	STRUCTURAL, STRAIGHT
SUSP	SUSPENDED
T&B	TOP AND BOTTOM
T/	TOP OF
TEMP	TEMPORARY
THK	THICK
TOB	TOP OF BEAM
TOC	TOP OF CONCRETE
TOF	TOP OF FOOTING
TOG	TOP OF GRATING
TOM	TOP OF MASONRY
TOS	TOP OF SLAB, TOP OF STEEL
TOW	TOP OF WALL
TPG	TOPPING, THROUGH PLATE GIRDER
TRD	TRENCH DRAIN
TYP	TYPICAL
ULT	ULTIMATE
UNO	UNLESS NOTED OTHERWISE
VERT	VERTICAL
VOL	VOLUME
W	WEST, WIDE, WIDE FLANGE BEAM
W/	WITH
W/O	WITHOUT
WF	WIDE FLANGE
WLD	WELDED
WM	WIRE MESH
WP	WORK POINT
WS	WATERSTOP
WT	WEIGHT
WWF	WELDED WIRE FABRIC

PATTERNS LEGEND



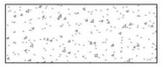
CMU IN PLAN



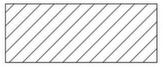
SLAB DEPRESSION/ MECHANICAL ZONE

GROUT/ SAND IN SECTION

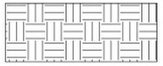
CONCRETE IN SECTION



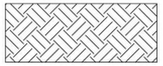
EXISTING CONCRETE



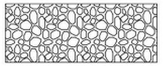
CONSTRUCTION BY OTHERS



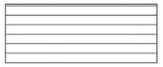
EARTH (UNDISTURBED)



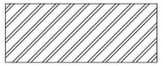
EARTH/ FILL (COMPACTED)



CRUSHED STONE/ GRAVEL FILL



CLAY CAP



STEEL IN SECTION

ABBREVIATION NOTES:

1. THESE ABBREVIATIONS APPLY TO THE STRUCTURAL SET OF CONTRACT DRAWINGS.
2. LISTING OF ABBREVIATIONS DOES NOT IMPLY THAT ALL ABBREVIATIONS ARE USED IN THE CONTRACT DRAWINGS.
3. ABBREVIATIONS SHOWN ON THIS SHEET INCLUDE VARIATIONS OF A WORD. FOR EXAMPLE, "MOD" MAY MEAN MODIFY OR MODIFICATION; "INC" MAY MEAN INCLUDED OR INCLUDING AND "REINF" MAY MEAN EITHER REINFORCE OR REINFORCING.

HDR
TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13/2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	W. DONELAN
DRAWN BY	H. GARCIA
CHECKED BY	C. ZIMMERMAN
APPROVED BY	J. NAVE
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
JASON C. NAVE
130766
06/13/25

LEWISVILLE
Deep Roots. Broad Wings. Bright Future

CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

GENERAL STRUCTURAL ABBREVIATIONS AND PATTERNS

0 1" 2"

FILENAME	Structural Standard Details
SCALE	NONE
SHEET	00S002

PIPING SYSTEMS

COLD WATER, POTABLE (CW)	
HOT WATER, POTABLE (HW)	
HOT WATER RECIRCULATING, POTABLE (HWC)	
NPW	NON POTABLE COLD WATER
140	HOT WATER - TEMPERATURE, POTABLE
TW	TEPID WATER, POTABLE
TWR	TEPID WATER RETURN, POTABLE
SAN	SANITARY SEWER BELOW GRADE
SAN	SANITARY SEWER ABOVE GRADE
V	SANITARY VENT
AW	ACID WASTE
AV	ACID VENT
CWV	COMBINATION WASTE AND VENT
PD	PRESSURE DRAINAGE
SD	STORM DRAIN ABOVE GRADE
SD	STORM DRAIN BELOW GRADE
OD	STORM DRAIN OVERFLOW
NG	NATURAL GAS
LP	LIQUEFIED PROPANE
CA	COMPRESSED AIR
HWS	HEATING HOT WATER SUPPLY
HWR	HEATING HOT WATER RETURN
GHWS	GLYCOL HEATING HOT WATER SUPPLY
GHWR	GLYCOL HEATING HOT WATER RETURN
CHWS	CHILLED WATER SUPPLY
CHWR	CHILLED WATER RETURN
GCWS	GLYCOL CHILLED WATER SUPPLY
GCWR	GLYCOL CHILLED WATER RETURN
CWS	CONDENSER WATER SUPPLY
CWR	CONDENSER WATER RETURN
RL	REFRIGERANT LIQUID
RS	REFRIGERANT SUCTION
CD	CONDENSATE DRAIN
CPD	CONDENSATE PUMP DISCHARGE
STM -15	STEAM SUPPLY - PSI
BBD	BOILER BLOW DOWN
BF	BOILER FEED
SV	STEAM VENT
MU	MAKE-UP WATER

PIPING SYMBOLOGY

- PIPE ANCHOR
- PIPE GUIDE
- EXPANSION JOINT
- PT — PRESSURE/ TEMPERATURE PORT
- THERMOMETER
- THERMOWELL
- PRESSURE GAUGE
- T — TEMPERATURE GAUGE
- FLEXIBLE PIPING CONNECTION
- WYE STRAINER
- MANUAL AIR VENT
- A — AUTOMATIC AIR VENT
- M — METER (WATER, GAS, OTHER)
- FCO — FLOOR CLEANOUT
- CO — CLEANOUT
- WCO — WALL CLEANOUT
- GCO — DOUBLE GRADE CLEANOUT
- WATER HAMMER ARRESTOR
- E — EARTHQUAKE VALVE
- CONCENTRIC REDUCER
- ECCENTRIC REDUCER, FLAT ON BOTTOM
- ECCENTRIC REDUCER, FLAT ON TOP
- ELBOW, 90° TURN DOWN
- ELBOW, 90° TURN UP
- TEE, OUTLET UP
- TEE, OUTLET DOWN
- TEE, OUTLET UP W/ 90° TURN
- TEE, OUTLET DOWN W/ 90° TURN
- PIPE BREAK
- PIPE CAP
- BLIND FLANGE
- UNION
- FLOW ARROW
- SHUTOFF VALVE (NORMALLY OPEN)
- SHUTOFF VALVE (NORMALLY CLOSED)
- DRAIN VALVE
- CHECK VALVE
- VB — VACUUM BREAKER
- AUTOMATIC FLOW CONTROL VALVE
- CALIBRATED MANUAL BALANCING VALVE
- OR — PRESSURE-RELIEF VALVE
- PRESSURE-REDUCING VALVE (PRV)
- AUTOMATIC CONTROL VALVE, 2-WAY
- AUTOMATIC CONTROL VALVE, 3-WAY
- BFP — BACKFLOW PREVENTER
- XX-1 — PLUMBING FIXTURE

HVAC SYMBOLOGY

- 24x18 — SUPPLY AIR OR OUTSIDE AIR DUCT UP (SECTION CUT, FIRST DIMENSION DUCT WIDTH)
- SUPPLY AIR OR OUTSIDE AIR DUCT DOWN (NO SECTION CUT)
- RETURN AIR DUCT UP (SECTION CUT)
- RETURN AIR DUCT DOWN (NO SECTION CUT)
- EXHAUST AIR DUCT UP (NO SECTION CUT)
- EXHAUST AIR DUCT DOWN (NO SECTION CUT)
- ROUND ELBOW UP
- ROUND ELBOW DOWN
- TRANSITION - RECTANGULAR TO ROUND DUCT
- STANDARD BRANCH
- ELBOW - W/TURNING VANE (RECTANGULAR)
- ELBOW - (RECTANGULAR), SMOOTH RADIUS
- 18x24 — RECTANGULAR DUCT OR OPENING SIZE FIRST NUMBER INDICATES SIZE OF SIDE SHOWN
- 18ø — ROUND DUCT SIZE
- R OR D — RECTANGULAR DUCT INCLINE - RISE OR DROP IN RESPECT TO THE AIR FLOW
- R OR D — ROUND DUCT INCLINE - RISE OR DROP IN RESPECT TO THE AIR FLOW
- 18x24 — HIDDEN DUCT
- T 9'-10" B 9'-0" / 18x10 — DUCT/PIPE ELEVATION TAG ABOVE FINISH FLOOR
- VOLUME DAMPER
- M — MOTOR OPERATED DAMPER
- FIRE DAMPER
- S — SMOKE DAMPER
- SMOKE AND FIRE DAMPER
- FLEXIBLE CONNECTION
- FLEXIBLE DUCT - TWO LINE
- FLEXIBLE DUCT - ONE LINE
- ACOUSTICAL LINING - DUCT DIMENSIONS FOR NET FREE AREA
- UC — UNDERCUT DOOR
- NEW TO EXISTING CONNECTION
- REMOVE EXISTING UP TO THIS POINT
- HVAC EMERGENCY SHUTDOWN SWITCH

- TAG-SIZE / CFM — SUPPLY AIR REGISTER
- TAG-SIZE / CFM — EXHAUST AIR OR RETURN AIR GRILLE
- TAG / CFM — EXHAUST AIR OR RETURN AIR GRILLE
- TAG / CFM — SUPPLY AIR ASSEMBLY SQUARE DIFFUSER
- TAG / CFM — SUPPLY AIR ASSEMBLY ROUND DIFFUSER

TEMPERATURE CONTROL DIAGRAM SYMBOLOGY

MISCELLANEOUS DEVICE IDENTIFIER

CO	SPACE CARBON MONOXIDE SENSOR
CO2	SPACE CARBON DIOXIDE SENSOR
H	SPACE HUMIDITY SENSOR
NO2	SPACE NITROGEN DIOXIDE SENSOR
S	SPACE TEMPERATURE SENSOR
T	THERMOSTAT

CONTROL DEVICE IDENTIFIER

AFS	AIRFLOW MEASURING STATION
AM	AIRFLOW MEASURING SENSOR
CO	CARBON MONOXIDE SENSOR
CO2	CARBON DIOXIDE SENSOR
F	FLOW SWITCH
FRZ	FREEZE STAT
H	HUMIDITY SENSOR
HS	HIGH STATIC SWITCH
LS	LOW STATIC SWITCH
NO2	NITROGEN DIOXIDE SENSOR
P	PRESSURE SENSOR
S	SPACE TEMPERATURE SENSOR
SD	SMOKE DETECTOR
T	TEMPERATURE SENSOR
TS	TEMPERATURE SWITCH
ΔP	DIFFERENTIAL PRESSURE SENSOR

CONTROL INPUT/OUTPUT IDENTIFIER

AI	ANALOG INPUT
AO	ANALOG OUTPUT
DI	DIGITAL INPUT
DO	DIGITAL OUTPUT

COIL IDENTIFIERS

CC	CHILLED WATER COOLING COIL
DG	DIRECT FIRED GAS BURNER
DX	DIRECT EXPANSION COOLING COIL
EH	ELECTRIC HEATING COIL
ER	DIRECT EVAPORATIVE COIL
FC	FACE AND BYPASS COOLING COIL
FH	FACE AND BYPASS HEATING COIL
HC	HEATING HOT WATER HEATING COIL
IG	INDIRECT FIRED GAS BURNER
ST	STEAM HEATING COIL

CONTROL ABBREVIATIONS

BTU	BTU METER
COMM	COMMUNICATION
CT	CURRENT TRANSMITTER
EC	ELECTRONICALLY COMMUTATED
EF	EXHAUST FAN
FM	FLOW METER
M	MOTOR ACTUATOR
MA	MIXED AIR
NC	NORMALLY CLOSED
NO	NORMALLY OPEN
OA	OUTDOOR AIR
RA	RETURN AIR
RL	RELIEF FAN
RF	RETURN FAN
SA	SUPPLY AIR
SF	SUPPLY FAN
TCC	TEMPERATURE CONTROL CONTRACTOR
VFC	VARIABLE FREQUENCY CONTROLLER

- S — DUCT MOUNTED SMOKE DETECTOR
- T — TEMPERATURE AVERAGING SENSOR
- M — MOTOR OPERATED DAMPER
- M — MOTOR OPERATED SINGLE BLADE DAMPER
- BACKDRAFT DAMPER
- HUMIDIFIER
- AFS — AIRFLOW MEASURING STATION
- INTAKE/ EXHAUST LOUVER
- FILTER
- FRZ — FREEZE STAT
- SEE CONTROL ABBREVIATIONS (TYP)
- M — FAN
- EC — FAN WITH EC MOTOR
- PUMP
- EC — PUMP WITH EC MOTOR

ABBREVIATIONS

AD	ACCESS DOOR
AFR	ABOVE FINISHED ROOF
AHU	AIR HANDLING UNIT
APD	AIR PRESSURE DROP
ARF	ABOVE RAISED FLOOR
AV	ABOVE RAISED FLOOR
BAS	BUILDING AUTOMATION SYSTEM
BDD	BACK DRAFT DAMPER
BHP	BRAKE HORSE POWER
BOE	BOTTOM OF EQUIPMENT
BTUH	BRITISH THERMAL UNITS PER HOUR
CAV	CONSTANT AIR VOLUME
CFH	CUBIC FEET PER HOUR
CFM	CUBIC FEET PER MINUTE
COP	COEFFICIENT OF PERFORMANCE
COR	CONTRACTING OFFICER'S REPRESENTATIVE
CRAC	COMPUTER ROOM AIR CONDITIONER
CU	CONDENSING UNIT
DB	DRY BULB
DDC	DIRECT DIGITAL CONTROL
DH	DEHUMIDIFIER
DX	DIRECT EXPANSION
EAT	ENTERING AIR TEMPERATURE
EDH	ELECTRIC DUCT HEATER
EER	ENERGY EFFICIENCY RATIO
EMCS	ENERGY MANAGEMENT CONTROL SYSTEM
ERU	ENERGY RECOVERY UNIT
ESP	EXTERNAL STATIC PRESSURE
ESS	EMERGENCY SHUTOFF SWITCH
EWT	ENTERING WATER TEMPERATURE
F	FUTURE
FA	FREE AREA
FCP	FAN CONTROL PANEL
FCU	FAN COIL UNIT
FDBK	FEEDBACK
FLA	FULL LOAD AMPS
FLT	FILTER
FPB	FAN POWERED BOX
FPM	FEET PER MINUTE
GC	GENERAL CONTRACTOR
GE	GRAVITY EXHAUST
GI	GRAVITY INTAKE
GPH	GALLONS PER HOUR
GPM	GALLONS PER MINUTE
I/O	INPUT/OUTPUT
I/P	CURRENT TO PNEUMATIC
IAQ	INDOOR AIR QUALITY
IPLV	INTEGRATED PART LOAD VALUE
LAT	LEAVING AIR TEMPERATURE
LVR	LOUVER
LWT	LEAVING WATER TEMPERATURE
MAU	MAKE-UP AIR UNIT
MBH	THOUSAND BTUH
MCC	MOTOR CONTROL CENTER
NC	NOISE CRITERIA
NO	NUMBER
NRC	NOISE REDUCTION COEFFICIENT
OS&Y	OUTSIDE SCREW AND YOKE
PD	PRESSURE DROP
PPH	POUNDS PER HOUR
RH	RELATIVE HUMIDITY
RTU	ROOFTOP UNIT
S	SIGNAL PORT
SCFM	STANDARD CUBIC FEET PER MINUTE
SEER	SEASONAL ENERGY EFFICIENCY RATIO
SP	STATIC PRESSURE
TC	TECHNOLOGY CONTRACTOR
TCP	TEMPERATURE CONTROL PANEL
TD	TEMPERATURE DIFFERENTIAL
TES	THERMAL ENERGY STORAGE
TSP	TOTAL STATIC PRESSURE
UH	UNIT HEATER
V&C	VALVE AND CAP
VAV	VARIABLE AIR VOLUME
VRF	VARIABLE REFRIGERANT FLOW
VTR	VENT THROUGH ROOF
WB	WET BULB
WC	WATER COLUMN
WPD	WATER PRESSURE DROP

GENERAL NOTES

GENERAL MECHANICAL DEMOLITION NOTES

1. THE CONTRACTOR SHALL COMPLETELY REMOVE ALL PIPING, DUCTWORK, COILS, EQUIPMENT, TERMINAL UNITS, ASSOCIATED CONTROLS, WIRING, AND OTHER ITEMS SHOWN BOLD AND/OR BOLD DASHED LINES UNLESS SPECIFICALLY NOTED OTHERWISE. THE ITEMS INDICATED ON THE DRAWINGS TO BE REMOVED ARE ONLY TO INDICATE IN GENERAL THE AMOUNT OF DEMOLITION WORK INVOLVED. A SITE INVESTIGATION BY THE CONTRACTOR MUST BE PERFORMED TO AID IN DETERMINING THE COMPLETE EXTENT OF WORK INVOLVED.
2. PIPING AND DUCTWORK EMBEDDED IN FLOORS, WALLS, AND CEILINGS MAY REMAIN IF SUCH MATERIALS DO NOT INTERFERE WITH NEW INSTALLATIONS. REMOVE MATERIALS ABOVE ACCESSIBLE CEILINGS. REMAINING PIPING SHALL BE DRAINED AND CAPPED WITHOUT CREATING DEAD LEGS IN THE SYSTEM. REMAINING DUCTWORK SHALL BE CAPPED.
3. LOCATE, IDENTIFY, AND PROTECT MECHANICAL SERVICES PASSING THROUGH DEMOLITION AREA AND SERVING OTHER AREAS OUTSIDE THE DEMOLITION LIMITS. MAINTAIN SERVICES TO AREAS OUTSIDE DEMOLITION LIMITS. WHEN SERVICES MUST BE INTERRUPTED, NOTIFY OWNER AND INSTALL TEMPORARY SERVICES FOR AFFECTED AREAS.
4. EXISTING EQUIPMENT BEING REMOVED AND CONSIDERED SALVAGEABLE BY THE OWNER SHALL BE TURNED OVER TO THE OWNER.
5. CONTRACTORS SHALL COORDINATE AND SCHEDULE ALL NECESSARY UTILITY SHUT-OFFS WITH OWNER PRIOR TO PROCEEDING WITH SUCH WORK.
6. COORDINATE SAW-CUTTING OF THE FLOOR OR WALL WITH OTHER TRADES.
7. THE CONTRACTOR SHALL BE RESPONSIBLE FOR PATCHING, PAINTING, REPAIRING OR REPLACEMENT OF ALL WALLS, FLOORS, CEILINGS, OR OTHER BUILDING ELEMENTS THAT ARE DISTURBED AS PART OF THE DEMOLITION OR INSTALLATION OF MECHANICAL WORK. SUCH WORK SHALL MATCH THE EXISTING CONSTRUCTION, FINISH, AND RATING. FIRE SEAL WALL OPENINGS AS REQUIRED.

GENERAL MECHANICAL NOTES

1. THESE NOTES ARE NOT ALL INCLUSIVE. REFER TO DRAWINGS AND SPECIFICATION FOR ADDITIONAL REQUIREMENTS.
2. THIS IS A STANDARD MECHANICAL (HVAC AND PLUMBING) SYMBOLOGY AND ABBREVIATIONS SHEET. LISTING OF SYMBOLS AND ABBREVIATIONS DOES NOT IMPLY ALL SYMBOLS AND ABBREVIATIONS HAVE BEEN USED ON THIS PROJECT.
3. VALVE SYMBOLS SHOWN HERE ARE APPLICABLE ONLY TO MECHANICAL SHEETS.
4. PROVIDE ALL MATERIALS, LABOR, AND EQUIPMENT FOR COMPLETE AND OPERABLE SYSTEMS AS INDICATED ON THE DRAWINGS AS SPECIFIED, OR AS REQUIRED BY CODE.
5. MECHANICAL INSTALLATION SHALL COMPLY WITH THE ADA/ABA ACCESSIBILITY GUIDELINES.
6. DETAILS APPLY TO THE ENTIRE PROJECT AND ARE ONLY REFERENCED TO PROVIDE CLARITY IF THERE ARE MULTIPLE DETAILS THAT COULD APPLY TO A PARTICULAR PROJECT CONDITION.
7. COORDINATE LOCATION OF ALL MECHANICAL EQUIPMENT, DUCTWORK, AND PIPING WITH OTHER TRADES BEFORE PROCEEDING WITH WORK. DO NOT INSTALL MECHANICAL EQUIPMENT, DUCTWORK, OR PIPING ABOVE ELECTRICAL EQUIPMENT WHERE PROHIBITED BY ELECTRICAL CODES (SWITCHBOARDS, PANELS, ETC.).
8. LIGHT LINE WEIGHT INDICATES EXISTING PIPING, DUCTWORK, AND/OR EQUIPMENT TO REMAIN. BOLD LINE WEIGHT INDICATES NEW WORK TO BE INSTALLED AS WORK OF THIS CONTRACT.
9. COORDINATE INSTALLATION OF OUTSIDE AIR INTAKE WITH INSTALLATION OF PLUMBING VENTS, FLUES AND EXHAUST/RELIEF OUTLETS TO MAINTAIN 10' SEPARATION.
10. ALL WORK IN FINISHED SPACES SHALL BE LOCATED ABOVE CEILINGS, IN CHASES OR OTHER CONCEALED ACCESSIBLE LOCATIONS UNLESS NOTED OTHERWISE. LOCATE AND ARRANGE VALVES, DRAIN FITTINGS, ETC. TO BE ACCESSIBLE THROUGH LAY-IN CEILINGS, ACCESS PANELS OR ACCESS DOORS. PROVIDE AN ACCESS PANEL OR DOOR FOR ALL NON-ACCESSIBLE INSTALLATIONS. COORDINATE LOCATION OF ACCESS PANELS OR DOORS WITH THE ARCHITECT/ENGINEER AND OTHER TRADES.
11. ALL MATERIALS LOCATED IN PLENUM SHALL BE RATED FOR PLENUM INSTALLATION.
12. ALL DUCTWORK, PIPING, AND EQUIPMENT SUPPORTED FROM STRUCTURAL STEEL SHALL BE COORDINATED WITH ALL TRADES. ALL ATTACHMENTS TO STEEL BAR JOISTS, TRUSSES, OR JOIST GIRDERS SHALL BE AT PANEL POINTS OR AS SHOWN ON THE MECHANICAL OR STRUCTURAL DRAWINGS. WELDING TO STRUCTURAL MEMBERS SHALL NOT BE PERMITTED.
13. ALL MISCELLANEOUS METALS AND MATERIALS REQUIRED TO ENSURE PROPER INSTALLATION AND AS SHOWN IN DETAILS FOR PIPING, DUCTWORK, AND EQUIPMENT (UNLESS OTHERWISE NOTED) SHALL BE PROVIDED BY THE INSTALLING CONTRACTOR.
14. PROVIDE DIELECTRIC UNIONS AT ALL CONNECTIONS OF DISSIMILAR METALS (SUCH AS COPPER TO GALVANIZED STEEL).
15. PROVIDE ISOLATION VALVES AT EACH PIECE OF EQUIPMENT. ALSO PROVIDE ISOLATION VALVES ON EACH BRANCH AND/OR RISER SERVING MULTIPLE PIECES OF EQUIPMENT OR FIXTURES AND ELSEWHERE AS INDICATED. INSTALL VALVES AS CLOSE TO MAIN AS POSSIBLE.

GENERAL HVAC NOTES

1. DUCTWORK DIMENSIONS: FIRST NUMBER INDICATES SIDE OF DUCTWORK SHOWN. ALL DIMENSIONS ARE IN INCHES AND ARE INSIDE CLEAR DIMENSIONS.
2. COORDINATE ALL GRILLE LOCATIONS WITH LIGHTING AND ALL OTHER CEILING MOUNTED DEVICES.
3. PROVIDE FLEXIBLE CONNECTIONS IN ALL DUCTWORK SYSTEMS CONNECTED TO FANS AND OTHER EQUIPMENT WHICH REQUIRE VIBRATION ISOLATION.
4. PROVIDE ACCESSIBLE VOLUME DAMPERS OR OTHER MEANS OF AIRFLOW ADJUSTMENT AT ALL DUCT RUN-OUTS TO GRILLES.
5. ALL DUCT RUN-OUTS TO GRILLES SHALL BE THE SAME AS THE GRILLE NECK SIZE UNLESS NOTED OTHERWISE.

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13/2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	B. PERLBERG
DRAWN BY	J. VALLES
CHECKED BY	K. CHAUDHARI
APPROVED BY	B. PERLBERG
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS — BRIAN R. PERLBERG — 115197 — LICENSED PROFESSIONAL ENGINEER — 06/13/2025

LEWISVILLE — Deep Roots. Broad Wings. Bright Future

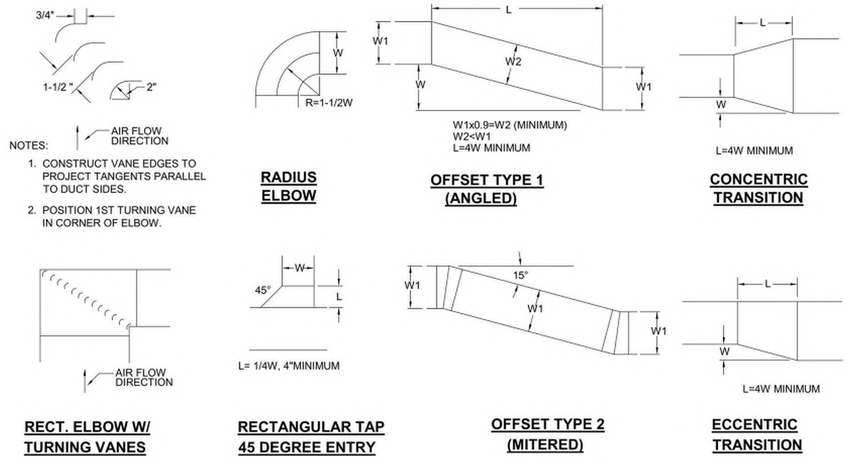
CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

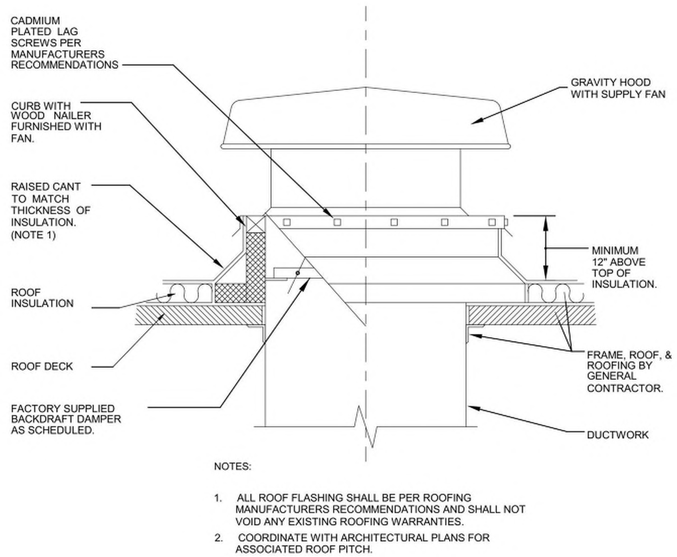
GENERAL MECHANICAL SYMBOLS, LEGENDS, AND ABBREVIATIONS

FILENAME	31 - Plant II BLOWER BLDG (PROPOSED)- MECH.RVT
SCALE	NOT TO SCALE
SHEET	00M001

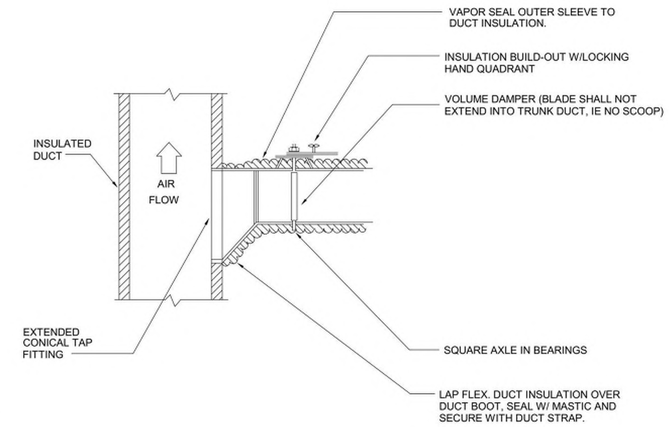
Autodesk Docs://10342803_COL_PCWWT_AB_Expansion_2024/31 - Plant II BLOWER BLDG (PROPOSED)- MECH.rvt
6/12/2025 10:57:51 PM



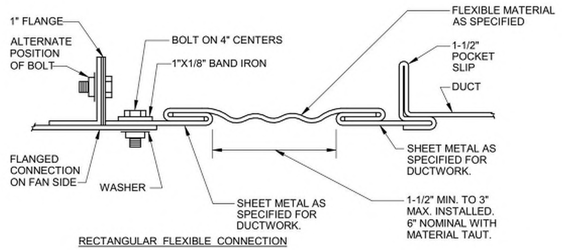
1 STANDARD DUCT CONSTRUCTION DETAILS
NOT TO SCALE



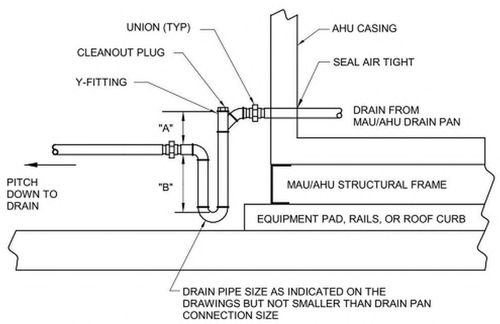
2 INTAKE HOOD WITH SUPPLY FAN DETAIL
NOTES: NOT TO SCALE



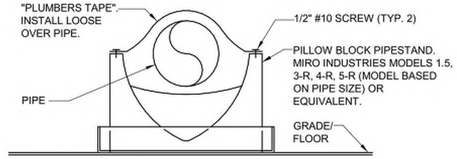
3 BOOT TAP DETAIL
NOT TO SCALE



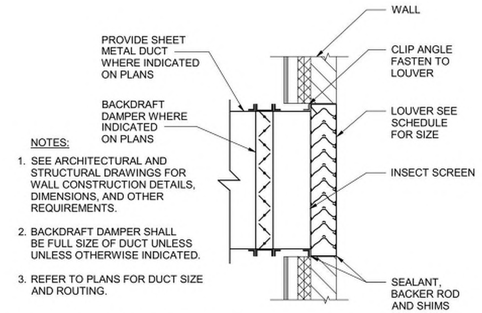
4 FLEXIBLE DUCT CONNECTION DETAIL
NOT TO SCALE



5 CONDENSATE DRAIN TRAP DETAIL
NOT TO SCALE



6 PIPE SUPPORT DETAIL
NOT TO SCALE



7 LOUVER IN WALL DETAIL
NOT TO SCALE

Autodesk Docs://10342803_COL_PCWWT_AB_Expansion_2024/31 - Plant II BLOWER BLDG (PROPOSED)- MECH.rvt
6/12/2025 10:57:51 PM

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13/2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	B. PERLBERG
DRAWN BY	J. VALLES
CHECKED BY	K. CHAUDHARI
APPROVED BY	B. PERLBERG
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
BRIAN R. PERLBERG
115197
LICENSED
PROFESSIONAL ENGINEER
06/13/2025

LEWISVILLE
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CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

GENERAL MECHANICAL DETAILS I

FILENAME	31 - Plant II BLOWER BLDG (PROPOSED)- MECH.RVT
SCALE	NOT TO SCALE
SHEET	00M501

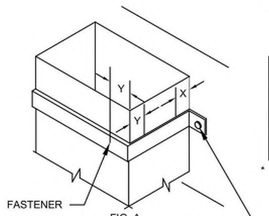


FIG. A

PROVIDE (2) 1/4"ø SCREWS EACH SIDE AT EACH STRAP.

FIG. A - SUGGESTED SIZING

DUCT SIZE	BAND
18" x 12"	1 1/2" x 16 GA.
24 x 20"	1" x 1/8"

DUCT GAGE	ALLOWABLE LOAD PER FASTENER*
28, 26,	25 LB
24, 22, 20	35 LB
18,16	50 LB

* WELD, BOLT OR NO. 8 SCREW (MIN.) DEVIATION PERMITTED BY OTHER ANALYSIS. X=1", Y=2"; ADD OTHERS TO ACCOMMODATE LOAD. MINIMUM OF 3 ON 24" WIDTH AND UP. ADD ALLONG SIDES NEAREST ANCHORS.

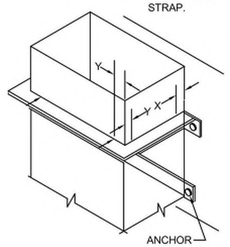
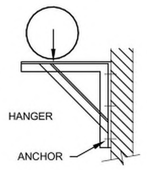


FIG. B



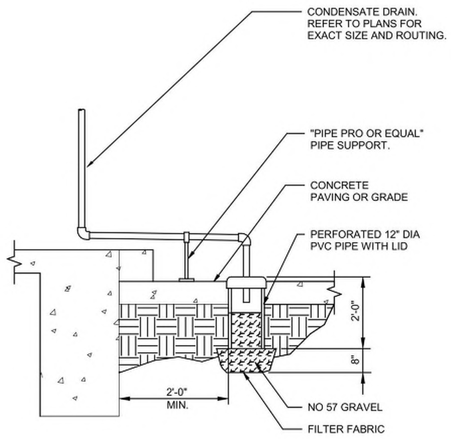
SEE KNEE BRACKET TABLES IN THE ROUND INDUSTRIAL STDS.

FIG. B - SUGGESTED SIZING

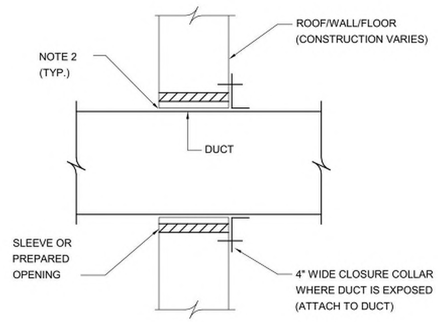
DUCT SIZE	BAND
30" x 12"	1" x 1" x 1/8"
36" x 18"	1" x 1" x 1/8"
42" x 24"	1 1/4" x 1 1/4" x 1/8"
48" x 30"	1 1/4" x 1 1/4" x 1/8"

NOTES:
1. BRACKETS ARE SIZED FOR 12 FEET OF DUCT MAXIMUM.
2. LOCATE DUCTS AGAINST WALL OR MAXIMUM 2 ' AWAY FROM WALL.
3. EACH WALL ANCHOR SHALL SATISFY THE FOLLOWING CRITERIA UNLESS OTHER ANALYSIS IS MADE:
   A. TENSILE LOAD = 3/8 x DUCT WEIGHT; SAFETY FACTOR 4.
   B. SHEAR LOAD x 1/2 x DUCT WEIGHT; SAFETY FACTOR 4.

1 SUPPORT FOR VERTICAL DUCT DETAIL
NOT TO SCALE

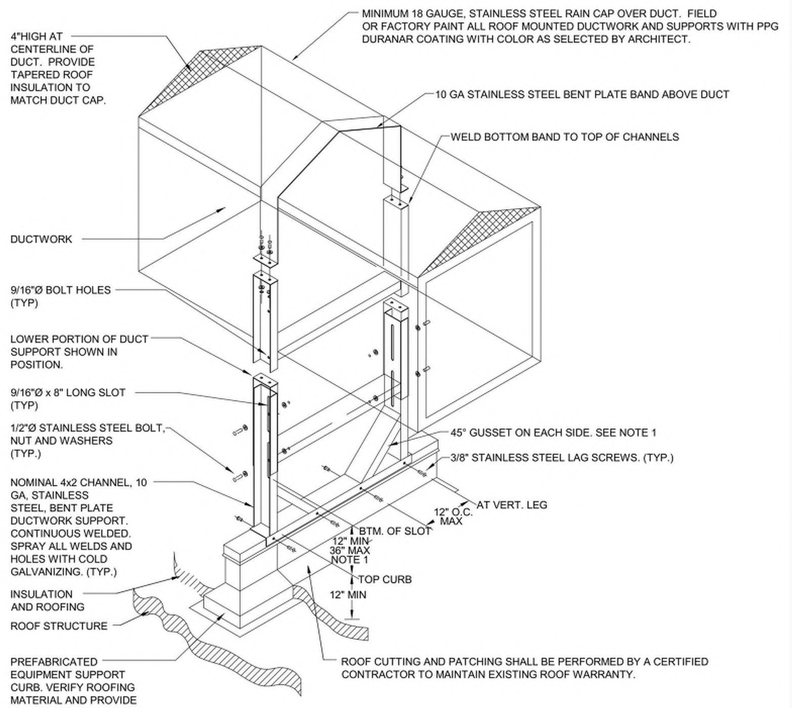


2 CONDENSATE DRYWELL DETAIL
NOT TO SCALE



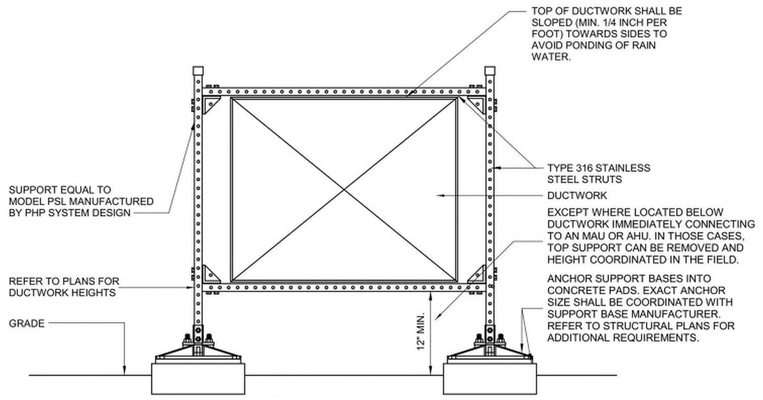
NOTES:
1. THIS DETAIL IS FOR NON-RATED CONSTRUCTION. DUCT PENETRATIONS IN FIRE-RATED CONSTRUCTION SHALL BE FIRESTOPPED WITH A UL-CLASSIFIED SYSTEM.
2. AT PENETRATIONS THRU INSULATED WALLS PROVIDE PACKING AND SEALANT.

3 DUCT PENETRATION THRU NON-RATED ROOF/WALL/FLOOR DETAIL
NOT TO SCALE

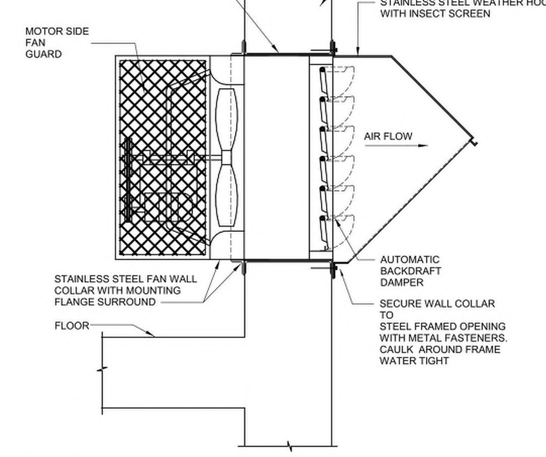


NOTES:
1. MAINTAIN THE TOP OF THE GUSSET JUST BELOW THE SLOT AND AT A 45° ANGLE. AS THE SUPPORT HEIGHT INCREASES, AND THE GUSSET MEET IN THE MIDDLE OF THE BASE, PROVIDE ONE DIAGONAL BRACE BETWEEN THE VERTICAL LEGS.
2. DUCT ROOF SUPPORT SHALL BE RATED FOR 30 PSF SNOW LOAD AND 20 PSF WIND LOAD.
3. PAINT RAIN COVER AND DUCT SUPPORTS TO MATCH DUCT.
4. CROSS BRACE SUPPORTS AS INDICATED ON THE PLAN. CROSS BRACING SHALL BE INSTALLED FROM BASE OF SUPPORT TO TOP OF THE ADJACENT SUPPORT TO LIMIT LATERAL MOVEMENT.

4 RECTANGULAR DUCT ROOF SUPPORT DETAIL
NOT TO SCALE



5 DUCT SUPPORT DETAIL
NOT TO SCALE



6 EXHAUST FAN THRU WALL DETAIL
NOT TO SCALE

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TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13/2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	B. PERLBERG
DRAWN BY	J. VALLES
CHECKED BY	K. CHAUDHARI
APPROVED BY	B. PERLBERG
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
BRIAN R. PERLBERG
115197
LICENSED
PROFESSIONAL ENGINEER
06/13/2025

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PRAIRIE CREEK

AERATION BASIN EXPANSION

GENERAL MECHANICAL DETAILS II

FILENAME	31 - Plant II BLOWER BLDG (PROPOSED)- MECH.RVT
SCALE	NOT TO SCALE
SHEET	00M502

FAN SCHEDULE

SYMBOL	SERVICE	TYPE	AIRFLOW (CFM)	ESP (IN. WC.)	FAN RPM	SONES (INLET)	DRIVE	ELECTRICAL (NOTE 1)					CONTROL TYPE (NOTE 8)	BASIS OF DESIGN		WEIGHT (LBS)	NOTES
								BHP	MHP	VOLTAGE/PHASE	DISCONNECT BY	CONTROLLER BY/TYPE		MANUFACTURER	MODEL		
EF-3101	BLOWER'S CONTROL CABINET	INLINE	955	0.50	1,340	9.4	DIRECT	0.198	0.25	120/1	MFR	MFR/NOTE 3	EF-A	LOREN COOK	SQI-D	110	2
EF-3102	BLOWER'S CONTROL CABINET	INLINE	955	0.50	1,340	9.4	DIRECT	0.198	0.25	120/1	MFR	MFR/NOTE 3	EF-A	LOREN COOK	SQI-D	110	2
EF-3103	BLOWER'S CONTROL CABINET	INLINE	955	0.50	1,340	9.4	DIRECT	0.198	0.25	120/1	MFR	MFR/NOTE 3	EF-A	LOREN COOK	SQI-D	110	2
EF-3104	BLOWER'S CONTROL CABINET	INLINE	955	0.50	1,340	9.4	DIRECT	0.198	0.25	120/1	MFR	MFR/NOTE 3	EF-A	LOREN COOK	SQI-D	110	2
EF-4001	RAS/WAS PS - PUMP ROOM 100	PROPELLER	875	0.25	1,305	12.9	DIRECT	0.113	0.50	480/3	MFR	MFR/NOTE 3	EF-B	LOREN COOK	AWD	200	2,5,6,7
EF-4002	RAS/WAS PS - PUMP ROOM 100	PROPELLER	875	0.25	1,305	12.9	DIRECT	0.113	0.50	480/3	MFR	MFR/NOTE 3	EF-B	LOREN COOK	AWD	200	2,5,6,7
EF-4003	RAS/WAS PS - PUMP ROOM 102	PROPELLER	875	0.25	1,305	12.9	DIRECT	0.113	0.50	480/3	MFR	MFR/NOTE 3	EF-B	LOREN COOK	AWD	200	2,5,6,7
EF-4004	RAS/WAS PS - PUMP ROOM 102	PROPELLER	875	0.25	1,305	12.9	DIRECT	0.113	0.50	480/3	MFR	MFR/NOTE 3	EF-B	LOREN COOK	AWD	200	2,5,6,7
PR-4001	PPU-4001 AND 4002 OA INTAKE	PROPELLER	500	0.40	1,486	11.6	DIRECT	0.120	0.125	120/1	MFR	MFR/NOTE 3	PPU-A	LOREN COOK	REBS	100	2,4,5

NOTES:
1. REFER TO ELECTRICAL PLANS/SPECIFICATIONS FOR ADDITIONAL INFORMATION.
2. PROVIDE EXTERIOR OF FAN WITH PHENOLIC EPOXY COATING RESISTANT TO WASTE WATER TREATMENT PLANT CONDITIONS.
3. PROVIDE WITH EC MOTOR AND FAN SPEED CONTROLLER. LOCATE SPEED CONTROLLER IN ACCESSIBLE LOCATION INTEGRAL TO FAN.
4. PROVIDE WITH 24" TALL INSULATED AND PHENOLIC EPOXY COATED CURB.
5. PROVIDE WITH AUTOMATIC GRAVITY BACKDRAFT DAMPER.
6. PROVIDE WITH OSHA APPROVED FAN/MOTOR GUARD.
7. PROVIDE WITH PHENOLIC EPOXY COATED WEATHER HOOD.
8. REFER TO SERIES 00M700 SHEETS FOR CONTROL TYPE DESCRIPTION.

POSITIVE PRESSURIZATION UNIT SCHEDULE

SYMBOL	SERVICE	TOTAL AIR (CFM)	OUTSIDE AIR (CFM)	CONFIGURATION	ELECTRICAL (NOTE 1)				CONTROL TYPE (NOTE 5)	BASIS OF DESIGN		NOTES
					MHP	VOLTAGE/PHASE	DISCONNECT BY	CONTROLLER BY/TYPE		MANUFACTURER	MODEL	
PPU-3101	BLOWER BLDG - 101 ELECTRICAL	500	250	VERTICAL	1	460/3	EC	MFR/VFD	PPU-A	PURAFIL	PPU	2,3,4
PPU-4001	RAS/WAS PS - 101 NEW ELECTRICAL	500	250	VERTICAL	1	460/3	EC	MFR/VFD	PPU-A	PURAFIL	PPU	2,3,4
PPU-4002	RAS/WAS PS - 103 EXIST. ELECTICAL	500	250	VERTICAL	1	460/3	EC	MFR/VFD	PPU-A	PURAFIL	PPU	2,3,4

NOTES:
1. REFER TO ELECTRICAL PLANS/SPECIFICATIONS FOR ADDITIONAL INFORMATION.
2. PROVIDE WITH STATIC PRESSURE GAUGE FOR PRE AND FINAL FILTERS ON FRONT OF UNIT.
3. PROVIDE WITH ROOM PRESSURIZATION PRESSURE GAUGE ON FRONT OF UNIT.
4. PROVIDE WITH OUTSIDE AIRFLOW MEASURING STATION AND READOUT ON FRONT OF UNIT.
5. REFER TO SERIES 00M700 SHEETS FOR CONTROL TYPE DESCRIPTION.

ELECTRIC UNIT HEATER SCHEDULE

SYMBOL	SERVICE	AIR FLOW (CFM)	HEATING CAPACITY (KW)	ELECTRICAL (NOTE 3)				CONTROL TYPE	BASIS OF DESIGN		WEIGHT (LBS.)	NOTES
				AMPS	VOLTAGE/PHASE	DISCONNECT BY	CONTROLLER BY		MANUFACTURER	MODEL		
EUH-4001	RAS/WAS PS - 100 PUMP ROOM	700	3	3.61	480/3	MFR	MFR	NOTE 1	REZNOR	EWHB	100	2
EUH-4002	RAS/WAS PS - 100 PUMP ROOM	700	3	3.61	480/3	MFR	MFR	NOTE 1	REZNOR	EWHB	100	2
EUH-4003	RAS/WAS PS - 100 PUMP ROOM	700	3	3.61	480/3	MFR	MFR	NOTE 1	REZNOR	EWHB	100	2
EUH-4004	RAS/WAS PS - 100 PUMP ROOM	700	3	3.61	480/3	MFR	MFR	NOTE 1	REZNOR	EWHB	100	2
EUH-4005	RAS/WAS PS - 102 PUMP ROOM	700	3	3.61	480/3	MFR	MFR	NOTE 1	REZNOR	EWHB	100	2
EUH-4006	RAS/WAS PS - 102 PUMP ROOM	700	3	3.61	480/3	MFR	MFR	NOTE 1	REZNOR	EWHB	100	2
EUH-4007	RAS/WAS PS - 102 PUMP ROOM	700	3	3.61	480/3	MFR	MFR	NOTE 1	REZNOR	EWHB	100	2
EUH-4008	RAS/WAS PS - 102 PUMP ROOM	700	3	3.61	480/3	MFR	MFR	NOTE 1	REZNOR	EWHB	100	2

NOTES:
1. PROVIDE WITH UNIT-MOUNTED THERMOSTAT.
2. SHALL BE CORROSION RESISTANT WASHDOWN TYPE. PROVIDE WALL OR CEILING BRACKET.
3. REFER TO ELECTRICAL PLANS/SPECIFICATIONS FOR ADDITIONAL INFORMATION.

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TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13/2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	B. PERLBERG
DRAWN BY	J. VALLES
CHECKED BY	K. CHAUDHARI
APPROVED BY	B. PERLBERG
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
BRIAN R. PERLBERG
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LEWISVILLE
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PRAIRIE CREEK

AERATION BASIN EXPANSION

GENERAL MECHANICAL SCHEDULES I

FILENAME	31 - Plant II BLOWER BLDG (PROPOSED)- MECH.RVT
SCALE	NOT TO SCALE
SHEET	00M601

PACKAGED AIR HANDLING UNIT SCHEDULE

SYMBOL	AHU-3103 AND 3104	AHU-4001 AND 4002	AHU-4003 AND 4004
SERVICE	BLOWER BLDG - 101 ELECT ROOM	RAS/WAS PS - 101 ELECT ROOM	RAS/WAS PS - 103 ELECT ROOM
SUPPLY FAN			
SUPPLY AIRFLOW (CFM)	2,000	600	600
DRIVE / TYPE	DIRECT / PLENUM	DIRECT / PLENUM	DIRECT / PLENUM
EXT. STATIC PRESSURE (IN. WC) (NOTE 1)	1.0	1.0	1.0
FAN RPM	1,805	1,565	1,565
BHP / MHP (NOTE 4)	0.58 / 1.7	0.21 / 0.5	0.21 / 0.5
DX COOLING COIL			
REFRIGERANT TYPE	R32	R32	R32
NUMBER OF COMPRESSORS (NOTE 9) / NUMBER OF CONDENSER FANS	1 / 2	1 / 2	1 / 2
AMBIENT TEMPERATURE	115	115	115
AIRFLOW (CFM)	2,000	600	600
TOTAL/SENSIBLE CAPACITY (MBH)	84.7 / 56.9	28.4 / 18.1	28.4 / 18.1
ENTERING AIR TEMP DB / WB (DEG F)	80 / 67	80 / 67	80 / 67
LEAVING AIR TEMP DB / WB (DEG F) (NOTE 8)	53 / 53	51 / 51	51 / 51
FILTERS			
TYPE	2" MERV 8	2" MERV 8	2" MERV 8
MAX FACE VEL (FPM)	250	250	250
DIRTY FILTER ALLOWANCE A.P.D. (IN. WC)	0.25	0.25	0.25
ELECTRICAL (NOTE 5)			
VOLTAGE/PHASE	460/3	460/3	460/3
MCA / MOCP	21.1 / 30	15.8 / 25	15.8 / 25
DISCONNECT BY / CONTROLLER/STARTER BY	MFR/MFR	MFR/MFR	MFR/MFR
UNIT INFORMATION			
WEIGHT (LBS)	1,700	1,500	1,500
CONTROL TYPE	NOTE 3	NOTE 3	NOTE 3
BASIS OF DESIGN MANUFACTURER	DAIKIN	DAIKIN	DAIKIN
BASIS OF DESIGN MODEL	DPSC	DPSC	DPSC
NOTES	6,7,10,11,12	2,6,10,11	2,6,10,11

NOTES:
1. EXTERNAL STATIC PRESSURE INCLUDES SYSTEM LOSSES AND CLEAN/DIRTY FILTER LOSSES ONLY.
2. PROVIDE WITH MINIMUM 24" TALL INSULATED ROOF CURB. UNIT SHALL HAVE SIDE DUCT CONNECTIONS FOR HORIZONTAL DISCHARGE.
3. PROVIDE WITH MFR. UNIT MOUNTED CONTROLS (INCLUDING REMOTE MOUNTED 24/7 PROGRAMMABLE THERMOSTAT/CONTROL PANEL, ECONOMIZER, ETC.) TO MAINTAIN SPACE AT 80 DEG F (ADJ.).
4. NO EQUIPMENT SHALL BE SELECTED ABOVE 90% OF MOTOR NAMEPLATE RATING. PROVIDE SUPPLY FAN WITH EC MOTOR.
5. PROVIDE WITH SINGLE POINT ELECTRICAL CONNECTION. REFER TO ELECTRICAL PLANS FOR ADDITIONAL INFORMATION.
6. PROVIDE CORROSION RESISTANT COATING FOR WASTEWATER TREATMENT FACILITIES ON EXTERIOR OF CABINET.
7. PROVIDE UNIT WITH RAILS FOR CONDENSATE DRAIN CONNECTIONS AND SIDE DUCT CONNECTIONS FOR HORIZONTAL DISCHARGE FOR INSTALLATION ON CONCRETE PAD ON GRADE.
8. TEMPERATURES LISTED IS IMMEDIATELY DOWNSTREAM OF ASSOCIATED COIL.
9. LEAD COMPRESSOR SHALL BE INVERTER OR DIGITAL SCROLL OR LEAD CIRCUIT SHALL BE PROVIDED WITH APR VALVE MANUFACTURERED BY RAWAL DEVICES INC.
10. PROVIDE UNIT WITH REMOVABLE HAIL GUARDS FOR CONDENSER COILS.
11. PROVIDE WITH BAROMETRIC RELIEF DAMPER FOR ECONOMIZER OPERATION.
12. SHALL BE PROVIDED ONLY IF NEUROS BLOWERS ARE PROVIDED.

PACKAGED AIR HANDLING UNIT SCHEDULE

SYMBOL	AHU-3101 AND 3102
SERVICE	BLOWER BLDG - 100 BLOWER ROOM
SUPPLY FAN	
SUPPLY AIRFLOW (CFM)	3,000
DRIVE / TYPE	DIRECT / PLENUM
EXT. STATIC PRESSURE (IN. WC) (NOTE 1)	1.5
FAN RPM	2,555
BHP / MHP (NOTE 4)	1.58 / 3
EXHAUST FAN	
EXHAUST AIRFLOW (CFM)	3,000
DRIVE / TYPE	DIRECT / PLENUM
EXT. STATIC PRESSURE (IN. WC) (NOTE 1)	0.75
FAN RPM	2,195
BHP/ MHP (NOTE 4)	0.78 / 4.4
HEAT PUMP COIL	
REFRIGERANT TYPE	R32
NUMBER OF COMPRESSORS (NOTE 9) / NUMBER OF CONDENSER FANS	1 / 2
AMBIENT TEMPERATURE HEATING / COOLING (DEG F)	47 / 115
AIRFLOW (CFM)	3,000
TOTAL / SENSIBLE COOLING CAPACITY (MBH)	117.6 / 82.3
COOLING ENTERING AIR TEMP DB / WB (DEG F)	80 / 67
COOLING LEAVING AIR TEMP DB / WB (DEG F) (NOTE 8)	54 / 54
TOTAL HEATING CAPACITY (MBH)	109.3
HEATING ENTERING AIR TEMP DB / WB (DEG F)	70
HEATING LEAVING AIR TEMP DB / WB (DEG F) (NOTE 8)	100
ELECTRIC HEATING COIL	
TYPE	SCR
AIRFLOW (CFM)	3,000
CAPACITY (KW)	18
ENTERING AIR TEMP (DEG F) / LEAVING AIR TEMP (DEG F) (NOTE 8)	50 / 68
FILTERS	
TYPE	2" MERV 8
MAX FACE VEL (FPM)	250
DIRTY FILTER ALLOWANCE A.P.D. (IN. WC)	0.25
ELECTRICAL (NOTE 5)	
VOLTAGE/PHASE	460/3
MCA / MOCP	60.1 / 70
DISCONNECT BY / CONTROLLER/STARTER BY	MFR/MFR
UNIT INFORMATION	
WEIGHT (LBS)	2,500
CONTROL TYPE	NOTE 3
BASIS OF DESIGN MANUFACTURER	DAIKIN
BASIS OF DESIGN MODEL	DPSH
NOTES	2,6,7,10

NOTES:
1. EXTERNAL STATIC PRESSURE INCLUDES SYSTEM LOSSES AND CLEAN/DIRTY FILTER LOSSES ONLY.
2. SHALL BE PROVIDED ONLY IF NEUROS BLOWERS ARE PROVIDED.
3. PROVIDE WITH MFR. UNIT MOUNTED CONTROLS (INCLUDING REMOTE MOUNTED 24/7 PROGRAMMABLE THERMOSTAT/CONTROL PANEL, ECONOMIZER, ETC.) TO MAINTAIN SPACE AT 80 DEG F (ADJ.).
4. NO EQUIPMENT SHALL BE SELECTED ABOVE 90% OF MOTOR NAMEPLATE RATING. PROVIDE SUPPLY FAN WITH EC MOTOR.
5. PROVIDE WITH SINGLE POINT ELECTRICAL CONNECTION. REFER TO ELECTRICAL PLANS FOR ADDITIONAL INFORMATION.
6. PROVIDE CORROSION RESISTANT COATING FOR WASTEWATER TREATMENT FACILITIES ON EXTERIOR OF CABINET.
7. PROVIDE UNIT WITH RAILS FOR CONDENSATE DRAIN CONNECTIONS AND SIDE DUCT CONNECTIONS FOR HORIZONTAL DISCHARGE FOR INSTALLATION ON CONCRETE PAD ON GRADE.
8. TEMPERATURES LISTED IS IMMEDIATELY DOWNSTREAM OF ASSOCIATED COIL.
9. LEAD COMPRESSOR SHALL BE INVERTER OR DIGITAL SCROLL OR LEAD CIRCUIT SHALL BE PROVIDED WITH APR VALVE MANUFACTURERED BY RAWAL DEVICES INC.
10. PROVIDE UNIT WITH REMOVABLE HAIL GUARDS FOR CONDENSER COILS.

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HDR
TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13/2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	B. PERLBERG
DRAWN BY	J. VALLES
CHECKED BY	K. CHAUDHARI
APPROVED BY	B. PERLBERG
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
BRIAN R. PERLBERG
115197
LICENSED
PROFESSIONAL ENGINEER
06/13/2025

LEWISVILLE
Deep Roots. Broad Wings. Bright Future

CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN
EXPANSION

GENERAL
MECHANICAL
SCHEDULES II

FILENAME: 31 - Plant II BLOWER BLDG (PROPOSED)- MECH.RVT
SCALE: NOT TO SCALE
SHEET: 00M602

MAKE-UP AIR HANDLING UNIT SCHEDULE

SYMBOL	MAU-3101	MAU-3102	MAU-4001	MAU-4002
SERVICE	BLOWER BLDG - 100 BLOWER ROOM	BLOWER BLDG - 100 BLOWER ROOM	RAS/WAS PS - 100 PUMP ROOM	RAS/WAS PS - 40-102 PUMP ROOM
LOCATION	GRADE MOUNTED	GRADE MOUNTED	ROOF MOUNTED	ROOF MOUNTED
SUPPLY FAN				
SUPPLY AIRFLOW (CFM)	9,750	9,750	1,750	1,750
DRIVE / TYPE	DIRECT / PLENUM	DIRECT / PLENUM	DIRECT / PLENUM	DIRECT / PLENUM
EXT. STATIC PRESSURE (IN. WC) (NOTE 1)	1.5	1.5	1.0	1.0
FAN RPM	1,268	1,268	2,321	2,321
BHP (NOTE 4)	4.35	4.35	0.71	0.71
MHP (NOTE 4)	5.7	5.7	1.3	1.3
RETURN / RELIEF FAN				
RETURN AIRFLOW (CFM)	3,500	3,500	N/A	N/A
DRIVE / TYPE	DIRECT / PLENUM	DIRECT / PLENUM	N/A	N/A
EXT. STATIC PRESSURE (IN. WC) (NOTE 1)	0.75	0.75	N/A	N/A
FAN RPM	965	965	N/A	N/A
BHP (NOTE 4)	0.63	0.63	N/A	N/A
MHP (NOTE 4)	3.8	3.8	N/A	N/A
ELECTRIC HEATING COIL				
TYPE	SCR	SCR	SCR	SCR
AIRFLOW (CFM)	9,750	9,750	1,750	1,750
CAPACITY (KW)	40	40	18	18
ENTERING AIR TEMPERATURE (DEG F)	50	50	25	25
LEAVING AIR TEMPERATURE (DEG F)	60	60	55	55
FILTERS				
TYPE	2" MERV 8	2" MERV 8	2" MERV 8	2" MERV 8
MAX FACE VEL (FPM)	250	250	250	250
DIRTY FILTER ALLOWANCE A.P.D. (IN. WC)	0.25	0.25	0.25	0.25
ELECTRICAL (NOTE 5)				
VOLTAGE/PHASE	460/3	460/3	460/3	460/3
MCA	87.2	87.2	28.9	28.9
MOCP	90	90	30	30
DISCONNECT BY	MFR	MFR	MFR	MFR
CONTROLLER/STARTER BY	MFR	MFR	MFR	MFR
UNIT INFORMATION				
WEIGHT (LBS)	5,300	5,300	750	750
CONTROL TYPE (NOTE 3)	MAU-A	MAU-A	MAU-B	MAU-B
BASIS OF DESIGN MANUFACTURER	DAIKIN	DAIKIN	DAIKIN	DAIKIN
BASIS OF DESIGN MODEL	DAHA	DAHA	DAHA	DAHA
NOTES	6,7,8	6,7,8	2,6	2,6

NOTES:
1. EXTERNAL STATIC PRESSURE INCLUDES SYSTEM LOSSES AND CLEAN/DIRTY FILTER LOSSES ONLY.
2. PROVIDE WITH MINIMUM 24" TALL INSULATED ROOF CURB. UNIT SHALL HAVE SIDE DUCT CONNECTIONS FOR HORIZONTAL DISCHARGE.
3. REFER TO SERIES 00M700 SHEETS FOR CONTROL TYPE DESCRIPTION.
4. NO EQUIPMENT SHALL BE SELECTED ABOVE 90% OF MOTOR NAMEPLATE RATING. PROVIDE SUPPLY FAN WITH EC MOTOR.
5. PROVIDE WITH SINGLE POINT ELECTRICAL CONNECTION. REFER TO ELECTRICAL PLANS FOR ADDITIONAL INFORMATION.
6. PROVIDE CORROSION RESISTANT COATING FOR WASTEWATER TREATMENT FACILITIES ON EXTERIOR OF CABINET.
7. PROVIDE UNIT WITH RAILS FOR CONDENSATE DRAIN CONNECTIONS AND SIDE DUCT CONNECTIONS FOR HORIZONTAL DISCHARGE FOR INSTALLATION ON CONCRETE PAD ON GRADE.
8. SHALL BE PROVIDED ONLY IF SULZER BLOWERS ARE PROVIDED.

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LEWISVILLE
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CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

GENERAL MECHANICAL SCHEDULES III

FILENAME: 31 - Plant II BLOWER BLDG (PROPOSED)- MECH.RVT
SCALE: NOT TO SCALE
SHEET: 00M603

MOTORIZED DAMPER SCHEDULE

SYMBOL	SERVICE	SIZE WxH (IN.)	CFM		BLADE CONFIGURATION	HORIZONTAL OR VERTICAL BLADES	INSULATED	ACTUATOR TYPE	ACTUATOR STYLE	POWER FAILURE POSITION	POSITIVE POSITION FEEDBACK	CONTROL TYPE (NOTE 3)	BASIS OF DESIGN		NOTES
			MAX.	MIN.									MANUFACTURER	MODEL	
MOD-3101	BLOWER MOTOR CABINET HEAT	20x12	955	0	PARALLEL	HORIZONTAL	NO	TWO POSITION	ELECTRIC	NC	YES	MAU-A	TAMCO	1000	1,2,4
MOD-3102	BLOWER MOTOR CABINET HEAT	20x12	955	0	PARALLEL	HORIZONTAL	NO	TWO POSITION	ELECTRIC	NC	YES	MAU-A	TAMCO	1000	1,2,4
MOD-3103	BLOWER MOTOR CABINET HEAT	20x12	955	0	PARALLEL	HORIZONTAL	NO	TWO POSITION	ELECTRIC	NC	YES	MAU-A	TAMCO	1000	1,2,4
MOD-3104	BLOWER MOTOR CABINET HEAT	20x12	955	0	PARALLEL	HORIZONTAL	NO	TWO POSITION	ELECTRIC	NC	YES	MAU-A	TAMCO	1000	1,2,4

NOTES:
1. COORDINATE DAMPER ACTUATOR LOCATION AND MOUNTING REQUIREMENTS WITH TEMPERATURE CONTROL CONTRACTOR. DAMPER SHALL BE CLASS 1A RATED.
2. SHALL BE 115 V - 1 PHASE.
3. REFER TO SERIES 00M700 SHEETS FOR CONTROL TYPE DESCRIPTION.
4. SHALL BE PROVIDED ONLY IF SULZER BLOWERS ARE PROVIDED.

GRILLES, REGISTERS, AND DIFFUSERS SCHEDULE

SYMBOL	MATERIAL	TYPE	MARGIN	INLET SIZE (IN)	FACE SIZE (IN)	FINISH	MANUFACTURER	MODEL	NOTES
RG-1	ALUMINUM	35 DEGREE DEFLECTION	DUCT MOUNTED	SEE PLANS	INLET +2	MILL	TITUS	350FL	
SG-1	ALUMINUM	DOUBLE DEFLECTION	DUCT MOUNTED	SEE PLANS	INLET +2	MILL	TITUS	300FL	

LOUVER SCHEDULE

SYMBOL	SERVICE	AIRFLOW (CFM)	SIZE WxH (IN)	VELOCITY (FPM)	MIN. FREE AREA (SQ.FT.)	MAX. PRESSURE LOSS (IN.W.G.)	BASIS OF DESIGN		NOTES
							MANUFACTURER	MODEL	
LVR-3101	PPU-3101 INTAKE	250	16x16	342	0.73	0.02	RUSKIN	ELF6375DX	1,2,3,4
LVR-3102	BLOWER ROOM RELIEF	25,000	102x108	478	52.3	0.03	RUSKIN	ELF6350DMP	1,2,3,4,5
LVR-3103	BLOWER ROOM RELIEF	25,000	102x108	478	52.3	0.03	RUSKIN	ELF6350DMP	1,2,3,4,5

NOTES:
1. FINAL APPROVAL OF COLOR BY ARCHITECT.
2. REFER TO ARCHITECTURAL PLANS FOR EXACT LOCATION.
3. PROVIDE WITH STAINLESS STEEL INSECT SCREEN.
4. PROVIDE WITH PVDF (KYNAR 500, HYLAR 5000 OR DURANAR) COATING.
5. PROVIDE WITH AUTOMATIC GRAVITY BACKDRAFT DAMPER EQUIVALENT TO RUSKIN BD6 FULL SIZE OF LOUVER. SET DAMPERS TO OPEN AT 0.03" W.G. (ADJ.) PRESSURE DIFFERENTIAL.

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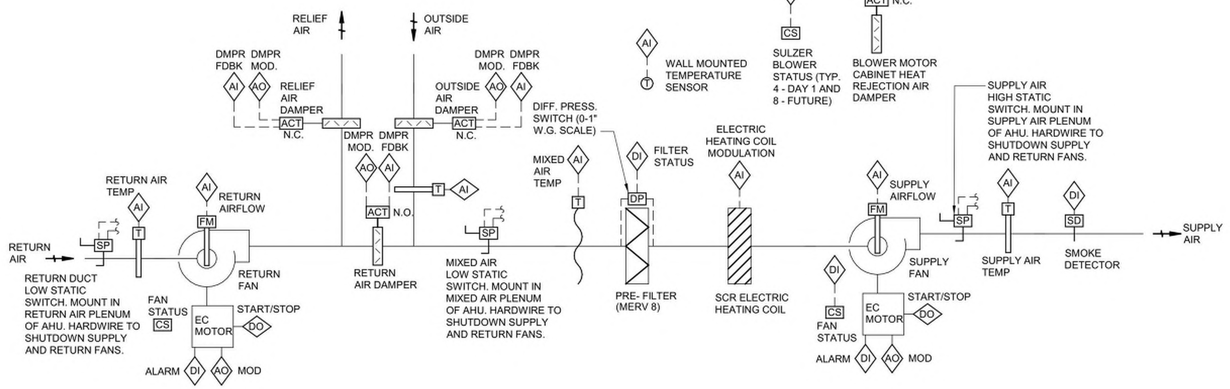
PRAIRIE CREEK

AERATION BASIN EXPANSION

GENERAL MECHANICAL SCHEDULES IV

FILENAME	31 - Plant II BLOWER BLDG (PROPOSED)- MECH.RVT
SCALE	NOT TO SCALE
SHEET	00M604



SEQUENCE OF OPERATION:
THIS SEQUENCE ONLY APPLIES IF SULZER BLOWERS ARE SELECTED. ASSOCIATED CONTROL PANEL SHALL BE TOUCH SCREEN TO ALLOW USER TO MONITOR AND TROUBLE SHOOT POINTS LISTED IN ASSOCIATED DIAGRAM AND SEQUENCE. SEQUENCE AND POINTS CAN BE ACCOMPLISHED THROUGH MAU MFR PROVIDED CONTROLS AND/OR TCC PROVIDED CONTROLS.

MAUS SHALL BE IN LEAD/LAG ARRANGMENT SO OPERATING HOURS ARE EQUAL. BOTH MAUS SHALL OPERATE AS NEEDED TO MAINTAIN SPACE TEMPERATURE.

SUPPLY FAN OPERATION:
SUPPLY FAN EC MOTOR SHALL MODULATE TO PROVIDE VENTILATION AIR NEEDED FOR BLOWER OPERATION OR MAINTAIN SPACE TEMPERATURE BETWEEN 65ºF (ADJ.) AND 85ºF (ADJ.) WHICHEVER REQUIRES MORE AIRFLOW.

RETURN FAN OPERATION:
RETURN FAN EC MOTOR SHALL BE INDEXED TO RUN WHENEVER THE SUPPLY FAN IS INDEXED TO RUN. CONTROL PANEL SHALL MODULATE SIGNAL TO RETURN FAN TO MAINTAIN THE AIRFLOW OFFSET AS INDICATED BELOW.

VENTILATION AIR CONTROL:
THE OUTSIDE AIR DAMPER SHALL BE OPEN BASED ON DESCRIPTION BELOW. THE RETURN AIR AND RELIEF AIR DAMPER SHALL MODULATE IN OPPOSITION TO MAINTAIN THE REQUIRED OUTSIDE AIR FLOW RATE, OR TO SATISFY THE ECONOMIZER DISCHARGE AIR SEQUENCE.

THE OUTSIDE AIR DAMPER SHALL MODULATE TO MAINTAIN THE OUTSIDE AIR REQUIRED FOR THE BLOWERS OPERATING OR MAINTAIN SPACE TEMPERATURE BETWEEN 65ºF (ADJ.) AND 85ºF (ADJ.) WHICHEVER REQUIRES MORE AIRFLOW. BLOWER OPERATION SHALL BE DETERMINED BY CURRENT SENSOR PROVIDED ON EACH BLOWER. EACH DAY 1 BLOWER REQUIRES 1,135 CFM OF OUTSIDE AIR. EXACT AIRFLOW FOR EACH BLOWER SHALL BE DETERMINED BASED ON FINAL APPROVED BLOWERS. OUTSIDE AIR DAMPER SHALL MODUALTE TO MATCH AIRFLOW ASSOCAITED WITH BLOWERS OPERATING (1 - 1,135 CFM...4 - 4,540 CFM).

HEATING COIL OPERATION:
CONTROLLER SHALL MODULATE THE SCR CONTROLLED ELECTRIC HEATING COIL TO MAINTAIN SPACE TEMPERATURE SETPOINT.

BLOWER MOTOR CABINET HEAT REJECTION MOTOR OPERATED DAMPER OPERATION:
IF SPACE TEMPERATURE DROPS BELOW 65ºF (ADJ.) FOR A MINIMUM OF 10 MINUTES (ADJ.), ONE MOD ASSOCIATED WITH OPERATING BLOWER SHALL OPEN TO ALLOW WARM AIR TO ENTER THE SPACE. IF SPACE TEMPERATURE REMAINS BELOW 65ºF (ADJ.) FOR A MINIMUM OF 10 MINUTES (ADJ.), A SECOND MOD ASSOCIATED WITH OPERATING BLOWER SHALL OPEN. THIS TREND SHALL CONTINUE UNTIL ALL FOUR MODS ARE OPEN. MODS SHALL CLOSE IN THE OPPOSITE DIRECTION THEY OPENED (FIRST OPEN, FIRST CLOSED). FIRST MOD CLOSES WHEN THE SPACE TEMPERATURE RISES ABOVE 70ºF (ADJ.) FOR A MINIMUM OF 10 MINUTES (ADJ.) OR WHEN ASSOCIATED BLOWER TURNS OFF FOR A MINIMUM OF 10 MINUTES (ADJ.). SECOND MOD CLOSES WHEN THE SPACE TEMPERATURE STAYS ABOVE 70ºF (ADJ.) FOR A MINIMUM OF 10 MINUTES (ADJ.) OR WHEN ASSOCIATED BLOWER TURNS OFF FOR A MINIMUM OF 10 MINUTES (ADJ.)THIS TREND SHALL CONTINUE UNTIL ALL MODS ARE CLOSED.

ECONOMIZER OPERATION:
WHEN THE OUTSIDE AIR DRY BULB TEMPERATURE IS LESS THAN THE RETURN AIR DRY BULB TEMPERATURE ECONOMIZER CONTROLS SHALL BE ENABLED. WHEN OUTSIDE AIR DRY BULB TEMPERATURE IS GREATER THAN THE RETURN AIR DRY BULB TEMPERATURE FOR 10 MINUTES ECONOMIZER CONTROLS SHALL BE DISABLED AND SHALL RETURN THE UNIT TO NON-ECONOMIZER OUTSIDE AIR MODE. ONCE ECONOMIZER CONTROLS HAVE BEEN ENABLED OR DISABLED, THE UNIT SHALL CONTINUE TO OPERATE IN THAT MODE FOR A MINIMUM OF 10 MINUTES (ADJ.) BEFORE BEING ALLOWED TO SWITCH BACK (TO PREVENT SHORT CYCLING).

IN ECONOMIZER MODE THE RETURN AND RELIEF DAMPERS SHALL MODULATE TO MAINTAIN SPACE TEMPERATURE SETPOINT.

ALARMS, INTERLOCKS, AND SAFETIES:
WHEN FIRE ALARM CONTROL PANEL INDICATES AN ALARM CONDITION, AHU SHALL BE SHUTDOWN.

THE FOLLOWING CONDITIONS SHALL SHUTDOWN THE AHU AND SHALL INDICATE AN ALARM CONDITION AT THE UMCS WORKSTATION:

- LOW STATIC PRESSURE SWITCH INDICATES RETURN DUCT PRESSURE LESS THAN THE SPECIFIED DUCT PRESSURE CLASS.
- LOW STATIC PRESSURE SWITCH INDICATES MIXED AIR PRESSURE LESS THAN THE SPECIFIED DUCT PRESSURE CLASS OF THE OUTSIDE AIR DUCTWORK.
- HIGH STATIC PRESSURE SWITCH INDICATES SUPPLY DUCT STATIC PRESSURE GREATER THAN THE SPECIFIED DUCT PRESSURE CLASS.

THE FOLLOWING CONDITIONS SHALL INDICATE AN ALARM AT THE UMCS, HOWEVER AHU SHALL CONTINUE TO OPERATE:

- AN ALARM IS INDICATED AT ANY FAN.
- DIFFERENTIAL PRESSURE SWITCH ACROSS PRE-FILTER (MERV 8) BANK EXCEEDS 0.4 INCHES W.G. (ADJ.)
- IF THE SPACE TEMPERATURE IS MORE THAN 5°F (ADJ.) ABOVE OR BELOW SETPOINT.

WHENEVER AHU IS SHUTDOWN THE FOLLOWING SHALL OCCUR:

- THE OUTSIDE AND RELIEF AIR DAMPERS SHALL FULLY CLOSE.
- RETURN AIR DAMPER SHALL FULLY OPEN.
- FANS SHALL BE DE-ENERGIZED.

1 00M701 MAKEUP AIR HANDLING UNIT CONTROL: MAU-A
1" = NTS

CONTROL SYMBOLS LIST

SYMBOL:	DESCRIPTION:
	FAN
	OCCUPANCY SENSOR
S	SWITCH IN ENCLOSURE
H	HUMIDISTAT/SENSOR (DUCT MOUNTED)
P	DIFF PRESSURE SENSOR (DUCT MOUNTED)
T	TEMPERATURE SENSOR (DUCT MOUNTED)
ACT	ACTUATOR
CS	CURRENT SENSOR
SD	SMOKE DETECTOR
	HEATING/COOLING COIL
	FILTER
ACT	MOTOR OPERATED DAMPER
	GRAVITY BACKDRAFT DAMPER

GENERAL CONTROL NOTES (APPLY TO ALL CONTROL SHEETS)

1. REFER TO EQUIPMENT SCHEDULES TO CROSS REFERENCE WHICH CONTROL DIAGRAMS APPLY TO WHICH EQUIPMENT.
2. ALL WIRING, CONTROL COMPONENTS, DEVICES, AND PROGRAMMING SHOWN ON THESE CONTROL DRAWINGS SHALL BE PROVIDED BY THE TCC UNLESS SPECIFICALLY NOTED OTHERWISE.
3. ALL ACTUATORS SHALL BE OF THE ELECTRICAL TYPE.
4. ALL MODULATING DAMPER ACTUATORS SHOWN WITH POSITION FEEDBACK SHALL HAVE THE VALVE POSITION DISPLAYED ON GRAPHICAL SCREEN ADJACENT TO THE DAMPER/VALVE COMMAND SIGNAL.
5. MODULATING SIGNALS SHALL BE DISPLAYED AS % OPEN (SIGNALS DISPLAYED AS % CLOSED ARE NOT ACCEPTABLE).
6. ALL CONTROL COMPONENTS SUCH AS RELAYS, SWITCHES, DDC CONTROLLERS, ETC. SHALL BE MOUNTED IN CORROSION RESISTANT NEMA 4X ENCLOSURES WITH STAINLESS STEEL MOUNTING BACKPLATES.
7. EACH CONTROL PANEL SHALL HAVE A LAMINATED COPY OF THE APPLICABLE SEQUENCE OF OPERATIONS AND CONTROL DIAGRAMS INDICATING THE COMPONENTS, AND OPERATION OF EQUIPMENT ASSOCIATED WITH EACH PANEL.
8. TCC SHALL WIRE THE CONTROL SIGNAL FROM THE ASSOCIATED AIR HANDLING UNIT OR AIR HANDLING UNIT CONTROL PANEL TO CONTROL IN ACCORDANCE WITH THE APPROPRIATE SEQUENCE OF OPERATION. TCC SHALL PROVIDE ALL CONDUIT, TRANSFORMERS, FUSING, AND ALL OTHER ELECTRICAL COMPONENTS REQUIRED FOR COMPLETE INSTALLATION.
9. TCC SHALL EXTEND CONTROL SIGNAL FROM ADDRESSABLE RELAY DEVICES SERVING EACH AIR HANDLING UNIT, EXHAUST FAN, ETC. REFER TO PLANS FOR LOCATIONS. TCC SHALL EXTEND AND TERMINATE WIRING AS REQUIRED FOR EMERGENCY SHUTDOWN.
10. TCC SHALL EXTEND 120 VOLT POWER FROM CONTROL PANEL JUNCTION BOX TO ALL VARIABLE AIR VOLUME CONTROLLERS SHOWN THE MECHANICAL PLANS. TCC SHALL PROVIDE ALL TRANSFORMERS, WIRING, SUPPORTS, FUSING, TOGGLE SWITCHES, AND ALL OTHER ELECTRICAL COMPONENTS REQUIRED FOR COMPLETE INSTALLATION.
11. TCC SHALL PROVIDE CONDUIT RUNS FOR OUTDOOR EQUIPMENT AND FOR EQUIPMENT INSTALLED REMOTELY FROM THE MAIN BUILDING THAT IS BEING MONITORED OR CONTROLLED.
12. TCC SHALL PROVIDE THERMOSTATS FOR AUTOMATIC CONTROL OF EQUIPMENT AS SHOWN IN THE CONTROL DIAGRAMS AND FLOOR PLANS. THERMOSTAT CONTACT AMP RATING SHALL BE MINIMUM 125% OF THE MAXIMUM CURRENT DRAW FOR THE EQUIPMENT BEING SERVED. WHERE THERMOSTATS CONTROL THE STARTING OF MOTORS SUCH AS FANS, THERMOSTATS SHALL BE RATED FOR MOTOR STARTING APPLICATIONS.
13. ELEMENT LENGTHS FOR BOTH MIXED AIR TEMPERATURE SENSORS AND LOW LIMIT TEMPERATURE SWITCHES SHALL BE MINIMUM 1 LINEAR FOOT PER SQUARE FOOT OF COIL SURFACE AREA. PROVIDE MULTIPLE SENSORS AND SWITCHES AS NEEDED TO ACHIEVE REQUIRED ELEMENT LENGTHS. LOCATE RESET SWITCHES MAXIMUM 6'-6" ABOVE ADJACENT STANDING SURFACE(I.E. ROOF, PLATFORM, OR FLOOR) SO THE RESET SWITCH CAN BE CYCLED WITHOUT THE NEED FOR A LADDER.
14. CONTROL DIAGRAMS ARE SCHEMATIC IN NATURE AND DO NOT SHOW ALL REQUIRED CONTROL DEVICES AND COMPONENTS. REFER TO FLOOR PLANS AND DETAILS FOR ADDITIONAL CONTROL DEVICES, COMPONENTS, AND REQUIREMENTS NOT SHOWN ON THE CONTROL DRAWINGS.
15. TCC SHALL PROVIDE ALL CONTROL COMPONENTS AND ACCESSORIES AS REQUIRED FOR EQUIPMENT TO BE CONTROLLED AS DESCRIBED IN THE SEQUENCE OF OPERATION REGARDLESS OF WHETHER ALL CONTROL COMPONENTS OR POINTS ARE SHOWN IN THE ASSOCIATED CONTROL DIAGRAM.

SEQUENCE OF OPERATION:
PROVIDE WITH UNIT MOUNTED CONTROLS. REFER TO PLANS AND SPECIFICATIONS FOR ADDITIONAL INFORMATION.

INTAKE HOOD FAN AND PPU SUPPLY FANS SHALL OPERATE CONTINUOUSLY.

ALARMS, INTERLOCKS, AND SAFETIES:
THE FOLLOWING CONDITIONS SHALL INDICATE A LOCAL ALARM AT THE UNIT'S CONTROLLER:

- ANY DIRTY FILTER SWITCH IS ACTIVATED
- A FAULT IS GENERATED AT THE UNIT CONTROLLER
- THE UNIT IS ENERGIZED BUT THE FLOW SWITCH IS NOT ACTIVATED

2 00M701 POSITIVE PRESSURE UNIT CONTROL: PPU-A
1" = NTS

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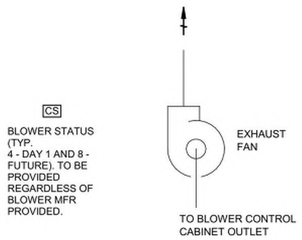
PRAIRIE CREEK
AERATION BASIN EXPANSION

GENERAL MECHANICAL CONTROLS I

FILENAME	31 - Plant II BLOWER BLDG (PROPOSED)- MECH.RVT
SCALE	NOT TO SCALE
SHEET	00M701



SEQUENCE OF OPERATION:
EXHAUST FAN SHALL OPERATE WHEN ASSOCIATED BLOWER IS OPERATING.

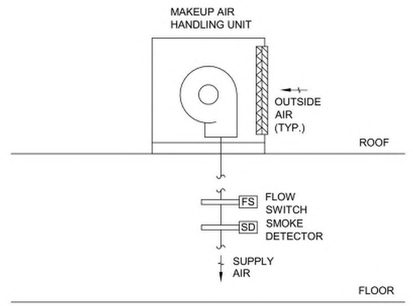
INSTALL FLOW SWITCH AND DUCT SMOKE DETECTOR IN MAIN DUCT IMMEIDATELY DOWNSTREAM OF THE UNIT BEFORE ANY TAPS ARE MADE.

ALARMS, INTERLOCK AND SAFETIES:
THE FOLLOWING CONDITIONS SHALL INDICATE AN ALARM CONDITION AT THE EXISTING SCADA SYSTEM.

- IF EXHAUST FAN IS COMMANDED TO TURN ON AND FAILS TO TURN ON.

REFER TO THE PLANS AND SPECIFICATIONS FOR ADDITIONAL INFORMATION.

1 00M702 EXHAUST FAN CONTROL: EF-A
1" = NTS



SEQUENCE OF OPERATION:
MAKEUP AIR HANDLING UNIT AND ASSOCIATED EXHAUST FANS (EF-B) SHALL OPERATE CONTINUOUSLY. UNIT'S ELECTRIC HEATING COIL SHALL MODULATE TO MAINTAIN DISCHARGE AIR TEMPERATURE OF 55°F (ADJ.).

INSTALL FLOW SWITCH AND DUCT SMOKE DETECTOR IN MAIN DUCT IMMEIDATELY DOWNSTREAM OF THE UNIT BEFORE ANY TAPS ARE MADE.

ALARMS, INTERLOCK AND SAFETIES:
THE FOLLOWING CONDITIONS SHALL INDICATE AN ALARM CONDITION AT THE LOCAL VISUAL AND AUDIBLE ALARM SYSTEM LOCATED ON THE INSIDE/OUTSIDE OF THE PUMP STATION.

- POWER FAILURE.
- DUCT MOUNTED FLOW SWITCH INDICATES FAILURE TO PROVIDE THE REQUIRED AIR CHANGES.
- DUCT SMOKE DETECTOR DETECTS SMOKE.

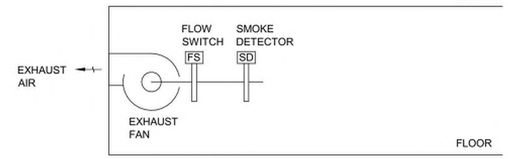
AN ALARM SHALL ALSO BE SENT TO THE EXISTING SCADA SYSTEM.

IF THE DUCT SMOKE DETECTOR DETECTS SMOKE, THE UNIT SHALL TURN OFF AND THE ASSOCIATED EXHAUST FANS (EF-B) SERVING THE PUMP STATION SHALL TURN OFF.

REFER TO PLANS FOR APPROXIMATE LOCATIONS OF FLOW SWITCH AND DUCT SMOKE DETECTOR.

REFER TO THE PLANS AND SPECIFICATIONS FOR ADDITIONAL INFORMATION.

2 00M702 MAKEUP AIR HANDLING UNIT CONTROL: MAU-B
1" = NTS



SEQUENCE OF OPERATION:
EXHAUST FAN SHALL OPERATE CONTINUOUSLY.

ASSOCIATED EF GRAVITY BACKDRAFT DAMPER SHALL FULLY OPEN WHEN FAN IS ENERGIZED. WHEN FAN IS DE-ENERGIZED, ASSOCIATED EF AND GRAVITY BACKDRAFT DAMPERS SHALL FULLY CLOSE.

ALARMS, INTERLOCK AND SAFETIES:
THE FOLLOWING CONDITIONS SHALL INDICATE AN ALARM CONDITION AT THE LOCAL VISUAL AND AUDIBLE ALARM SYSTEM LOCATED ON THE INSIDE/OUTSIDE OF THE PUMP STATION.

- POWER FAILURE.
- DUCT MOUNTED FLOW SWITCH INDICATES FAILURE TO PROVIDE THE REQUIRED AIR CHANGES.
- DUCT SMOKE DETECTOR DETECTS SMOKE.

AN ALARM SHALL ALSO BE SENT TO THE SCADA SYSTEM.

IF EXHAUST FAN'S DUCT SMOKE DETECTORS DETECTS SMOKE, EXHAUST FAN AND THE MAKEUP AIR HANDLING UNIT (MAU-A) SERVING THE PUMP STATION SHALL TURN OFF.

REFER TO PLANS FOR APPROXIMATE LOCATIONS OF FLOW SWITCH AND DUCT SMOKE DETECTOR.

REFER TO THE 00M002, 00M003, AND THE ELECTRICAL PLANS FOR ADDITIONAL INFORMATION.

3 00M702 EXHAUST FAN CONTROL: EF-B
1" = NTS

Autodesk Docs://10342803_COL_PCWWT_AB_Expansion_2024/31 - Plant II BLOWER BLDG (PROPOSED)- MECH.rvt
6/12/2025 10:57:56 PM

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13/2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	B. PERLBERG
DRAWN BY	J. VALLES
CHECKED BY	K. CHAUDHARI
APPROVED BY	B. PERLBERG
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

LEWISVILLE
Deep Roots. Broad Wings. Bright Future

CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

GENERAL MECHANICAL CONTROLS II

FILENAME	31 - Plant II BLOWER BLDG (PROPOSED)- MECH.RVT
SCALE	NOT TO SCALE

SHEET
00M702

LOW - VOLTAGE CIRCUIT BREAKER (CB). RATINGS AND NO. OF POLES AS SHOWN. WHEN SPECIFIC TYPE IS REQUIRED, X INDICATES TYPE.

TYPES:
MCCB - MOLDED CASE
ICCB - INSULATED CASE
LVP - LOW - VOLTAGE POWER
MCP - MOTOR CIRCUIT PROTECTOR
(RATING PER CONNECTED LOAD)

SEPARATELY MOUNTED CIRCUIT BREAKER; SEE ELECTRICAL ONE - LINE DIAGRAM OR SCHEDULE FOR DESCRIPTION

MEDIUM - VOLTAGE CIRCUIT BREAKER

FUSE, SIZE, AND NUMBER OF FUSES AS NOTED

FUSED CUTOUT, CURRENT RATING, FUSE SIZE, AND NUMBER OF POLES AS NOTED

FUSIBLE SWITCH, CURRENT RATING, FUSE SIZE, AND QUANTITY AS NOTED

NON-FUSED SWITCH, CURRENT RATING, AND NUMBER OF POLES AS NOTED

DISCONNECT OR DRAWOUT CONNECTION

MAGNETIC MOTOR STARTER AND SEPARATELY MOUNTED COMBINATION MAGNETIC MOTOR STARTER

MOTOR CONTROLLER AND SEPARATELY MOUNTED MOTOR CONTROLLER WITH SHORT CIRCUIT PROTECTION AND DISCONNECT

MOTOR STARTER AND CONTROLLER SUBSCRIPTS:

A - MAGNETIC STARTER NEMA SIZE

B - STARTER TYPE
NONE - FULL VOLTAGE NON-REVERSING (FVNR)
FVR - FULL VOLTAGE REVERSING
2S - TWO SPEED
RVAT - REDUCED VOLTAGE AUTO TRANSFORMER

C - CONTROL DIAGRAM OR CONTROLS SCHEDULE NUMBER (IF REQUIRED)

D - CONTROLLER TYPE
VFD - VARIABLE FREQUENCY DRIVE
SS - SOLID STATE
SSRV - SOLID STATE REDUCED VOLTAGE

SEPARATELY MOUNTED COMBINATION MOTOR STARTER OR CONTROLLER; SEE ELECTRICAL ONE - LINE DIAGRAM OR SCHEDULE FOR DESCRIPTION

THERMAL OVERLOAD ELEMENT

THERMAL OVERLOAD RELAY CONTACT

DISCONNECT OR SAFETY SWITCH, 30A, 3P, NON-FUSED UNLESS OTHERWISE NOTED

DISCONNECT OR SAFETY SWITCH WITH AUXILIARY CONTACTS, 30A, 3P, NON-FUSED UNLESS OTHERWISE NOTED

MOTOR WITH DESIGN HORSEPOWER (WHEN INDICATED)

GENERATOR

TRANSFER SWITCH, CURRENT RATING, AND NUMBER OF POLES AS NOTED

ATS - AUTOMATIC
MTS - MANUAL

TRANSFORMER
3-PHASE, 3-WIRE DELTA CONNECTION
3-PHASE, 4-WIRE GROUNDED WYE CONNECTION

SWITCHBOARD OR PANELBOARD; NAME, VOLTAGE, PHASE, NUMBER OF WIRES WHEN INDICATED

NON-MOTOR LOAD WITH DESIGN KVA, KW, OR AMP

CONTROL POWER TRANSFORMER (CPT)

VOLTAGE TRANSFORMER (VT OR PT)

CURRENT TRANSFORMER (CT)

GROUND

LIGHTNING ARRESTER

ELECTRICAL CONNECTION

NO ELECTRICAL CONNECTION

SOLENOID VALVE

CONTROL/RELAY COIL; X INDICATES TYPE, Y INDICATES LOOP NO. WHEN USED

TYPES:
CR - CONTROL RELAY
DP - DEFINITE PURPOSE RELAY
LC - LIGHTING CONTACTOR
M - MOTOR STARTER
PC - PHOTO CELL
TC - TIME CLOCK
TR - TIMING RELAY

NORMALLY OPEN CONTACT (N.O.)

NORMALLY CLOSED CONTACT (N.C.)

NORMALLY OPEN TIME DELAY RELAY CONTACT WITH TIME DELAY ON CLOSING AFTER COIL IS ENERGIZED

NORMALLY CLOSED TIME DELAY RELAY CONTACT WITH TIME DELAY ON OPENING AFTER COIL IS ENERGIZED

NORMALLY OPEN TIME DELAY RELAY CONTACT WITH TIME DELAY ON OPENING AFTER COIL IS DE-ENERGIZED

NORMALLY CLOSED TIME DELAY RELAY CONTACT WITH TIME DELAY ON CLOSING AFTER COIL IS DE-ENERGIZED

NORMALLY OPEN TEMPERATURE SWITCH; CLOSE ON RISING TEMPERATURE

NORMALLY CLOSED TEMPERATURE SWITCH; OPEN ON RISING TEMPERATURE

NORMALLY OPEN FLOW SWITCH; CLOSE ON INCREASING FLOW

NORMALLY CLOSED FLOW SWITCH; OPEN ON INCREASING FLOW

NORMALLY OPEN LEVEL SWITCH, CLOSE ON RISING LEVEL

NORMALLY CLOSED LEVEL SWITCH, OPEN ON RISING LEVEL

NORMALLY OPEN PRESSURE SWITCH, CLOSE ON INCREASING PRESSURE

NORMALLY CLOSED PRESSURE SWITCH, OPEN ON INCREASING PRESSURE

NORMALLY OPEN LIMIT SWITCH, CLOSE ON REACHING LIMIT

NORMALLY CLOSED LIMIT SWITCH, OPEN ON REACHING LIMIT

FIELD WIRING EXTERNAL TO CONTROL PANEL

INTERLOCK; X INDICATES TYPE

TYPES:
E - ELECTRICAL
M - MECHANICAL
K - KEY
I - INTERLOCK

3 POSITION SELECTOR SWITCH, MAINTAINED CONTACTS; UNLESS OTHERWISE NOTED, 2-POSITION SIMILAR

NORMALLY OPEN PUSHBUTTON, MOMENTARY CONTACT UNLESS OTHERWISE NOTED

NORMALLY CLOSED PUSHBUTTON, MOMENTARY CONTACT UNLESS OTHERWISE NOTED

INDICATING LIGHT, X INDICATES LENS COLOR

PUSH TO TEST INDICATING LIGHT, X INDICATES LENS COLOR

LENS COLORS:

R - RED	Y - YELLOW
G - GREEN	W - WHITE
B - BLUE	A - AMBER

CONTROL PANEL INTEGRAL OR PROVIDED WITH ASSOCIATED EQUIPMENT

CONTROL PANEL WITH DISCONNECT SWITCH INTEGRAL OR PROVIDED WITH ASSOCIATED EQUIPMENT

POWER COMPONENTS
SUBSCRIPTS:
CS - CONTROL STATION
DMP - DIGITAL METERING PACKAGE
ESS OR ES - EMERGENCY STOP SWITCH
ETLS - END OF TRAVEL LIMIT SWITCH
ETM - ELAPSED TIME METER
GFP - GROUND FAULT PROTECTION
HIS - HOOD INTERLOCK SWITCH
HOA - HAND-OFF-AUTO SWITCH
IC - INSTRUMENTATION/CONTROL CONNECTION
J - JUNCTION OR PULL BOX
LCS - LOCAL CONTROL STATION
MOR - MANUAL-OFF-REMOTE SWITCH
MSH - MOTOR MOISTURE SWITCH
PB - PUSH BUTTON
PMR - PHASE MONITOR RELAY
POT - POTENTIOMETER
PSH - MOTOR PRESSURE SWITCH
RPLS - REVERSE PERMISSIVE LIMIT SWITCH
RTM - RUN TIME METER
SH - MOTOR SPACE HEATER
SPD - LOW VOLTAGE SURGE PROTECTIVE DEVICE
SS - SELECTOR SWITCH
TDUV - TIME DELAY RELAY FOR STEPPED REACCELERATION
TS - TEMPERATURE SWITCH
TSH - MOTOR TEMPERATURE SWITCH
TQOL - OVERLOAD TORQUE SWITCH
VFD - VARIABLE FREQUENCY DRIVE
WH - UTILITY WATT-HOUR METER PER UTILITY REQUIREMENTS
ZSS - ZERO SPEED SWITCH

EQUIPMENT CONNECTION

PANELBOARD (250V TO 600V)

PANELBOARD (LESS THAN 250V)

ELECTRICAL EQUIPMENT ENCLOSURE: SWITCHBOARD, MOTOR CONTROL CENTER, CONTROL PANEL, OR OTHER EQUIPMENT AS INDICATED

LIGHTING CONTROL COMPONENT
SUBSCRIPTS:
PC - PHOTOCELL
OS - OCCUPANCY SENSOR CEILING MOUNTED

CEILING/PENDANT MOUNTED LUMINAIRE - LED

WALL MOUNTED LUMINAIRE - LED

CEILING/PENDANT MOUNTED LUMINAIRE - LED

WALL/SURFACE MOUNTED LUMINAIRE - LED

CEILING/PENDANT MOUNTED LUMINAIRE - LED (NORMAL/EMERGENCY)

WALL MOUNTED LUMINAIRE - LED (NORMAL/EMERGENCY)

CEILING/PENDANT MOUNTED LUMINAIRE - LED (NORMAL/EMERGENCY)

WALL MOUNTED LUMINAIRE - LED (NORMAL/EMERGENCY)

EMERGENCY LUMINAIRE, 2 ATTACHED HEADS AS SHOWN

EMERGENCY LUMINAIRE, REMOTE MOUNTED HEAD

DOUBLE-FACED CEILING OR WALL MOUNTED EXIT SIGN; DIRECTIONAL ARROWS (IF REQUIRED) AS INDICATED ON PLANS

SINGLE-FACED CEILING OR WALL MOUNTED EXIT SIGN; DIRECTIONAL ARROWS (IF REQUIRED) AS INDICATED ON PLANS

AREA OR ROADWAY LUMINAIRE - POLE MOUNTED

LUMINAIRE SUBSCRIPTS:
X - INDICATES FIXTURE TYPE PER LIGHTING FIXTURE SCHEDULE
Y - INDICATES CIRCUIT NUMBER FROM PANELBOARD
z - INDICATES CONTROLLING SWITCH (IF REQUIRED)

TOGGLE SWITCH
SUBSCRIPTS:
X - INDICATES TYPE
NONE - SINGLE POLE
3 - THREE-WAY
4 - FOUR-WAY
D - DIMMER
K - KEY SWITCH
L - LIGHTED HANDLE
M - TOGGLE SWITCH, HORSEPOWER RATED
OS - OCCUPANCY SENSOR
P - PILOT LIGHT
TE - MANUAL MOTOR STARTER WITH THERMAL ELEMENT
WP - WEATHER PROOF
Y - INDICATES CONTROLLING SWITCH (IF REQUIRED)

SPECIAL-PURPOSE RECEPTACLE AS DEFINED ON PLANS

PLUG-IN RECEPTACLE STRIP, QUANTITY AND SPACING OF RECEPTACLES AS NOTED OR SPECIFIED

TELECOMMUNICATIONS SERVICE OUTLET (VOICE/DATA)

TELECOMMUNICATIONS SERVICE OUTLET (DATA ONLY)

TELECOMMUNICATIONS SERVICE OUTLET (VOICE ONLY - WALL MOUNTED AT 48" A.F.F.)

QUAD-DUPLEX RECEPTACLE, TWO NEMA 5-20R UNDER COMMON COVER PLATE

DUPLEX RECEPTACLE, NEMA 5-20R

SIMPLEX RECEPTACLE, NEMA 5-20R

SUBSCRIPTS:
X - INDICATES TYPE
GFCI - GROUND FAULT CIRCUIT INTERRUPTER
Y - INDICATES CIRCUIT NUMBER FROM PANELBOARD
WP - WEATHER PROOF

SPECIAL DEVICE AND/OR CONNECTION AS NOTED

CONDUIT TURNING UP

CONDUIT TURNING DOWN

HOME RUN TO PANEL, 2 #12, 1 #12G IN 3/4"C UNLESS OTHERWISE NOTED

CIRCUIT RUN BETWEEN DEVICES EXPOSED IN NON-ARCHITECTURALLY FINISHED AREAS; CONCEALED IN ARCHITECTURALLY FINISHED AREAS. CONDUIT AND CONDUCTOR SIZES SHALL BE THE SAME AS THE HOMERUN FOR THE CIRCUIT.

CONDUIT RUN BETWEEN DEVICES CONCEALED IN NON-ARCHITECTURALLY FINISHED AREAS OR UNDER FLOOR SLAB. CONDUIT AND CONDUCTOR SIZES SHALL BE THE SAME AS THE HOMERUN FOR THE CIRCUIT.

CIRCUIT HASH MARKS (WHEN INDICATED); LONG, SHORT, SINGLE DOT, AND DOUBLE DOT REPRESENT PHASE, NEUTRAL, EQUIPMENT GROUND, AND ISOLATED EQUIPMENT GROUND, RESPECTIVELY. #12 IN 3/4" CONDUIT UNLESS OTHERWISE INDICATED.

CIRCUIT CONTINUATION

CONDUIT STUBBED OUT AND CAPPED

CONDUIT TAG OR CIRCUIT NUMBER - WIRE AND CONDUIT SIZE AS SPECIFIED IN CIRCUIT SCHEDULE ON THE SHEETS

GROUNDING CONDUCTOR

UNDERGROUND CONCRETE ENCASED DUCT BANK

DIRECT BURIED CONDUIT

OVERHEAD SECONDARY CIRCUIT AND CONDUCTORS

LINETYPE, DENOTES EXISTING TO REMAIN

LINETYPE, DENOTES EXISTING TO BE DEMOLISHED

LINETYPE, DENOTES NEW CONSTRUCTION

GROUND ROD

GROUND TEST WELL

FACP - FIRE ALARM CONTROL PANEL

HH - HANDHOLE

MH - MANHOLE

AREA DESIGNATION:

INDOOR AREA TYPES ARE DEFINED ON THE PLAN DRAWINGS TO ESTABLISH MATERIALS AND METHODS IN ACCORDANCE WITH THE SPECIFICATIONS.

GENERAL REQUIREMENTS:

1. CONTRACTOR SHALL BE RESPONSIBLE FOR ROUTING ALL CONDUITS ON PLANS, ONE-LINE DIAGRAMS, BLOCK DIAGRAMS, FOR SYSTEMS DESCRIBED IN SPECIFICATIONS, AND FOR CONDUITS NOT SHOWN ON THE DRAWINGS.
2. CONTRACTOR SHALL BE RESPONSIBLE FOR FURNISHING PROPERLY SIZED STARTER OVERLOADS FOR EQUIPMENT FURNISHED, OR PROPER SETTING OF SOLID-STATE OVERLOAD RELAYS.
3. INSTRUMENTATION AND CONTROL ONE-LINE DIAGRAMS PROVIDE CABLE AND CONDUIT REQUIREMENT FOR EACH DEVICE. PROVIDE SEPARATE RACEWAYS FOR 24VDC AND 120VAC CONTROL CIRCUITS, AND FOR INSTRUMENTATION CIRCUITS. CONTRACTOR SHALL COMBINE SIMILAR CIRCUIT RUNS TO MINIMIZE THE NUMBER OF CONDUIT TERMINATIONS AT CONTROL PANELS, DCS EQUIPMENT, ETC. THE FOLLOWING IS A GUIDELINE BUT DOES NOT INCLUDE ALL COMBINATION TYPES AND SUBJECT TO EQUIPMENT AND MATERIAL SUPPLIED.

A. NO. 14 AWG XHHW CONTROL WIRE:	¾"C - 14 MAXIMUM 1"C - 23 MAXIMUM 1 ¼"C - 41 MAXIMUM 1 ½"C - 57 MAXIMUM 2"C - 94 MAXIMUM
B. N0. 16 AWG TSP INSTRUMENT CABLE:	1"C - 2 MAXIMUM 1 ½"C - 9 MAXIMUM 2"C - 14 MAXIMUM

4. LIGHTING, RECEPTACLE AND MISCELLANEOUS 120VAC CIRCUITS INDICATED ON THE PLANS ARE NOT SHOWN ON THE ONE-LINE DIAGRAMS. PROVIDE 2#12, #12G IN 3/4 INCH CONDUIT UNLESS OTHERWISE NOTED.
5. WHERE CIRCUITING OVERSIZED TO ACCOMMODATE VOLTAGE DROP TO LIGHTING FIXTURES, RECEPTACLES, TOGGLE SWITCHES, AND SIMILAR DEVICES, SPLICE THE CIRCUIT DOWN TO #12 AWG AT THE DEVICE LOCATION FOR TERMINATION.
6. COORDINATE FINAL LOCATIONS WITH EQUIPMENT PROVIDED.

GENERAL NOTES:

1. THIS IS A STANDARD ELECTRICAL SYMBOLOGY SHEET. NOT ALL SYMBOLS MAY BE USED ON THIS PROJECT.
2. SCREENING OR SHADING OF WORK IS USED TO INDICATE EXISTING COMPONENTS OR TO DE-EMPHASIZE PROPOSED IMPROVEMENTS TO HIGHLIGHT SELECTED TRADE WORK. REFER TO CONTEXT OF EACH SHEET FOR USAGE.
3. SEE P&ID LEGEND SHEET FOR PROJECT-SPECIFIC EQUIPMENT SYMBOLS, EQUIPMENT ABBREVIATIONS, AND PIPING SYSTEM ABBREVIATIONS.
4. ONE-LINE DIAGRAMS SHOW CIRCUIT IDENTIFICATION, WIRE QUANTITY AND SIZES, AND CONDUIT SIZE WITHIN STRUCTURES. ONE-LINE DIAGRAMS ALSO INDICATE ORIGIN AND DESTINATION OF CIRCUITS, AND IDENTIFY CIRCUITS ROUTED UNDERGROUND. ONE-LINE DIAGRAMS DO NOT SHOW ALL JUNCTION BOXES AND CONDULETS NEEDED OR MANDATED BY THE NATIONAL ELECTRICAL CODE FOR WHICH THE INSTALLING CONTRACTOR IS RESPONSIBLE TO PROVIDE.
5. FOR CIRCUITS WITHOUT UNDERGROUND PORTIONS, BUILDING FLOOR PLANS SHOW LOCATION OF EQUIPMENT FOR DETERMINING CIRCUIT LENGTH WITHIN THE STRUCTURE. FOR CIRCUITS WITH UNDERGROUND PORTIONS, ANTICIPATED PENETRATION OF UNDERGROUND CONDUITS ARE SHOWN ON STRUCTURE PLANS FOR DETERMINING THE LENGTH OF THE IN-STRUCTURE PORTION OF CIRCUITS. BUILDING FLOOR PLANS MAY ALSO SHOW HOME RUNS FOR LIGHTING, RECEPTACLE, AND OTHER MISCELLANEOUS EQUIPMENT CIRCUITS.
6. SITE PLANS INDICATE THE GENERAL ROUTING OF UNDERGROUND CONDUITS AND DUCT BANK. CIRCUITS ROUTED IN UNDERGROUND CONDUITS OR DUCT BANK ARE INDICATED IN DUCTBANK SECTIONS REFERENCED ON THE SITE PLAN.
7. DUCT BANK SECTIONS IDENTIFY CONDUIT SIZE, ARRANGEMENT OF UNDERGROUND CONDUITS, AND CIRCUITS ROUTED IN EACH UNDERGROUND CONDUIT.
8. IF THERE IS ANY CONFLICT OR DISCREPANCY BETWEEN STANDARD SPECIFICATIONS, OR CODES OF ANY TECHNICAL SOCIETY, ORGANIZATION, OR ASSOCIATION, OR BETWEEN LAWS AND REGULATIONS, THE HIGHER PERFORMANCE REQUIREMENT SHALL BE BINDING, UNLESS OTHERWISE DIRECTED BY THE OWNER/ENGINEER.
9. SEE INSTRUMENTATION ONE-LINE DIAGRAMS ON INSTUMENTATION AND CONTROLS SHEETS FOR INSTRUMENT SPECIFIC HOMERUNS.

HDR
TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	O. JONGUITUD
DRAWN BY	B. LOREDO
CHECKED BY	G. JAGLOWSKI
APPROVED BY	O. JONGUITUD
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
OSCAR JONGUITUD
133057
LICENSED
PROFESSIONAL
ENGINEER
6-13-25

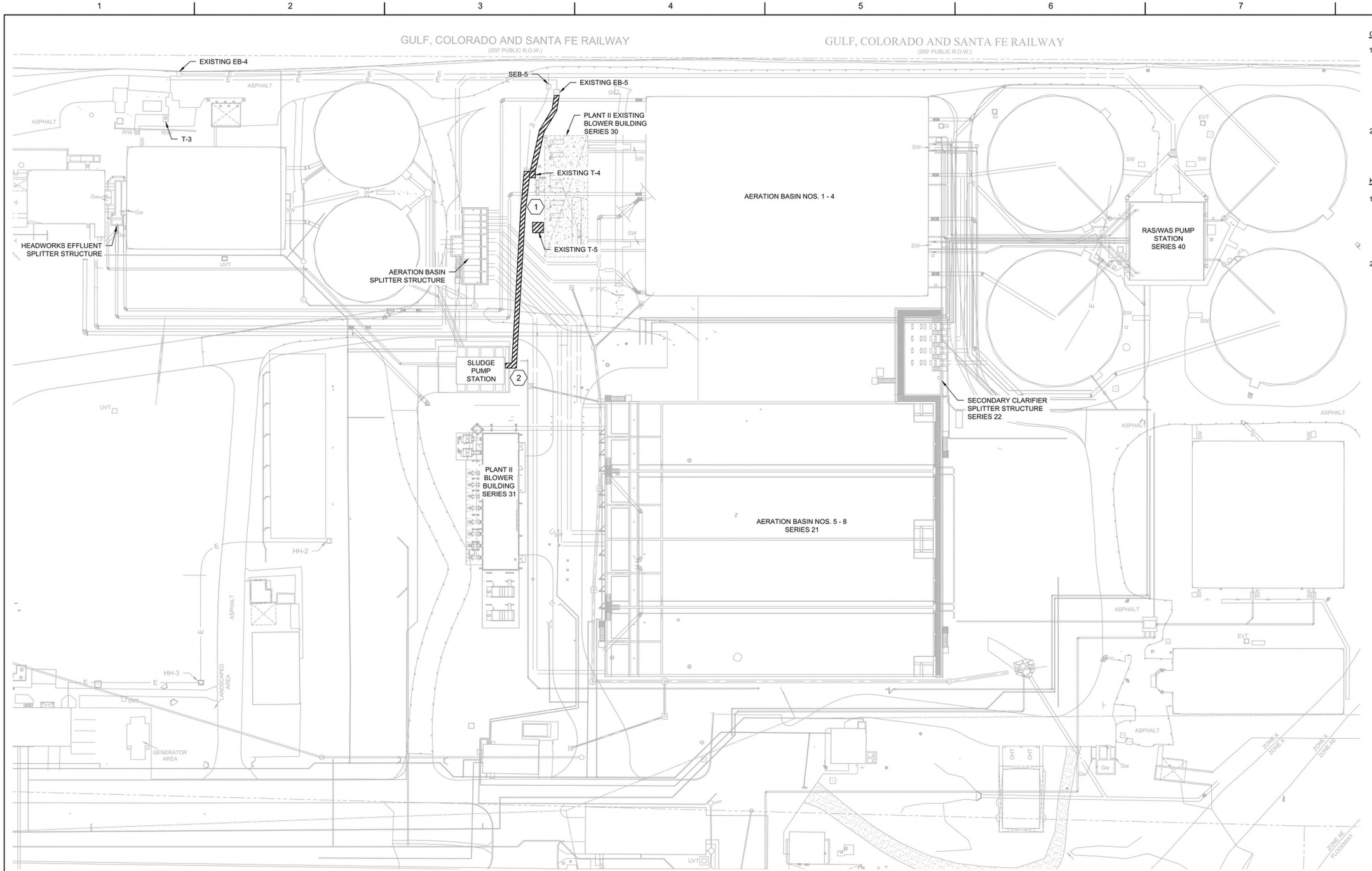
LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

GENERAL ELECTRICAL LEGEND AND SYMBOLS

0 1" 2"

FILENAME	00E001.dwg
SCALE	NONE
SHEET	00E001



1 ELECTRICAL DEMOLITION SITE PLAN
1"=40'

GENERAL NOTES:

1. INFORMATION ON EXISTING STRUCTURES AND DUCTBANKS IS TAKEN FROM THE "1995 WASTEWATER TREATMENT PLANT IMPROVEMENTS" RECORD DRAWINGS. CONTRACTOR SHALL FIELD VERIFY EXISTING CONDITIONS AND NOTIFY ENGINEER OF ANY DISCREPANCIES.
2. TRANSFORMERS T-4 AND T-5 SHALL REMAIN IN SERVICE UNTIL THE NEW BLOWER BUILDING IS FINISHED AND OPERATIONAL.

KEYED NOTES: (#)

1. DISCONNECT AND REMOVE HATCHED ELECTRICAL COMPONENTS INCLUDING BUT NOT LIMITED TO: CABLES, CONDUITS, JUNCTION BOXES, DISCONNECTS, AND TRANSFORMERS. REFER TO MEDIUM VOLTAGE DEMOLITION ONE-LINE.
2. DEMOLISH EXISTING 480V FEED FOR THE SLUDGE PUMP STATION. DEMOLISH FROM T-4 TO MCC-3 MCB. CONTRACTOR SHALL KEEP SLUDGE PUMP STATION ENERGIZED DURING CONSTRUCTION AND MIGRATE FEEDER AFTER ENERGIZATION OF TRANSFORMER T-11.

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CITY PROJECT NO.	U2100
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STATE OF TEXAS
OSCAR JONGUITUD
13057
LICENSED
PROFESSIONAL ENGINEER
6-13-25

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

GENERAL ELECTRICAL DEMOLITION SITE PLAN

N
0 1" 2"

FILENAME 00EX101.dwg
SCALE 1" = 40'

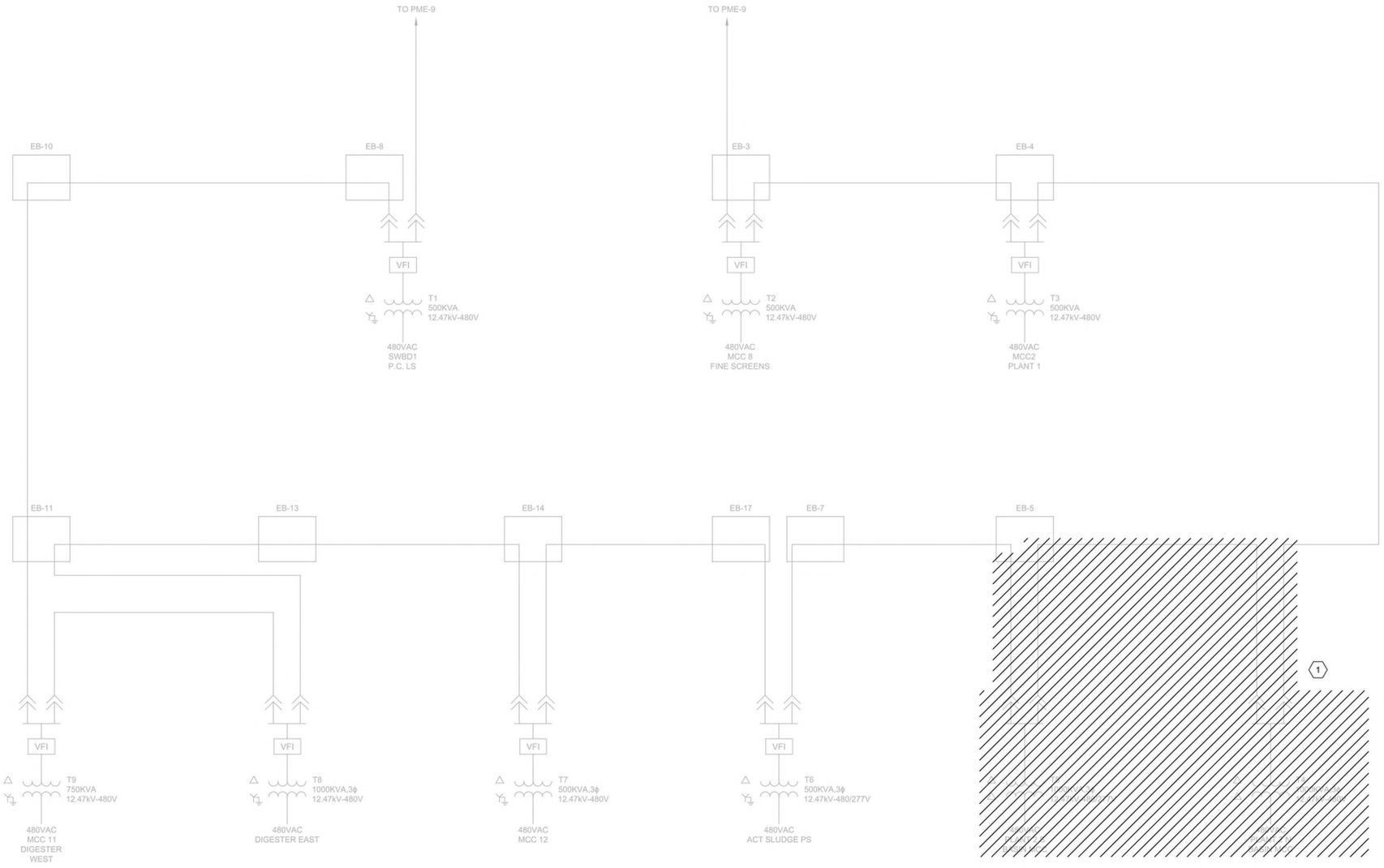
SHEET
00EX101

GENERAL NOTES:

1. COORDINATE DISPOSAL OF DEMOLISHED EQUIPMENT WITH OWNER.

KEYED NOTES: (#)

1. COORDINATE TRANSFORMER DEMOLITION WITH OWNER. NOT TO BE DEMOLISHED UNTIL NEW WORK IS COMPLETED.



1 / - EXISTING LEWISVILLE WWTP 12.47KV DISTRIBUTION

SCALE: NONE

TEXAS P.E. FIRM
Registration No. F-754

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CITY PROJECT NO.	U2100
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STATE OF TEXAS
OSCAR JONGUITUD
133057
LICENSED
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6-13-25

LEWISVILLE
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CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

GENERAL ELECTRICAL MEDIUM VOLTAGE DEMOLITION ONE-LINE DIAGRAM

0 1" 2"

FILENAME	00EX601.dwg
SCALE	NONE
SHEET	00EX601

GULF, COLORADO AND SANTA FE RAILWAY

GULF, COLORADO AND SANTA FE RAILWAY
(200' PUBLIC R.O.W.)

EXISTING EB-4

EXISTING T-3

ASPHALT

HEADWORKS EFFLUENT SPLITTER STRUCTURE

AREA CLASSIFICATION:
OUTDOOR-WET/CORROSIVE

EB-18

EXISTING EB-5

PLANT II EXISTING BLOWER BUILDING

EXISTING T-4

LIT-1101

AERATION BASIN SPLITTER STRUCTURE

EXISTING T-5

AERATION BASIN NOS. 1 - 4

RAS/WAS PUMP STATION SERIES 40

EXISTING T-6

SEE ENLARGED SITE PLAN AREA ON SHEET 00E102.

FUTURE XFMR T-12

T-11

PP-2201

PPS-2201

SECONDARY CLARIFIER SPLITTER STRUCTURE SERIES 22

PLANT II BLOWER BUILDING SERIES 31

AERATION BASIN NOS. 5 - 8
SERIES 21

HH-2

HH-3

LANDSCAPED AREA

GENERATOR AREA

ZONE X
ZONE X
ZONE AE

ZONE AE
FLOODWAY

1 - ELECTRICAL SITE PLAN
1"=40'

GENERAL NOTES:

1. DUCTBANK ROUTING, MANHOLES, AND HANDHOLE PLACEMENT SHOWN IS DIAGRAMMATIC. CONTRACTOR SHALL FIELD ROUTE DUCTBANK BASED ON SITE CONDITIONS AND MAKE CHANGES AS NEEDED.
2. TRANSFORMERS T-4 AND T-5 SHALL REMAIN IN SERVICE UNTIL THE NEW BLOWER BUILDING IS FINISHED AND OPERATIONAL.
3. PROVIDE TOGGLE SWITCH FOR ALL INSTRUMENTATION DEVICES REQUIRING 120V POWER. TOGGLE SWITCH TO BE WITHIN SIGHT OF INSTRUMENT FOR DISCONNECTING MEANS.

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LEWISVILLE
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CITY OF LEWISVILLE
PRAIRIE CREEK

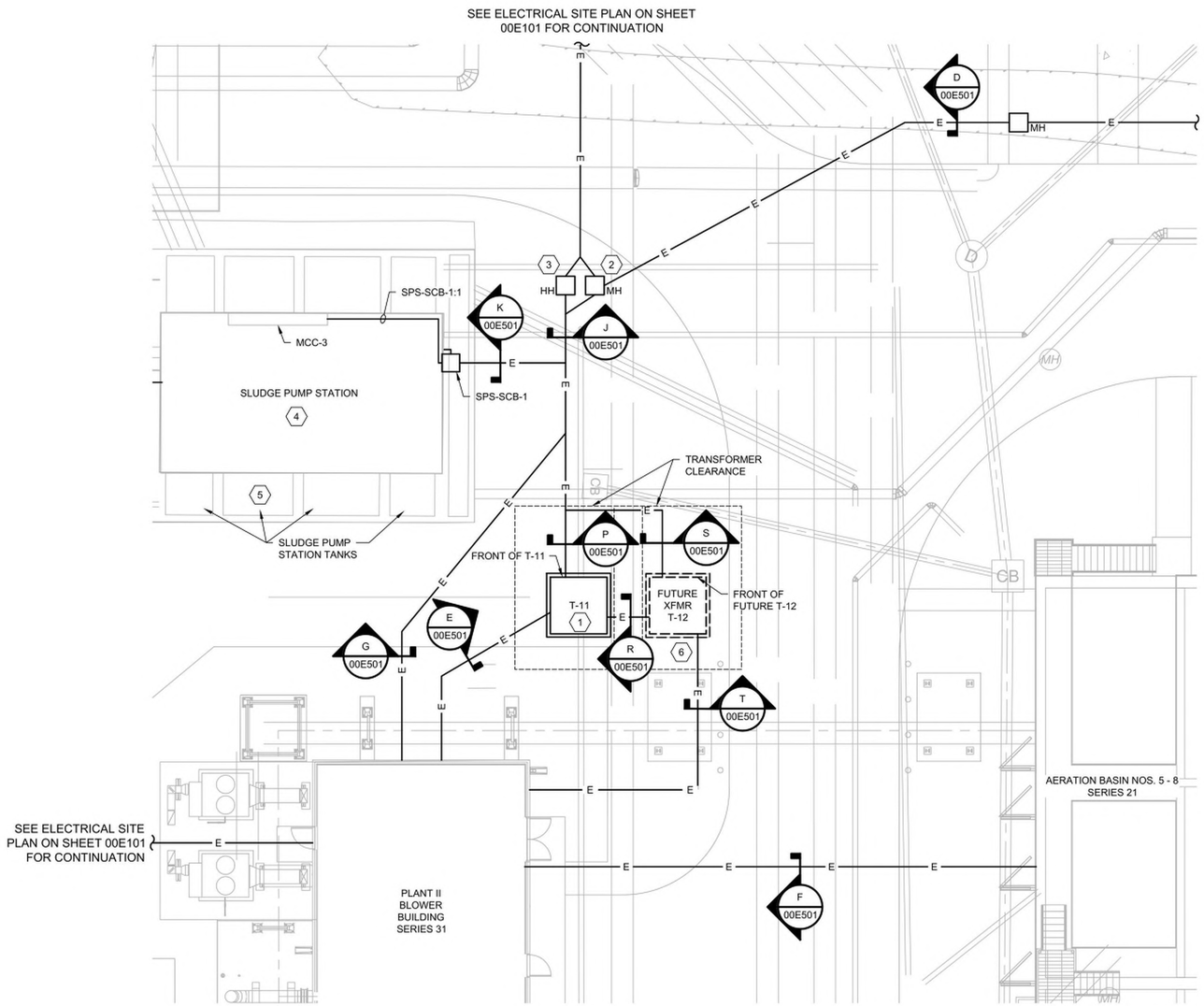
AERATION BASIN EXPANSION

N
0 1" 2"

GENERAL ELECTRICAL SITE PLAN

FILENAME 00E101.dwg
SCALE 1" = 40'

SHEET
00E101



1 - ELECTRICAL SITE PLAN
1"=10'

GENERAL NOTES:

1. DUCTBANK ROUTING, MANHOLES, AND HANDHOLE PLACEMENT SHOWN IS DIAGRAMMATIC. CONTRACTOR SHALL FIELD ROUTE DUCTBANK BASED ON SITE CONDITIONS AND MAKE CHANGES AS NEEDED.
2. TRANSFORMERS T-4 AND T-5 SHALL REMAIN IN SERVICE UNTIL THE NEW BLOWER BUILDING IS FINISHED AND OPERATIONAL.

KEYED NOTES: (#)

1. PROVIDE CONCRETE PAD FOR TRANSFORMER. SEE 1/99E502 FOR TRANSFORMER CONCRETE PAD DETAIL.
2. ROUTE 480V POWER AND INSTRUMENTATION CABLES THROUGH MANHOLE.
3. ROUTE 15KV POWER CABLES THROUGH HANDHOLE.
4. AREA CLASSIFICATION AT SLUDGE PUMP STATION IS CLASS 1 DIVISION 2. SEE NFPA 820 2020, TABLE 6.2.2(a), ROW 9, LINE A FOR EXTENT OF AREA CLASSIFICATION.
5. A CLASSIFICATION AT SLUDGE PUMP TANKS IS CLASS 1 DIVISION 2. SEE NFPA 820 2020, TABLE 6.2.2(a), ROW 10, LINE C FOR EXTENT OF AREA CLASSIFICATION.
6. STUB AND CAP CONDUITS FOR FUTURE TRANSFORMER T-12.

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	O. JONGUITUD
DRAWN BY	B. LOREDO
CHECKED BY	G. JAGLOWSKI
APPROVED BY	O. JONGUITUD
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS · OSCAR JONGUITUD · 133057 · LICENSED PROFESSIONAL ENGINEER · 6-13-25

LEWISVILLE
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CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

N
0 1" 2"

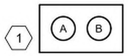
GENERAL ENLARGED ELECTRICAL SITE PLAN AREA

FILENAME 00E102.dwg
SCALE 1" = 10'

SHEET 00E102

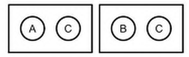
KEYED NOTES: (#)

1. REFER TO 1/99E501 FOR CONCRETE ENCASED DUCT BANK SECTION DETAIL FOR ALL DUCT BANK SECTIONS ON THIS SHEET.
2. ROUTE 1"C FOR FUTURE MIXERS TO FUTURE MCC SECTION. SEE PLANT II BLOWER BUILDING ENLARGED ELECTRICAL ROOM POWER PLAN FOR FUTURE MCC SECTION LOCATIONS.



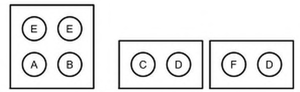
A. EB-18:1
B. 4"C SPARE

A 00E101 DUCTBANK SECTION A
NOT TO SCALE



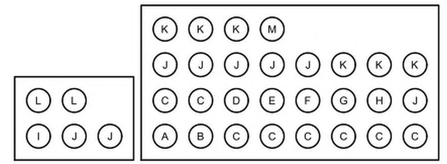
A. 3/4"C FOR AERATION BASIN SPLITTER STRUCTURE LEVEL TRANSMITTER - ANALOG SIGNAL
B. LP-3101:35
C. 1"C SPARE

B 00E101 DUCTBANK SECTION B
NOT TO SCALE



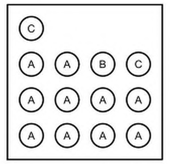
A. EB-18:1
B. EB-18:2
C. 3/4"C FOR AERATION BASIN SPLITTER STRUCTURE LEVEL TRANSMITTER - ANALOG SIGNAL
D. 1"C SPARE
E. 4"C SPARE
F. LP-3101:35

C 00E101 DUCTBANK SECTION C
NOT TO SCALE



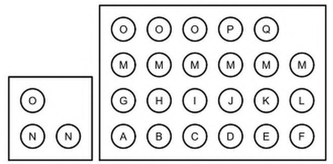
2
A. SWBD-3101:7
B. SWBD-3101:14
C. 1"C FOR FUTURE MIXERS
D. 1-1/2"C FOR FUTURE IMLR PUMP VFD 1
E. 1-1/2"C FOR FUTURE IMLR PUMP VFD 2
F. 1-1/2"C FOR FUTURE IMLR PUMP VFD 3
G. 1-1/2"C FOR FUTURE IMLR PUMP VFD 4
H. 2"C FOR I&C DIGITAL SIGNAL WIRING
I. 2"C FOR I&C ANALOG SIGNAL WIRING
J. 2"C SPARE
K. 2"C FOR FUTURE I&C DIGITAL SIGNAL WIRING
L. 2"C FOR FUTURE I&C ANALOG SIGNAL WIRING
M. MCC-3101:9

D 00E102 DUCTBANK SECTION D
NOT TO SCALE



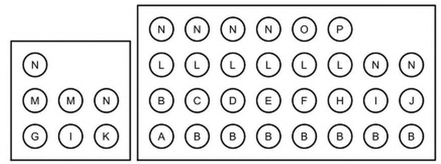
A. T-11:2
B. T-11:3
C. 4"C SPARE

E 00E102 DUCTBANK SECTION E
NOT TO SCALE



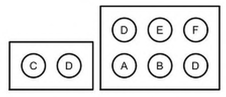
A. VFD-P-2153:1
B. VFD-P-2163:1
C. VFD-P-2173:1
D. VFD-P-2183:1
E. MCC-3101:1
F. MCC-3101:2
G. MCC-3101:3
H. MCC-3101:4
I. MCC-3101:5
J. MCC-3101:6
K. MCC-3101:7
L. MCC-3101:8
M. 2"C FOR I&C DIGITAL SIGNAL WIRING
N. 2"C FOR I&C ANALOG SIGNAL WIRING
O. 2"C SPARE
P. 1"C FOR AB 5 & 6 HEAT TRACE
Q. 1"C FOR AB 7 & 8 HEAT TRACE

F 00E102 DUCTBANK SECTION F
NOT TO SCALE



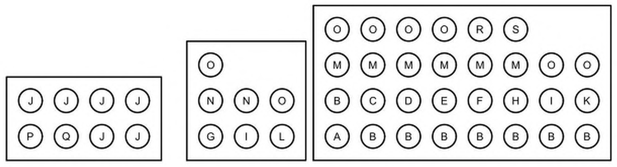
A. SWBD-3101:7
B. 1"C FOR FUTURE MIXERS
C. 1-1/2"C FOR FUTURE IMLR PUMP VFD 1
D. 1-1/2"C FOR FUTURE IMLR PUMP VFD 2
E. 1-1/2"C FOR FUTURE IMLR PUMP VFD 3
F. 1-1/2"C FOR FUTURE IMLR PUMP VFD 4
G. 3/4"C FOR AERATION BASIN SPLITTER STRUCTURE LEVEL TRANSMITTER - ANALOG SIGNAL
H. SWBD-3101:14
I. 1"C SPARE
J. 2"C FOR I&C DIGITAL SIGNAL WIRING
K. 2"C FOR I&C ANALOG SIGNAL WIRING
L. 2"C FOR FUTURE I&C DIGITAL SIGNAL WIRING
M. 2"C FOR FUTURE I&C ANALOG SIGNAL WIRING
N. 2"C SPARE
O. MCC-3101:9
P. LP-3101:35

G 00E102 DUCTBANK SECTION G
NOT TO SCALE



A. MCC-3101:9
B. 2"C FOR I&C DIGITAL SIGNAL WIRING
C. 2"C FOR I&C ANALOG SIGNAL WIRING
D. 2"C SPARE
E. SWBD-3101:7
F. SWBD-3101:14

H 00E101 DUCTBANK SECTION H
NOT TO SCALE

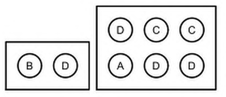


2
A. SWBD-3101:7
B. 1"C FOR FUTURE MIXERS
C. 1-1/2"C FOR FUTURE IMLR PUMP VFD 1
D. 1-1/2"C FOR FUTURE IMLR PUMP VFD 2
E. 1-1/2"C FOR FUTURE IMLR PUMP VFD 3
F. 1-1/2"C FOR FUTURE IMLR PUMP VFD 4
G. 3/4"C FOR AERATION BASIN SPLITTER STRUCTURE LEVEL TRANSMITTER - ANALOG SIGNAL
H. SWBD-3101:14
I. 1"C SPARE
J. 4"C SPARE
K. 2"C FOR I&C DIGITAL SIGNAL WIRING
L. 2"C FOR I&C ANALOG SIGNAL WIRING
M. 2"C FOR FUTURE I&C DIGITAL SIGNAL WIRING
N. 2"C FOR FUTURE I&C ANALOG SIGNAL WIRING
O. 2"C SPARE
P. EB-18:1
Q. EB-18:2
R. MCC-3101:9
S. LP-3101:35

J 00E102 DUCTBANK SECTION J
NOT TO SCALE

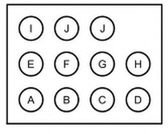
A. T-11:1
B. 3"C SPARE

K 00E102 DUCTBANK SECTION K
NOT TO SCALE



A. 2"C FOR I&C DIGITAL SIGNAL WIRING
B. 2"C FOR I&C ANALOG SIGNAL WIRING
C. 2"C FOR FIBER
D. 2"C SPARE

L 00E101 DUCTBANK SECTION L
NOT TO SCALE



A. PP-2201:1,3,5
B. PP-2201:7,9,11
C. PP-2201:13,15,17
D. PP-2201:19,21,23
E. PPS-2201:1
F. PPS-2201:3
G. PPS-2201:5
H. PPS-2201:7
I. PPS-2201:4
J. 2"C SPARE

M 00E101 DUCTBANK SECTION M
NOT TO SCALE

A. 2"C FOR FIBER
B. 2"C SPARE

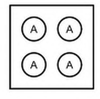
N 00E101 DUCTBANK SECTION N
NOT TO SCALE

A. EB-18:1
B. EB-18:2
C. 4"C SPARE

P 00E102 DUCTBANK SECTION P
NOT TO SCALE

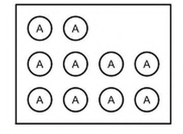
A. 4"C SPARE

R 00E102 DUCTBANK SECTION R
NOT TO SCALE



A. 4"C SPARE

S 00E102 DUCTBANK SECTION S
NOT TO SCALE



A. 4"C SPARES FOR FUTURE T-12

T 00E102 DUCTBANK SECTION T
NOT TO SCALE

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	O. JONGUITUD
DRAWN BY	B. LOREDO
CHECKED BY	G. JAGLOWSKI
APPROVED BY	O. JONGUITUD
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
OSCAR JONGUITUD
133057
LICENSED
PROFESSIONAL ENGINEER
6-13-25

LEWISVILLE
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CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

GENERAL
ELECTRICAL
DUCTBANK SECTIONS

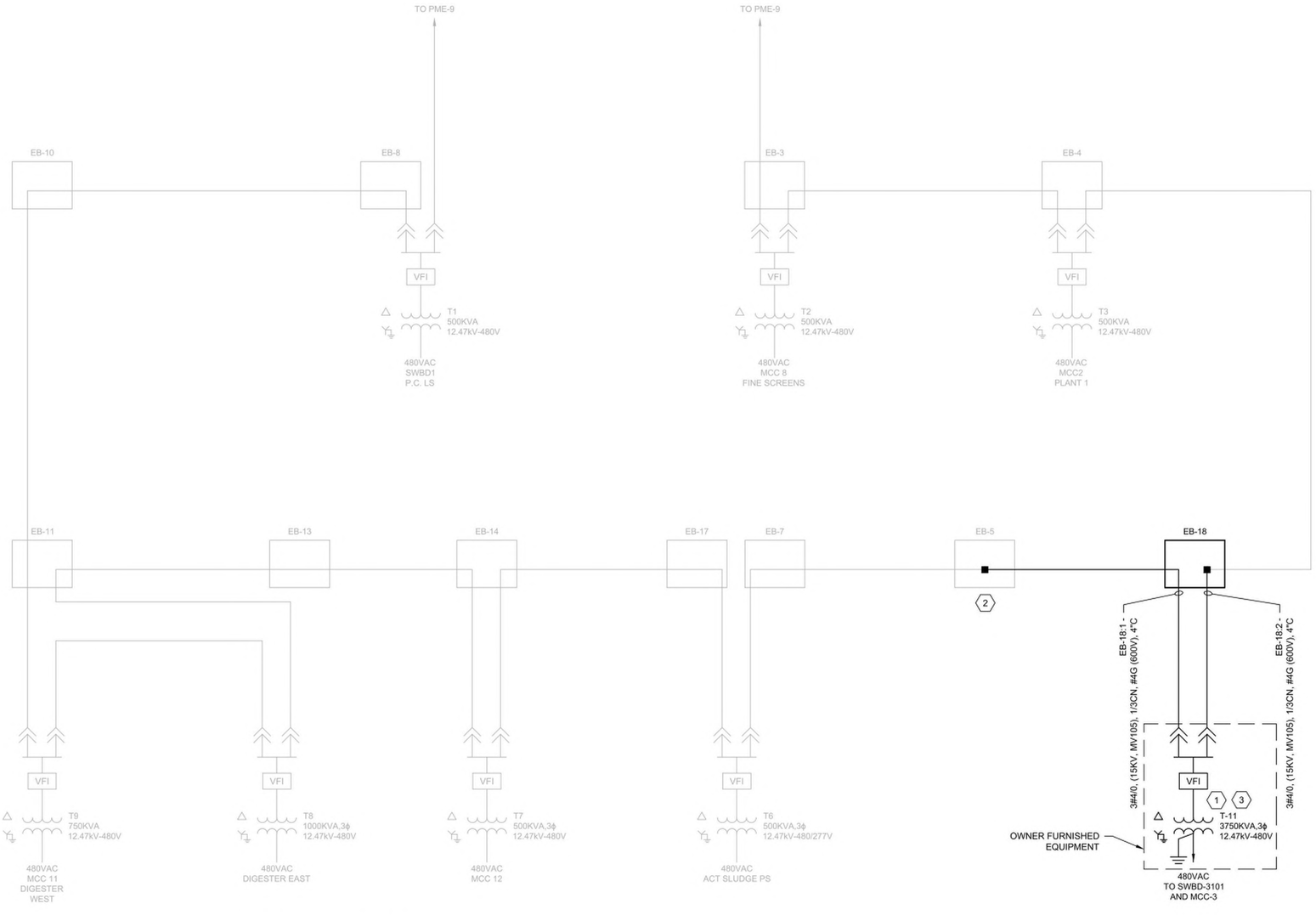
0 1" 2"

FILENAME 00E501.dwg
SCALE NONE

SHEET
00E501

KEYED NOTES: (#)

1. CONTRACTOR SHALL VERIFY CABLE LENGTHS TO BE SUFFICIENT FOR CONNECTION OF NEW TRANSFORMERS. IF LENGTH IS INSUFFICIENT, PROVIDE NEW CONDUCTORS TO MATCH EXISTING AND SPLICE AS NEEDED TO CONNECT TRANSFORMERS.
2. CONTRACTOR SHALL COORDINATE SPLICING WITH NEW AND DEMOLITION WORK.
3. COORDINATE MAXIMUM PLANT OUTAGE WITH OWNER.



1 - LEWISVILLE WWTP 12.47KV DISTRIBUTION
SCALE: NONE

PRAIRIE CREEK WWTP LOAD ANALYSIS
MEDIUM VOLTAGE SERVICE

LOADS	**FLA @ 12.47KV**
PEAK DEMAND	11.53
LOAD DELTA OF WAS/RAS PS	7.9
SWBD-3101	115.3
SUBTOTAL LOADS	134.7
25% OF EXISTING LOAD	2.9
25% OF LARGEST MOTOR	5.2
SUBTOTAL - MINIMUM MCC AMPACITY PER NEC	142.8
EXISTING SERVICE SIZE:	200A

2 - LEWISVILLE WWTP LOAD ANALYSIS
SCALE: NONE

TEXAS P.E. FIRM
Registration No. F-754

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CITY PROJECT NO.	U2100
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STATE OF TEXAS
OSCAR JONGUITUD
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LEWISVILLE
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CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

GENERAL ELECTRICAL MEDIUM VOLTAGE ONE-LINE DIAGRAM

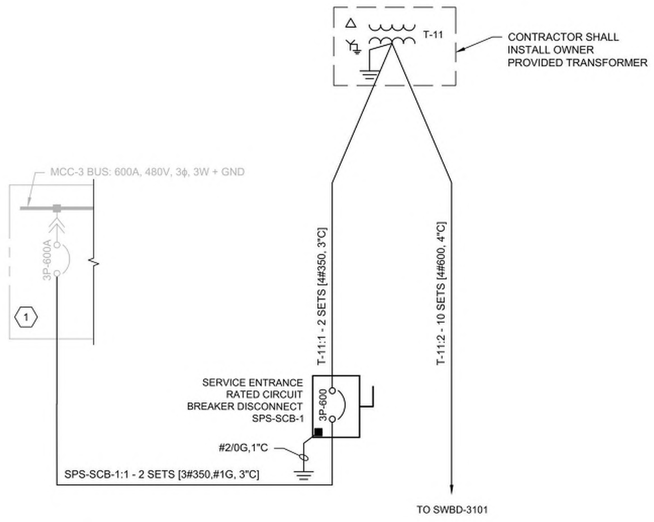
0 1" 2"

FILENAME	00E601.dwg
SCALE	NONE

SHEET 00E601

KEYED NOTES: (#)

1. CONTRACTOR SHALL REMOVE THE NEUTRAL TO GROUND BOND AT MCC-3.



1 - TRANSFORMER T-11 ONE-LINE DIAGRAM
SCALE: NONE

T-11 LOAD ANALYSIS

LOADS	**KVA**
SWBD-3101	2490
MCC-3 FEEDER	360
SUBTOTAL NON-MOTOR LOADS	2850
SUBTOTAL CONNECTED LOAD	2850
25% OF LARGEST MOTOR	112
SUBTOTAL	2963
15% SPARE CAPACITY	444
TOTAL, WITH +15% SPARE CAPACITY	3407
XFMR SIZE:	3750KVA

2 - TRANSFORMER T-11 LOAD ANALYSIS
SCALE: NONE

TEXAS P.E. FIRM
Registration No. F-754

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STATE OF TEXAS — OSCAR JONGUITUD — 133057 — LICENSED PROFESSIONAL ENGINEER — 6-13-25

LEWISVILLE
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CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

GENERAL ELECTRICAL TRANSFORMER T-11 ONE-LINE DIAGRAM

0 1" 2"

FILENAME 00E602.dwg
SCALE NONE

SHEET 00E602

LIGHTING FIXTURE SCHEDULE

TAG	DESCRIPTION	LAMPS	MOUNTING	MANUFACTURER/MODEL NUMBER MANUFACTURER	STYLE
A/AE	LED LINEAR STRIP LIGHT WITH HIGH-GLOSS, BAKED WHITE POLYESTER, FIVE-STAGE IRON PHOSPHATE PRE-TREATMENT PAINT FOR RUST RESISTANCE. PROVIDE FIXTURES LABELED AE AND BE WITH INTEGRAL EMERGENCY BATTERY BACKUP AND SPD OPTION.	LED	SUSPENDED	LITHONIA #CLX L48 7000LM SEF L/LENS WD MVOLT GZ10 40K 80CRI WH (LUMENS: 7000, POWER: 46.6W, LIGHT COLOR: 4000K)	
B/BE				LITHONIA #CLX L48 5000LM SEF L/LENS ND MVOLT GZ10 40K 80CRI WH (LUMENS: 5000, POWER: 31.8W, LIGHT COLOR: 4000K)	
D	EXTERIOR AREA FLOODLIGHT FIXTURE WITH DIE-CAST ALUMINUM HOUSING AND PRECISION ACRYLIC LENS. DARK BRONZE FINISH.	LED	SURFACE, WALL	LITHONIA RSXF1 LED P1 40K MFL MVOLT AAWB DDBXD (LUMENS: 7,477, POWER: 51W, LIGHT COLOR: 4000K)	
E	EXIT SIGN WITH EMERGENCY BATTERY (NICKEL-CADMIUN) PACK, DIE-CAST ALUMINUM HOUSING, 6" HIGH WITH 3/4" STROKE RED LETTERS, UNIVERSAL DIRECTIONAL CHEVRONS, SELF-DIAGNOSTIC, UNIVERSAL MOUNTING.	LED	SURFACE, WALL	LITHONIA #LE S 1 R EL N SD	
F1	EXTERIOR AREA FIXTURE WITH DIE-CAST ALUMINUM HOUSING, DURABLE POWDER COATED SURFACE, AND FULLY SEALED TEMPERED GLASS. PROVIDE FIXTURE WITH PHOTOCELL.	LED	20' POLE, ROUND	LUMINAIRE: LUMARK #NHRS50H33SBZ740 (LUMENS: 20,287, POWER: 150W, LIGHT COLOR: 4000K) LIGHT POLE: (1) VALMONT R 20006060604 DDB 313	
F2				LUMINAIRE: LUMARK #NHRS50HSBZ740 (LUMENS: 21,718, POWER: 150W, LIGHT COLOR: 4000K) LIGHT POLE: (1) VALMONT R 20006060604 DDB 313	
G/GE	WET LOCATION INDUSTRIAL LED FIXTURE, CAST ALUMNIMUN HOUSING WITH SUPER DURABLE TGIC THERMOSET POWDER FINISH. TYPE V DISTRIBUTION.	LED	PENDANT	HOLOPHANE #PXLW 8000LM SOWD MVOLT 40K 80CRI PM DWHXD (LUMENS: 8,239, POWER: 58W) LIGHT COLOR: 4000K	
H/HE				HOLOPHANE #PXLW 5000LM SOWD MVOLT 40K 80CRI PM CR DWHXD (LUMENS: 5,157, POWER: 35W) LIGHT COLOR: 4000K	
W1/W1E	EXTERIOR WALL PACK WITH DIE-CAST ALUMINUM HOUSING AND FULLY GASKETED DOOR FRAME, DARK BRONZE ZINC-INFUSED TGIC THERMOSET POWDER COAT FINISH. PROVIDE FIXTURE WITH PHOTOCELL. PROVIDE FIXTURE LABELED W1E WITH INTEGRAL EMERGENCY BATTERY BACKUP AND PHOTOCELL.	LED	SURFACE, WALL	LITHONIA #ARC1 LED P2 40K MVOLT PE DDBXD (LUMENS: 2,151, POWER: 17W, LIGHT COLOR: 4000K)	
W2				LITHONIA #ARC1 LED P2 40K MVOLT DDBXD (LUMENS: 2,151, POWER: 17W, LIGHT COLOR: 4000K)	
CIS-1	CENTRAL INVERTER DESIGNED TO POWER DESIGNATED EMERGENCY LIGHT FIXTURES. UNIT IS SELF-TESTING AND SELF-DIAGNOSTIC FOR CONDUCTING NECESSARY MONTHLY AND ANNUAL TESTING. IOTA IIS 750 SUPPLIES 750W OF EMERGENCY POWER. CIS-1 TO CONTROL LIGHT FIXTURE TYPE BE AND GE IN THE BLOWER BUILDING AND LIGHT FIXTURES TYPE AE IN THE RAS/WAS PUMP STATION.	-	SURFACE, WALL	LITHONIA IIS 750 120 90M SD 3ZONE	

KEYED NOTES: (1)

1. REFER TO AERATION BASIN NOS. 5-8 LIGHTING PLAN AND SECONDARY CLARIFIER SPLITTER STRUCTURE ELECTRICAL PLAN FOR LIGHT POLE DRILL MOUNTING LOCATIONS AS NEEDED FOR LIGHT FIXTURES SHOWN ON PLANS.

1 / - LIGHTING FIXTURE SCHEDULE

SCALE: NONE

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PRAIRIE CREEK

AERATION BASIN EXPANSION

GENERAL
ELECTRICAL
LIGHT FIXTURE SCHEDULE

0 1" 2"

FILENAME	00E603.dwg
SCALE	NONE

SHEET **00E603**

PRIMARY ELEMENT SYMBOLOGY

- ORIFICE PLATE
- PITOT TUBE OR ANNUBAR
- FI — ROTOMETER
- SONIC OR ULTRASONIC FLOWMETER
- M — MAGNETIC FLOWMETER
- FT — MASS DISPERSION FLOWMETER
- FLUME
- WEIR
- PROPELLER OR TURBINE METER
- VENTURI TUBE
- FLOAT SWITCH
- TE — TEMPERATURE ELEMENT WITH THERMOWELL
- INLINE SEAL
- DIAPHRAGM SEAL
- ANNULAR SEAL
- ULTRASONIC LEVEL SENSOR
- RADAR LEVEL SENSOR

LINE TYPES

- MAIN PROCESS LINE
- SECONDARY PROCESS LINE
- AUXILIARY PROCESS LINE
- DIRECTION OF FLOW
- PNEUMATIC SIGNAL
- ELECTRICAL SIGNAL
- EH — ELECTRICAL HEAT TRACING
- HYDRAULIC SIGNAL
- SOFTWARE OR DATA LINK
- SIGNAL CONNECTION
- CROSSOVER – NO CONNECTION
- CAPILLARY

CROSS REFERENCE SYMBOLOGY

- 00Y–03 A — CONTINUATION TO POINT A ON SHEET 00Y–03
- A 00Y–02 — CONTINUATION FROM POINT A ON SHEET 00Y–02

INSTRUMENT SYMBOLOGY

- LOCALLY MOUNTED FIELD INSTRUMENTATION
- MOUNTED ON PANEL FRONT
- MOUNTED INSIDE PANEL
- XXX — FRONT PANEL MOUNTED ON AUXILIARY PANEL (SUBSCRIPT INDICATES PANEL)
- MOUNTED INSIDE AUXILIARY PANEL
- PILOT LIGHT
- BEACON
- INSTRUMENT FUNCTIONS SHARING COMMON HOUSING
- COMPLEX INTERLOCK AS DEFINED IN CONTROL DIAGRAM OR IN SPECIFICATIONS
- SHARED DISPLAY, SHARED CONTROL, FIELD MOUNTED
- SHARED DISPLAY, SHARED CONTROL, PRIMARY LOCATION – NORMALLY ACCESSIBLE TO OPERATOR
- PROGRAMMABLE LOGIC CONTROL, PRIMARY LOCATION – NORMALLY ACCESSIBLE TO OPERATOR
- PROGRAMMABLE LOGIC CONTROL, FIELD MOUNTED

ACTUATOR SYMBOLOGY

- X — OPERATOR ABBREVIATIONS:
  M = MOTOR
  P = PNEUMATIC
  S = SOLENOID
- FLOAT OPERATOR
- SPRING–OPPOSED SINGLE–ACTING PNEUMATIC CYLINDER
- DOUBLE–ACTING PNEUMATIC CYLINDER
- PNEUMATIC DIAPHRAGM
- PNEUMATIC DIAPHRAGM WITH POSITIONER

TYPES OF POWER SUPPLY

A	PLANT COMPRESSED AIR
IA	INSTRUMENTATION AIR
ES	ELECTRIC SUPPLY
NG	NATURAL GAS
HYD	HYDRAULIC
120VAC	120VAC POWER
480VAC	480VAC POWER

INSTRUMENT IDENTIFICATION LETTERS

	FIRST LETTER		SUCCEEDING LETTERS		
	MEASURED OR INITIATING VARIABLE	MODIFIER	READOUT OR PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
A	ANALYSIS		ALARM		
B	BURNER, COMBUSTION		USER'S CHOICE	USER'S CHOICE	USER'S CHOICE
C	USERS CHOICE			CONTROL	CLOSED
D	USERS CHOICE	DIFFERENTIAL			
E	VOLTAGE		SENSOR (PRIMARY ELEMENT)		
F	FLOW RATE	RATIO (FRACTION)			
G	USER'S CHOICE		GLASS, VIEWING DEVICE		
H	HAND				HIGH
I	CURRENT (ELECTRICAL)		INDICATE		
J	POWER	SCAN			
K	TIME, TIME SCHEDULE	TIME; RATE OF CHANGE		CONTROL STATION	
L	LEVEL		LIGHT		LOW
M	MOISTURE	MOMENTARY			MIDDLE, INTERMEDIATE
N	USER'S CHOICE		USER'S CHOICE	USER'S CHOICE	USER'S CHOICE
O	TORQUE		ORIFICE, RESTRICTION		
P	PRESSURE, VACUUM		POINT (TEST) CONNECTION		
Q	QUANTITY	INTEGRATE, TOTALIZE			
R	RADIATION		RECORD		
S	SPEED, FREQUENCY	SAFETY		SWITCH	
T	TEMPERATURE			TRANSMIT	
U	MULTIVARIABLE		MULTIFUNCTION	MULTIFUNCTION	MULTIFUNCTION
V	VIBRATION, MECH. ANALYSIS			VALVE, DAMPER, LOUVER	
W	WEIGHT, FORCE		WELL		
X	UNCLASSIFIED	X AXIS	UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED
Y	EVENT, STATE OR PRESENCE	Y AXIS		RELAY, COMPUTE, CONVERT	
Z	POSITION, DIMENSION	Z AXIS		DRIVER, ACTUATOR, UNCLASSIFIED FINAL CONTROL ELEMENT	

MISCELLANEOUS INSTRUMENTATION ABBREVIATIONS

AI	ANALOG INPUT
ALK	ALKALINITY (ANALYZER MODIFIER)
AO	ANALOG OUTPUT
CL2	CHLORINE (ANALYZER MODIFIER)
CO	CARBON MONOXIDE (ANALYZER MODIFIER)
CO2	CARBON DIOXIDE (ANALYZER MODIFIER)
COMB	COMBUSTIBLES (ANALYZER MODIFIER)
COND	CONDUCTIVITY (ANALYZER MODIFIER)
DEN	DENSITY (ANALYZER MODIFIER)
DI	DIGITAL INPUT
DO	DIGITAL OUTPUT
DO	DISSOLVED OXYGEN (ANALYZER MODIFIER)
E/P	VOLTAGE TO PNEUMATIC
H2S	HYDROGEN SULFIDE (ANALYZER MODIFIER)
I/O	INPUT/OUTPUT
I/P	CURRENT TO PNEUMATIC
NH3	AMMONIA (ANALYZER MODIFIER)
NO3	NITRATE (ANALYZER MODIFIER)
NOX	NITROGEN OXIDE (ANALYZER MODIFIER)
OIT	OPERATOR INTERFACE TERMINAL
O2	OXYGEN (ANALYZER MODIFIER)
P&ID	PROCESS AND INSTRUMENTATION DIAGRAM
PHOS	PHOSPHORUS (ANALYZER MODIFIER)
SS	SUSPENDED SOLIDS (ANALYZER MODIFIER)
TURB	TURBIDITY (ANALYZER MODIFIER)
WAN	WIDE AREA NETWORK
VFD	VARIABLE FREQUENCY DRIVE
LCP	LOCAL CONTROL PANEL
LCS	LOCAL CONTROL STATION
MCC	MOTOR CONTROL CENTER
MSH	MOTOR SPACE HEATER
TSH	MOTOR TEMPERATURE SWITCH
INF	PLANT INFLUENT
FIL	FILTRATE
D	DRAIN
PS	PRIMARY SLUDGE
WAS	WASTE ACTIVATED SLUDGE
TPS	THICKENED PRIMARY SLUDGE
TWAS	THICKENED WASTE ACTIVATED SLUDGE
CLGV	CHLORINE GAS VACUUM
CLS	CHLORINE SOLUTION
POL	POLYMER SOLUTION
SDGV	SULPHUR DIOXIDE GAS VACUUM
FA	FOUL AIR
NPW	NON POTABLE WATER
DG	DIGESTER GAS
SDGP	SULPHUR DIOXIDE GAS PRESSURE
CLGP	CHLORINE GAS PRESSURE

- △ DISCRETE INPUT (DI)
- ▲ ANALOG INPUT (AI)
- ▽ DISCRETE OUTPUT (DO)
- ▼ ANALOG OUTPUT (AO)

CONTROL SWITCH NOTATION ABBREVIATIONS

XXX / XXXX — XXX

ACK	ACKNOWLEDGE
CLS	CLOSE
ESTOP	EMERGENCY STOP
FAIL	FAILURE
FOR	FORWARD–OFF–REVERSE
FR	FORWARD–REVERSE
FS	FAST–SLOW
FWD	FORWARD
HA	HAND–AUTO
HOA	HAND–OFF–AUTO
HOR	HAND–OFF–REMOTE
LL	LEAD–LAG
LLS	LEAD–LAG–STANDBY
LOA	LOCAL–OFF–AUTO
LSR	LOCAL–STOP–REMOTE
LR	LOCAL–REMOTE
LS	LEAD–STANDBY
MA	MANUAL–AUTO
OAC	OPEN–AUTO–CLOSE
OC	OPEN–CLOSE
OO	ON–OFF
OPN	OPEN
OSC	OPEN–STOP–CLOSE
REV	REVERSE
RJ	RUN–JOG
RJR	RUN–JOG–REVERSE
SIL	SILENCE
SS	START–STOP

VALVES

- EXPANSION JOINT
- BALL VALVE
- BUTTERFLY VALVE, DAMPER
- CONE VALVE
- CHECK VALVE
- DOUBLE–DISK CHECK VALVE
- BALL CHECK VALVE
- DIAPHRAGM VALVE
- GATE VALVE
- GLOBE VALVE
- KNIFE GATE VALVE
- NEEDLE VALVE
- PINCH VALVE
- PLUG VALVE
- THREE–WAY BALL VALVE
- THREE–WAY PLUG VALVE
- PRESSURE–REDUCING VALVE
- PRESSURE–REGULATING VALVE
- THREE–WAY CONTROL VALVE
- OR — PRESSURE–RELIEF VALVE
- X — AIR–RELEASE VACUUM VALVE
  A = AIR RELEASE
  VAC = VACUUM
- S — SOLENOID VALVE
- VACUUM REGULATING VALVE
- MUD VALVE

MISCELLANEOUS SYMBOLOGY

- CENTRIFUGAL PUMP
- M — MOTOR
- CENTRIFUGAL BLOWER OR FAN
- INSTRUMENTS/EQUIPMENT SUPPLIED BY ELECTRICAL CONTRACTOR
- INSTRUMENTS/EQUIPMENT SUPPLIED BY EQUIPMENT VENDOR
- STOP LOG
- GATE
- M — SUMP PUMP
- M — PERISTALTIC METERING PUMP
- JB — JUNCTION BOX
- AXIAL PUMP
- TD — THERMAL MASS FLOWMETER
- SLIDE GATE VALVE
- WEIR
- FLOAT SWITCH WITH WEIGHT

PROCESS ABBREVIATIONS

GENERAL NOTES:

1. SEE GENERAL DRAWINGS FOR PROCESS ABBREVIATIONS.

EQUIPMENT TAGGING

XXX – XXXXX

EQPT. TAG NO.
ABBR. 1ST/2ND NUMBERS: PROCESS AREA
3RD/4TH NUMBERS: SEQUENCE
5TH NUMBER: OPTIONAL SEQUENCE
(1 LETTER ONLY IF NEEDED)

GENERAL NOTES:

1. THIS IS A STANDARD INSTRUMENTATION SYMBOLOGY AND ABBREVIATIONS SHEET. LISTING OF SYMBOLS AND ABBREVIATIONS DOES NOT IMPLY ALL SYMBOLS AND ABBREVIATIONS HAVE BEEN USED ON THIS PROJECT.
2. SEE PROCESS, MECHANICAL AND PLUMBING LEGEND SHEET FOR MISCELLANEOUS PIPING SYMBOLS.
3. SCREENING OR SHADING OF WORK IS USED TO INDICATE EXISTING COMPONENTS OR TO DE–EMPHASIZE PROPOSED IMPROVEMENTS TO HIGHLIGHT SELECTED TRADE WORK. REFER TO CONTEXT OF EACH SHEET FOR USAGE.
4. VALVE SYMBOLS SHOWN HERE ARE APPLICABLE ONLY TO INSTRUMENTATION DIAGRAMS. SEE PROCESS, MECHANICAL AND PLUMBING LEGEND SHEET FOR VALVE SYMBOLS USED ELSEWHERE ON THE SHEETS.

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Date 6/13/2025 7:45:10 AM

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER JOEL R. CANTWELL

DESIGNED BY	P. KAPADIA
DRAWN BY	P. KAPADIA
CHECKED BY	S. HORRAS
APPROVED BY	
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS — PRANAVKUMAR KAPADIA — 105500 — LICENSED PROFESSIONAL ENGINEER
06/13/2025

LEWISVILLE
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CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

GENERAL INSTRUMENTATION LEGEND AND ABBREVIATIONS

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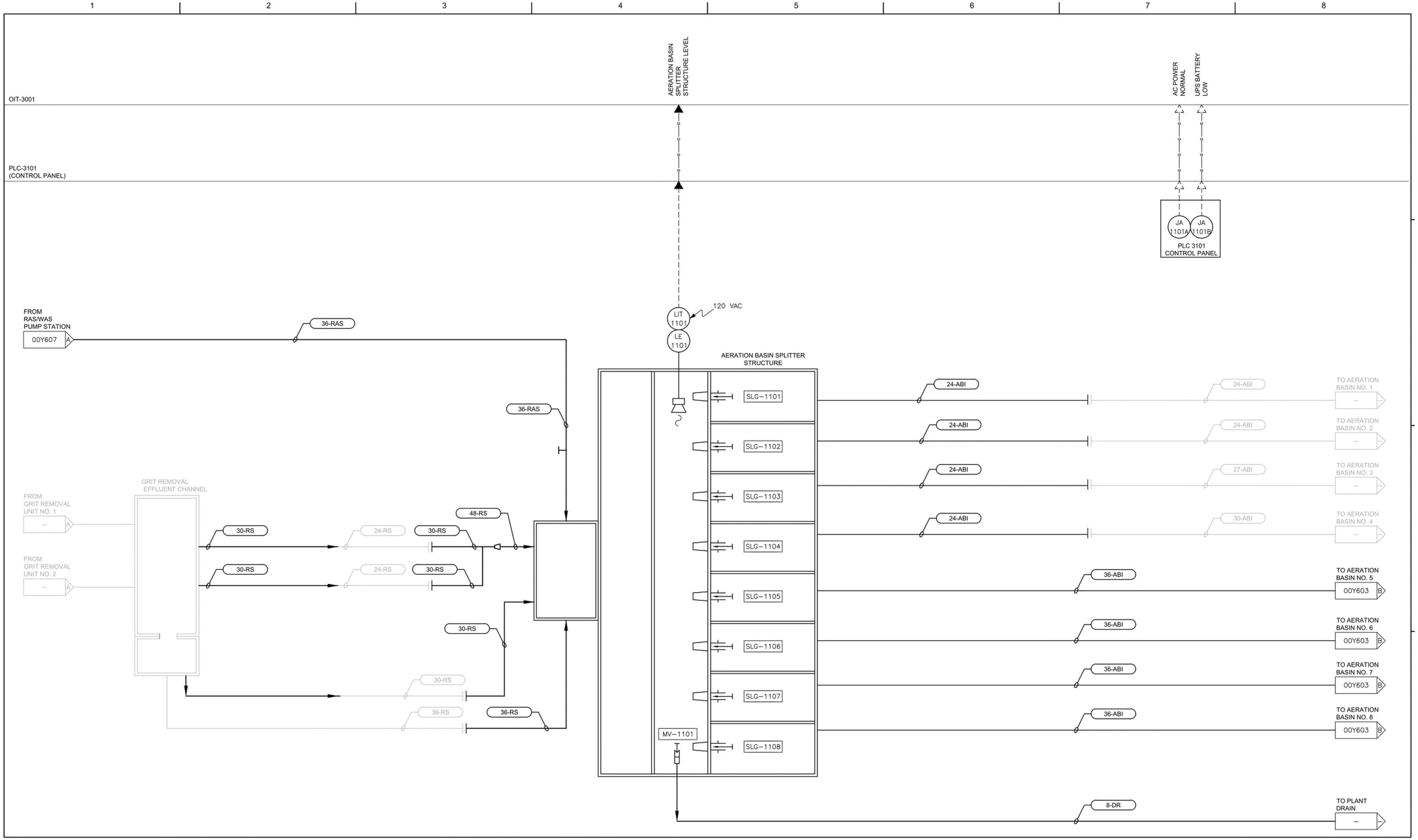
SHEET 00Y001



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TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	P. KAPADIA
DRAWN BY	P. KAPADIA
CHECKED BY	S. HORRAS
APPROVED BY	
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
PRANAVKUMAR KAPADIA
105500
LICENSED
PROFESSIONAL ENGINEER
06/13/2025

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CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

GENERAL INSTRUMENTATION AERATION BASIN SPLITTER STRUCTURE P&ID

0 1" 2"

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SCALE NO SCALE

SHEET
00Y601

RESERVED FOR FUTURE PROJECT

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	P. KAPADIA
DRAWN BY	P. KAPADIA
CHECKED BY	S. HORRAS
APPROVED BY	
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
PRANAVKUMAR KAPADIA
105500
LICENSED
PROFESSIONAL ENGINEER
06/13/2025

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PRAIRIE CREEK

AERATION BASIN EXPANSION

GENERAL INSTRUMENTATION RESERVED FOR FUTURE PROJECT

0 1" 2"

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SCALE	NO SCALE

SHEET
00Y602

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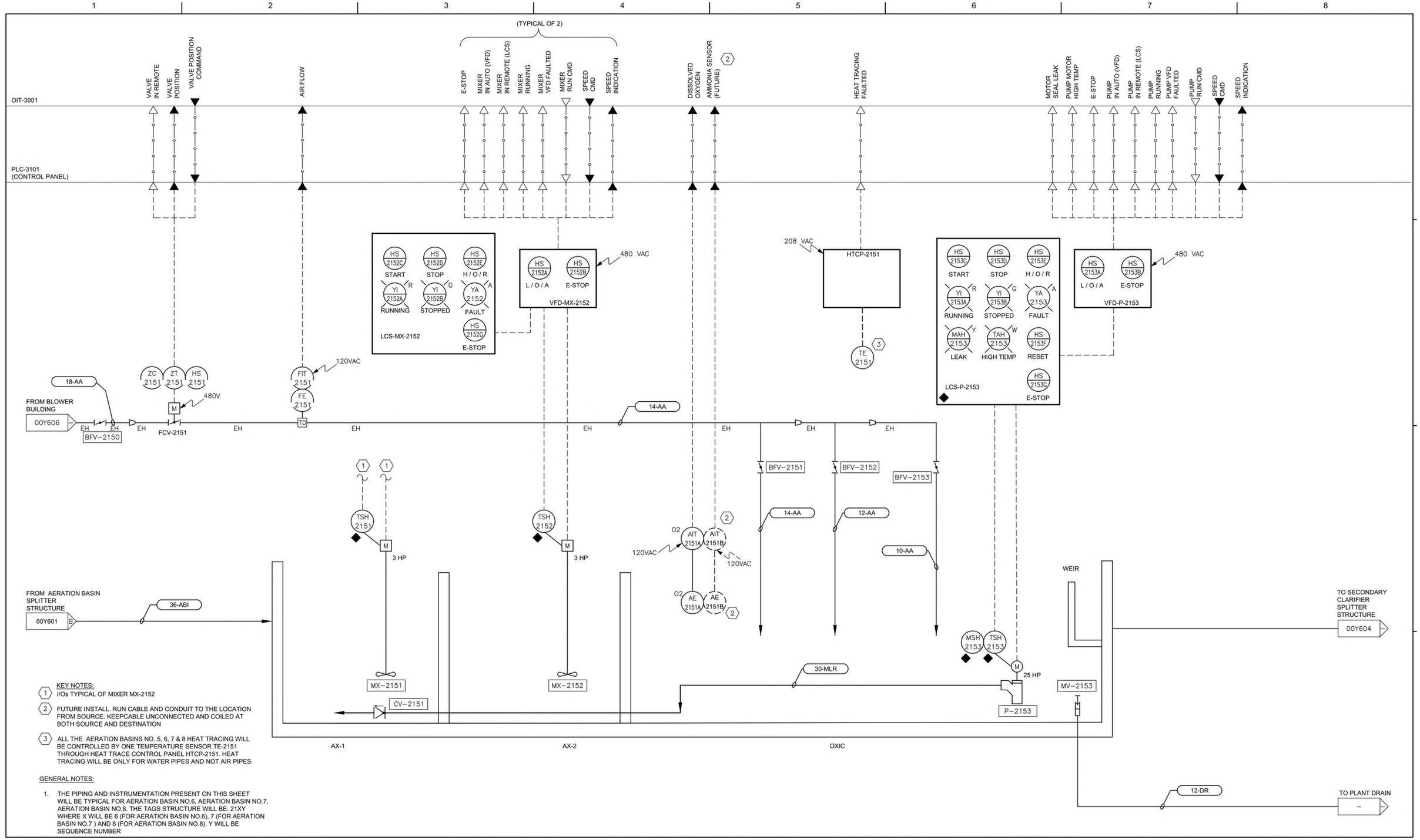

KEY NOTES:

1. I/Os TYPICAL OF MIXER MX-2152
2. FUTURE INSTALL. RUN CABLE AND CONDUIT TO THE LOCATION FROM SOURCE. KEEPCABLE UNCONNECTED AND COILED AT BOTH SOURCE AND DESTINATION
3. ALL THE AERATION BASINS NO. 5, 6, 7 & 8 HEAT TRACING WILL BE CONTROLLED BY ONE TEMPERATURE SENSOR TE-2151 THROUGH HEAT TRACE CONTROL PANEL HTCP-2151. HEAT TRACING WILL BE ONLY FOR WATER PIPES AND NOT AIR PIPES

GENERAL NOTES:

1. THE PIPING AND INSTRUMENTATION PRESENT ON THIS SHEET WILL BE TYPICAL FOR AERATION BASIN NO.6, AERATION BASIN NO.7, AERATION BASIN NO.8. THE TAGS STRUCTURE WILL BE: 21XY WHERE X WILL BE 6 (FOR AERATION BASIN NO.6), 7 (FOR AERATION BASIN NO.7) AND 8 (FOR AERATION BASIN NO.8). Y WILL BE SEQUENCE NUMBER

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
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PROJECT MANAGER	JOEL R. CANTWELL
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DRAWN BY	P. KAPADIA
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APPROVED BY	
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PROJECT NUMBER	10342803

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AERATION BASIN EXPANSION

GENERAL INSTRUMENTATION AERATION BASIN NO. 5 P&ID

0 1" 2"

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SCALE NO SCALE

SHEET 00Y603

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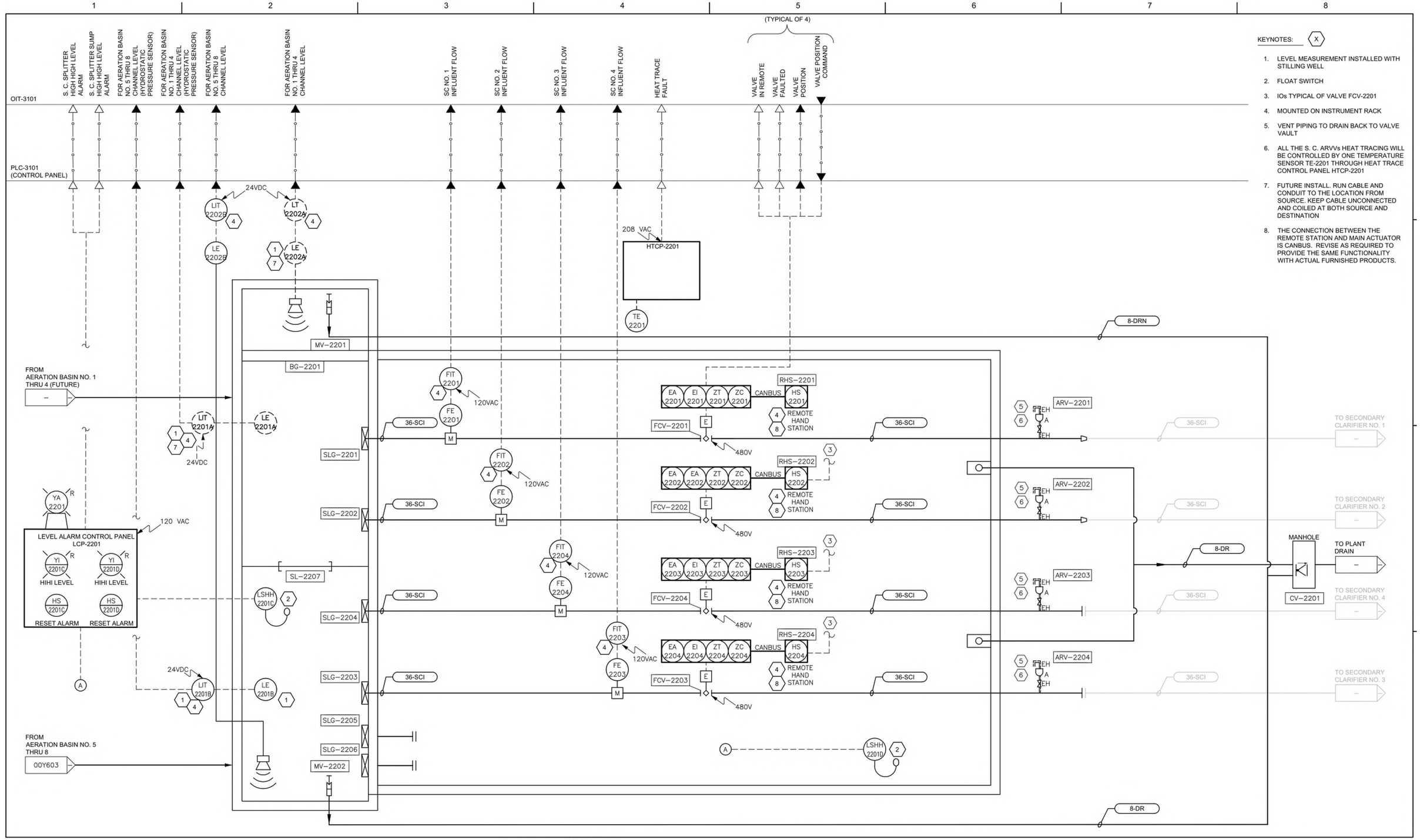

KEYNOTES: (X)

1. LEVEL MEASUREMENT INSTALLED WITH STILLING WELL
2. FLOAT SWITCH
3. IOs TYPICAL OF VALVE FCV-2201
4. MOUNTED ON INSTRUMENT RACK
5. VENT PIPING TO DRAIN BACK TO VALVE VAULT
6. ALL THE S. C. ARVVs HEAT TRACING WILL BE CONTROLLED BY ONE TEMPERATURE SENSOR TE-2201 THROUGH HEAT TRACE CONTROL PANEL HTCP-2201
7. FUTURE INSTALL. RUN CABLE AND CONDUIT TO THE LOCATION FROM SOURCE. KEEP CABLE UNCONNECTED AND COILED AT BOTH SOURCE AND DESTINATION
8. THE CONNECTION BETWEEN THE REMOTE STATION AND MAIN ACTUATOR IS CANBUS. REVISE AS REQUIRED TO PROVIDE THE SAME FUNCTIONALITY WITH ACTUAL FURNISHED PRODUCTS.

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Registration No. F-754

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100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
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DRAWN BY	P. KAPADIA
CHECKED BY	S. HORRAS
APPROVED BY	
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

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105500
LICENSED PROFESSIONAL ENGINEER
06/13/2025

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PRAIRIE CREEK
AERATION BASIN EXPANSION

GENERAL INSTRUMENTATION SECONDARY CLARIFIER SPLITTER STRUCTURE P&ID

0 1" 2"

FILENAME 00Y604.dwg
SCALE NO SCALE

SHEET 00Y604

RESERVED FOR BLOWER #1 TO #4

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PROJECT MANAGER	JOEL R. CANTWELL
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APPROVED BY	
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

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AERATION BASIN EXPANSION

GENERAL INSTRUMENTATION RESERVED FOR FUTURE PROJECT

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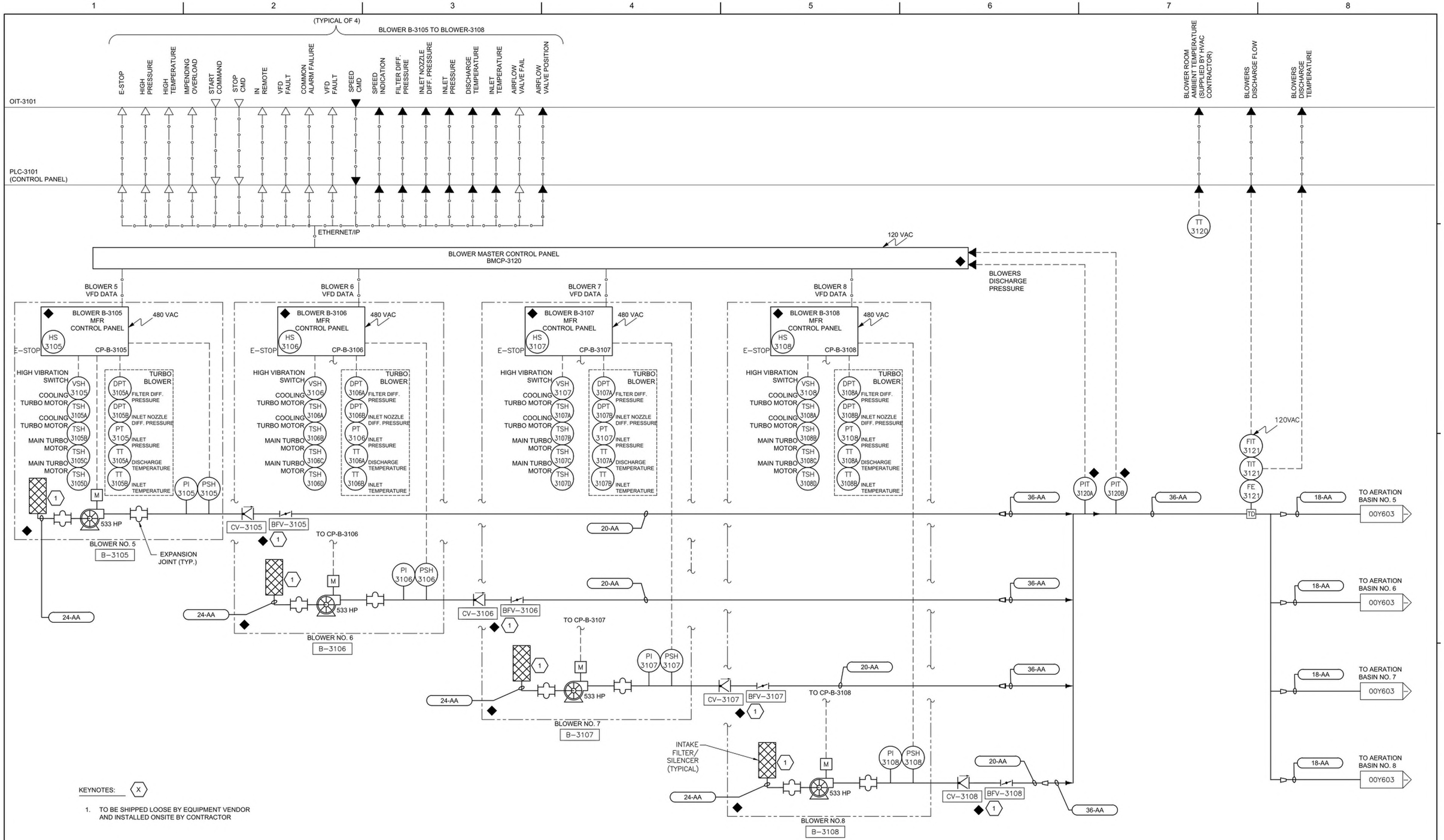

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Registration No. F-754

ISSUE	DATE	DESCRIPTION
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PROJECT MANAGER	JOEL R. CANTWELL
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DRAWN BY	P. KAPADIA
CHECKED BY	S. HORRAS
APPROVED BY	
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

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AERATION BASIN EXPANSION

GENERAL INSTRUMENTATION AERATION BASIN NO. 5 - 8 BLOWERS P&ID

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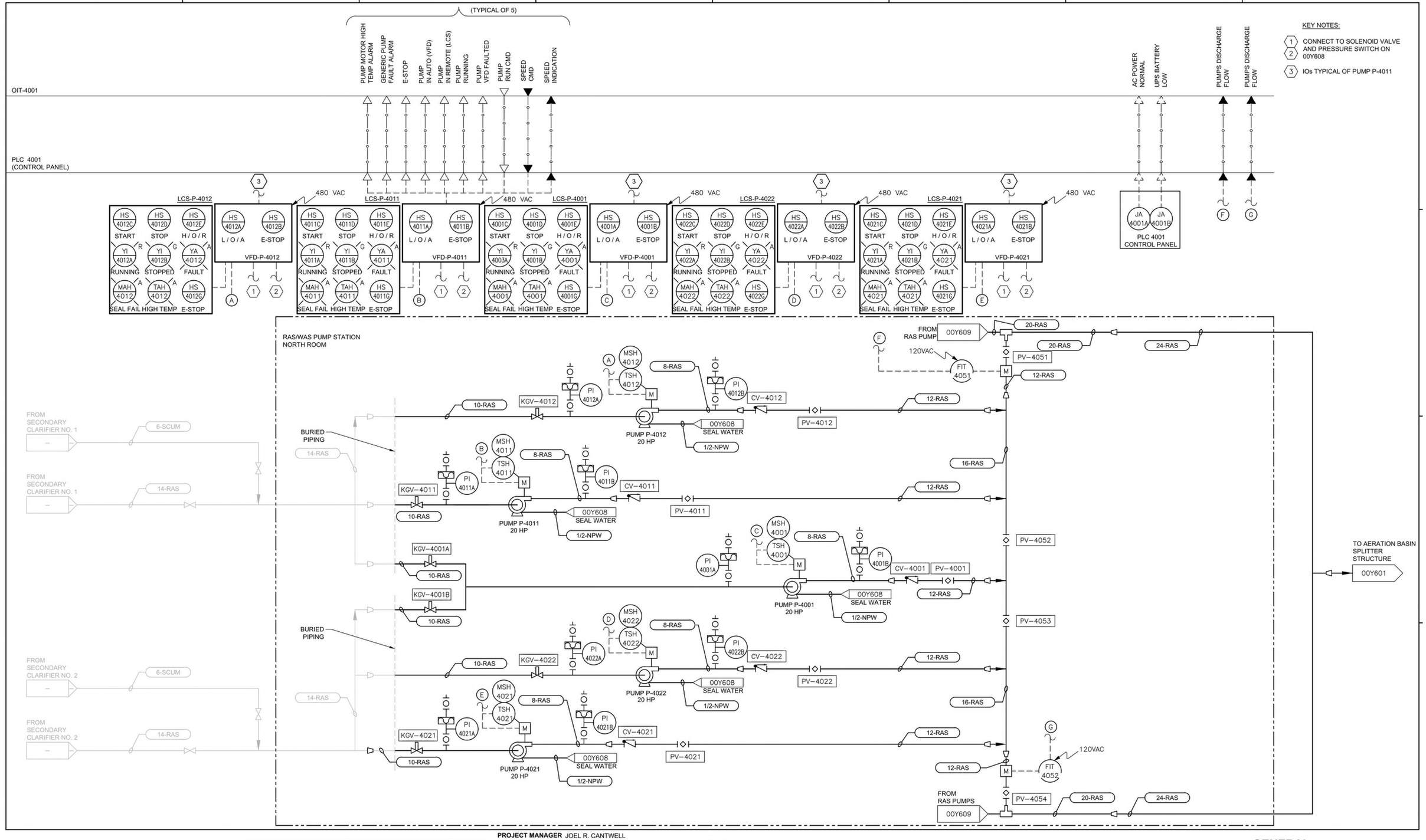

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Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	P. KAPADIA
DRAWN BY	P. KAPADIA
CHECKED BY	S. HORRAS
APPROVED BY	
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
PRANAVKUMAR KAPADIA
105500
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PRAIRIE CREEK

AERATION BASIN EXPANSION

GENERAL INSTRUMENTATION RAS/WAS PUMP STATION SEC. CLARIFIER NO. 1 & 2 P&ID

0 1" 2"

FILENAME 00Y607.dwg
SCALE NO SCALE

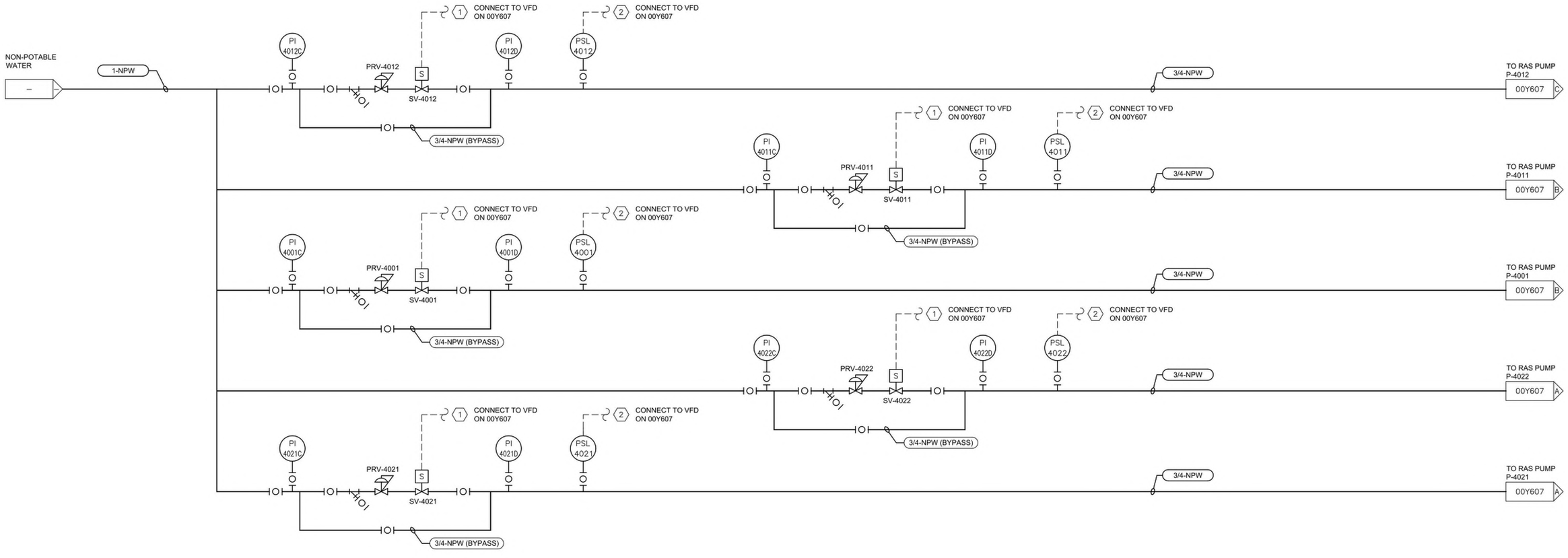
SHEET 00Y607

1 NON-POTTABLE WATER SOLENOID VALVE WILL BE INTERLOCKED TO CORRESPONDING RAS PUMP VFD LOCATED ON SHEET 00Y607

2 LOW PRESSURE SWITCH WILL BE CONNECTED TO RAS PUMP VFD LOCATED ON SHEET 00Y607. WHEN LOW PRESSURE IS DETECTED, THE CORRESPONDING RAS PUMP WILL BE SHUT DOWN

OIT-4001

PLC 4001
(CONTROL PANEL)



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TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	P. KAPADIA
DRAWN BY	P. KAPADIA
CHECKED BY	S. HORRAS
APPROVED BY	
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
PRANAVKUMAR KAPADIA
105500
LICENSED PROFESSIONAL ENGINEER
06/13/2025

LEWISVILLE
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CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

GENERAL INSTRUMENTATION
RAS PUMPS P-4001, P-4011, P-4012, P-4021 & P-4022 SEAL WATER P&ID

0 1" 2"

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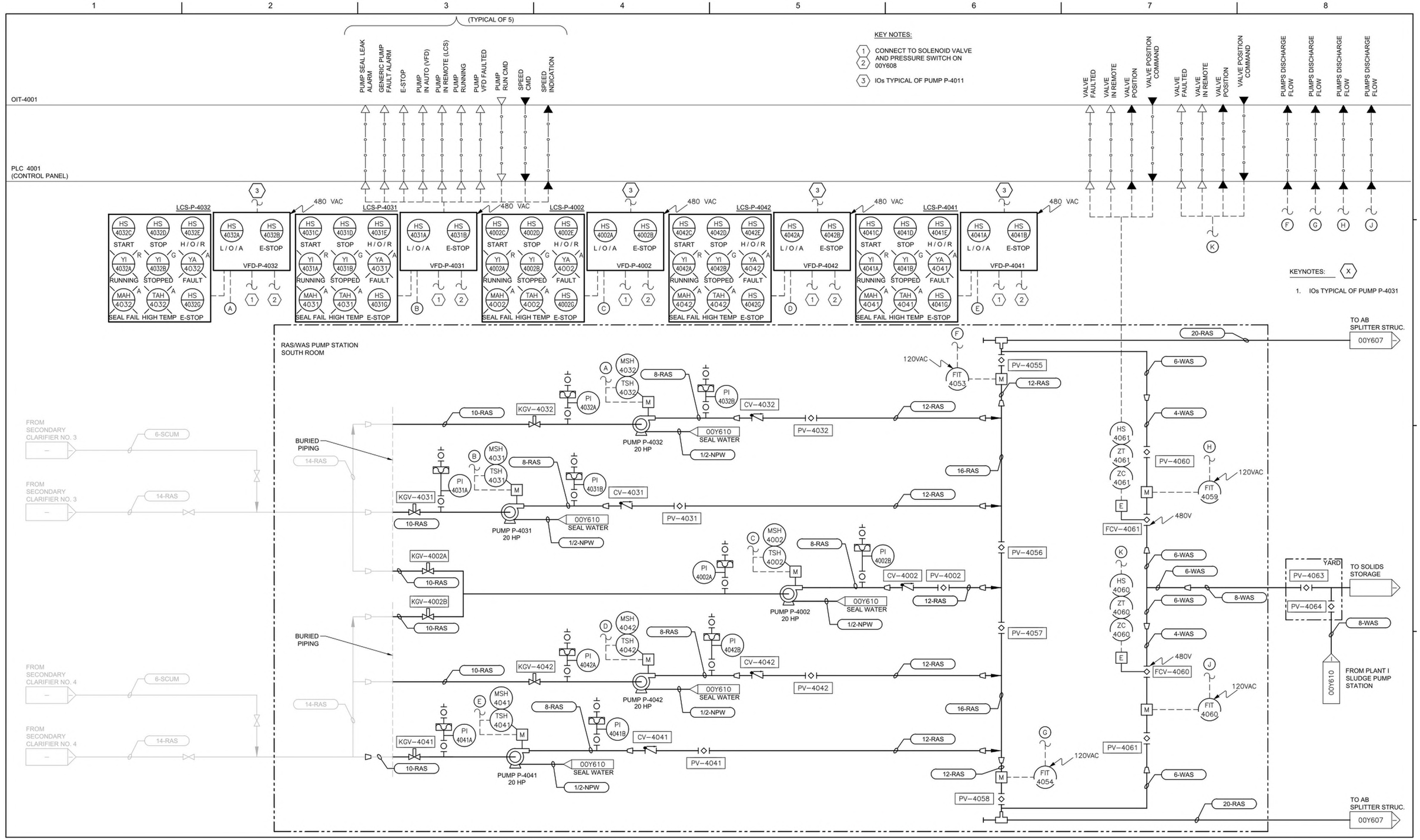
SHEET 00Y608



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TEXAS P.E. FIRM
Registration No. F-754

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100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
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DRAWN BY	P. KAPADIA
CHECKED BY	S. HORRAS
APPROVED BY	
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
PRANAVKUMAR KAPADIA
105500
LICENSED PROFESSIONAL ENGINEER
06/13/2025

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PRAIRIE CREEK

AERATION BASIN EXPANSION

GENERAL INSTRUMENTATION RAS/WAS PUMP STATION SEC. CLARIFIER NO. 3 & 4 P&ID

0 1" 2"

FILENAME 00Y609.dwg
SCALE NO SCALE

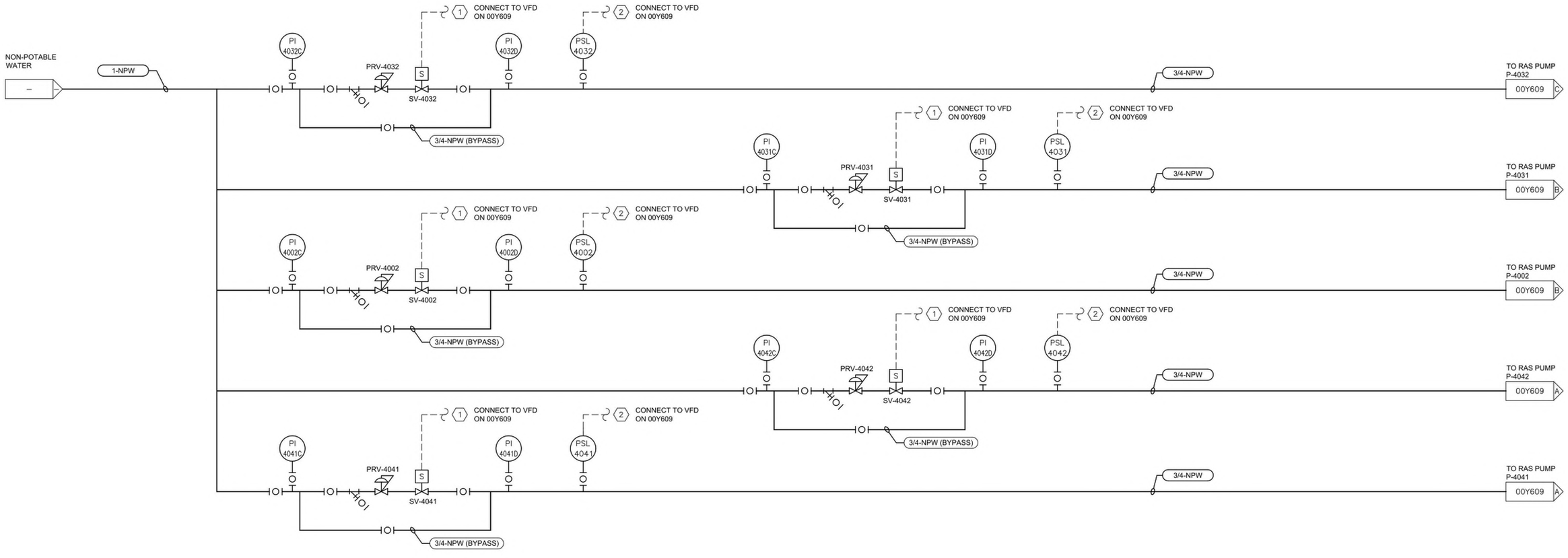
SHEET 00Y609

1 NON-POTTABLE WATER SOLENOID VALVE WILL BE INTERLOCKED TO CORRESPONDING RAS PUMP VFD LOCATED ON SHEET 00Y607

2 LOW PRESSURE SWITCH WILL BE CONNECTED TO RAS PUMP VFD LOCATED ON SHEET 00Y607. WHEN LOW PRESSURE IS DETECTED, THE CORRESPONDING RAS PUMP WILL BE SHUT DOWN

OIT-4001

PLC 4001
(CONTROL PANEL)



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HDR
TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	P. KAPADIA
DRAWN BY	P. KAPADIA
CHECKED BY	S. HORRAS
APPROVED BY	
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
PRANAVKUMAR KAPADIA
105500
LICENSED
PROFESSIONAL ENGINEER
06/13/2025

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

GENERAL INSTRUMENTATION
RAS PUMPS P-4002, P-4031, P-4032, P-4041 & P-4042 SEAL WATER P&ID

0 1" 2"

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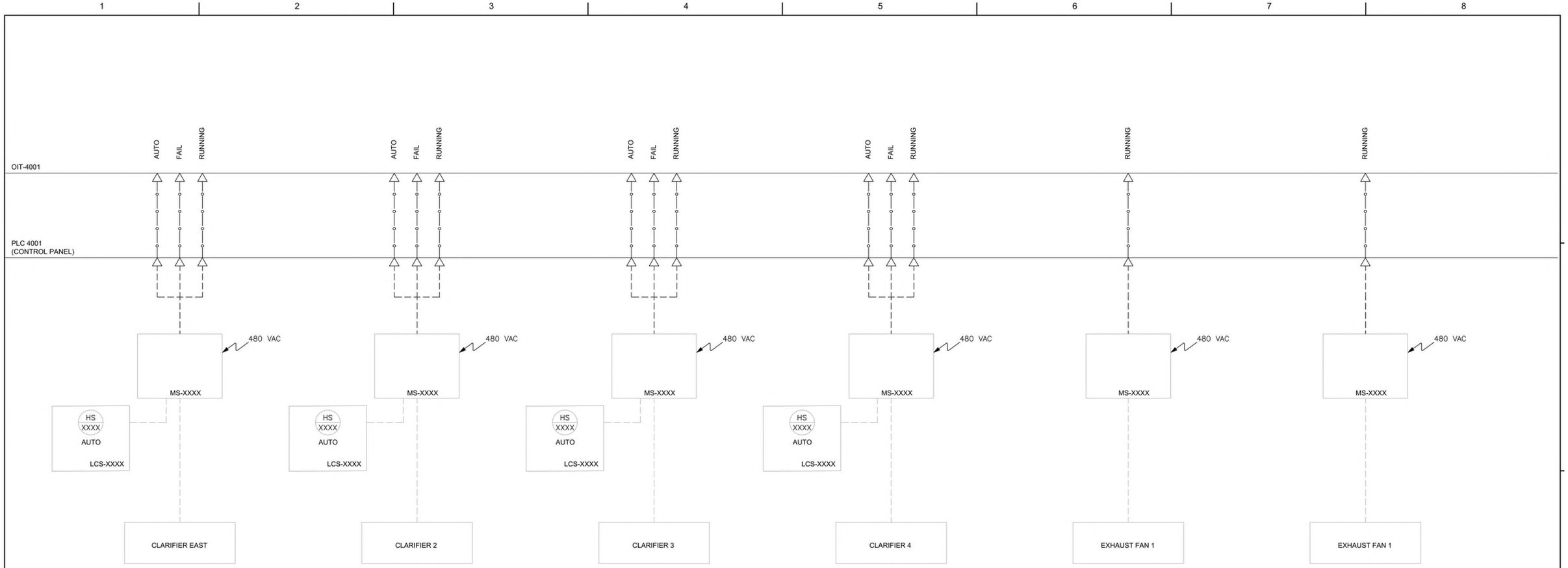

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TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	P. KAPADIA
DRAWN BY	P. KAPADIA
CHECKED BY	S. HORRAS
APPROVED BY	
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
PRANAVKUMAR KAPADIA
105500
LICENSED
PROFESSIONAL ENGINEER
06/13/2025

LEWISVILLE
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CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

GENERAL INSTRUMENTATION MISC. P&ID

0 1" 2"

FILENAME 00Y611.dwg
SCALE NO SCALE

SHEET
00Y611

GENERAL NOTES:

1. PROVIDE RACEWAY, WIRING AND TERMINATIONS FOR ALL INSTRUMENTS, DEVICES AND CKT #'S SHOWN ON ONE-LINE.
2. CONTROL WIRES AND CABLES OF LIKE VOLTAGE AND TYPE MAY BE COMBINED INTO MULTI-CONDUCTOR CABLES AND/OR CONDUITS.
3. REFER TO ELECTRICAL DIV 26 SPECIFICATIONS FOR CONDUIT MATERIAL.

CONTINUED BELOW
FROM LEFT

PLC CONTROL PANEL

PLC-3101

C-3001:
(2)PR#16
TSP,
3/4"C

LIT
1101

C-3002:
MANUFACTURER SUPPLIED CABLE

LE
1101

CONTINUED FROM
TOP RIGHT

PLC CONTROL PANEL

PLC-3101

RESERVED FOR FUTURE PROJECT

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TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	P. KAPADIA
DRAWN BY	P. KAPADIA
CHECKED BY	S. HORRAS
APPROVED BY	
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
PRANAVKUMAR KAPADIA
105500
LICENSED
PROFESSIONAL ENGINEER
06/13/2025

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CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

GENERAL INSTRUMENTATION ONE LINE DIAGRAM PLC-3101 CONTROL PNL (SH 1 OF 6)

0 1" 2"

FILENAME 00Y614.dwg
SCALE NO SCALE

SHEET
00Y614

1 2 3 4 5 6 7 8

GENERAL NOTES:

1. PROVIDE RACEWAY, WIRING AND TERMINATIONS FOR ALL INSTRUMENTS, DEVICES AND CKT #'S SHOWN ON ONE-LINE.
2. CONTROL WIRES AND CABLES OF LIKE VOLTAGE AND TYPE MAY BE COMBINED INTO MULTI-CONDUCTOR CABLES AND/OR CONDUITS.
3. REFER TO ELECTRICAL DIV 26 SPECIFICATIONS FOR CONDUIT MATERIAL.

CONTINUED BELOW FROM LEFT

PLC CONTROL PANEL

PLC-3101

RESERVED FOR FUTURE PROJECT

CONTINUED FROM TOP RIGHT

PLC CONTROL PANEL

PLC-3101

RESERVED FOR FUTURE PROJECT

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TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	P. KAPADIA
DRAWN BY	P. KAPADIA
CHECKED BY	S. HORRAS
APPROVED BY	
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
PRANAVKUMAR KAPADIA
105500
LICENSED
PROFESSIONAL ENGINEER
06/13/2025

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CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

GENERAL INSTRUMENTATION ONE LINE DIAGRAM PLC-3101 CONTROL PNL (SH 2 OF 6)

0 1" 2"

FILENAME 00Y615.dwg
SCALE NO SCALE

SHEET
00Y615

GENERAL NOTES:

1. PROVIDE RACEWAY, WIRING AND TERMINATIONS FOR ALL INSTRUMENTS, DEVICES AND CKT #'S SHOWN ON ONE-LINE.
2. CONTROL WIRES AND CABLES OF LIKE VOLTAGE AND TYPE MAY BE COMBINED INTO MULTI-CONDUCTOR CABLES AND/OR CONDUITS.
3. REFER TO ELECTRICAL DIV 26 SPECIFICATIONS FOR CONDUIT MATERIAL.

CONTINUED BELOW FROM LEFT

PLC CONTROL PANEL

PLC-3101

RESERVED FOR FUTURE PROJECT

CONTINUED FROM TOP RIGHT

PLC CONTROL PANEL

PLC-3101

C-1201: 6/C#14, 3/4"C

C-1202: (2)PR#16 TSP, 3/4"C

E MODULATING FLOW CONTROL VALVE 2151

C-1206: (1)PR#16 TSP, 3/4"C

FIT 2151

C-1207: MANUFACTURER SUPPLIED CABLE

FE 2151

C-1211: 14/C#14, 3/4"C

C-1212: (2)PR#16 TSP, 3/4"C

MIXER MX-2151 VFD

LCS-MX-2151

TSH 2151

M MX-2151

C-1216: 14/C#14, 3/4"C

C-1217: (2)PR#16 TSP, 3/4"C

MIXER MX-2152 VFD

LCS-MX-2152

TSH 2152

M MX-2152

C-1221: (1)PR#16 TSP, 3/4"C

C-1222: (1)PR#16 TSP, 3/4"C

AIT 2151A

AIT 2151B

C-1223: MANUFACTURER SUPPLIED CABLE

C-1224: MANUFACTURER SUPPLIED CABLE

AE 2151A

AE 2151A

C-1226: 20/C#14, 1"C

C-1227: (2)PR#16 TSP, 3/4"C

PUMP P-2153 VFD

LCS-P-2153

MSH 2153

TSH 2153

M PUMP P-2153

AERATION BASIN NO. 5

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Date 6/12/2025 11:56:43 AM

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	P. KAPADIA
DRAWN BY	P. KAPADIA
CHECKED BY	S. HORRAS
APPROVED BY	
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
PRANAVKUMAR KAPADIA
105500
LICENSED
PROFESSIONAL ENGINEER
06/13/2025

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CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

GENERAL INSTRUMENTATION ONE LINE DIAGRAM
PLC-3101 CONTROL PNL (SH 3 OF 6)

0 1" 2"

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SCALE NO SCALE

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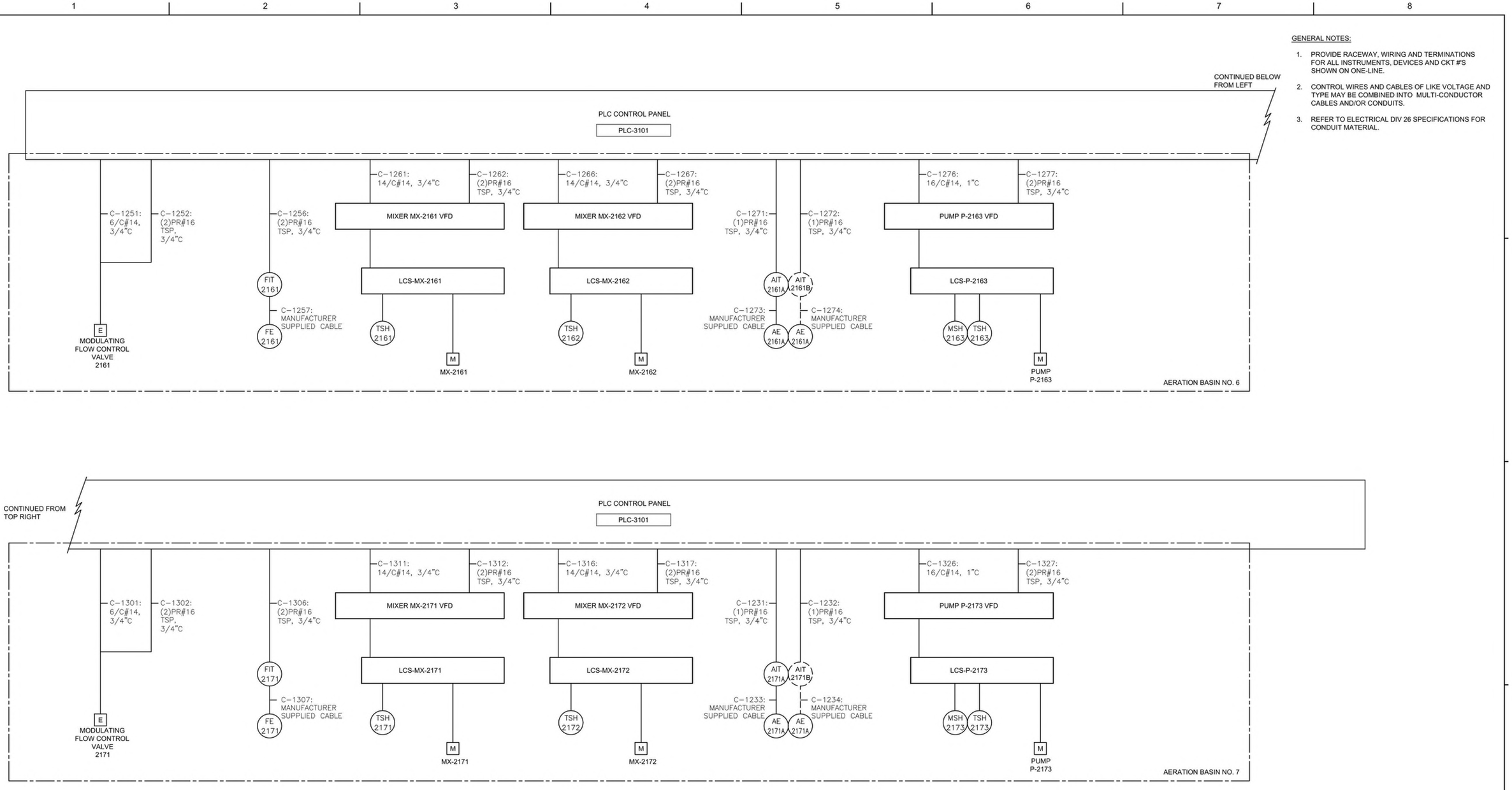

GENERAL NOTES:

1. PROVIDE RACEWAY, WIRING AND TERMINATIONS FOR ALL INSTRUMENTS, DEVICES AND CKT #'S SHOWN ON ONE-LINE.
2. CONTROL WIRES AND CABLES OF LIKE VOLTAGE AND TYPE MAY BE COMBINED INTO MULTI-CONDUCTOR CABLES AND/OR CONDUITS.
3. REFER TO ELECTRICAL DIV 26 SPECIFICATIONS FOR CONDUIT MATERIAL.

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TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	P. KAPADIA
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CHECKED BY	S. HORRAS
APPROVED BY	
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
PRANAVKUMAR KAPADIA
105500
LICENSED
PROFESSIONAL ENGINEER
06/13/2025

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PRAIRIE CREEK

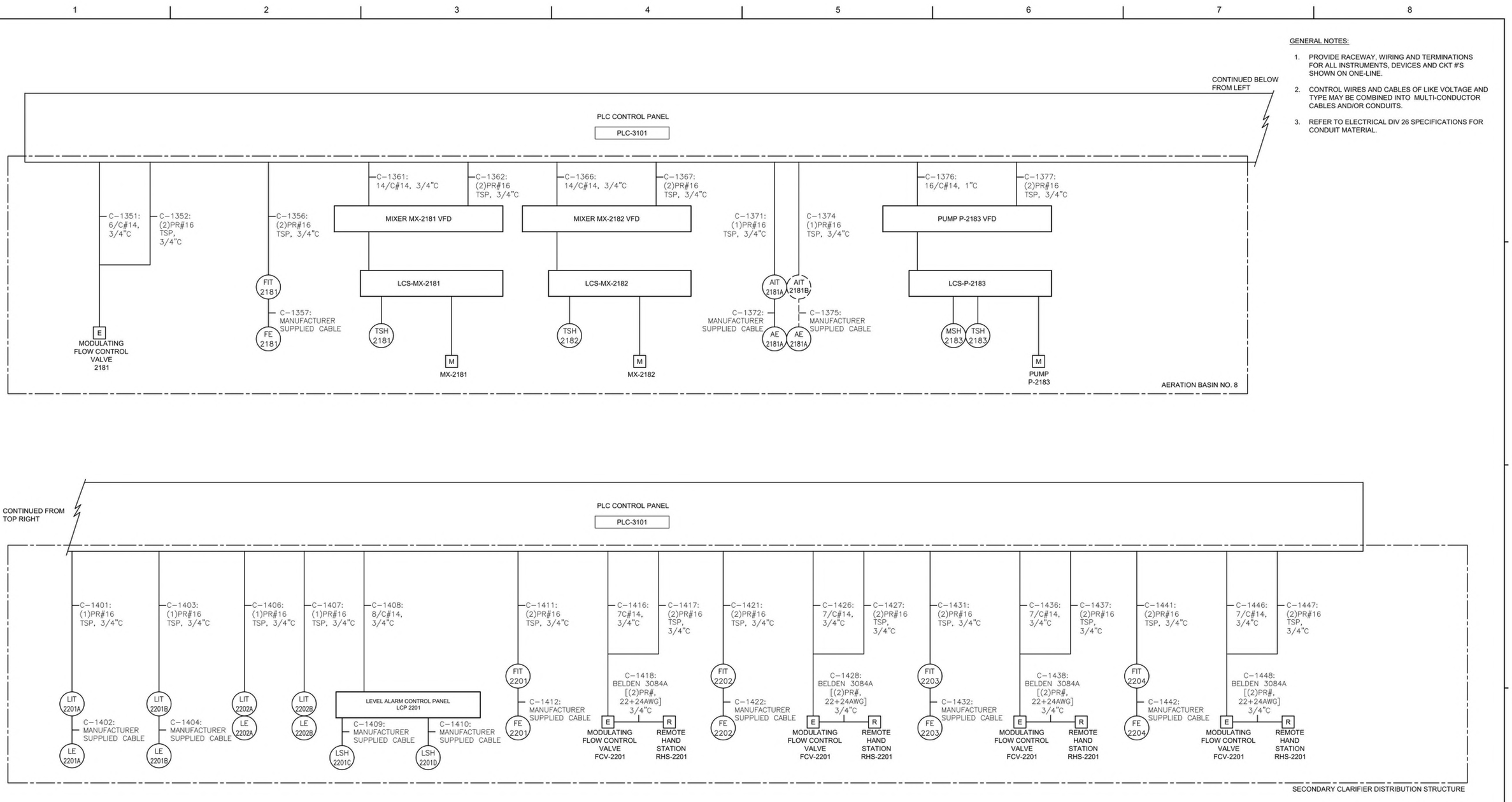
AERATION BASIN EXPANSION

GENERAL INSTRUMENTATION ONE LINE DIAGRAM PLC-3101 CONTROL PNL (SH 4 OF 6)

0 1" 2"

FILENAME 00Y617.dwg
SCALE NO SCALE

SHEET 00Y617



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TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	P. KAPADIA
DRAWN BY	P. KAPADIA
CHECKED BY	S. HORRAS
APPROVED BY	
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
PRANAVKUMAR KAPADIA
105500
LICENSED PROFESSIONAL ENGINEER
06/13/2025

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PRAIRIE CREEK

AERATION BASIN EXPANSION

GENERAL INSTRUMENTATION ONE LINE DIAGRAM PLC-3101 CONTROL PNL (SH 5 OF 6)

0 1" 2"

FILENAME 00Y618.dwg
SCALE NO SCALE

SHEET 00Y618

GENERAL NOTES:

1. PROVIDE RACEWAY, WIRING AND TERMINATIONS FOR ALL INSTRUMENTS, DEVICES AND CKT #'S SHOWN ON ONE-LINE.
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3. REFER TO ELECTRICAL DIV 26 SPECIFICATIONS FOR CONDUIT MATERIAL.

CONTINUED BELOW FROM LEFT

PLC CONTROL PANEL
PLC-3101

RESERVED FOR FUTURE PROJECT

CONTINUED FROM TOP RIGHT

PLC CONTROL PANEL
PLC-3101

C-1476: (3)PR#16 TSP, 3/4"C
C-1477: (1)PR#16 TSP, 3/4"C
C-1486: (2)PR#16 TSP, 3/4"C
C-1487: (2)PR#16 TSP, 3/4"C
C-1490: CAT6 CABLE, 3/4"C

TIT 3121
FIT 3121
FE 3121
TT 3120
PIT 3120A
PIT 3120B

BLOWER MASTER CONTROL PANEL
BMCP-3120

C-1491A: CAT6 CABLE, 3/4"C	C-1492A: TBD BASED ON VENDOR SELECTION	C-1491B: CAT6 CABLE, 3/4"C	C-1492B: TBD BASED ON VENDOR SELECTION	C-1491C: CAT6 CABLE, 3/4"C	C-1492C: TBD BASED ON VENDOR SELECTION	C-1491D: CAT6 CABLE, 3/4"C	C-1492D: TBD BASED ON VENDOR SELECTION
BLOWER CONTROL PANEL B-3105		BLOWER CONTROL PANEL B-3106		BLOWER CONTROL PANEL B-3107		BLOWER CONTROL PANEL B-3108	
C-1493A: TBD BASED ON VENDOR SELECTION		C-1493B: TBD BASED ON VENDOR SELECTION		C-1493C: TBD BASED ON VENDOR SELECTION		C-1493D: TBD BASED ON VENDOR SELECTION	
BLOWER B-3105		BLOWER B-3106		BLOWER B-3107		BLOWER B-3108	

AERATION BASIN NO. 5-8 BLOWERS

KEYNOTES: (X)

1. TO BE SUPPLIED AND INSTALLED BY EQUIPMENT VENDOR

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	P. KAPADIA
DRAWN BY	P. KAPADIA
CHECKED BY	S. HORRAS
APPROVED BY	
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
PRANAVKUMAR KAPADIA
105500
LICENSED
PROFESSIONAL ENGINEER
06/13/2025

LEWISVILLE
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CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

GENERAL INSTRUMENTATION ONE LINE DIAGRAM
PLC-3101 CONTROL PNL (SH 6 OF 6)

0 1" 2"

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SCALE NO SCALE

SHEET 00Y619

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GENERAL NOTES:

1. PROVIDE RACEWAY, WIRING AND TERMINATIONS FOR ALL INSTRUMENTS, DEVICES AND CKT #'S SHOWN ON ONE-LINE.
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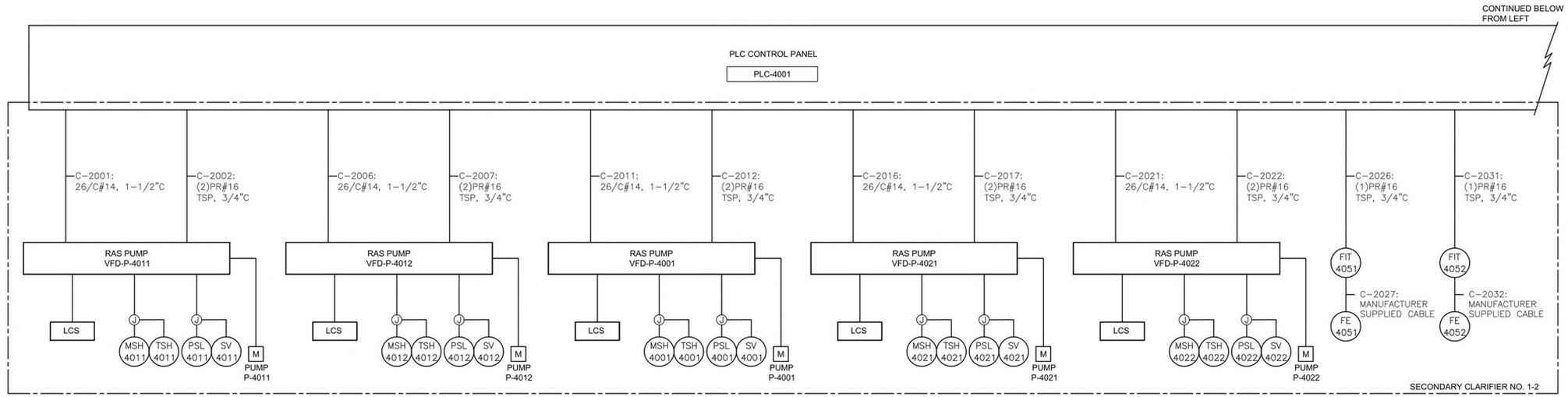

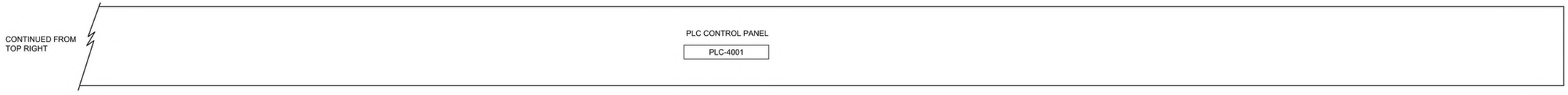

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TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	P. KAPADIA
DRAWN BY	P. KAPADIA
CHECKED BY	S. HORRAS
APPROVED BY	
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
PRANAVKUMAR KAPADIA
105500
LICENSED PROFESSIONAL ENGINEER
06/13/2025

LEWISVILLE
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CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

GENERAL INSTRUMENTATION ONE LINE DIAGRAM PLC-4001 CONTROL PNL (SH 1 OF 2)

0 1" 2"

FILENAME 00Y620.dwg
SCALE NO SCALE

SHEET 00Y620

GENERAL NOTES:

1. PROVIDE RACEWAY, WIRING AND TERMINATIONS FOR ALL INSTRUMENTS, DEVICES AND CKT #'S SHOWN ON ONE-LINE.
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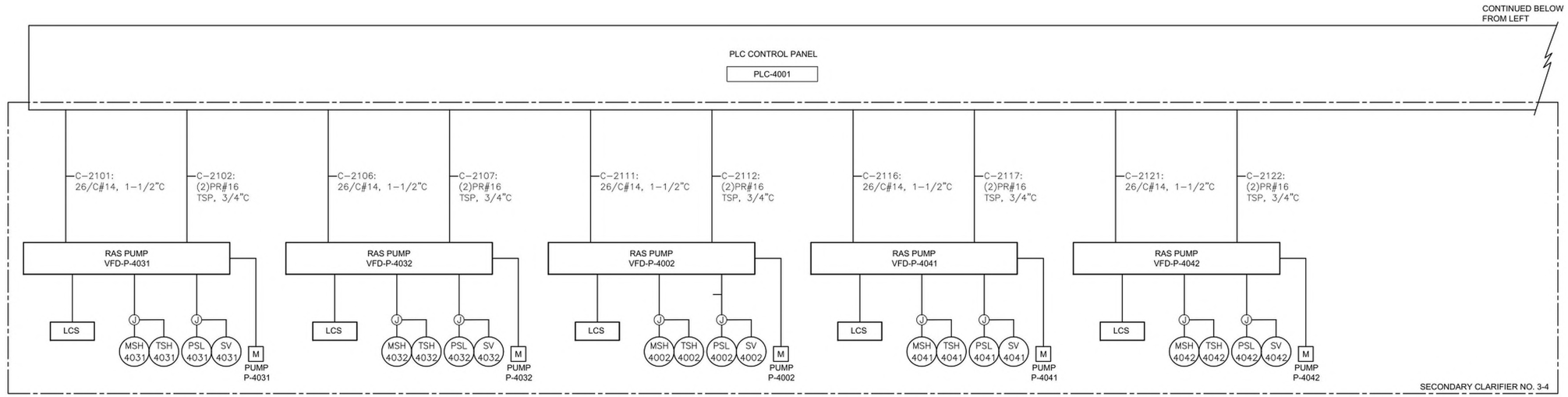

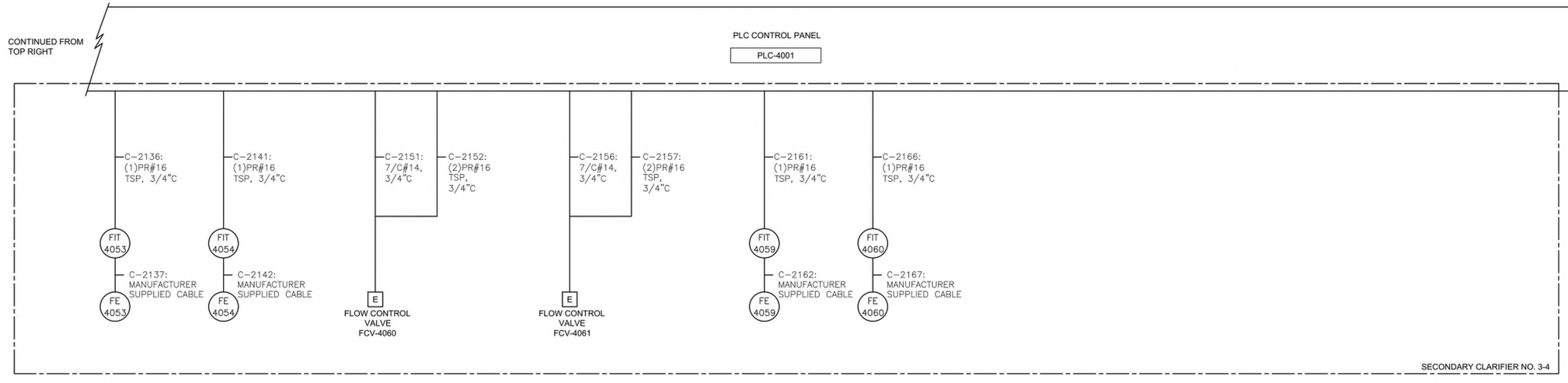

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TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	P. KAPADIA
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CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
PRANAVKUMAR KAPADIA
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LICENSED PROFESSIONAL ENGINEER
06/13/2025

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CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

GENERAL INSTRUMENTATION ONE LINE DIAGRAM PLC-4001 CONTROL PNL (SH 2 OF 2)

0 1" 2"

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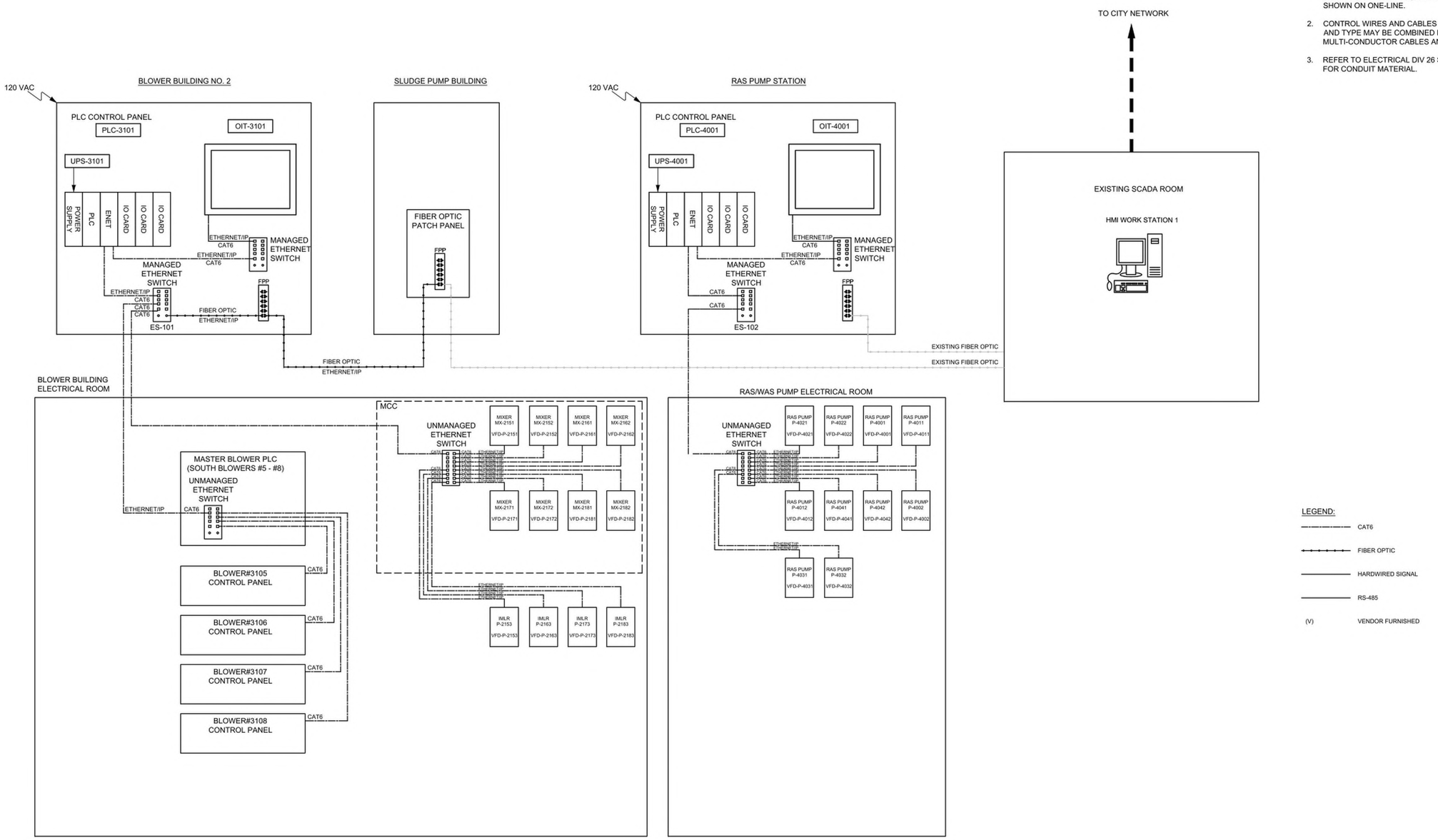
SCALE NO SCALE

SHEET 00Y621



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Date 6/12/2025 12:05:43 PM

TEXAS P.E. FIRM
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PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	P. KAPADIA
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APPROVED BY	
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
PRANAVKUMAR KAPADIA
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06/13/2025

LEWISVILLE
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CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

GENERAL INSTRUMENTATION NETWORK ARCHITECTURE

0 1" 2"

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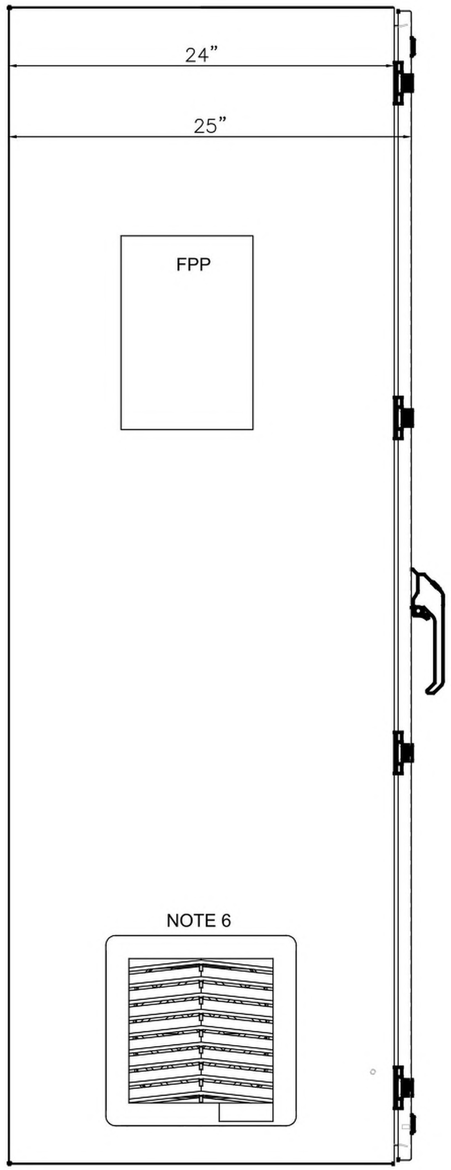
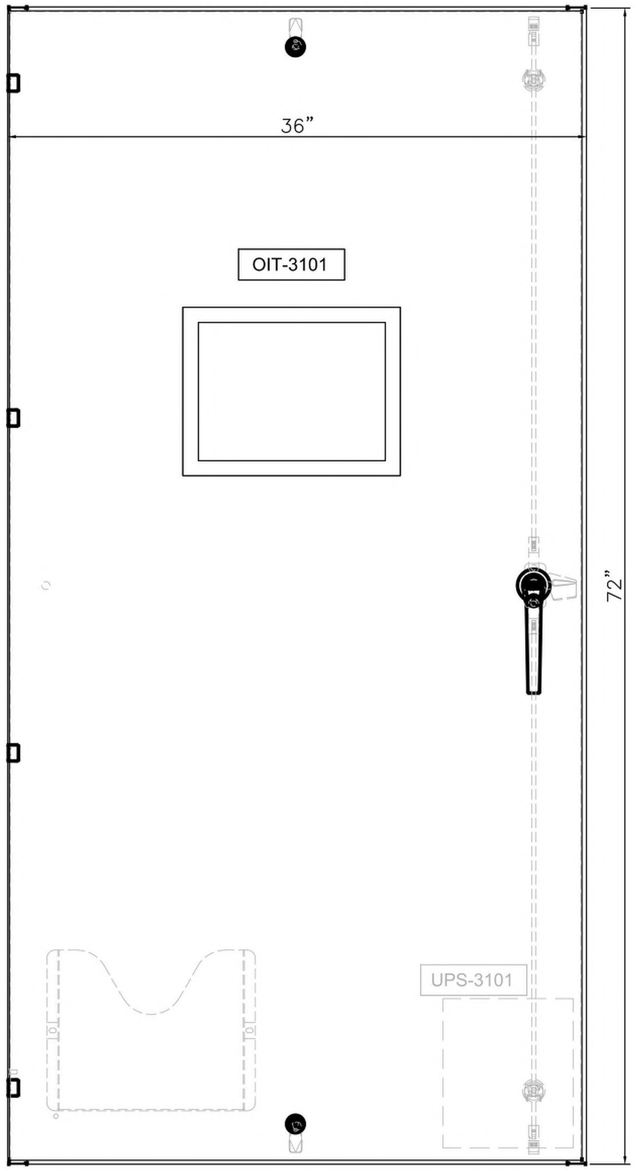
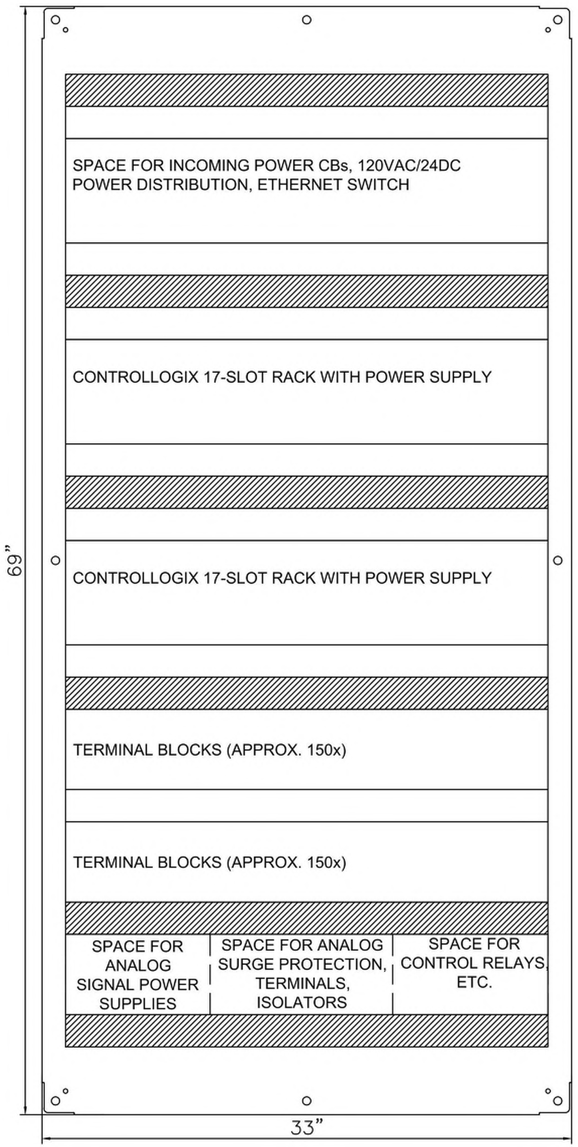
SCALE NO SCALE

SHEET 00Y631

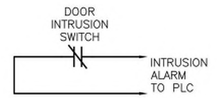




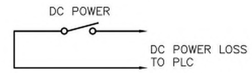


GENERAL NOTES:

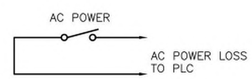
1. PANEL SIZE SHOWN MINIMUM REQUIRED. PANEL SIZING REQUIRED BY SYSTEM INTEGRATOR CONSIDERING ALL I/O POINTS WIRED TO THE PANEL AND SUBMITTED FOR APPROVAL TO OWNER AND ENGINEER
2. REFER ELECTRICAL SHEET 31E102 FOR PANEL LOCATION ON THE SITE.
3. PROVIDE NEMA DETAILS, PANEL SIZE, FREESTANDING/WALL-MOUNT DETAILS, MATERIAL OF PANEL CONSTRUCTION
4. PLC CONTROL PANEL TAG NUMBER: PLC-3101
5. THE CONTROL PANEL SHOWN HERE IS CONCEPTUAL DESIGN. REFER DIV 40 SPECIFICATIONS FOR MORE DETAILS.
6. PROVIDE COOLING FAN AND FILTERS IF NEEDED. CONTRACTOR TO RUN TOTAL HEAT LOAD CALCULATIONS. THE ROOM WHERE THE CONTROL ENCLOSURE WILL BE LOCATED WILL BE CLIMATE CONTROLLED
7. ALL SIGNAL WIRES AND COMMUNICATION CABLES SHALL BE TERMINATED AND CLEARLY LABELED PRIOR TO LEAVING THE ENCLOSURE.



1 00Y637 INTRUSION ALARM SCHEMATIC
NOT TO SCALE



2 00Y637 DC POWER LOSS SCHEMATIC
NOT TO SCALE



3 00Y637 AC POWER LOSS SCHEMATIC
NOT TO SCALE

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Date 6/13/2025 7:48:18 AM

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	P. KAPADIA
DRAWN BY	P. KAPADIA
CHECKED BY	S. HORRAS
APPROVED BY	
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
PRANAVKUMAR KAPADIA
105500
LICENSED PROFESSIONAL ENGINEER
06/13/2025

LEWISVILLE
Deep Roots. Broad Wings. Bright Future

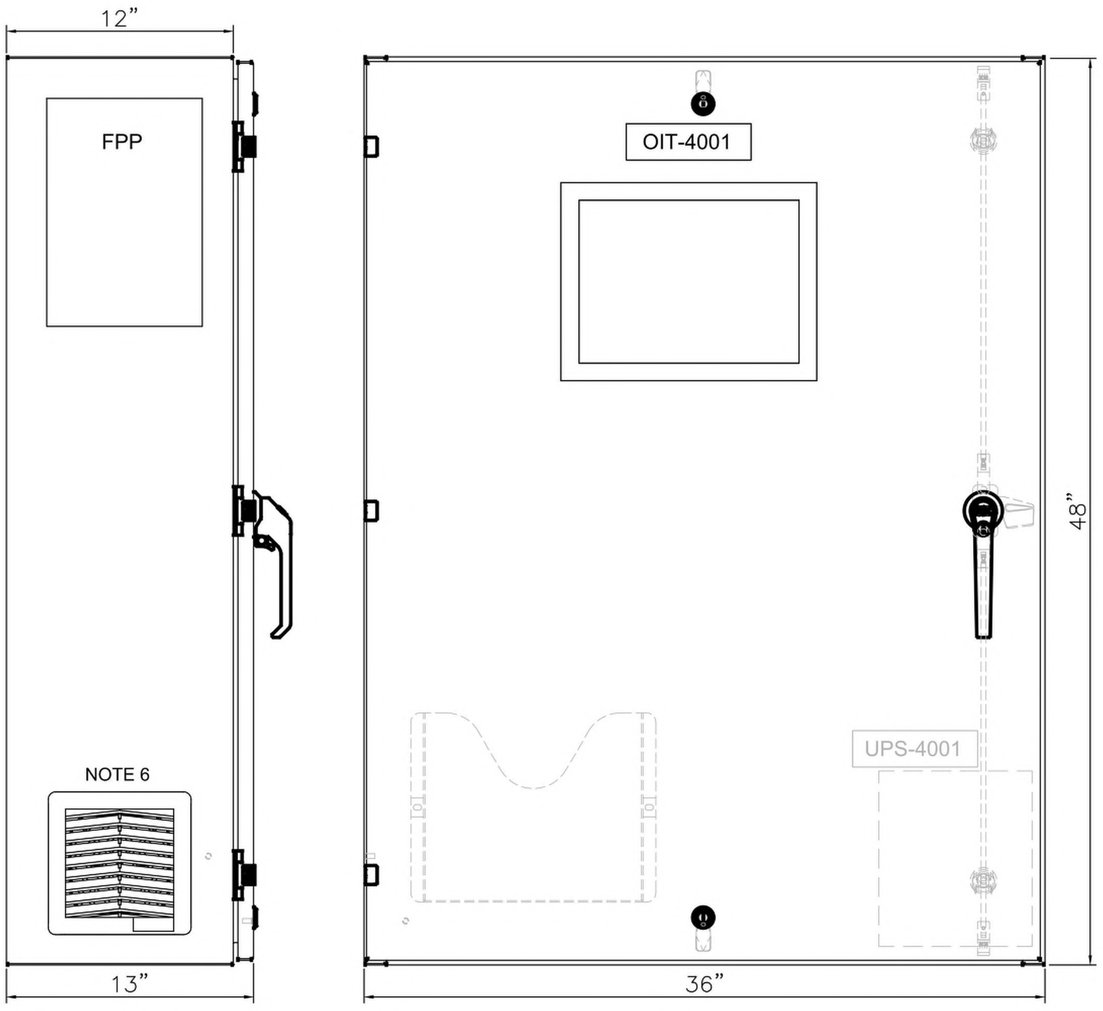
CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

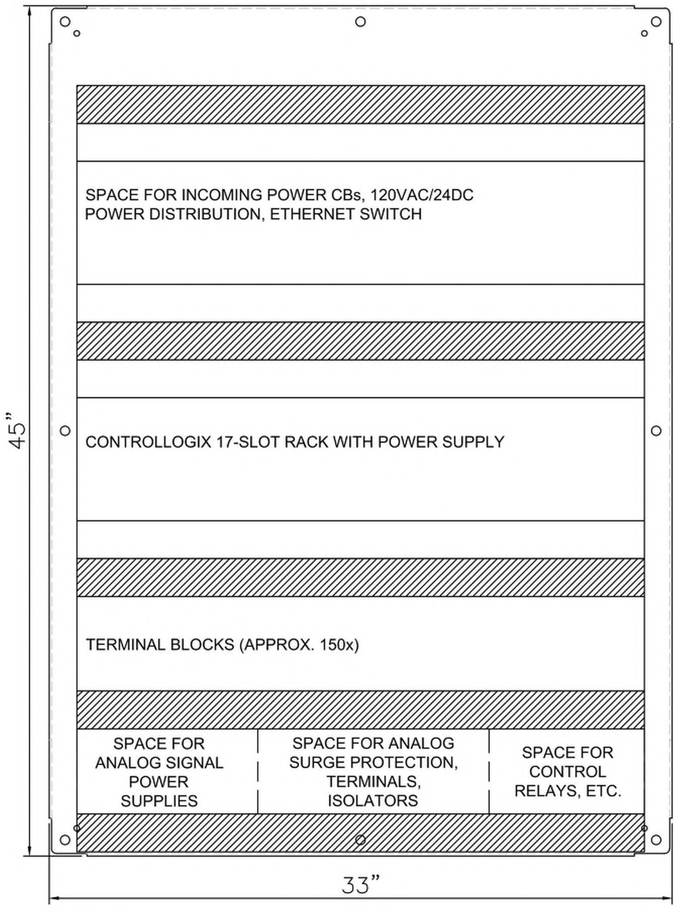
GENERAL INSTRUMENTATION
BLOWER BUILDING (PROPOSED)
PLC-3101 PANEL LAYOUTS

0 1” 2”

FILENAME 00Y637.dwg
SCALE NO SCALE

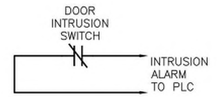
SHEET 00Y637



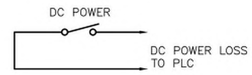


GENERAL NOTES:

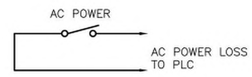
1. PANEL SIZE SHOWN MINIMUM REQUIRED. PANEL SIZING REQUIRED BY SYSTEM INTEGRATOR CONSIDERING ALL I/O POINTS WIRED TO THE PANEL AND SUBMITTED FOR APPROVAL TO OWNER AND ENGINEER
2. REFER ELECTRICAL SHEET 31E102 FOR PANEL LOCATION ON THE SITE.
3. PROVIDE NEMA DETAILS, PANEL SIZE, FREESTANDING/WALL-MOUNT DETAILS, MATERIAL OF PANEL CONSTRUCTION
4. PLC CONTROL PANEL TAG NUMBER: PLC-3101
5. THE CONTROL PANEL SHOWN HERE IS CONCEPTUAL DESIGN. REFER DIV 40 SPECIFICATIONS FOR MORE DETAILS.
6. PROVIDE COOLING FAN AND FILTERS IF NEEDED. CONTRACTOR TO RUN TOTAL HEAT LOAD CALCULATIONS. THE ROOM WHERE THE CONTROL ENCLOSURE WILL BE LOCATED WILL BE CLIMATE CONTROLLED
7. ALL SIGNAL WIRES AND COMMUNICATION CABLES SHALL BE TERMINATED AND CLEARLY LABELED PRIOR TO LEAVING THE ENCLOSURE.



1 00Y638 INTRUSION ALARM SCHEMATIC
NOT TO SCALE



2 00Y638 DC POWER LOSS SCHEMATIC
NOT TO SCALE



3 00Y638 AC POWER LOSS SCHEMATIC
NOT TO SCALE

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Date 6/12/2025 12:08:51 PM

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	P. KAPADIA
DRAWN BY	P. KAPADIA
CHECKED BY	S. HORRAS
APPROVED BY	
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
PRANAVKUMAR KAPADIA
105500
LICENSED
PROFESSIONAL ENGINEER
06/13/2025

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

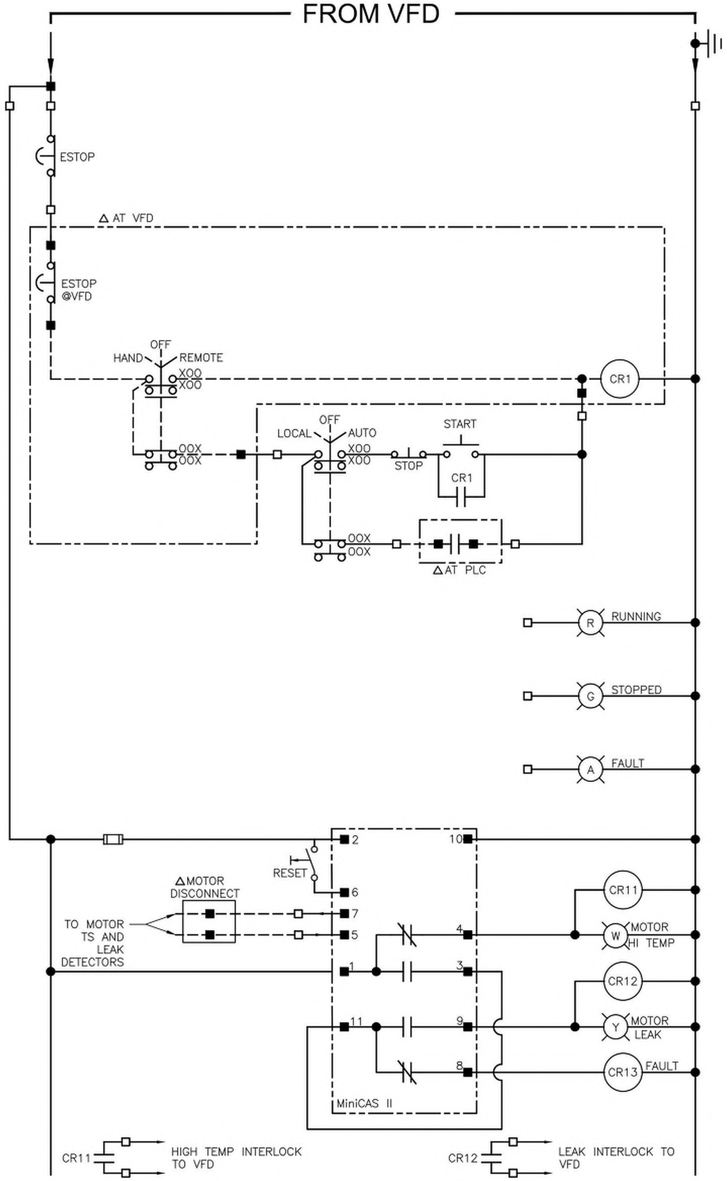
CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN
EXPANSION

GENERAL
INSTRUMENTATION
RAS/WAS BUILDING
PLC-4001 PANEL LAYOUTS

0 1” 2”

FILENAME 00Y638.dwg
SCALE NO SCALE

SHEET
00Y638

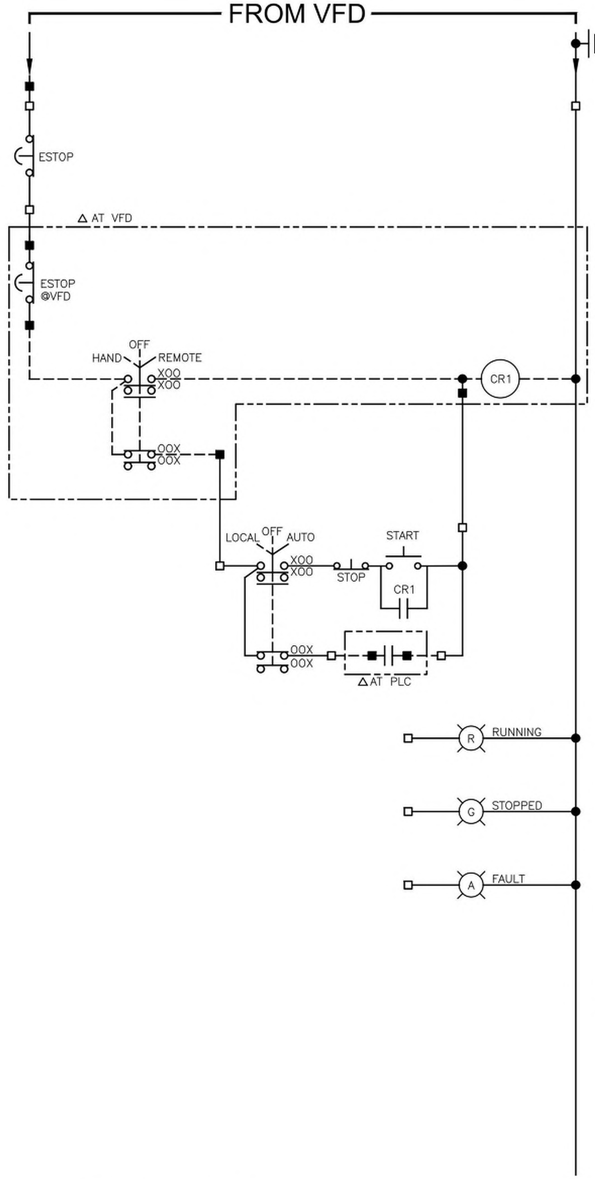


1 00Y651 IMLR PUMPS LCS CONTROL SCHEMATICS

NOT TO SCALE

KEY NOTES:

- □ TERMINALS IN LCS.
- ■ TERMINALS IN VFD CABINET.

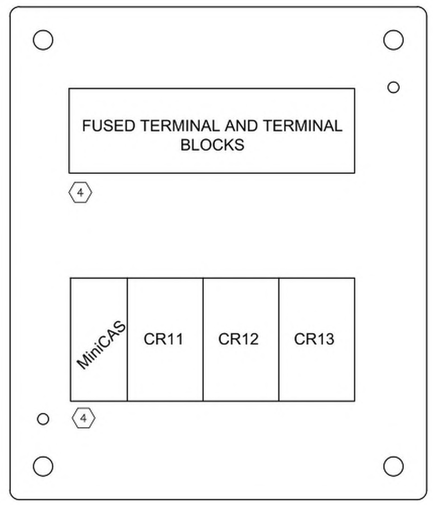


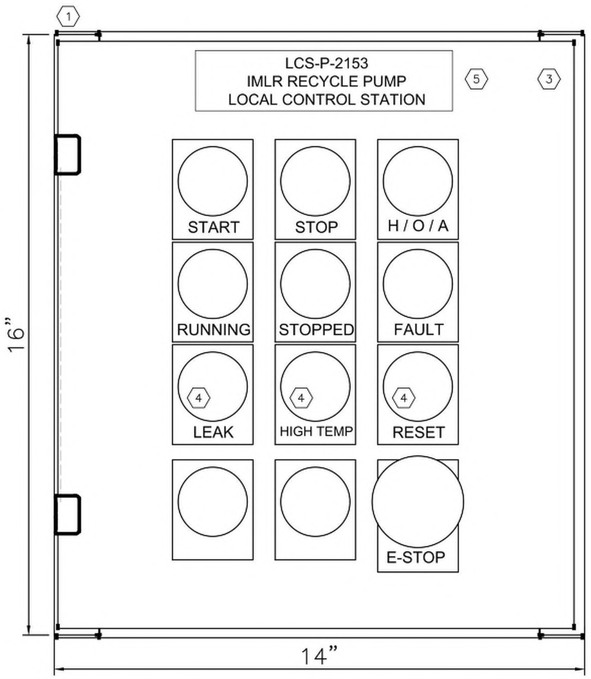
2 00Y651 RAS PUMPS & MIXERS LCS CONTROL SCHEMATICS

NOT TO SCALE

KEY NOTES:

- □ TERMINALS IN LCS.
- ■ TERMINALS IN VFD CABINET.





SUGGESTED BILL OF MATERIAL

ITEM	QTY	DESCRIPTION
1	1	WALL MOUNT ENCLOSURE, NEMA 4X, SS316 16"Hx14"WX8"D MINIMUM
7 2	A/R	PUSHBUTTONS, SELECTOR SWITCHES & PILOT LIGHTS
3	A/R	CONTROL RELAYS
4	1	MiniCAS SUPERVISION RELAY FOR TEMP. & LEAKAGE SENSOR
5	A/R	FUSED TERMINALS, TERMINAL BLOCKS, DIN RAIL, ETC. PANEL HARDWARE

KEYED NOTES:

1. PANEL SIZE SHOWN MINIMUM REQUIRED. PANEL SIZING REQUIRED BY VENDOR CONSIDERING ALL THE REQUIREMENTS AND SUBMITTED FOR APPROVAL TO OWNER AND ENGINEER.
2. REFER TO FOLLOWING FOR DETAILED SPECIFICATIONS: SECTION 40 67 00 CONTROL SYSTEM EQUIPMENT PANELS AND RACKS SECTION 40 78 00 PANEL MOUNTED INSTRUMENTS
3. PUMP VENDOR TO SUPPLY COMPLETELY WIRED CONTROL PANEL FOR IMLR PUMPS AND MOUNT IT ON A PEDESTAL. THE MOTOR TEMPERATURE AND LEAK SENSOR WILL BE WIRED BACK TO THE PANEL

   REFER TO ELECTRICAL DRAWINGS 31E605 FOR MOTOR DISCONNECT SWITCH WIRING AND MOUNTING DETAILS. FOR CONTROL SCHEMATICS, REFER TO ELECTRICAL DRAWINGS 31E605 & 40E604
4. FOR RECYCLE PUMPS ONLY
5. SAMPLE NAMEPLATE. CHANGE TO SUIT APPLICATION
6. RAS PUMPS, MIXER LCS & IMLR PUMPS: TO BE FURNISHED BY CONTRACTOR
7. MIXER LCS CONTROL PANEL COMPONENTS (PUSHBUTTONS, PILOT LIGHTS, SELECTOR SWITCHES, ETC.) TO BE RATED NEMA 4X
8. PROVIDE SUNSHADE FOR ALL THE LCS CONTROL PANELS

TEXAS P.E. FIRM Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	P. KAPADIA
DRAWN BY	P. KAPADIA
CHECKED BY	S. HORRAS
APPROVED BY	
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS — PRANAVKUMAR KAPADIA — 105500 — LICENSED PROFESSIONAL ENGINEER
06/13/2025

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

GENERAL INSTRUMENTATION PUMPS LOCAL CONTROL STN DETAILS

0 1" 2"

FILENAME 00Y651.dwg
SCALE NO SCALE
SHEET 00Y651

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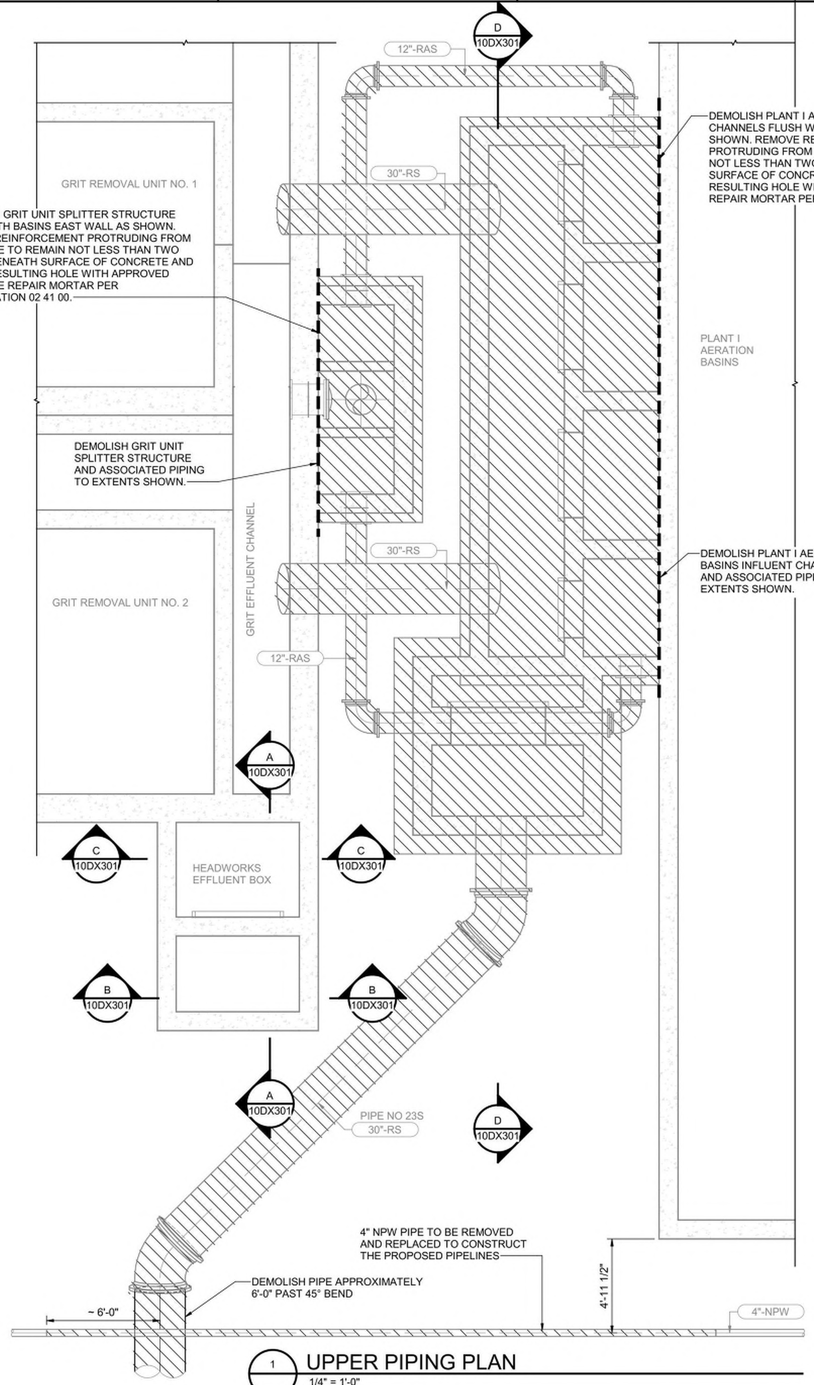
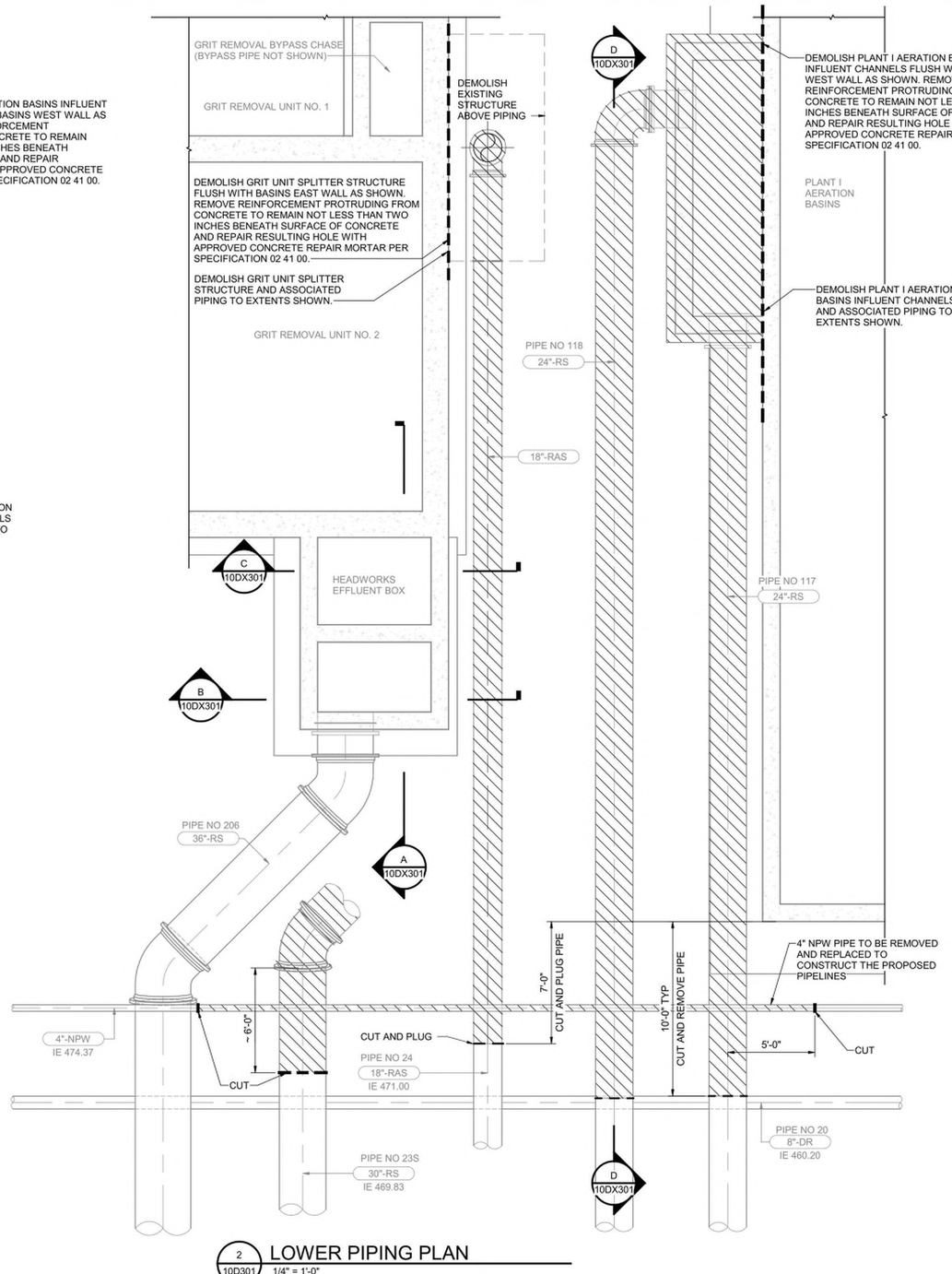


1 UPPER PIPING PLAN
1/4" = 1'-0"



2 10D301 LOWER PIPING PLAN
1/4" = 1'-0"

GENERAL NOTES:

1. CONSTRUCTION SEQUENCING REQUIREMENTS APPLY TO THE WORK IN THIS AREA. SEE SECTION 01 14 16 - COORDINATION WITH OWNER'S OPERATIONS FOR DETAILS.
2. EXISTING CONDITIONS AND DIMENSIONS SHOWN ON AREA 10 HEADWORKS EFFLUENT SPLITTER STRUCTURE DRAWINGS ARE BASED ON THE HISTORICAL DRAWINGS INDICATED BELOW. CONTRACTOR SHALL FIELD VERIFY EXISTING CONDITIONS AND NOTIFY ENGINEER OF ANY DISCREPANCIES PRIOR TO ORDERING MATERIALS.
   - A. PROJECT NO. 5395 WASTEWATER TREATMENT PLANT EXPANSION BY BIRKHOFF, HENDRICKS & CONWAY, L.L.P. DATED SEPTEMBER 2004.
   - B. 1995 WASTEWATER TREATMENT PLANT AND LIFT STATION IMPROVEMENTS BY NRS DATED MARCH 1995.
   - C. EXPANSION OF WASTWATER TREATMENT PLANT BY SHIMEK, JACOBS & FINKLEA DATED APRIL 1987.

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13/2025	ISSUED FOR BID

PROJECT MANAGER	J. R. CANTWELL
DESIGNED BY	A. VAN SICKLE
DRAWN BY	A. FREEMON
CHECKED BY	M. BOND
APPROVED BY	T. PAULMANN
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
THOMAS A. PAULMANN
128794
LICENSED
PROFESSIONAL ENGINEER
6/13/25

LEWISVILLE
Deep Roots. Broad Wings. Bright Future

CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

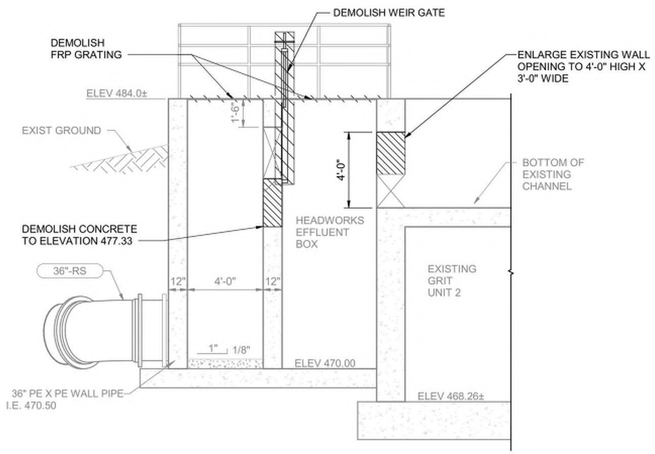
HEADWORKS EFFLUENT STRUCTURE DEMOLITION PLANS

N
0 1" 2"

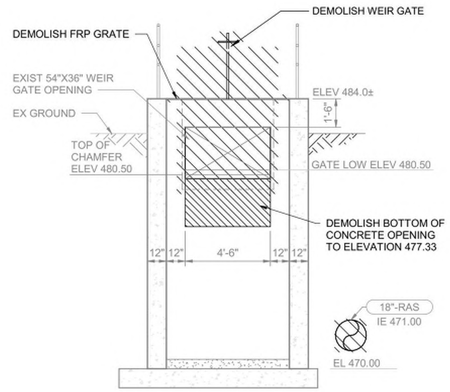
FILENAME 10 - HEADWORKS EFFLUENT STRUCTURE (EXISTING)
SCALE 1/4" = 1'-0"

SHEET
10DX101

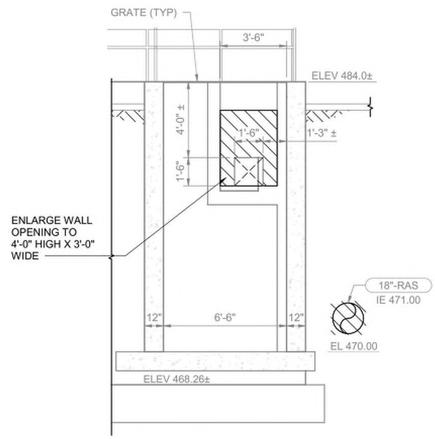
Autodesk Docs://10342803_COL_PCWWT_AB_Expansion_2024/10 - HEADWORKS EFFLUENT SPLITTER STRUCTURES (EXISTING) - PROCESS.rvt
6/13/2025 9:38:51 AM



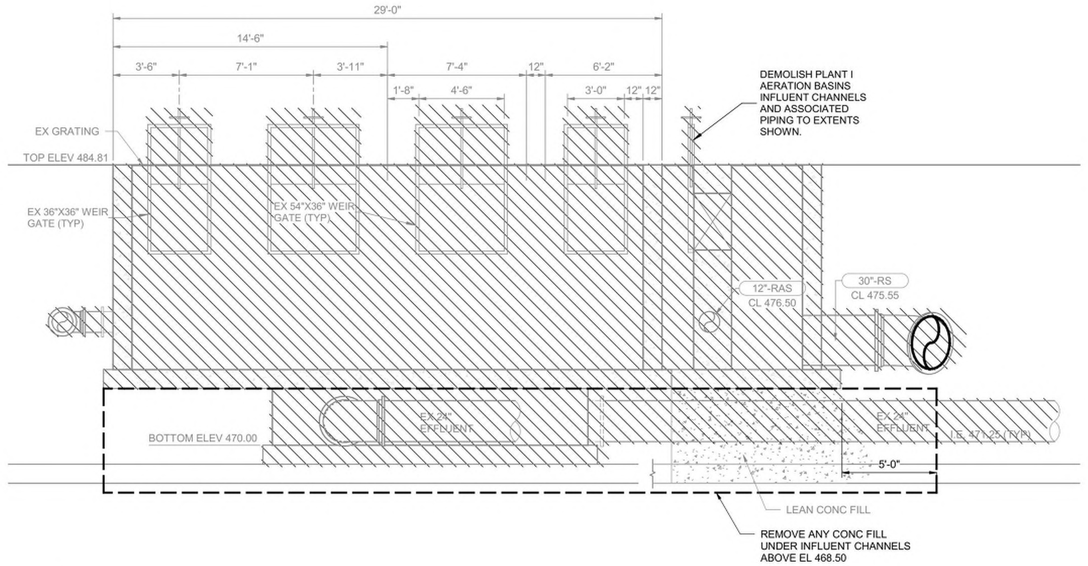
A 10DX101 SECTION
1/4" = 1'-0"



B 10DX101 SECTION
1/4" = 1'-0"



C 10DX101 SECTION
1/4" = 1'-0"



D 10DX101 SECTION
1/4" = 1'-0"

GENERAL NOTES:

1. SEE GENERAL NOTES ON DRAWING 10DX101.
2. EXISTING CONDITIONS AND DIMENSIONS SHOWN ON AREA 10 HEADWORKS EFFLUENT SPLITTER STRUCTURE DRAWINGS ARE BASED ON THE HISTORICAL DRAWINGS INDICATED BELOW. CONTRACTOR SHALL FIELD VERIFY EXISTING CONDITIONS AND NOTIFY ENGINEER OF ANY DISCREPANCIES PRIOR TO ORDERING MATERIALS.
   - A. PROJECT NO. 5395 WASTEWATER TREATMENT PLANT EXPANSION BY BIRKHOFF, HENDRICKS & CONWAY, L.L.P. DATED SEPTEMBER 2004.
   - B. 1995 WASTEWATER TREATMENT PLANT AND LIFT STATION IMPROVEMENTS BY NRS DATED MARCH 1995.
   - C. EXPANSION OF WASTWATER TREATMENT PLANT BY SHIMEK, JACOBS & FINKLEA DATED APRIL 1987.

TEXAS P.E. FIRM
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DRAWN BY	A. FREEMON
CHECKED BY	M. BOND
APPROVED BY	T. PAULMANN
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
THOMAS A. PAULMANN
128794
LICENSED PROFESSIONAL ENGINEER
6/13/25

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

HEADWORKS EFFLUENT STRUCTURE DEMOLITION SECTIONS

FILENAME: 10 - HEADWORKS EFFLUENT STRUCTURE (EXISTING)
SCALE: 1/4" = 1'-0"
0 1" 2"

SHEET
10DX301

Autodesk Docs://10342803_COL_PCWWT_AB_Expansion_2024/10 - HEADWORKS EFFLUENT SPLITTER STRUCTURES (EXISTING) - PROCESS.rvt
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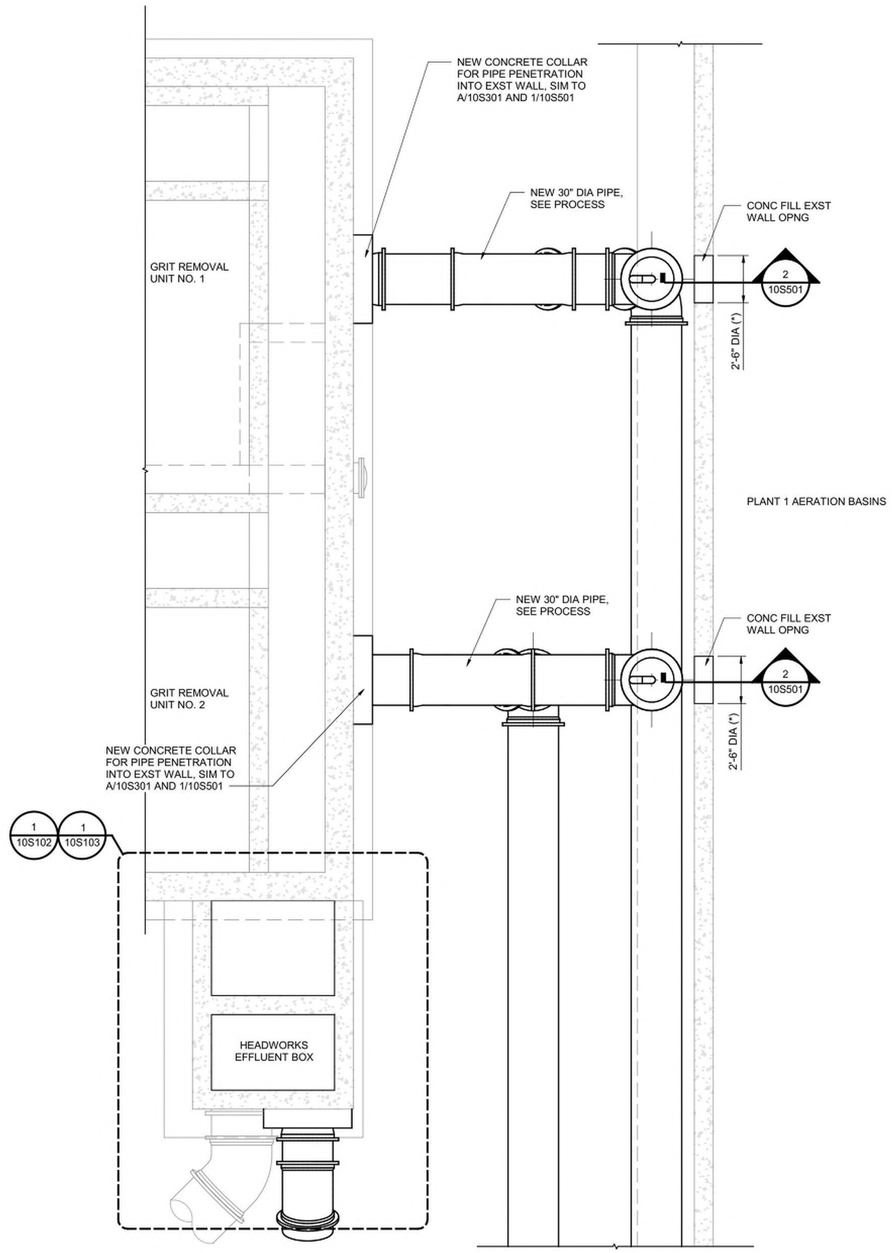


AREA PLAN

1/4" = 1'-0"

PLAN NOTES:

1. CONSTRUCTION SEQUENCING REQUIREMENTS APPLY TO THE WORK IN THIS AREA. SEE SPECIFICATION SECTION 01 14 16 - COORDINATION WITH OWNER'S OPERATIONS FOR DETAILS.
2. ALL GRAYED-OUT LINE-WORK REPRESENTS EXISTING STRUCTURE INFORMATION AND IS BASED ON THE HISTORICAL DRAWINGS INDICATED BELOW. CONTRACTOR SHALL FIELD VERIFY EXISTING CONDITIONS AND NOTIFY ENGINEER OF ANY DISCREPANCIES PRIOR TO CONSTRUCTION. ALL BLACK LINE-WORK REPRESENTS THE NEW WORK DONE FOR THIS PROJECT.
   A. PROJECT NO. 5395 WASTEWATER TREATMENT PLANT EXPANSION BY BIRKHOFF, HENDRICKS & CONWAY, L.L.P. DATED SEPTEMBER 2004.
   B. 1995 WASTEWATER TREATMENT PLANT AND LIFT STATION IMPROVEMENTS BY NRS DATED MARCH 1995.
   C. EXPANSION OF WASTWATER TREATMENT PLANT BY SHIMEK, JACOBS & FINKLEA DATED APRIL 1987.
3. DIMENSIONS AND ELEVATIONS INDICATED WITH AN (*) ARE BASED ON EXISTING CONSTRUCTION PLANS DESCRIBED IN NOTE #2 AND ARE TO BE VERIFIED BY THE CONTRACTOR. ANY DISCREPANCIES SHALL BE SUBMITTED TO THE ENGINEER PRIOR TO CONSTRUCTION.
4. SEE STANDARD DRAWINGS FOR GENERAL STRUCTURAL NOTES AND STANDARD DETAILS.
5. SEE PROCESS/MECHANICAL DRAWINGS FOR ALL PIPE SIZES, LOCATIONS, AND PENETRATION DETAILS.
6. DO NOT UNDERMINE EXISTING STRUCTURES TO REMAIN.

HDR
TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13/2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	W. DONELAN
DRAWN BY	H. GARCIA
CHECKED BY	C. ZIMMERMAN
APPROVED BY	J. NAVE
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
JASON C. NAVE
130766
06/13/25

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK

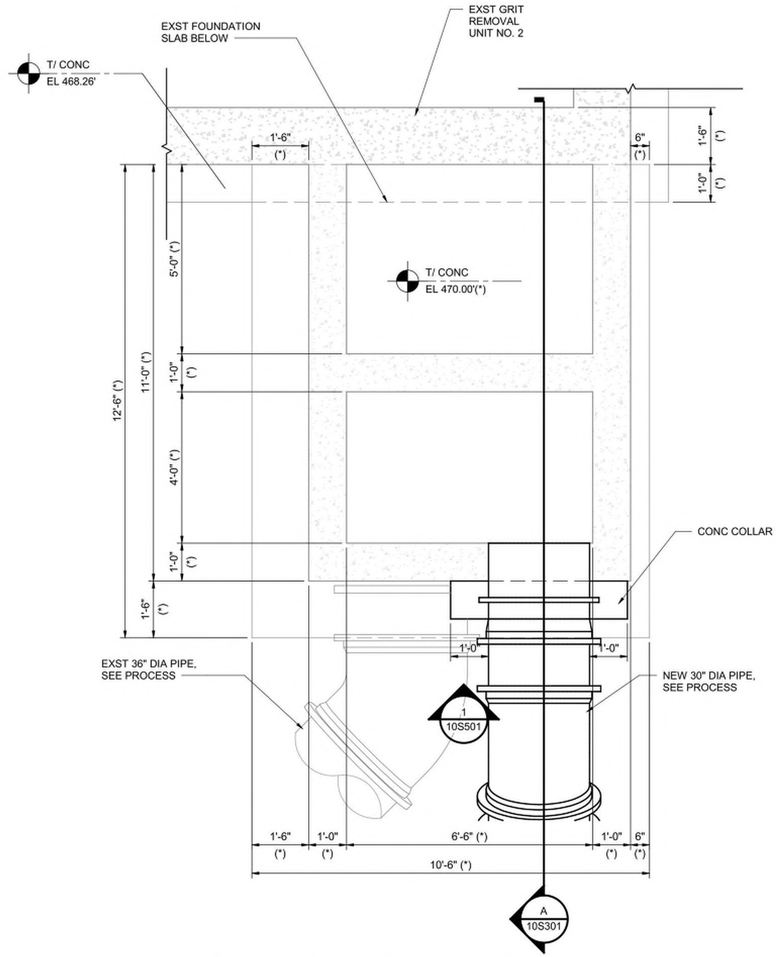
AERATION BASIN EXPANSION

HEADWORKS EFFLUENT STRUCTURE (EXISTING) STRUCTURAL PLAN

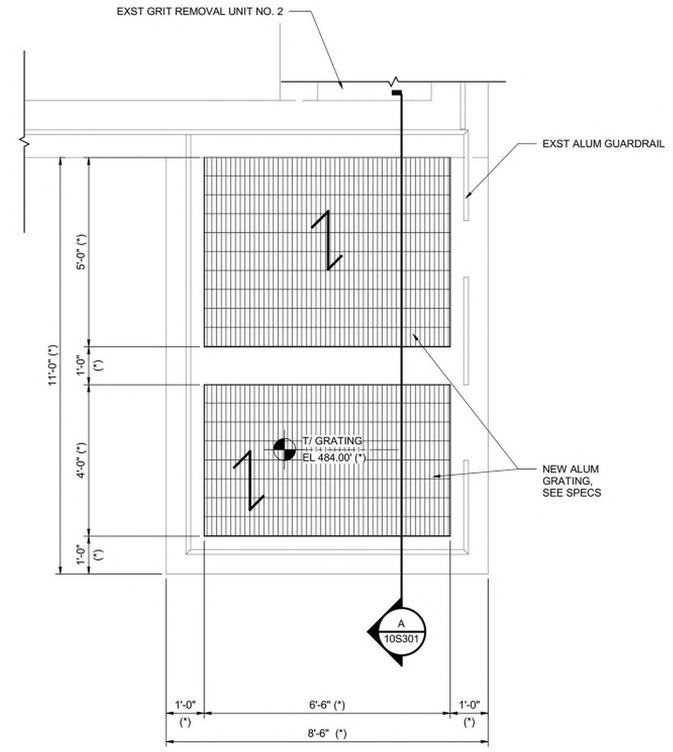
N

0 1" 2"

FILENAME: HDRE_ALL_DISCIPLINES.rte
SCALE: 1/4" = 1'-0"
SHEET: 10S101



1 10S101 FOUNDATION PLAN
1/2" = 1'-0"



2 10S101 UPPER PLAN
1/2" = 1'-0"

PLAN NOTES:

1. CONSTRUCTION SEQUENCING REQUIREMENTS APPLY TO THE WORK IN THIS AREA. SEE SECTION 01 14 16 - COORDINATION WITH OWNER'S OPERATIONS FOR DETAILS.
2. ALL GRAYED-OUT LINE-WORK REPRESENTS EXISTING STRUCTURE INFORMATION AND IS BASED ON THE HISTORICAL DRAWINGS INDICATED BELOW. CONTRACTOR SHALL FIELD VERIFY EXISTING CONDITIONS AND NOTIFY ENGINEER OF ANY DISCREPANCIES PRIOR TO CONSTRUCTION. ALL BLACK LINE-WORK REPRESENTS THE NEW WORK DONE FOR THIS PROJECT.
   A. PROJECT NO. 5395 WASTEWATER TREATMENT PLANT EXPANSION BY BIRKHOFF, HENDRICKS & CONWAY, L.L.P. DATED SEPTEMBER 2004.
   B. 1995 WASTEWATER TREATMENT PLANT AND LIFT STATION IMPROVEMENTS BY NRS DATED MARCH 1995.
   C. EXPANSION OF WASTWATER TREATMENT PLANT BY SHIMEK, JACOBS & FINKLEA DATED APRIL 1987.
3. SEE STANDARD DRAWINGS FOR GENERAL STRUCTURAL NOTES AND STANDARD DETAILS.
4. DIMENSIONS AND ELEVATIONS INDICATED WITH AN (*) ARE BASED ON EXISTING CONSTRUCTION PLANS DESCRIBED IN NOTE #2 AND ARE TO BE VERIFIED BY THE CONTRACTOR. ANY DISCREPANCIES SHALL BE SUBMITTED TO THE ENGINEER PRIOR TO CONSTRUCTION.
5. SEE PROCESS/MECHANICAL DRAWINGS FOR ALL PIPE SIZES, LOCATIONS, AND PENETRATION DETAILS.
6. ALL GRATING SHALL BE ALUMINUM, SEE SPECIFICATIONS. ALL OPENINGS AND EDGES IN GRATING SHALL BE BANDED. GRATING DEPTH SHALL BE 2 IN, UNLESS OTHERWISE NOTED.
7. DO NOT UNDERMINE EXISTING STRUCTURES TO REMAIN.

LEGEND

SPAN DIRECTION

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
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PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	W. DONELAN
DRAWN BY	H. GARCIA
CHECKED BY	C. ZIMMERMAN
APPROVED BY	J. NAVE
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
JASON C. NAVE
130766
06/13/25

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK

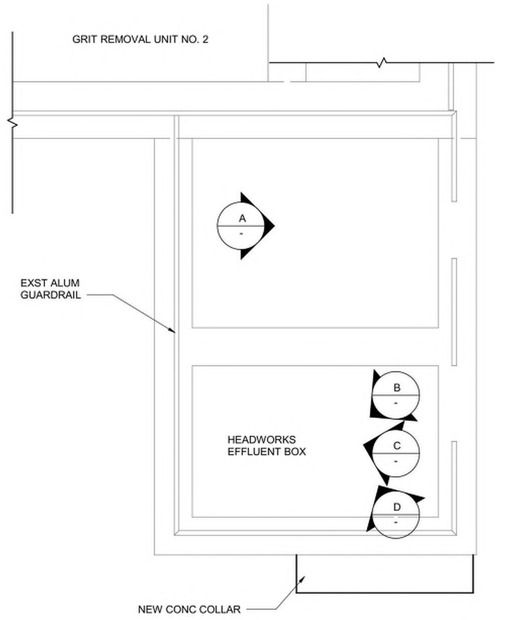
AERATION BASIN EXPANSION

HEADWORKS EFFLUENT STRUCTURE (EXISTING) STRUCTURAL
HEADWORKS EFFLUENT BOX PLANS

N

0 1" 2"

FILENAME: HDRE_ALL_DISCIPLINES.rte
SCALE: 1/2" = 1'-0"
SHEET: 10S102



1 PHOTOGRAPH KEY PLAN
1/2" = 1'-0"

A PHOTOGRAPH 1
NOT TO SCALE

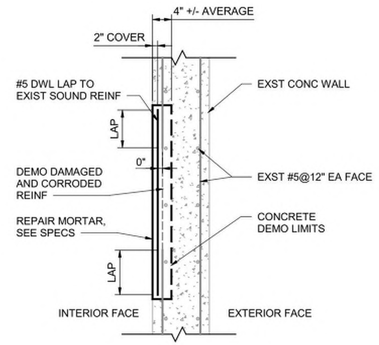
B PHOTOGRAPH 2
NOT TO SCALE

C PHOTOGRAPH 3
NOT TO SCALE

D PHOTOGRAPH 4
NOT TO SCALE

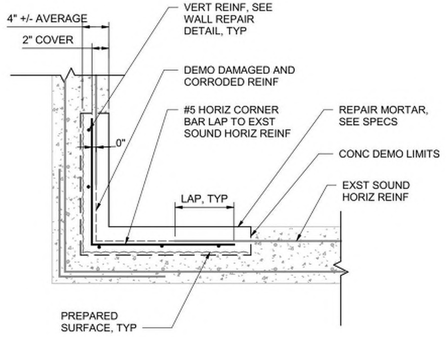
REPAIR NOTES:

1. PHOTOGRAPHS ARE INCLUDED TO DEPICT ACTUAL CONDITION OF STRUCTURE AS OF JANUARY 2025 AND SHALL BE USED TO DEVELOP A BASIS OF UNDERSTANDING OF THE LEVEL AND EXTENT OF CONCRETE AND REINFORCING DETERIORATION EXISTING AND QUANTITY OF REPAIR NEEDED.
2. CONTRACTOR SHALL PROVIDE MINIMUM 14 DAYS NOTICE TO OWNER'S REPRESENTATIVE AND ENGINEER ONCE EXISTING STRUCTURE HAS BEEN TAKEN OFF LINE AND CLEANED. CONTRACTOR SHALL PROVIDE ACCESS AND ASSISTANCE TO OWNER'S REPRESENTATIVE AND ENGINEER TO CONDUCT A CONDITION ASSESSMENT AND IDENTIFY AND MARK GENERAL EXTENTS OF AREAS TO BE REPAIRED.
3. SAW CUT MINIMUM 1/2" DEEP AROUND AREA TO BE REPAIRED TO PREVENT FEATHERED EDGES. REPAIR AREA TO BE RECTANGULAR WITHOUT ANY ACUTE ANGLES. REMOVE CONCRETE 1" ALL AROUND EXPOSED EXISTING REINFORCING IF GREATER THAN 1/2" BAR DIAMETER IS EXPOSED. DO NOT DAMAGE EXISTING REINFORCING DURING SAW-CUTTING.
4. PREPARE EXISTING CONCRETE SURFACE PER SPECIFICATIONS AND REPAIR MORTAR MANUFACTURER'S INSTRUCTIONS TO REMOVE LOOSE AND DETERIORATED CONCRETE TO EXPOSE SOUND CONCRETE SUBSTRATE (1/2"-2" AVERAGE EXPECTED REMOVAL FROM DETERIORATED SURFACE).
5. REMOVE CORROSION FROM REINFORCING PRIOR TO PATCHING AND COAT ALL NEW AND EXISTING EXPOSED REINFORCING STEEL WITH APPROVED CORROSION INHIBITOR SIMILAR TO SIKA ARMATEC 110 EPOCEM, SEE SPECIFICATIONS.
6. APPLY AND CURE APPROVED REPAIR MORTAR PER SPECIFICATIONS AND MANUFACTURER INSTRUCTIONS TO WALLS. IN NO CASE SHALL CLEAR COVER BE LESS THEN 2 INCHES AFTER REPAIR.
7. PAYMENT FOR CONCRETE REPAIRS WILL BE BASED ON A SQUARE FOOT BASIS AND PAYMENT FOR REINFORCEMENT WILL BE BASED ON A LINEAR FOOT BASIS AS DESCRIBED IN SPECIFICATION 03 01 30. CONTRACTOR TO ASSUME 40 SQUARE FEET OF TYPE I (THIN) CONCRETE REPAIR, 40 SQUARE FEET OF TYPE II (MODERATE) CONCRETE REPAIR, 20 SQUARE FEET OF TYPE III (SEVERE) CONCRETE REPAIR AND 50 LINEAR FEET OF REINFORCEMENT REPLACEMENT FOR BIDDING PURPOSES.
8. ADD/DEDUCT UNIT PRICES INCLUDED IN THE SPECIFICATION SHALL INCLUDE MATERIAL, LABOR, MEANS OF ACCESSING THE WORK, REMOVAL OF WASTE MATERIALS AND DEMOLISHED STRUCTURE AND ALL OTHER COSTS AS REQUIRED TO PERFORM THE WORK.
9. COAT ALL INTERIOR SURFACES OF HEADWORKS EFFLUENT BOX AFTER REPAIRS ARE COMPLETED PER SPECIFICATION 09 96 00.

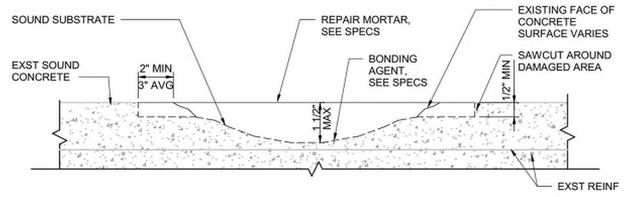


NOTE:
DETAIL SIMILAR FOR HORIZ REINF REPAIR

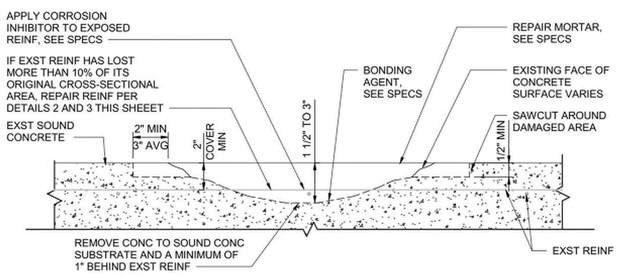
2 WALL REINFORCEMENT REPLACEMENT DETAIL
3/4" = 1'-0"



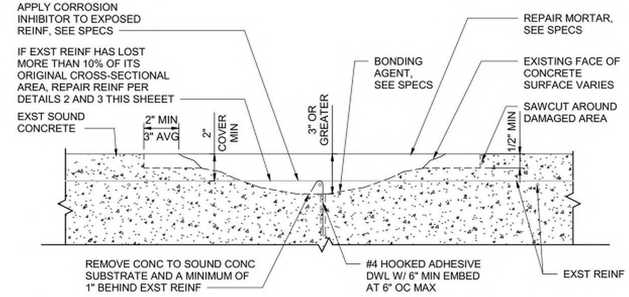
3 WALL REINFORCEMENT REPLACEMENT DETAIL AT CORNER
3/4" = 1'-0"



4 TYPE I (THIN) CONCRETE REPAIR DETAIL (NO EXPOSED REINFORCEMENT)
NOT TO SCALE



5 TYPE II (MODERATE) CONCRETE REPAIR DETAIL
NOT TO SCALE



6 TYPE III (SEVERE) CONCRETE REPAIR DETAIL
NOT TO SCALE

HDR
TEXAS P.E. FIRM
Registration No. F-754

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PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	W. DONELAN
DRAWN BY	H. GARCIA
CHECKED BY	C. ZIMMERMAN
APPROVED BY	J. NAVE
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
JASON C. NAVE
130766
06/13/25

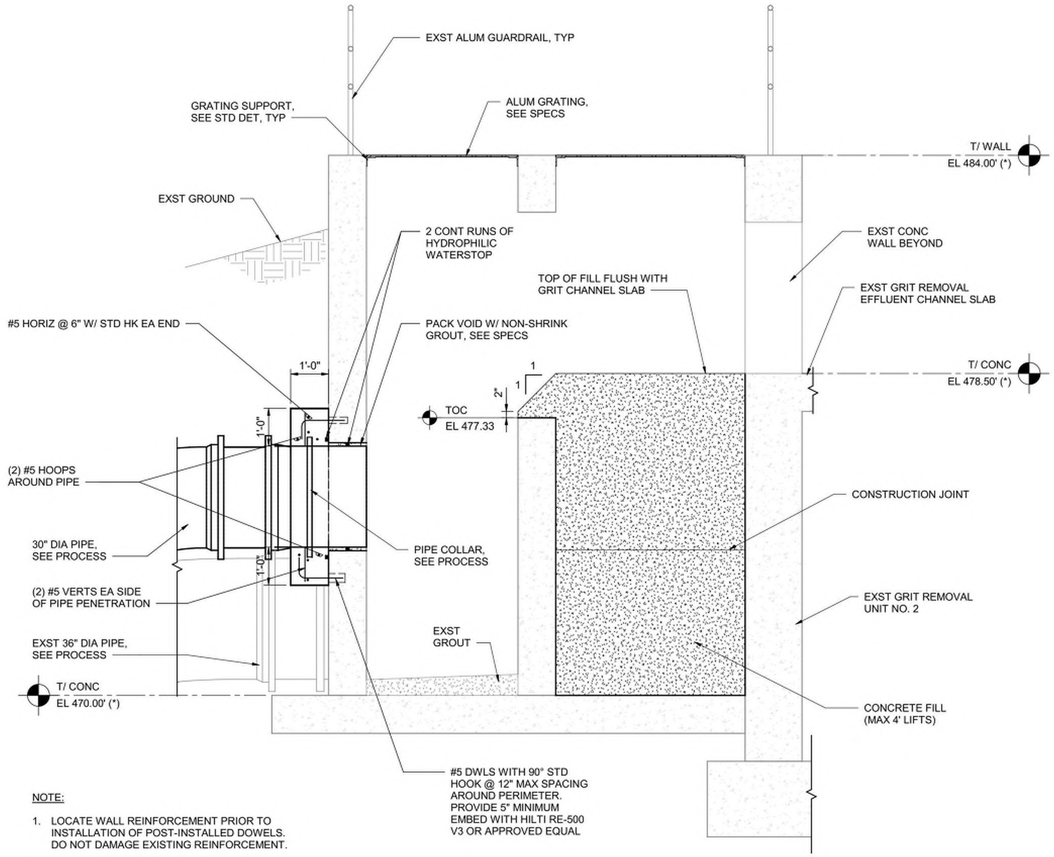
LEWISVILLE
Deep Roots. Broad Wings. Bright Future

CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

HEADWORKS EFFLUENT STRUCTURE (EXISTING)
STRUCTURAL
HEADWORKS EFFLUENT BOX REPAIR

FILENAME: HDRE_ALL_DISCIPLINES.rte
SCALE: As indicated
0 1" 2"
SHEET: 10S103



NOTE:

1. LOCATE WALL REINFORCEMENT PRIOR TO INSTALLATION OF POST-INSTALLED DOWELS. DO NOT DAMAGE EXISTING REINFORCEMENT.
2. ELEVATIONS INDICATED BY (*) SHALL BE VERIFIED BY THE CONTRACTOR BASED ON AS-BUILT CONDITIONS.

A / 10S102 SECTION

1/2" = 1'-0"

TEXAS P.E. FIRM
Registration No. F-754

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06/13/25

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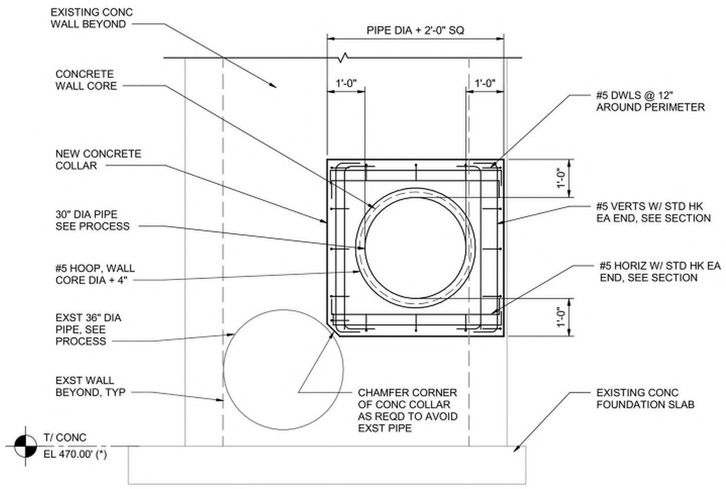
PRAIRIE CREEK

AERATION BASIN EXPANSION

HEADWORKS EFFLUENT STRUCTURE (EXISTING) STRUCTURAL
HEADWORKS EFFLUENT BOX SECTION

0 1" 2"

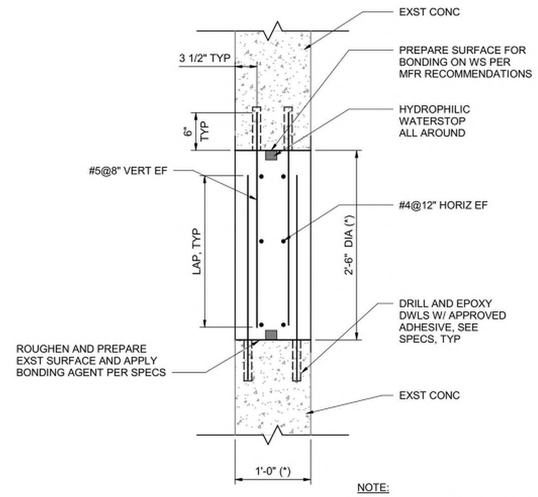
FILENAME HDRE_ALL_DISCIPLINES.rte
SCALE 1/2" = 1'-0"
SHEET **10S301**



NOTE:

1. ELEVATIONS INDICATED BY (*) SHALL BE VERIFIED BY THE CONTRACTOR BASED ON AS-BUILT CONDITIONS.

1 / 10S102 ELEVATION
1/2" = 1'-0"



NOTE:

1. DIMENSIONS INDICATED BY (*) SHALL BE VERIFIED BY THE CONTRACTOR BASED ON AS-BUILT CONDITIONS.

2 / 10S101 DETAIL
1" = 1'-0"

TEXAS P.E. FIRM
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06/13/25

LEWISVILLE
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CITY OF LEWISVILLE
PRAIRIE CREEK

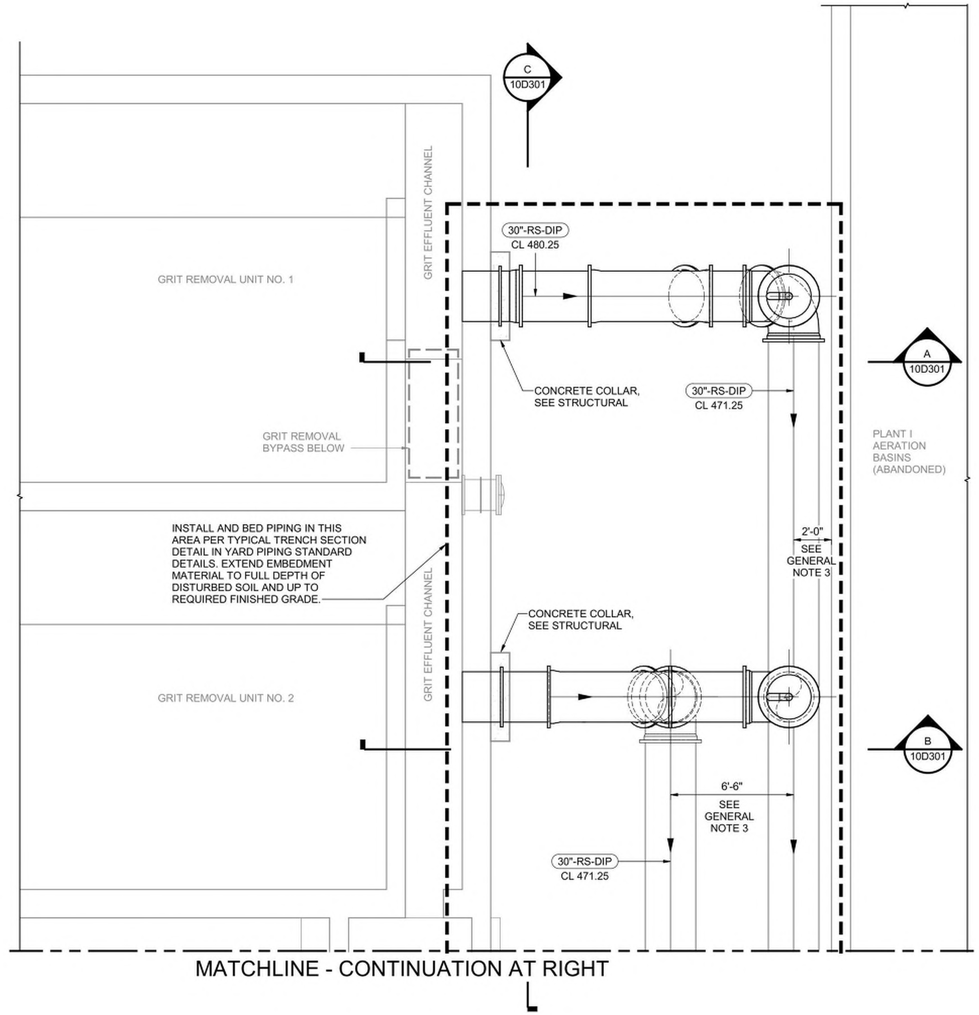
AERATION BASIN EXPANSION

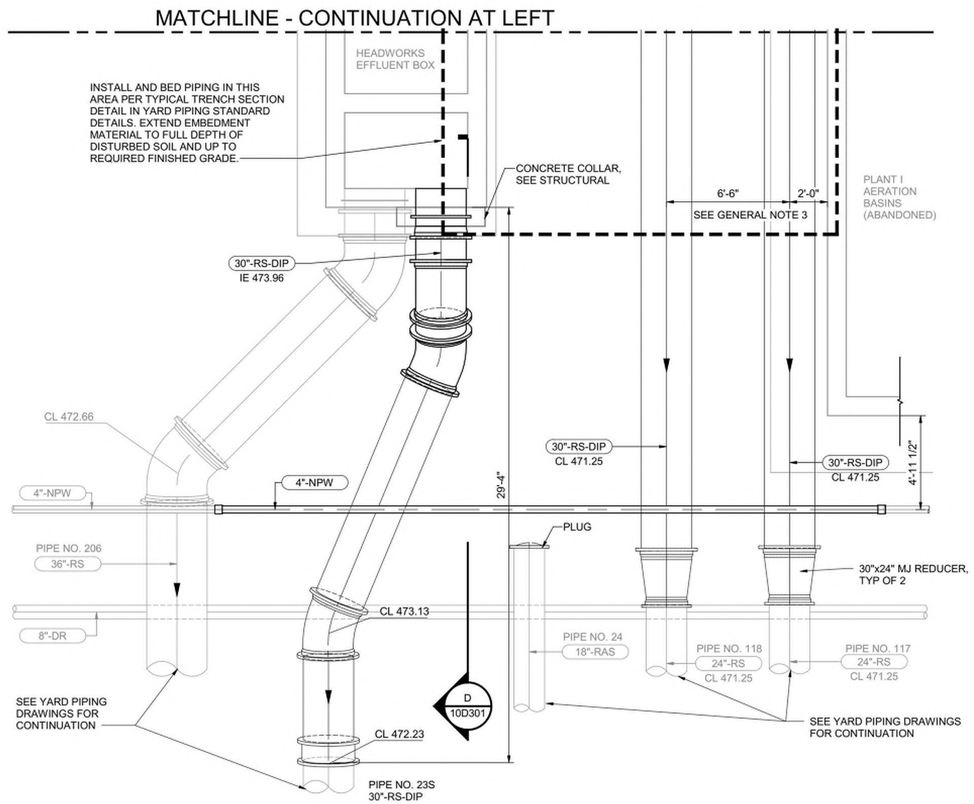
HEADWORKS EFFLUENT STRUCTURE (EXISTING) STRUCTURAL DETAILS

0 1" 2"

FILENAME	HDRE_ALL_DISCIPLINES.rte
SCALE	As indicated

SHEET 10S501





1 NORTH PIPING PLAN
1/4" = 1'-0"

2 SOUTH PIPING PLAN
1/4" = 1'-0"

GENERAL NOTES:

1. CONSTRUCTION SEQUENCING REQUIREMENTS APPLY TO THE WORK IN THIS AREA. SEE SECTION 01 14 16 - COORDINATION WITH OWNER'S OPERATIONS FOR DETAILS.
2. SEE EXISTING CONDITIONS NOTE ON DRAWING 10DX101.
3. ALL GRAYED-OUT LINE-WORK REPRESENTS EXISTING STRUCTURE INFORMATION AND IS BASED ON THE HISTORICAL DRAWINGS INDICATED BELOW. CONTRACTOR SHALL FIELD VERIFY EXISTING CONDITIONS AND NOTIFY ENGINEER OF ANY DISCREPANCIES PRIOR TO CONSTRUCTION. ALL BLACK LINE-WORK REPRESENTS THE NEW WORK DONE FOR THIS PROJECT.
   - A. PROJECT NO. 5395 WASTEWATER TREATMENT PLANT EXPANSION BY BIRKHOFF, HENDRICKS & CONWAY, L.L.P. DATED SEPTEMBER 2004.
   - B. 1995 WASTEWATER TREATMENT PLANT AND LIFT STATION IMPROVEMENTS BY NRS DATED MARCH 1995.
   - C. EXPANSION OF WASTWATER TREATMENT PLANT BY SHIMEK, JACOBS & FINKLEA DATED APRIL 1987.

Autodesk Docs://10342803_COL_PCWWT_AB_Expansion_2024/10 - HEADWORKS EFFLUENT SPLITTER STRUCTURES (EXISTING) - PROCESS.rvt
6/13/2025 9:38:52 AM

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13/2025	ISSUED FOR BID

PROJECT MANAGER	J. R. CANTWELL
DESIGNED BY	A. VAN SICKLE
DRAWN BY	A. FREEMON
CHECKED BY	M. BOND
APPROVED BY	T. PAULMANN
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
THOMAS A. PAULMANN
128794
LICENSED
PROFESSIONAL ENGINEER
6/13/25

LEWISVILLE
Deep Roots. Broad Wings. Bright Future

CITY OF LEWISVILLE
PRAIRIE CREEK

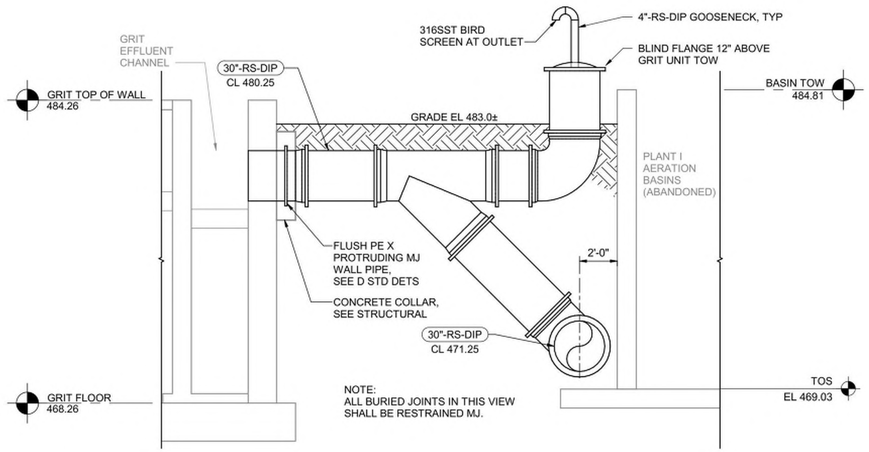
AERATION BASIN EXPANSION

N
0 1" 2"

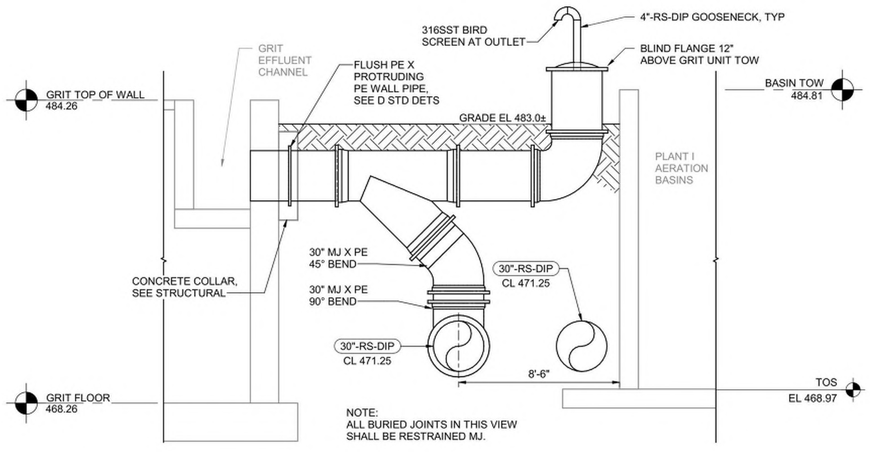
HEADWORKS EFFLUENT STRUCTURE PROCESS PLANS

FILENAME: 10 - HEADWORKS EFFLUENT STRUCTURE (EXISTING)
SCALE: 1/4" = 1'-0"

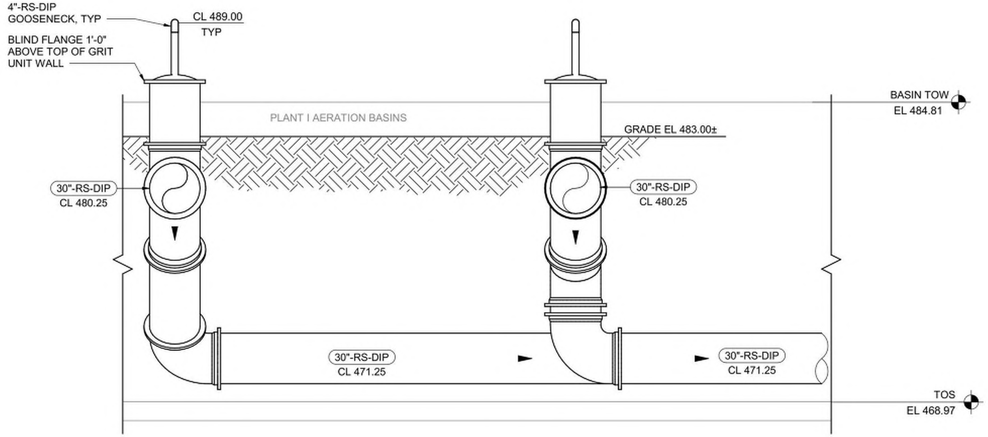
SHEET: **10D101**



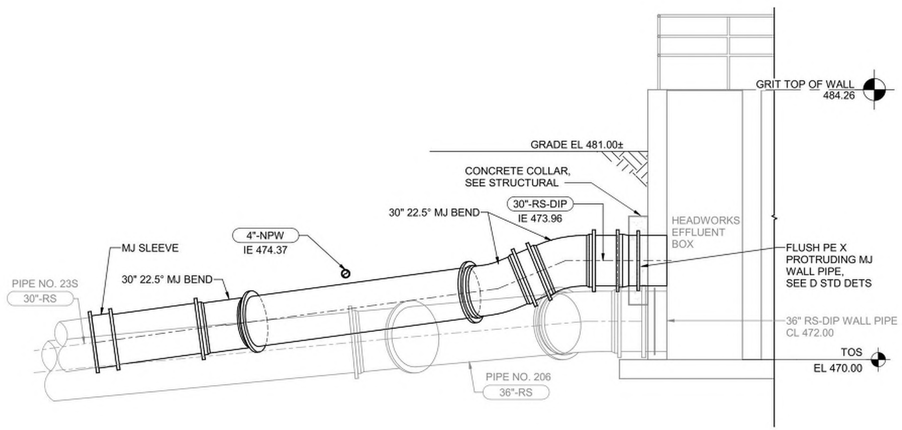
A 10D101 **SECTION**
1/4" = 1'-0"



B 10D101 **SECTION**
1/4" = 1'-0"



C 10D101 **SECTION**
1/4" = 1'-0"



D 10D101 **SECTION**
1/4" = 1'-0"

GENERAL NOTES:

1. SEE GENERAL NOTES ON DRAWING 10D101.
2. ALL GRAYED-OUT LINE-WORK REPRESENTS EXISTING STRUCTURE INFORMATION AND IS BASED ON THE HISTORICAL DRAWINGS INDICATED BELOW. CONTRACTOR SHALL FIELD VERIFY EXISTING CONDITIONS AND NOTIFY ENGINEER OF ANY DISCREPANCIES PRIOR TO CONSTRUCTION. ALL BLACK LINE-WORK REPRESENTS THE NEW WORK DONE FOR THIS PROJECT.
   - A. PROJECT NO. 5395 WASTEWATER TREATMENT PLANT EXPANSION BY BIRKHOFF, HENDRICKS & CONWAY, L.L.P. DATED SEPTEMBER 2004.
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Autodesk Docs://10342803_COL_PCWWT_AB_Expansion_2024/10 - HEADWORKS EFFLUENT SPLITTER STRUCTURES (EXISTING) - PROCESS.rvt
6/13/2025 9:38:53 AM

TEXAS P.E. FIRM
Registration No. F-754

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CHECKED BY	M. BOND
APPROVED BY	T. PAULMANN
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS · THOMAS A. PAULMANN · 128794 · LICENSED PROFESSIONAL ENGINEER · 6/13/25

LEWISVILLE
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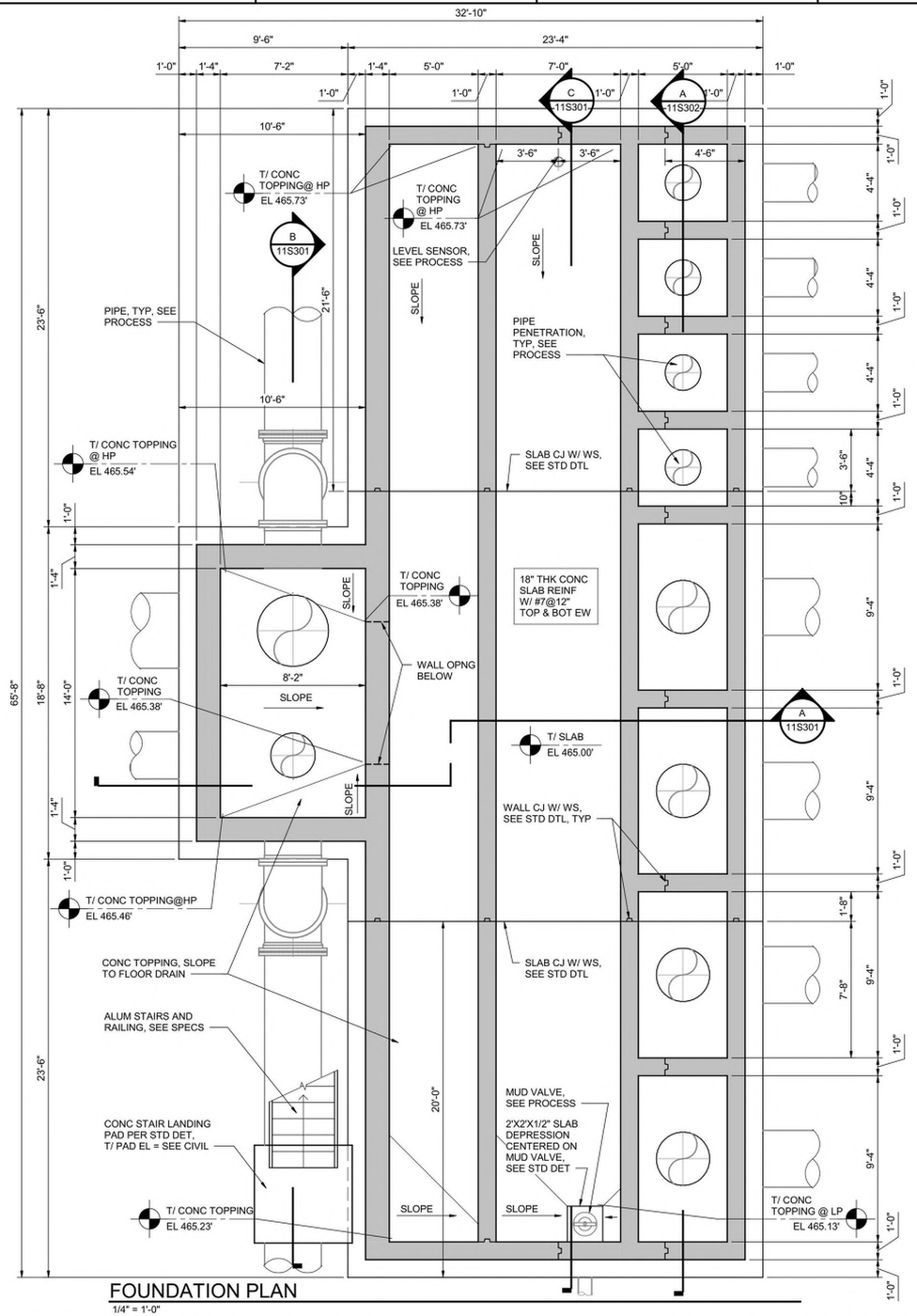
CITY OF LEWISVILLE
PRAIRIE CREEK

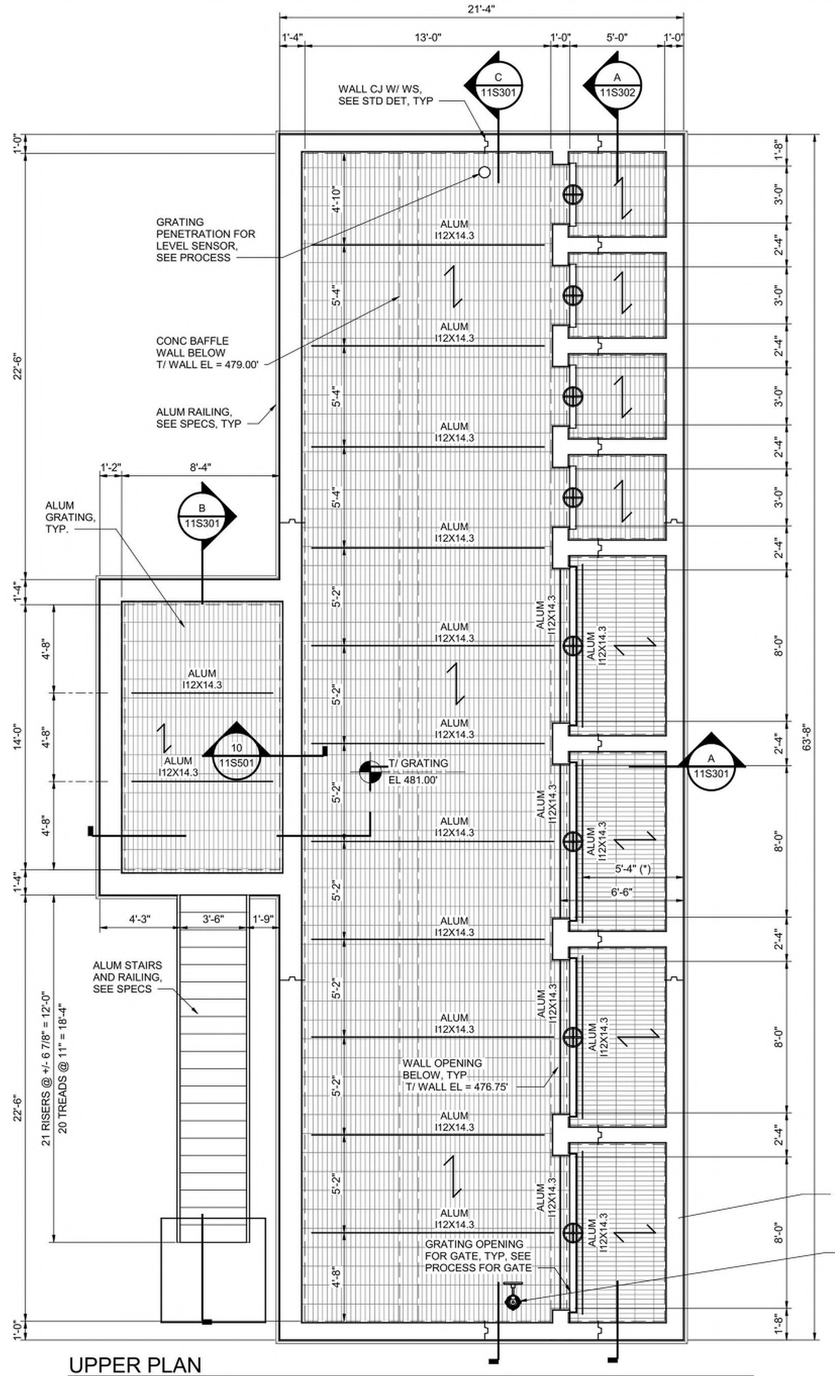
AERATION BASIN EXPANSION

HEADWORKS EFFLUENT STRUCTURE PROCESS SECTIONS

FILENAME: 10 - HEADWORKS EFFLUENT STRUCTURE (EXISTING)
SCALE: 1/4" = 1'-0"
0 1" 2"

SHEET **10D301**





PLAN NOTES:

1. SEE STANDARD DRAWINGS FOR GENERAL STRUCTURAL NOTES AND STANDARD DETAILS.
2. SEE PROCESS/MECHANICAL DRAWINGS FOR ALL PIPE SIZES, LOCATIONS, AND PENETRATION DETAILS.
3. ALL STAIR FRAMING, GRATING AND RAILING SHALL BE ALUMINUM, SEE SPECIFICATIONS. ALL OPENINGS AND EDGES IN GRATING SHALL BE BANDED. GRATING DEPTH SHALL BE 2 IN, UNLESS OTHERWISE NOTED.
4. ALL FOUNDATION CONCRETE SHALL CONTAIN CRYSTALLINE CEMENTITIOUS WATERPROOFING ADMIXTURE AND ALL CONCRETE ABOVE FOUNDATION SHALL CONTAIN XYPEX BIO-SAN C500 ANTIMICROBIAL CRYSTALLINE ADMIXTURE. REFERENCE SPECIFICATION 03 31 30.
5. ALL PIPING BELOW THE FOUNDATION SHALL BE ENCASED PER STANDARD DETAILS TO EDGE OF FOUNDATION.
6. DIMENSIONS INDICATED WITH AN ASTERISK (*) SHALL BE COORDINATED WITH EQUIPMENT PROVIDED.

LEGEND

SPAN DIRECTION

HDR
TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
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DESIGNED BY	W. DONELAN
DRAWN BY	H. GARCIA
CHECKED BY	C. ZIMMERMAN
APPROVED BY	J. NAVE
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
JASON C. NAVE
130766
10/16/25

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PRAIRIE CREEK

AERATION BASIN EXPANSION

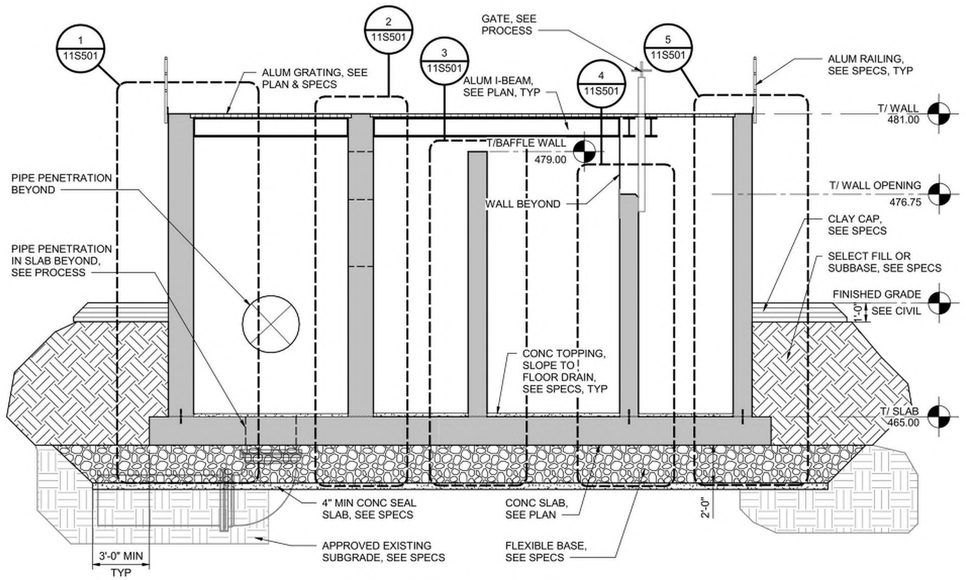
N

0 1" 2"

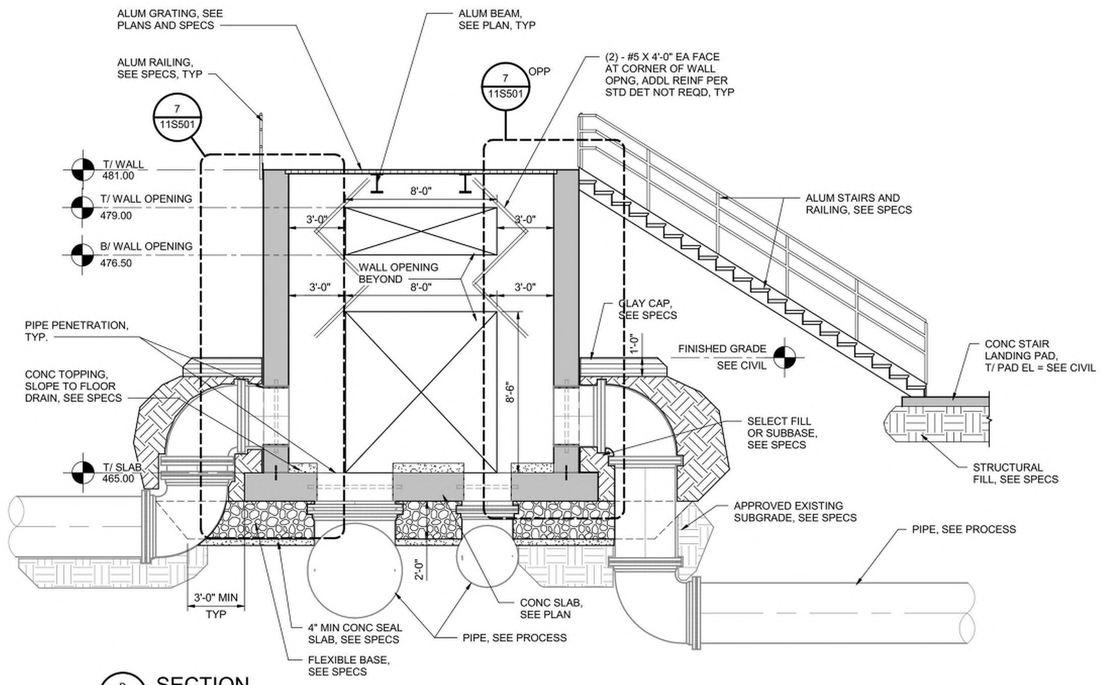
AERATION BASIN SPLITTER STRUCTURE
STRUCTURAL
PLANS

FILENAME	STRUCTURAL CONTAINER FILE.RVT
SCALE	1/4" = 1'-0"

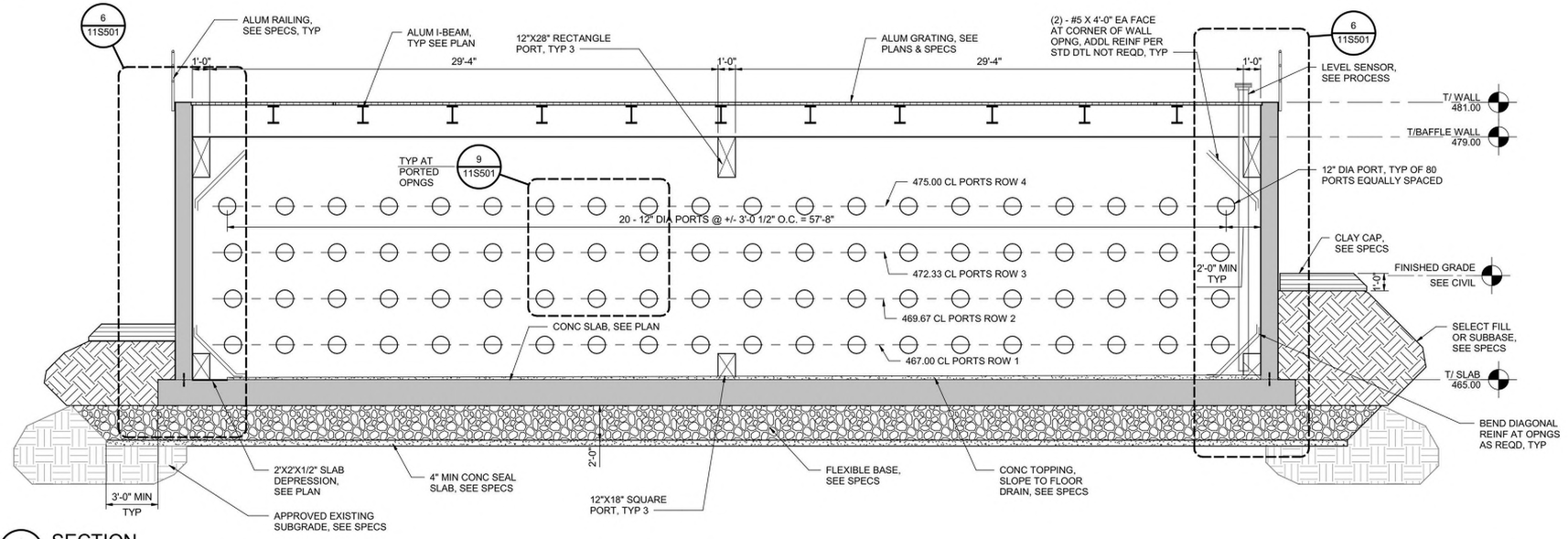
SHEET 11S101



A 11S101 SECTION
1/4" = 1'-0"



B 11S101 SECTION
1/4" = 1'-0"



C 11S101 SECTION
1/4" = 1'-0"

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CITY OF LEWISVILLE
PRAIRIE CREEK

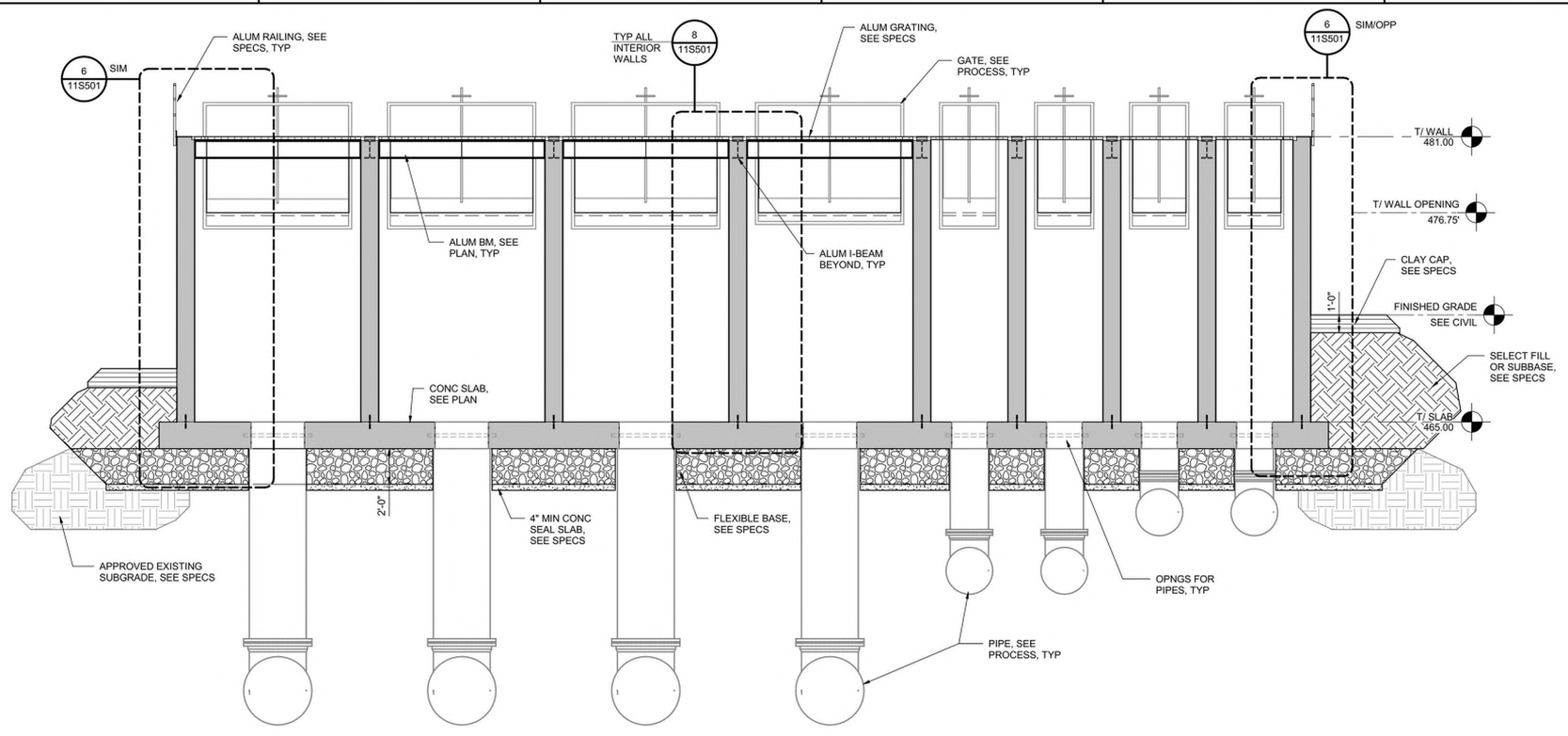
AERATION BASIN EXPANSION

AERATION BASIN SPLITTER STRUCTURE STRUCTURAL SECTIONS

0 1" 2"

FILENAME: STRUCTURAL CONTAINER FILE.RVT
SCALE: 1/4" = 1'-0"

SHEET
11S301



A
11S101
SECTION
1/4" = 1'-0"

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CITY OF LEWISVILLE
PRAIRIE CREEK

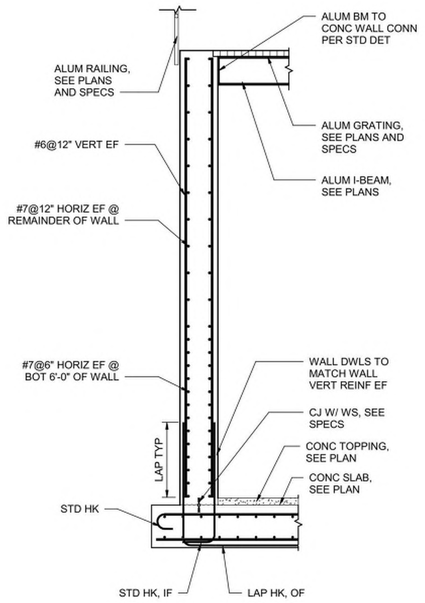
AERATION BASIN EXPANSION

AERATION BASIN SPLITTER STRUCTURE
STRUCTURAL
SECTIONS

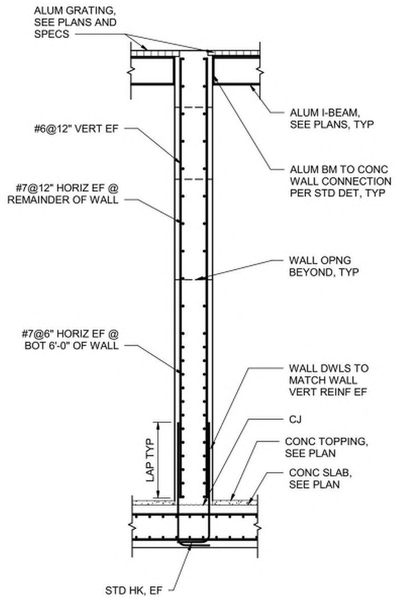
0 1" 2"

FILENAME: STRUCTURAL CONTAINER FILE.RVT
SCALE: 1/4" = 1'-0"

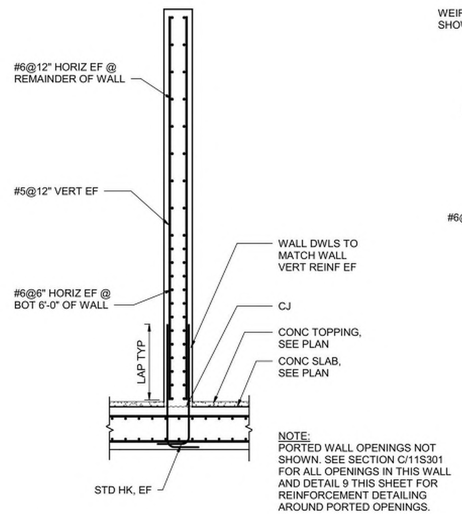
SHEET
11S302



1 DETAIL
11S301 3/8" = 1'-0"

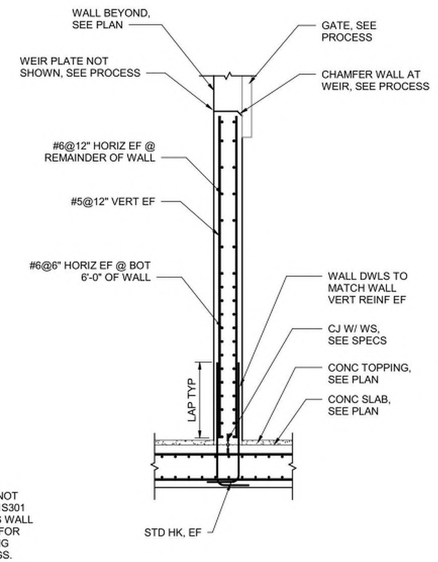


2 DETAIL
11S301 3/8" = 1'-0"

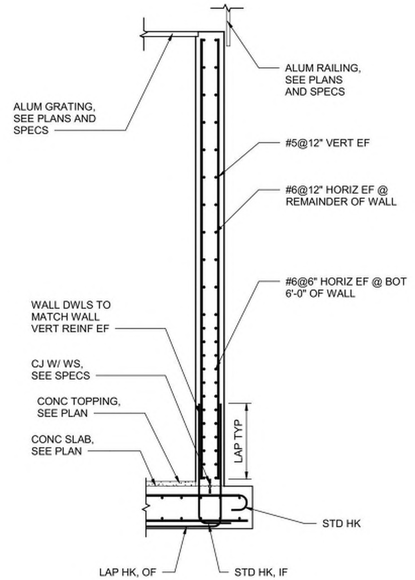


NOTE:
PORTED WALL OPENINGS NOT SHOWN. SEE SECTION C/11S301 FOR ALL OPENINGS IN THIS WALL AND DETAIL 9 THIS SHEET FOR REINFORCEMENT DETAILING AROUND PORTED OPENINGS.

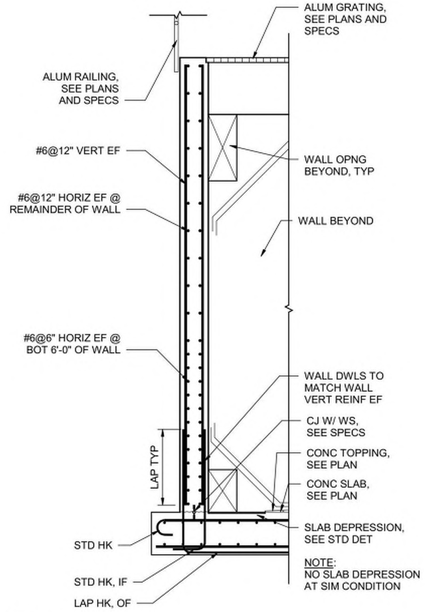
3 DETAIL
11S301 3/8" = 1'-0"



4 DETAIL
11S301 3/8" = 1'-0"

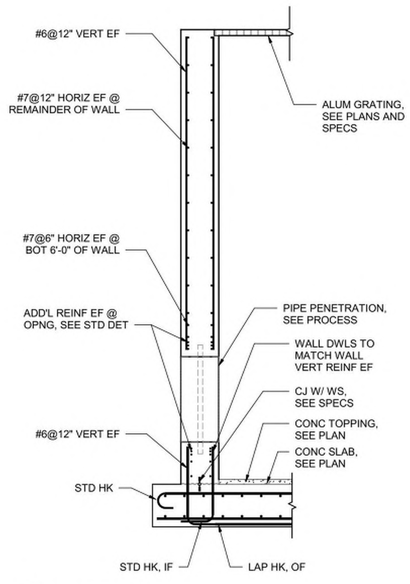


5 DETAIL
11S301 3/8" = 1'-0"

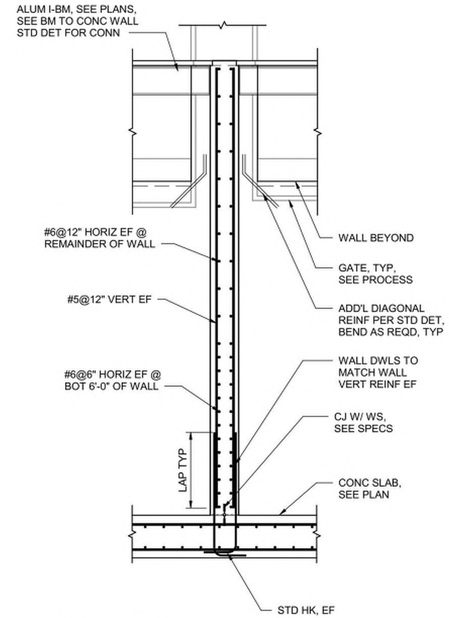


NOTE:
NO SLAB DEPRESSION AT SIM CONDITION

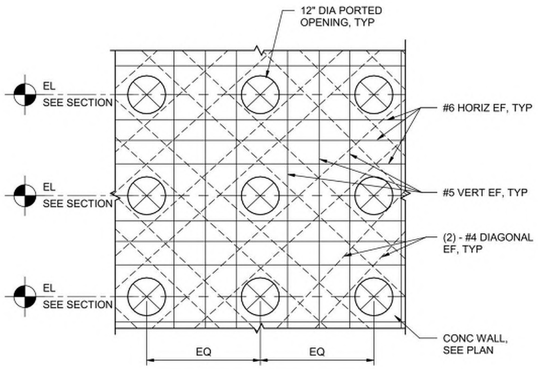
6 DETAIL
11S301 3/8" = 1'-0"



7 DETAIL
11S301 3/8" = 1'-0"

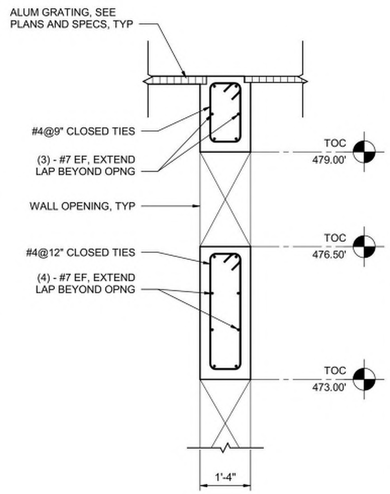


8 DETAIL
11S302 3/8" = 1'-0"



NOTE:
SEE DETAIL 3 THIS SHEET FOR VERTICAL AND HORIZONTAL WALL REINFORCEMENT SPACING.

9 DETAIL
11S301 1/2" = 1'-0"



10 DETAIL
11S101 1/2" = 1'-0"

HDR
TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	OCT 16/2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	W. DONELAN
DRAWN BY	H. GARCIA
CHECKED BY	C. ZIMMERMAN
APPROVED BY	J. NAVE
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
JASON C. NAVE
130766
10/16/25

LEWISVILLE
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CITY OF LEWISVILLE
PRAIRIE CREEK

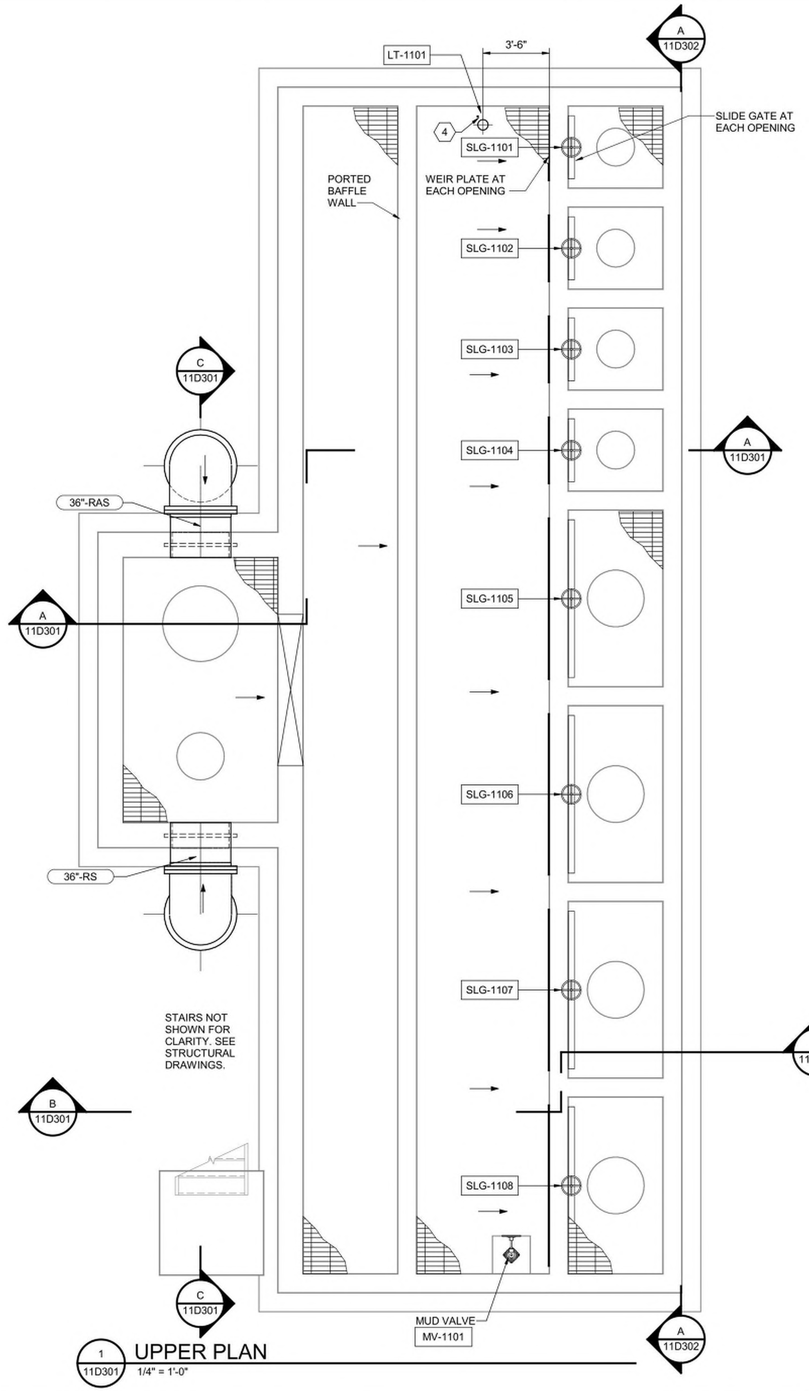
AERATION BASIN EXPANSION

AERATION BASIN SPLITTER STRUCTURE STRUCTURAL DETAILS

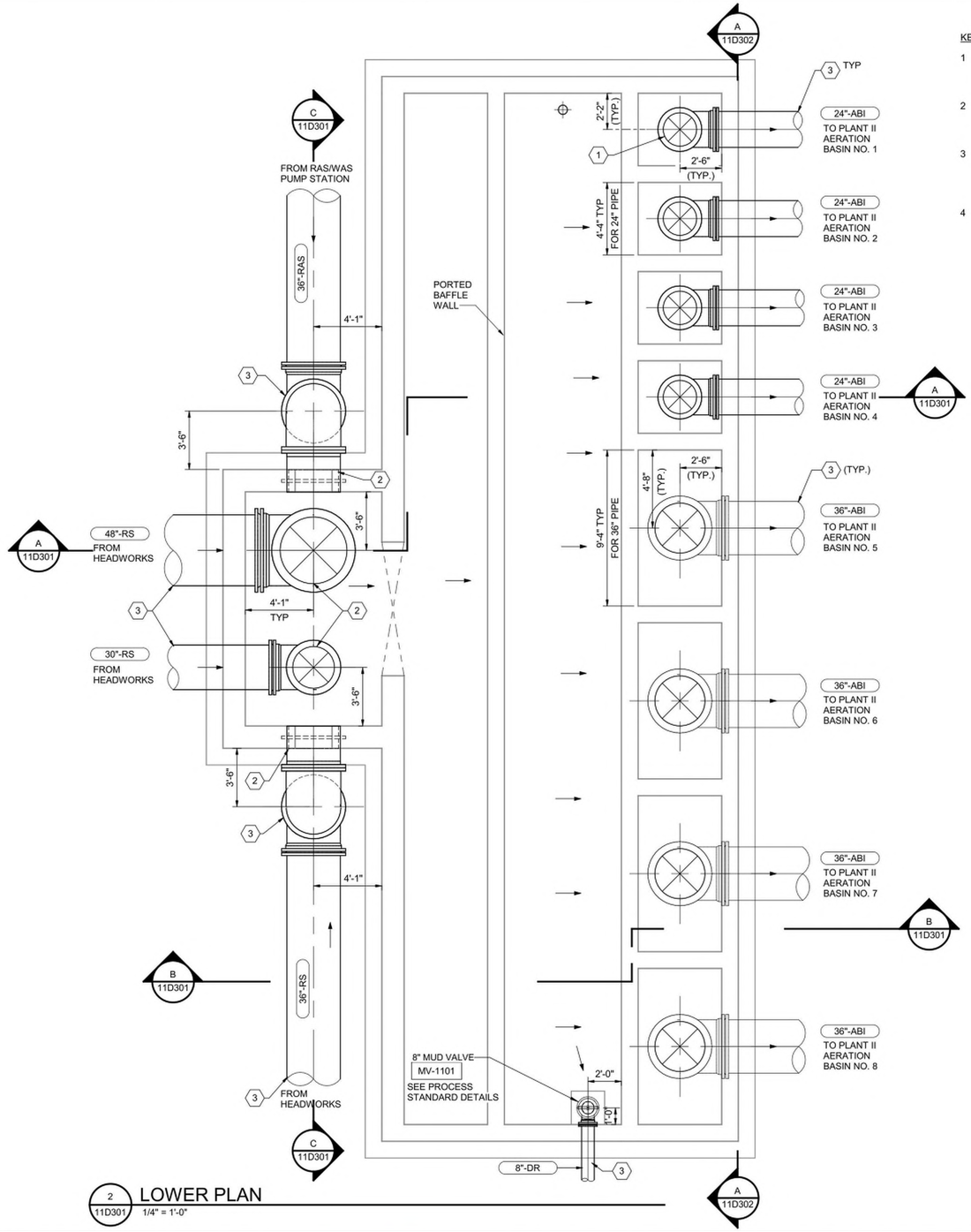
0 1" 2"

FILENAME: STRUCTURAL CONTAINER FILE.RVT
SCALE: As indicated

SHEET: 11S501



1 11D301 UPPER PLAN
1/4" = 1'-0"



2 11D301 LOWER PLAN
1/4" = 1'-0"

KEYNOTES (#)

1 FLUSH PE X PROTRUDING MJ DUCTILE IRON WALL PIPE, TYPICAL. SEE PROCESS STANDARD DETAILS.

2 FLUSH PE X PROTRUDING PE DUCTILE IRON WALL PIPE, LENGTH AS REQUIRED, SEE PROCESS STANDARD DETAILS.

3 SEE YARD PIPING DRAWINGS FOR ADDITIONAL REQUIREMENTS FOR YARD PIPING CONNECTIONS TO THE STRUCTURE.

4 FURNISH ULTRASONIC LEVEL SENSOR WITH STILLING WELL, SEE INSTRUMENTATION STANDARD DETAILS.

HDR
TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
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PROJECT MANAGER	J. R. CANTWELL
DESIGNED BY	T. PAULMANN
DRAWN BY	A. FREEMON
CHECKED BY	M. BOND
APPROVED BY	T. PAULMANN
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
THOMAS A. PAULMANN
128794
LICENSED PROFESSIONAL ENGINEER
6/13/25

LEWISVILLE
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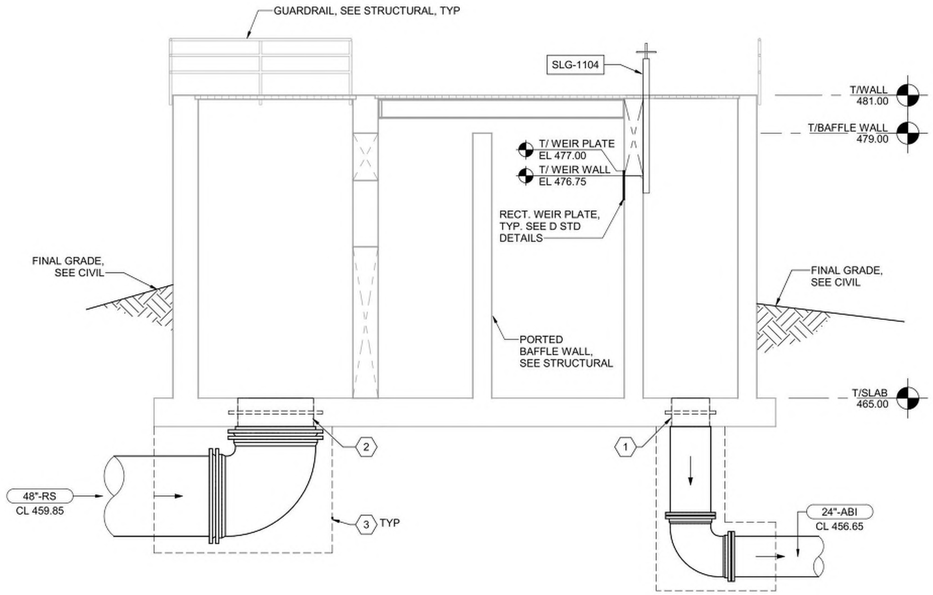
CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

AERATION BASIN SPLITTER STRUCTURE PROCESS PLANS

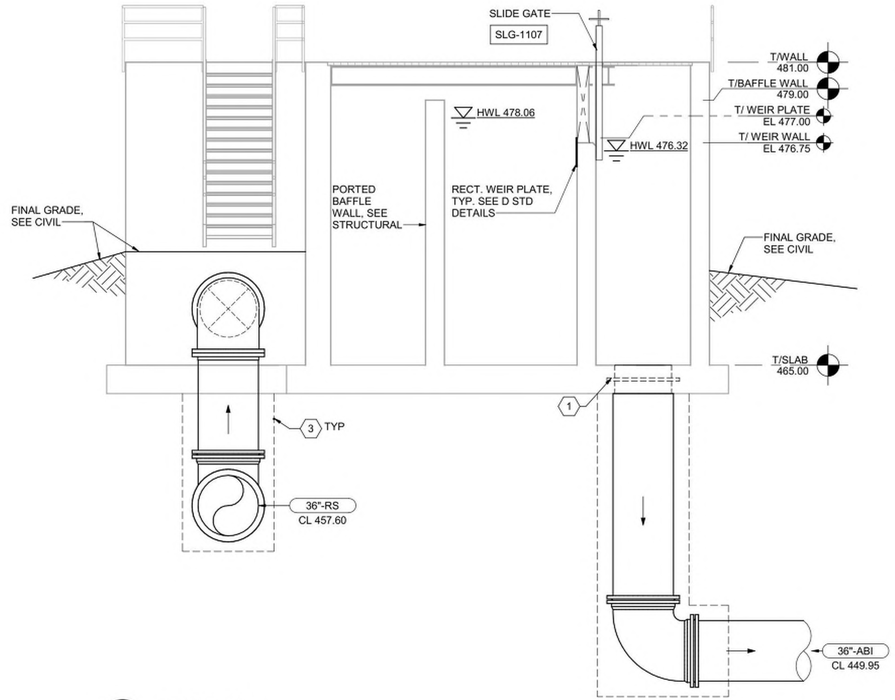
FILENAME 11 AERATION BASIN
SCALE 1/4" = 1'-0"
0 1" 2"

SHEET 11D101

Autodesk Docs://10342803_COL_PCWWT_AB_Expansion_2024/11 - AERATION BASIN SPLITTER STRUCTURE - PROCESS.rvt
6/13/2025 11:38:16 AM



A 11D101 SECTION
1/4" = 1'-0"



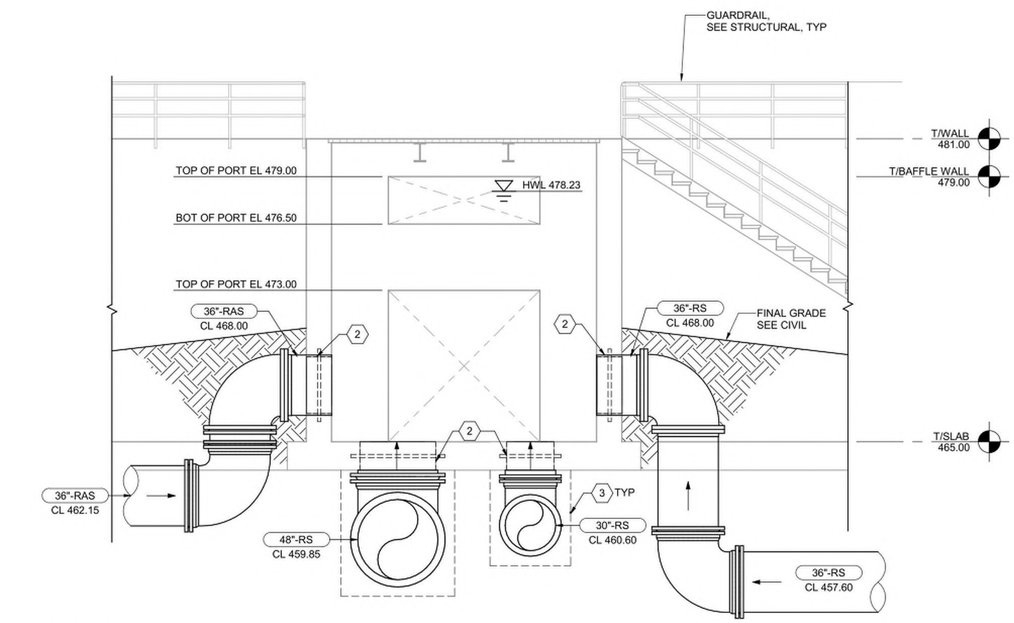
B 11D101 SECTION
1/4" = 1'-0"

KEYNOTES (#)

1 FLUSH PE X PROTRUDING MJ DUCTILE IRON WALL PIPE, TYPICAL. SEE PROCESS STANDARD DETAILS.

2 FLUSH PE X PROTRUDING PE DUCTILE IRON WALL PIPE, LENGTH AS REQUIRED, SEE PROCESS STANDARD DETAILS.

3 UNDERSLAB PIPE ENCASEMENT, SEE STRUCTURAL STANDARD DETAILS.



C 11D101 SECTION
1/4" = 1'-0"

Autodesk Docs://10342803_COL_PCWWT_AB_Expansion_2024/11 - AERATION BASIN SPLITTER STRUCTURE - PROCESS.rvt
6/13/2025 11:38:16 AM

HDR
TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
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PROJECT MANAGER	J. R. CANTWELL
DESIGNED BY	T. PAULMANN
DRAWN BY	A. FREEMON
CHECKED BY	M. BOND
APPROVED BY	T. PAULMANN
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
THOMAS A. PAULMANN
128794
LICENSED
PROFESSIONAL ENGINEER
6/13/25

LEWISVILLE
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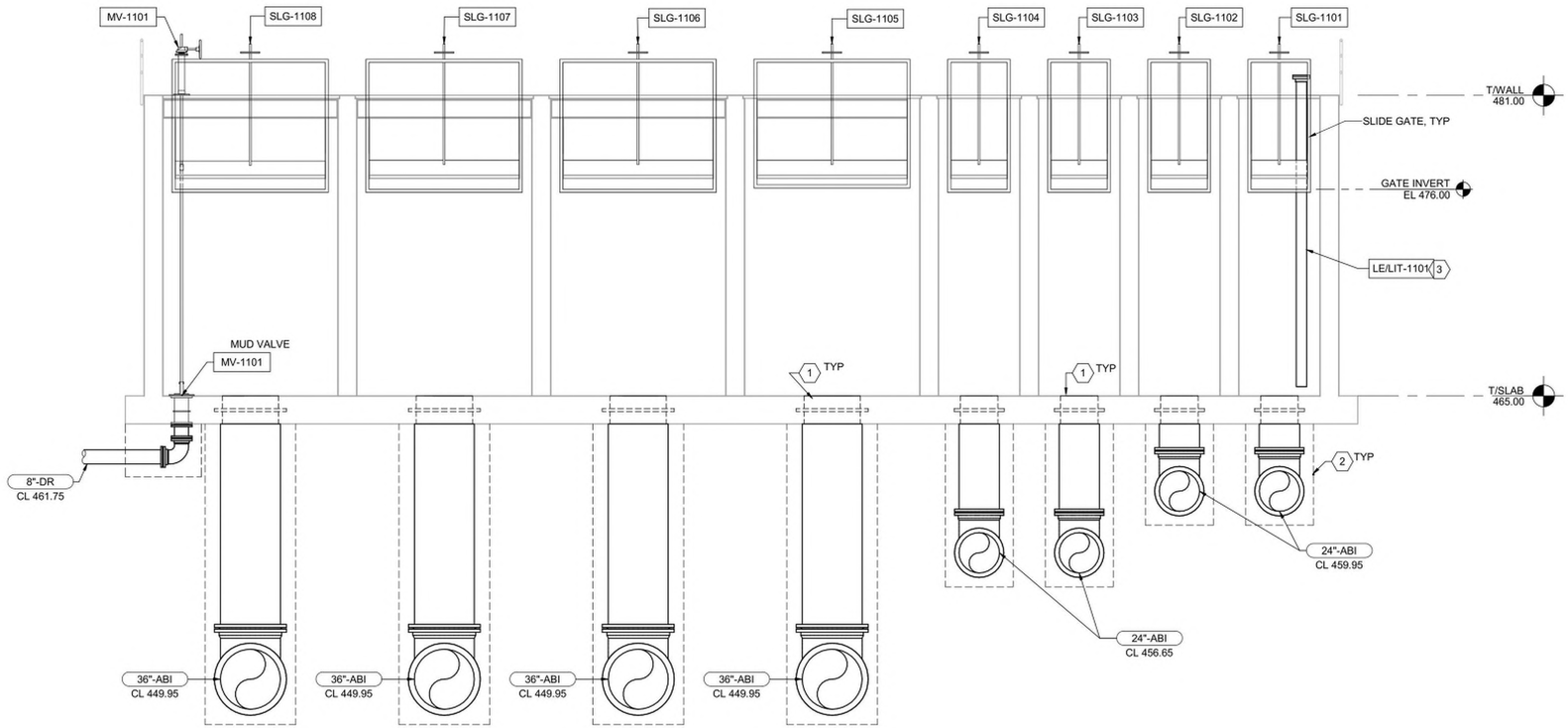
PRAIRIE CREEK
AERATION BASIN
EXPANSION

AERATION BASIN SPLITTER STRUCTURE
PROCESS
SECTIONS

FILENAME 11 AERATION BASIN
SCALE 1/4" = 1'-0"
0 1" 2"

SHEET
11D301



A 11D101 SECTION
1/4" = 1'-0"

KEYNOTES #

1 FLUSH PE X PROTRUDING MJ DUCTILE IRON WALL PIPE, TYPICAL. SEE PROCESS STANDARD DETAILS.

2 UNDERSLAB PIPE ENCASEMENT, SEE STRUCTURAL STANDARD DETAILS.

3 FURNISH ULTRASONIC LEVEL SENSOR WITH STILLING WELL, SEE INSTRUMENTATION STANDARD DETAILS.

Autodesk Docs://10342803_COL_PCWWT_AB_Expansion_2024/11 - AERATION BASIN SPLITTER STRUCTURE - PROCESS.rvt
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LEWISVILLE
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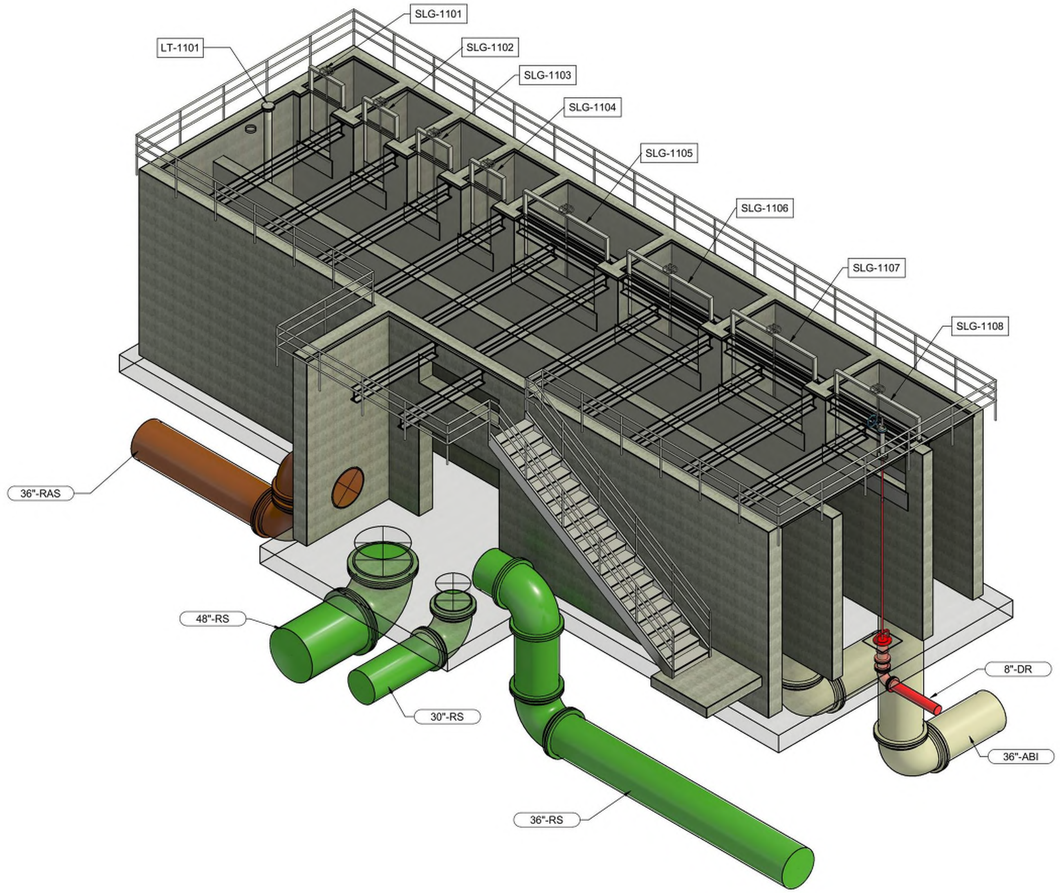
CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

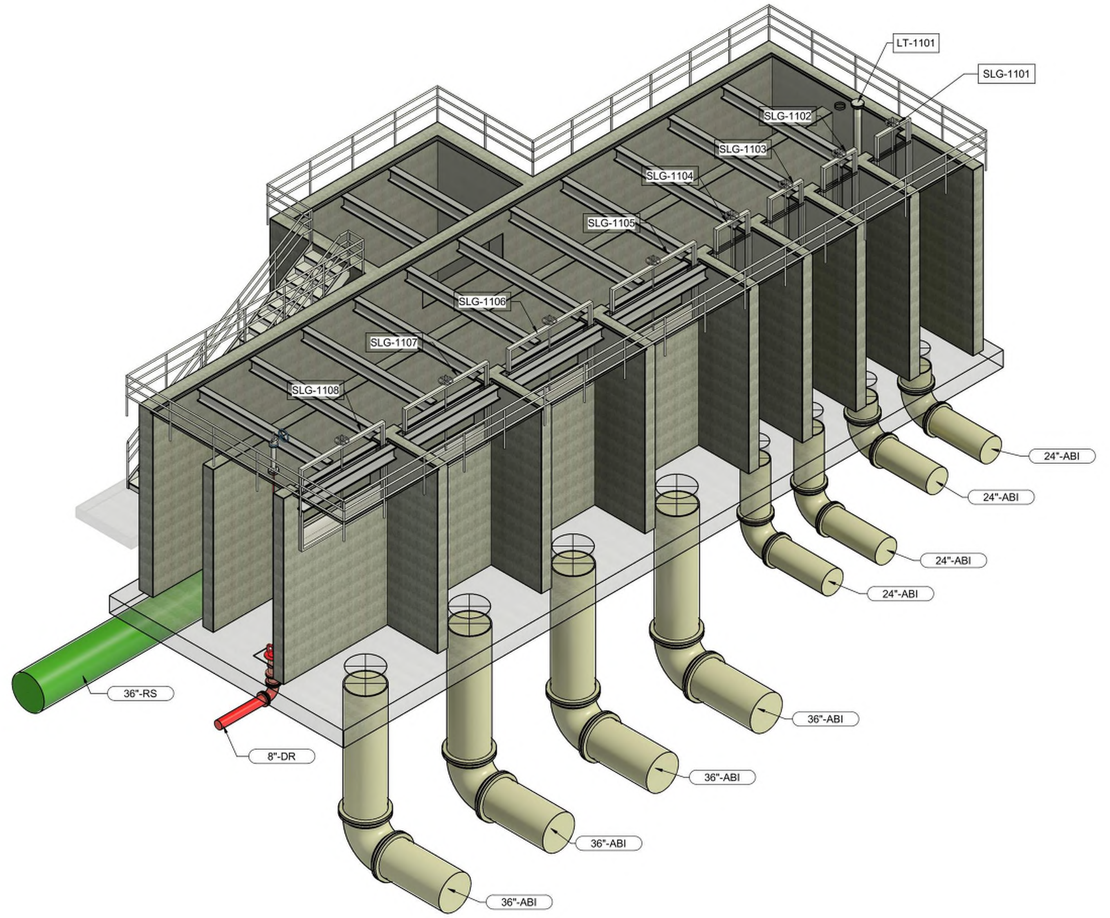
AERATION BASIN SPLITTER STRUCTURE PROCESS SECTIONS

FILENAME 11 AERATION BASIN
SCALE 1/4" = 1'-0"
0 1" 2"

SHEET **11D302**



WEST FACE ISOMETRIC



EAST FACE ISOMETRIC

Autodesk Docs://10342803_COL_PCWWT_AB_Expansion_2024/11 - AERATION BASIN SPLITTER STRUCTURE - PROCESS.rvt
6/13/2025 11:38:22 AM

HDR
TEXAS P.E. FIRM
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PROJECT MANAGER	J. R. CANTWELL
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DRAWN BY	A. FREEMON
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CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
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6/13/25

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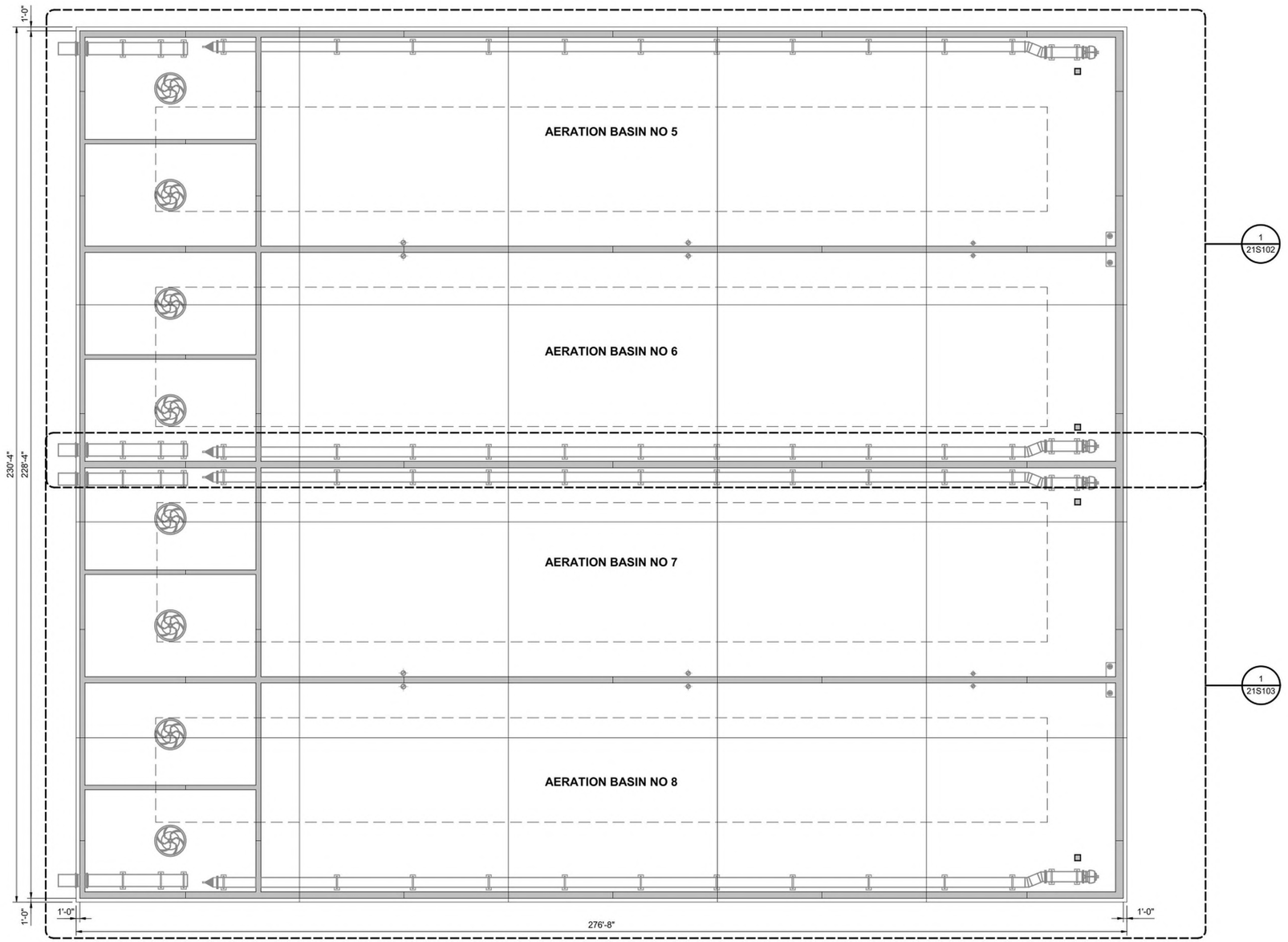
CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

AERATION BASIN SPLITTER STRUCTURE PROCESS ISOMETRIC

FILENAME 11 AERATION BASIN
SCALE 0 1" 2"
SHEET 11D601



OVERALL FOUNDATION PLAN

1/16" = 1'-0"

TEXAS P.E. FIRM
Registration No. F-754

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DESIGNED BY	W. DONELAN
DRAWN BY	H. GARCIA
CHECKED BY	C. ZIMMERMAN
APPROVED BY	J. NAVE
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
JASON C. NAVE
130766
10/16/25

LEWISVILLE
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CITY OF LEWISVILLE
PRAIRIE CREEK

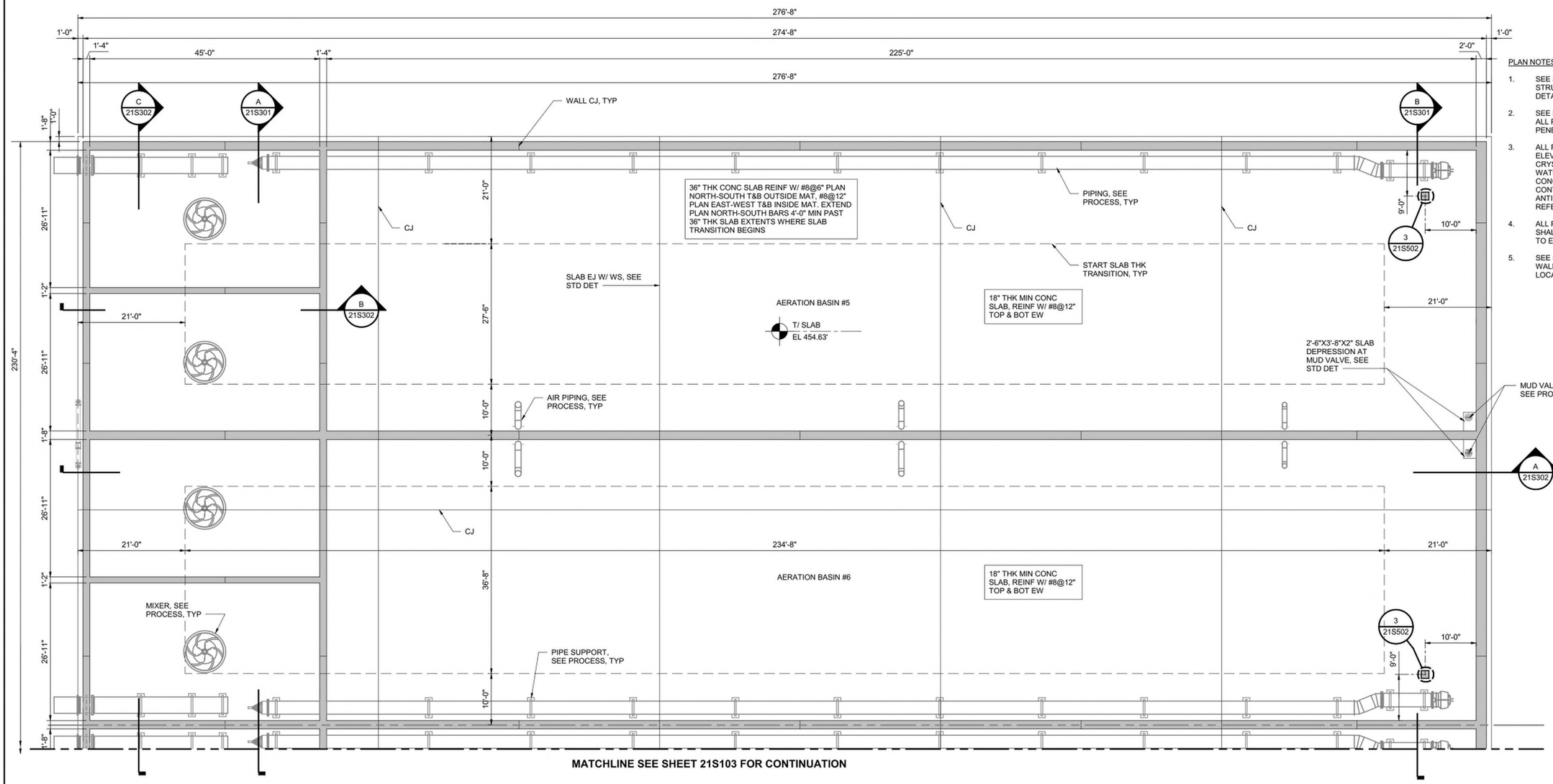
AERATION BASIN EXPANSION

N

0 1" 2"

PLANT II AERATION BASIN NOS. 5-8
STRUCTURAL
OVERALL FOUNDATION PLAN

FILENAME HDRE_ALL_DISCIPLINES.rte
SCALE 1/16" = 1'-0"
SHEET **21S101**



MATCHLINE SEE SHEET 21S103 FOR CONTINUATION

PLAN NOTES:

1. SEE STANDARD DRAWINGS FOR GENERAL STRUCTURAL NOTES AND STANDARD DETAILS.
2. SEE PROCESS/MECHANICAL DRAWINGS FOR ALL PIPE SIZES, LOCATIONS, AND PENETRATION DETAILS.
3. ALL FOUNDATION AND WALL CONCRETE TO ELEVATION 465.82' SHALL CONTAIN CRYSTALLINE CEMENTITIOUS WATERPROOFING ADMIXTURE AND ALL CONCRETE ABOVE ELEVATION 465.82' SHALL CONTAIN XYPEX BIO-SAN C500 ANTIMICROBIAL CRYSTALLINE ADMIXTURE. REFERENCE SPECIFICATION 03 31 30.
4. ALL PIPING BELOW THE FOUNDATION SHALL BE ENCASED PER STANDARD DETAILS TO EDGE OF FOUNDATION.
5. SEE SHEET 21S107 FOR FOUNDATION AND WALL CONSTRUCTION AND EXPANSION JOINT LOCATIONS.

1 / 21S101 FOUNDATION PLAN AB 5-6

3/32" = 1'-0"

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
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PROJECT MANAGER	JOEL R. CANTWELL
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DRAWN BY	H. GARCIA
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APPROVED BY	J. NAVE
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
JASON C. NAVE
130766
10/16/25

LEWISVILLE
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CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

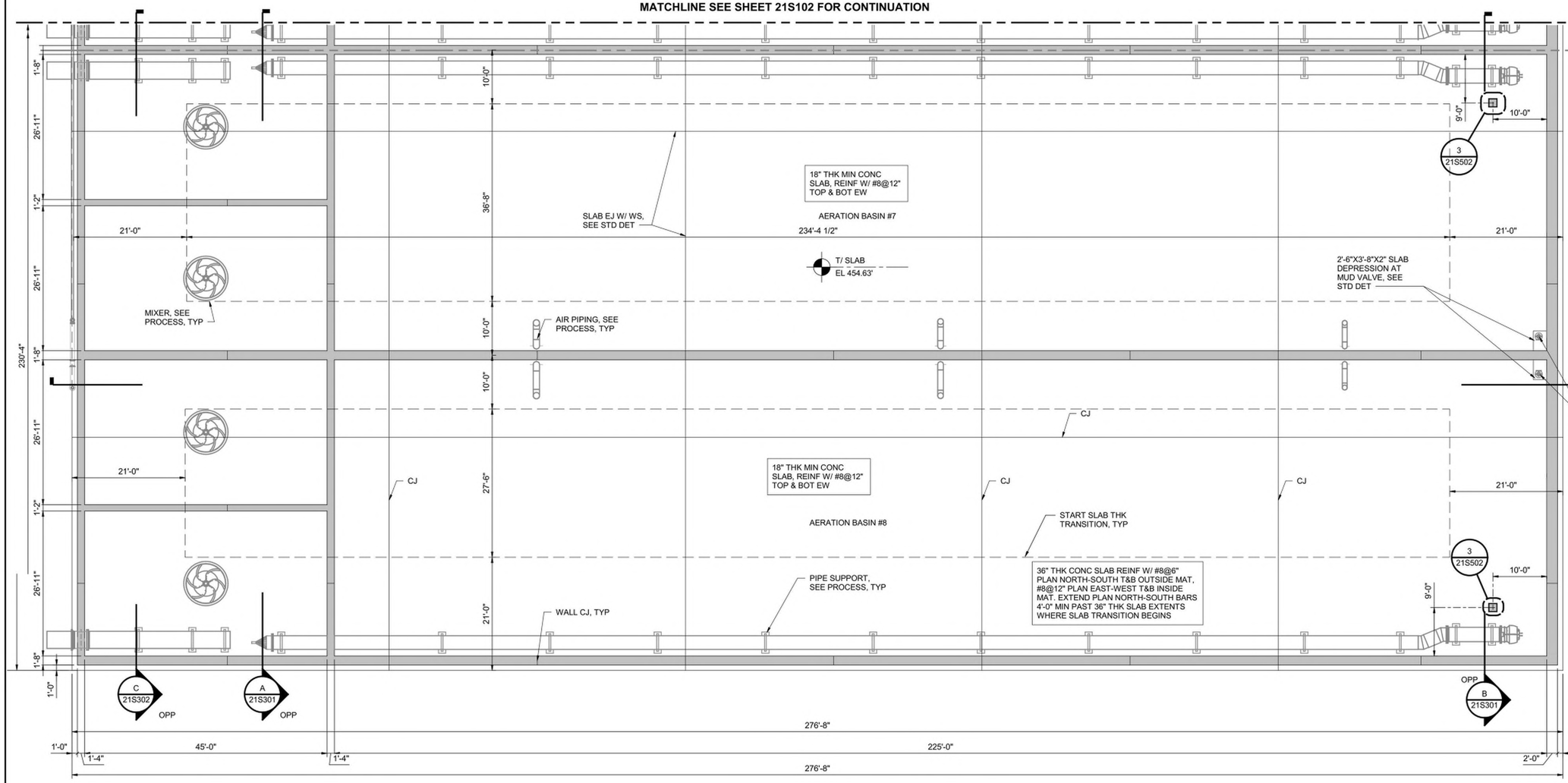
N

0 1" 2"

PLANT II AERATION BASIN NOS. 5-8
STRUCTURAL
AERATION BASIN 5 & 6
FOUNDATION PLAN

FILENAME	HDRE_ALL_DISCIPLINES.rte
SCALE	3/32" = 1'-0"

SHEET 21S102



PLAN NOTES:

1. SEE STANDARD DRAWINGS FOR GENERAL STRUCTURAL NOTES AND STANDARD DETAILS.
2. SEE PROCESS/MECHANICAL DRAWINGS FOR ALL PIPE SIZES, LOCATIONS, AND PENETRATION DETAILS.
3. ALL FOUNDATION AND WALL CONCRETE TO ELEVATION 465.82' SHALL CONTAIN CRYSTALLINE CEMENTITIOUS WATERPROOFING ADMIXTURE AND ALL CONCRETE ABOVE ELEVATION 465.82' SHALL CONTAIN XYPEX BIO-SAN C500 ANTIMICROBIAL CRYSTALLINE ADMIXTURE. REFERENCE SPECIFICATION 03 31 30.
4. ALL PIPING BELOW THE FOUNDATION SHALL BE ENCASED PER STANDARD DETAILS TO EDGE OF FOUNDATION.
5. SEE SHEET 21S107 FOR FOUNDATION AND WALL CONSTRUCTION AND EXPANSION JOINT LOCATIONS.

1 / 21S101 FOUNDATION PLAN AB 7-8
3/32" = 1'-0"

HDR
TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
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PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	W. DONELAN
DRAWN BY	H. GARICA
CHECKED BY	C. ZIMMERMAN
APPROVED BY	J. NAVE
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
JASON C. NAVE
130766
10/16/25

LEWISVILLE
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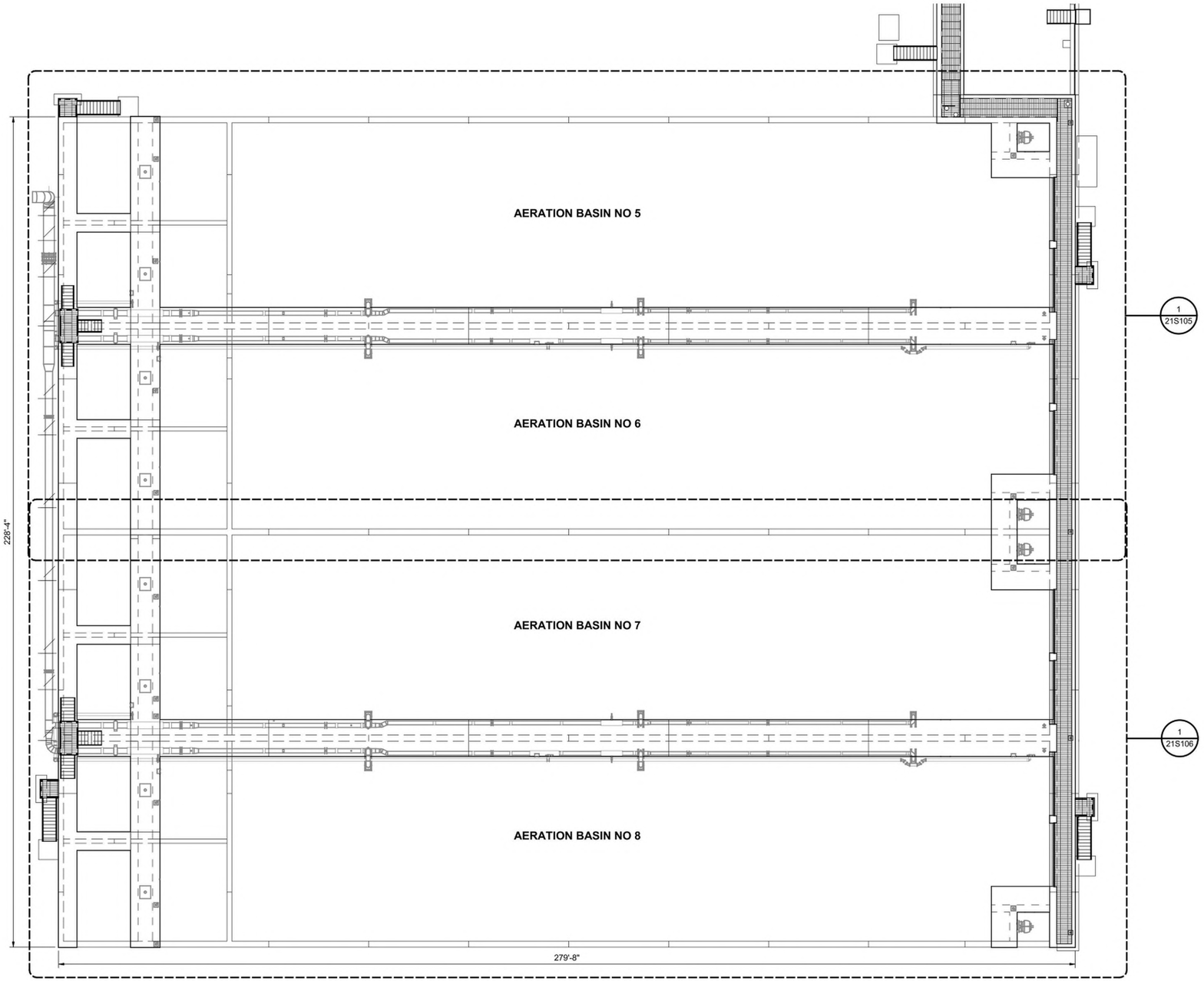
CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

N
0 1" 2"

PLANT II AERATION BASIN NOS. 5-8
STRUCTURAL
AERATION BASIN 7 & 8
FOUNDATION PLAN

FILENAME HDRE_ALL_DISCIPLINES.rte
SCALE 3/32" = 1'-0"
SHEET **21S103**



OVERALL UPPER PLAN

1/16" = 1'-0"

HDR

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130766
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CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

N

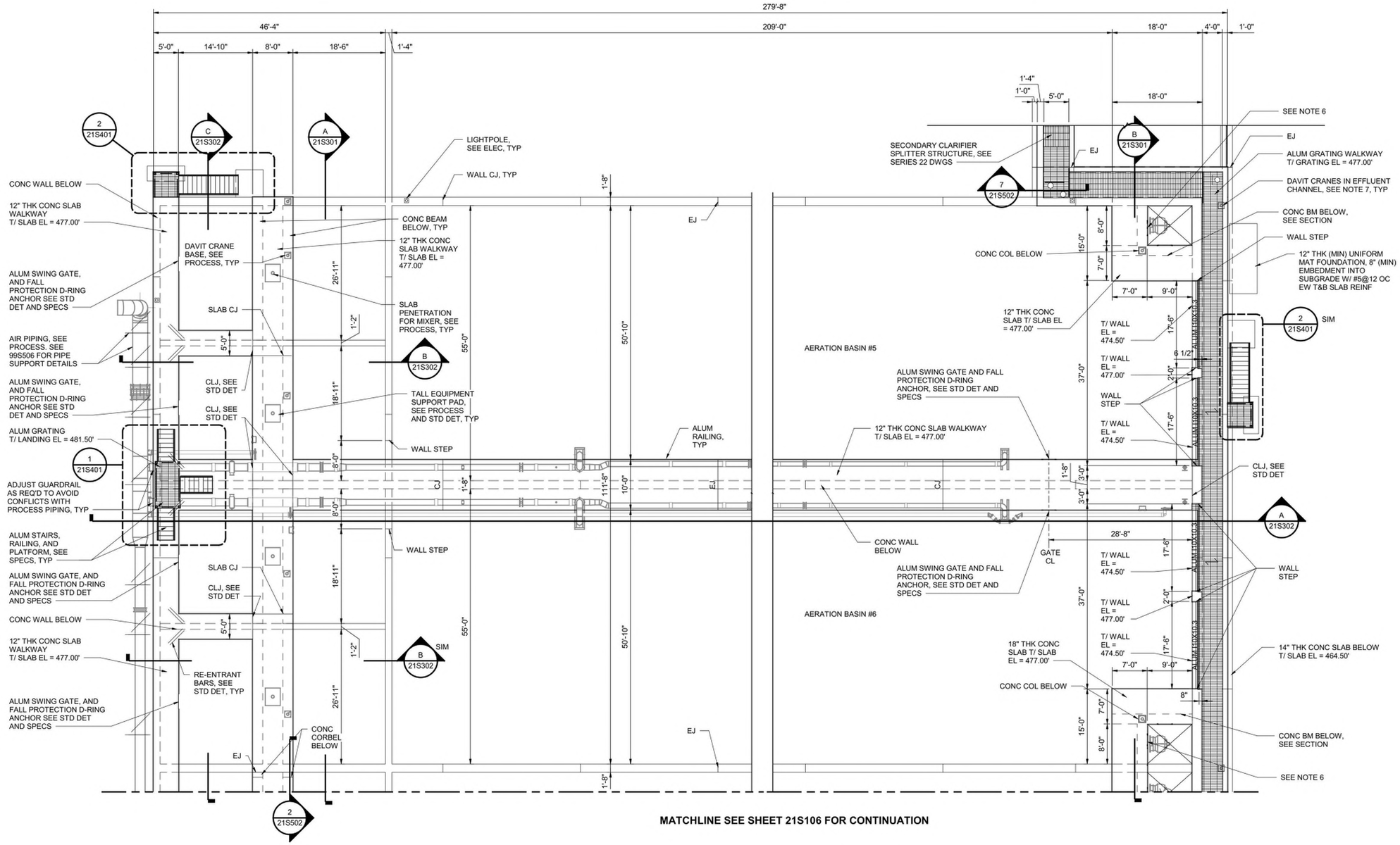
0 1" 2"

PLANT II AERATION BASIN NOS. 5-8
STRUCTURAL
OVERALL UPPER PLAN

FILENAME HDRE_ALL_DISCIPLINES.rte

SCALE 1/16" = 1'-0"

SHEET **21S104**



MATCHLINE SEE SHEET 21S106 FOR CONTINUATION

PLAN NOTES:

1. SEE STANDARD DRAWINGS FOR GENERAL STRUCTURAL NOTES AND STANDARD DETAILS.
2. SEE PROCESS/MECHANICAL DRAWINGS FOR ALL PIPE SIZES, LOCATIONS, AND PENETRATION DETAILS.
3. ALL STAIR FRAMING, GRATING AND RAILING SHALL BE ALUMINUM. SEE SPECIFICATIONS. ALL OPENINGS AND EDGES IN GRATING SHALL BE BANDED. GRATING DEPTH SHALL BE 2 IN, UNLESS OTHERWISE NOTED.
4. ALL FOUNDATION AND WALL CONCRETE TO ELEVATION 465.82' SHALL CONTAIN CRYSTALLINE CEMENTITIOUS WATERPROOFING ADMIXTURE AND ALL CONCRETE ABOVE ELEVATION 465.82' SHALL CONTAIN XYPEX BIO-SAN C500 ANTIMICROBIAL CRYSTALLINE ADMIXTURE. REFERENCE SPECIFICATION 03 31 30.
5. SEE SHEET 21S108 FOR WALL AND UPPER SLAB CONSTRUCTION, CONTROL, AND EXPASION JOINT LOCATIONS.
6. THE CONTRACTOR MUST COORDINATE THE PLACEMENT OF GATES WITH THE LOCATIONS AND REQUIREMENTS OF THE DAVIT CRANES AND EQUIPMENT, BASED ON THE FINAL SELECTION OF PROCESS EQUIPMENT. ENSURE THAT ALL EQUIPMENT CAN BE PASSED THROUGH THE GATES. FURNISH FALL PROTECTION D-RING ANCHOR AND GATE PER STRUCTRAL STANDARD DETAILS AT EVERY DAVIT CRANE BASE, SEE PROCESS DRAWINGS FOR ADDITIONAL LOCATIONS.
7. BAND GRATING OPENING AT DAVIT CRANE PENETRATION PER SPECS. PROVIDE REMOVABLE GRATING SECTION AT DAVIT CRANE LOCATIONS.

LEGEND

SPAN DIRECTION

1 UPPER PLAN AB 5-6
1 / 21S104 — 3/32" = 1'-0"

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
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PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	W. DONELAN
DRAWN BY	H. GARICA
CHECKED BY	C. ZIMMERMAN
APPROVED BY	J. NAVE
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS — JASON C. NAVE — 130766 — 10/16/25

LEWISVILLE — Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

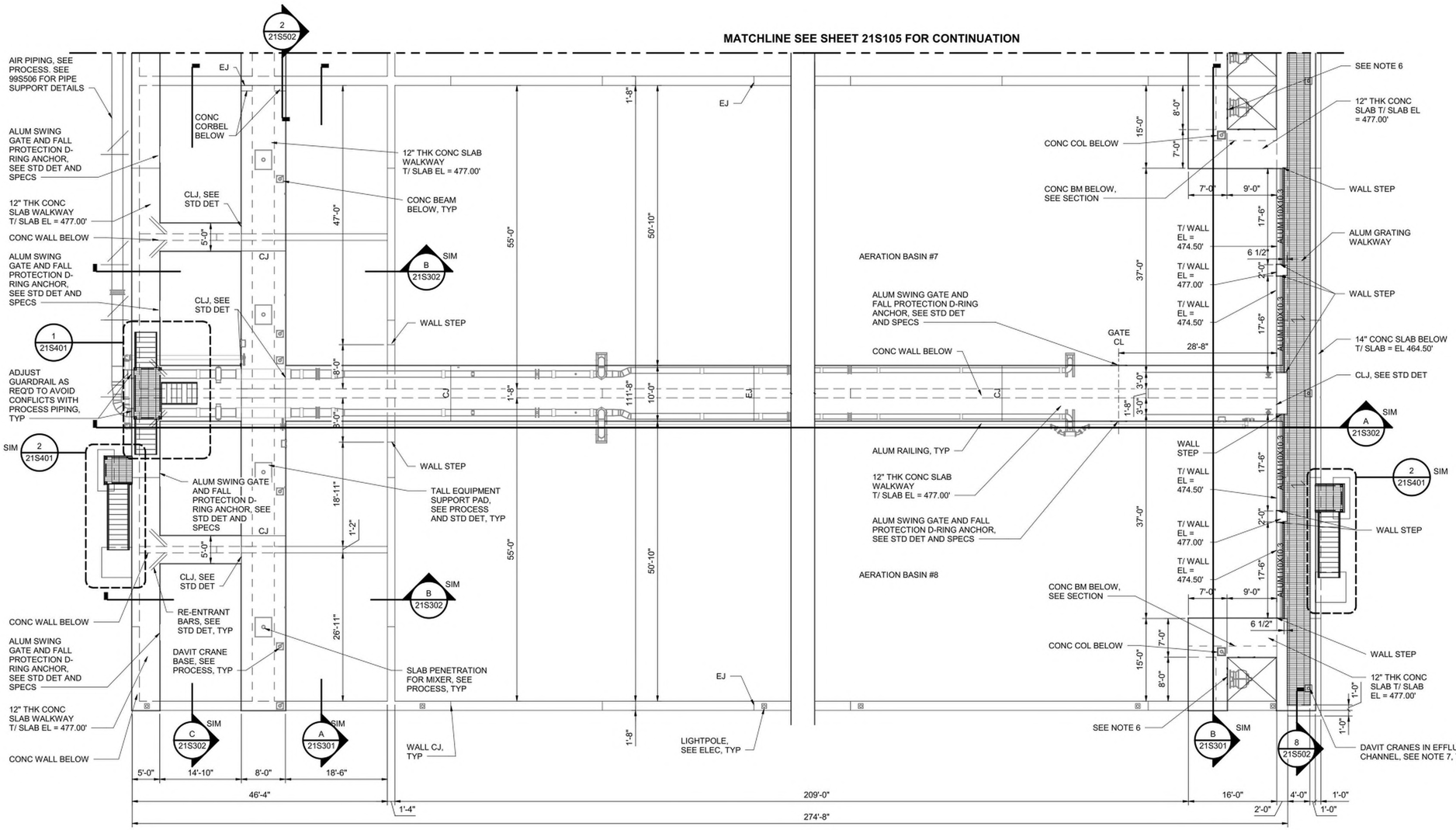
N

PLANT II AERATION BASIN NOS. 5-8
STRUCTURAL
AERATION BASIN 5 & 6
UPPER PLAN

0 1" 2"

FILENAME: HDRE_ALL_DISCIPLINES.rte
SCALE: 3/32" = 1'-0"
SHEET: 21S105

MATCHLINE SEE SHEET 21S105 FOR CONTINUATION



PLAN NOTES:

1. SEE STANDARD DRAWINGS FOR GENERAL STRUCTURAL NOTES AND STANDARD DETAILS.
2. SEE PROCESS/MECHANICAL DRAWINGS FOR ALL PIPE SIZES, LOCATIONS, AND PENETRATION DETAILS.
3. ALL STAIR FRAMING, GRATING AND RAILING SHALL BE ALUMINUM. SEE SPECIFICATIONS. ALL OPENINGS AND EDGES IN GRATING SHALL BE BANDED. GRATING DEPTH SHALL BE 2 IN, UNLESS OTHERWISE NOTED.
4. ALL FOUNDATION AND WALL CONCRETE TO ELEVATION 465.82' SHALL CONTAIN CRYSTALLINE CEMENTITIOUS WATERPROOFING ADMIXTURE AND ALL CONCRETE ABOVE ELEVATION 465.82' SHALL CONTAIN XYPEX BIO-SAN C500 ANTIMICROBIAL CRYSTALLINE ADMIXTURE. REFERENCE SPECIFICATION 03 31 30.
5. SEE SHEET 21S108 FOR WALL AND UPPER SLAB CONSTRUCTION, CONTROL, AND EXPANSION JOINT LOCATIONS.
6. THE CONTRACTOR MUST COORDINATE THE PLACEMENT OF GATES WITH THE LOCATIONS AND REQUIREMENTS OF THE DAVIT CRANES AND EQUIPMENT, BASED ON THE FINAL SELECTION OF PROCESS EQUIPMENT. ENSURE THAT ALL EQUIPMENT CAN BE PASSED THROUGH THE GATES. FURNISH FALL PROTECTION D-RING ANCHOR AND GATE PER STRUCTURAL STANDARD DETAILS AT EVERY DAVIT CRANE BASE, SEE PROCESS DRAWINGS FOR ADDITIONAL LOCATIONS.
7. BAND GRATING OPENING AT DAVIT CRANE PENETRATION PER SPECS. PROVIDE REMOVABLE GRATING SECTION AT DAVIT CRANE LOCATIONS.

LEGEND

SPAN DIRECTION

1 21S104 UPPER PLAN AB 7-8

3/32" = 1'-0"

TEXAS P.E. FIRM
Registration No. F-754

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100%	OCT 16/2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	W. DONELAN
DRAWN BY	H. GARICA
CHECKED BY	C. ZIMMERMAN
APPROVED BY	J. NAVE
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
JASON C. NAVE
130766
10/16/25

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

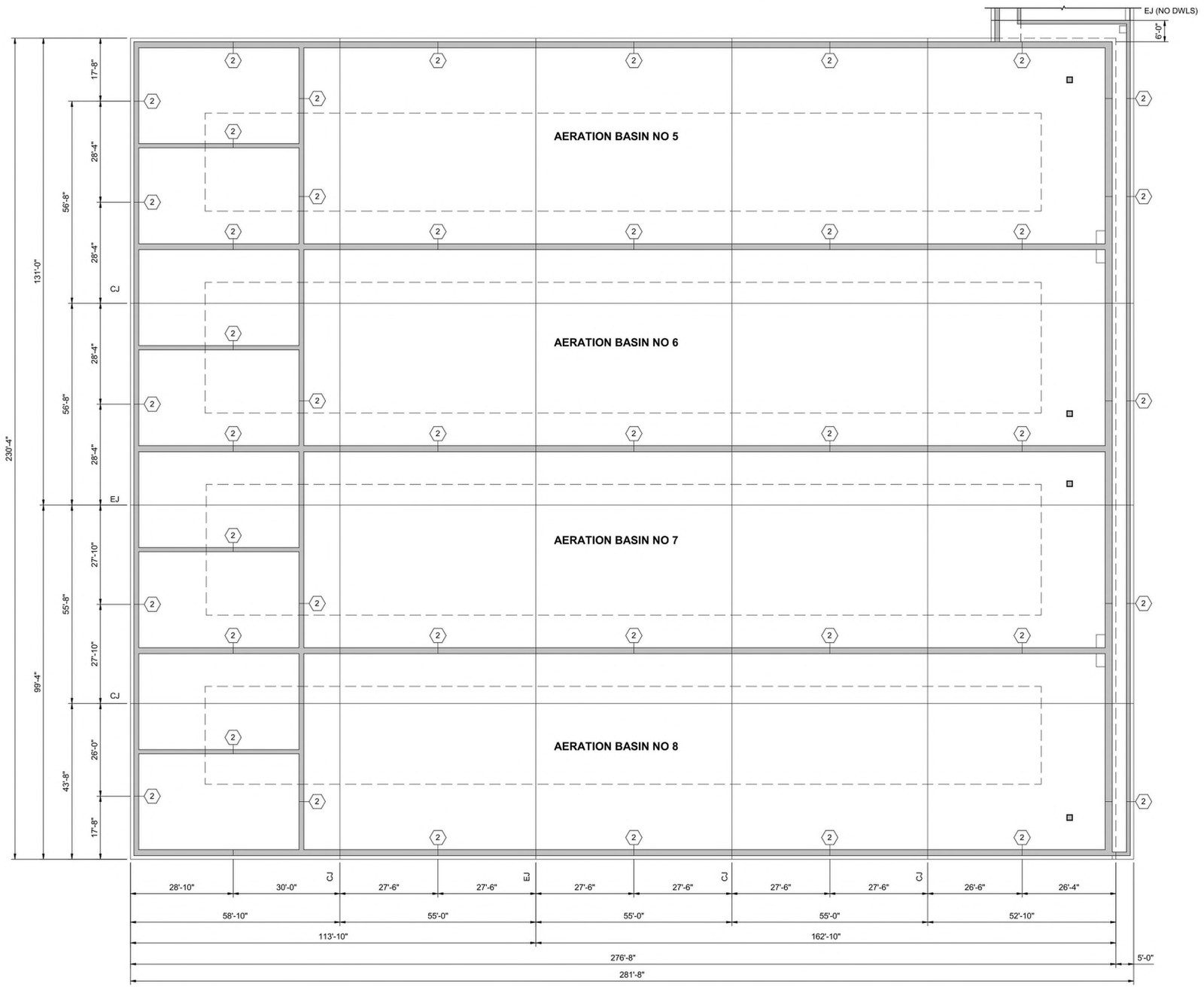
CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

PLANT II AERATION BASIN NOS. 5-8
STRUCTURAL
AERATION BASIN 7 & 8
UPPER PLAN

0 1" 2"

FILENAME	HDRE_ALL_DISCIPLINES.rte
SCALE	3/32" = 1'-0"
SHEET	21S106



1 / 21S301 FOUNDATION JOINTING PLAN
1/16" = 1'-0"

PLAN NOTES:

1. UNLESS NOTED OTHERWISE, ALL JOINTS INDICATED SHALL BE CONTINUOUS THROUGH STRUCTURE (THROUGH FOUNDATION AND WALLS).
2. A MINIMUM OF 72 HOURS SHALL ELAPSE BETWEEN PLACEMENT OF ADJOINING CONSTRUCTION, SEE SPECIFICATIONS.
3. LOCATIONS OF JOINTS OTHER THAN THOSE SHOWN SHALL BE APPROVED BY THE ENGINEER THROUGH REVIEW OF CONCRETE PLACEMENT SUBMITTALS.
4. ALL EXPANSION JOINTS SHALL BE DOWELED AND SEALED PER STANDARD DETAILS, UNLESS NOTED OTHERWISE. SEE STANDARD DETAILS FOR OTHER JOINT REQUIREMENTS.
5. ALL CONCRETE SHALL BE MOIST CURED FOR 7 DAYS MINIMUM, SEE SPECIFICATIONS.

KEYNOTES: (#)

1. CONTROL JOINT IN UPPER SLAB ONLY, SEE STANDARD DETAILS
2. CONSTRUCTION JOINT (CJ) IN WALLS ONLY (ABOVE FOUNDATION). MAKE WATERSTOPS CONTINUOUS WITH WALL/FOUNDATION CJ WATERSTOPS.
3. EXPANSION JOINT (EJ) IN UPPER WALKWAY SLAB ONLY.
4. CONSTRUCTION JOINT (CJ) IN WALLS AND UPPER SLAB ONLY (ABOVE FOUNDATION).
5. CONSTRUCTION JOINT (CJ) IN UPPER SLAB ONLY.

HDR
TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
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APPROVED BY	J. NAVE
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
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130766
10/16/25

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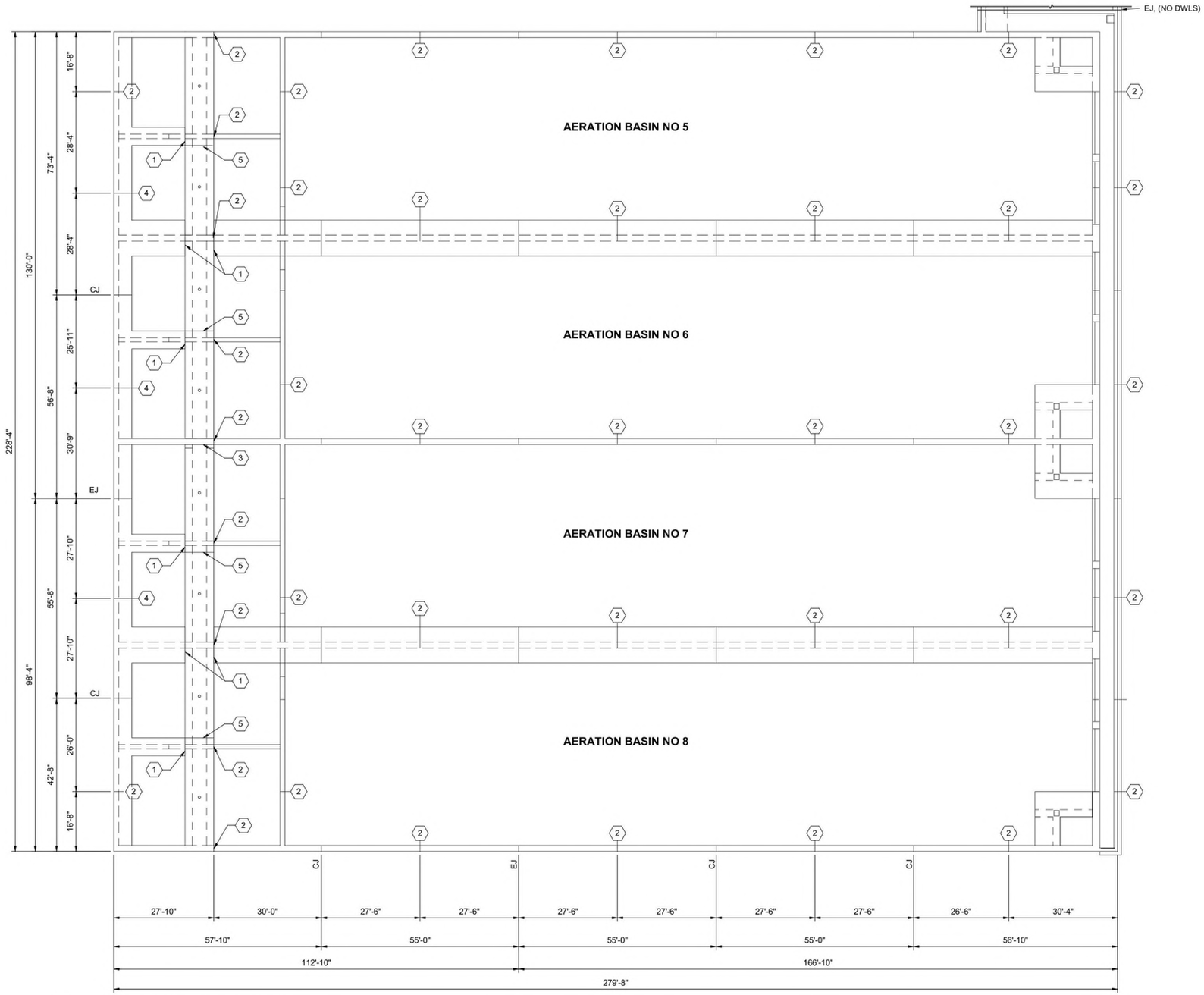
PRAIRIE CREEK
AERATION BASIN EXPANSION

N

PLANT II AERATION BASIN NOS. 5-8
STRUCTURAL
FOUNDATION JOINTING PLAN

0 1" 2"

FILENAME	HDRE_ALL_DISCIPLINES.rte
SCALE	1/16" = 1'-0"
SHEET	21S107



1 / 21S301 UPPER JOINTING PLAN
1/16" = 1'-0"

PLAN NOTES:

1. UNLESS NOTED OTHERWISE, ALL JOINTS INDICATED SHALL BE CONTINUOUS THROUGH STRUCTURE (THROUGH FOUNDATION AND WALLS).
2. A MINIMUM OF 72 HOURS SHALL ELAPSE BETWEEN PLACEMENT OF ADJOINING CONSTRUCTION, SEE SPECIFICATIONS.
3. LOCATIONS OF JOINTS OTHER THAN THOSE SHOWN SHALL BE APPROVED BY THE ENGINEER THROUGH REVIEW OF CONCRETE PLACEMENT SUBMITTALS.
4. ALL EXPANSION JOINTS SHALL BE DOWELED AND SEALED PER STANDARD DETAILS, UNLESS NOTED OTHERWISE. SEE STANDARD DETAILS FOR OTHER JOINT REQUIREMENTS.
5. ALL CONCRETE SHALL BE MOIST CURED FOR 7 DAYS MINIMUM, SEE SPECIFICATIONS.

KEYNOTES: (#)

1. CONTROL JOINT IN UPPER SLAB ONLY, SEE STANDARD DETAILS
2. CONSTRUCTION JOINT (CJ) IN WALLS ONLY (ABOVE FOUNDATION). MAKE WATERSTOPS CONTINUOUS WITH WALL/FOUNDATION CJ WATERSTOPS.
3. EXPANSION JOINT (EJ) IN UPPER WALKWAY SLAB ONLY.
4. CONSTRUCTION JOINT (CJ) IN WALLS AND UPPER SLAB ONLY (ABOVE FOUNDATION).
5. CONSTRUCTION JOINT (CJ) IN UPPER SLAB ONLY.

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PRAIRIE CREEK

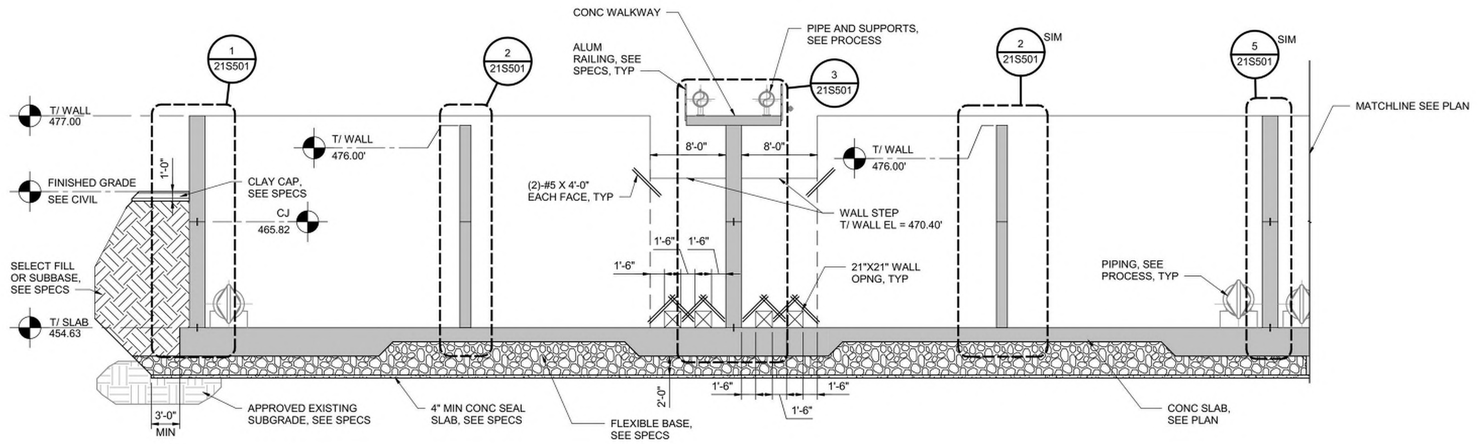
AERATION BASIN EXPANSION

N

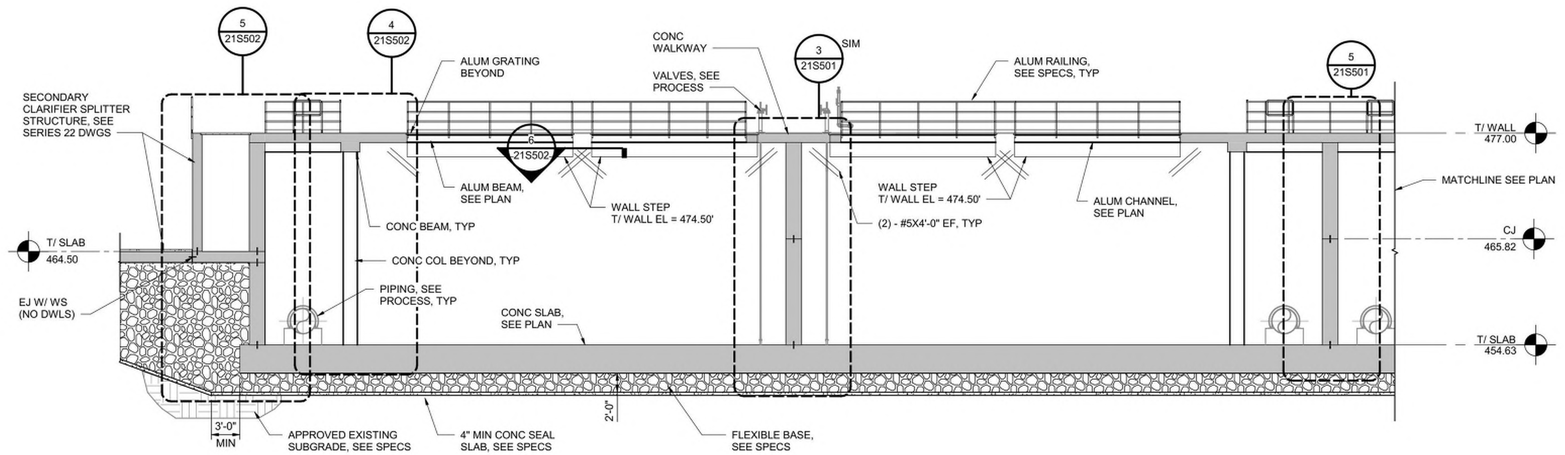
0 1" 2"

PLANT II AERATION BASIN NOS. 5-8
STRUCTURAL
UPPER JOINTING PLAN

FILENAME HDRE_ALL_DISCIPLINES.rte
SCALE 1/16" = 1'-0"
SHEET 21S108



A 21S102 **SECTION**
1/8" = 1'-0"



B 21S102 **SECTION**
1/8" = 1'-0"

100%	OCT 16/2025	ISSUED FOR BID
ISSUE	DATE	DESCRIPTION

PROJECT MANAGER	JOEL R. CANTWELL
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APPROVED BY	J. NAVE
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

TEXAS P.E. FIRM
Registration No. F-754

STATE OF TEXAS
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130766
10/16/25

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PRAIRIE CREEK

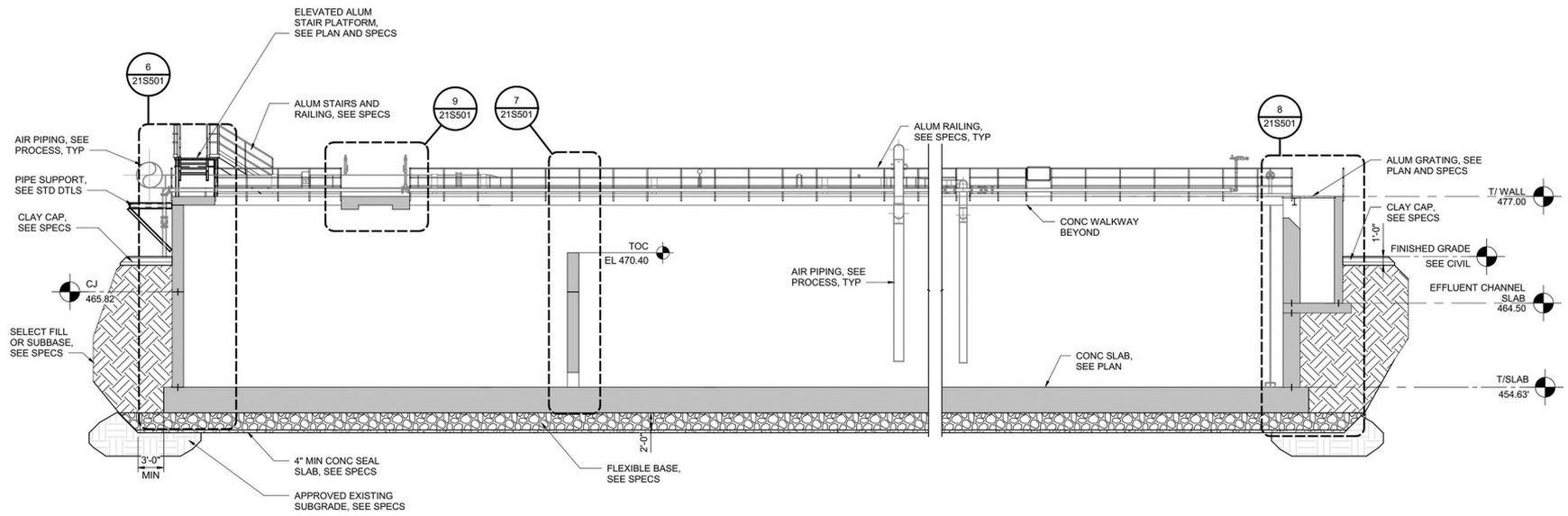
AERATION BASIN EXPANSION

PLANT II AERATION BASIN NOS. 5-8
STRUCTURAL
SECTIONS I

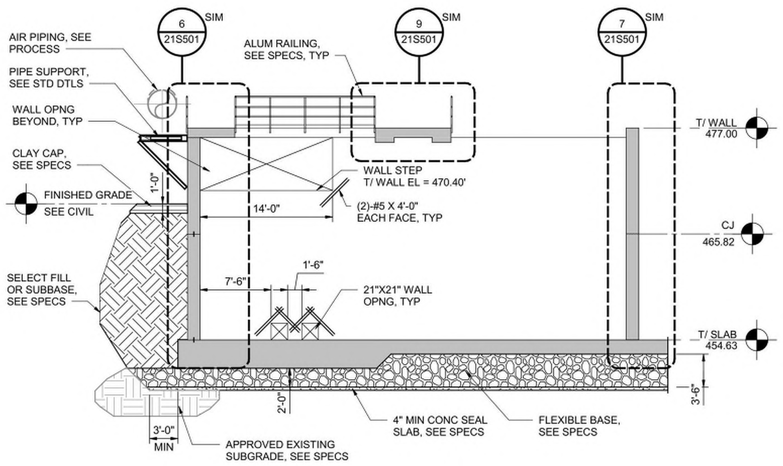
0 1" 2"

FILENAME HDRE_ALL_DISCIPLINES.rte
SCALE 1/8" = 1'-0"

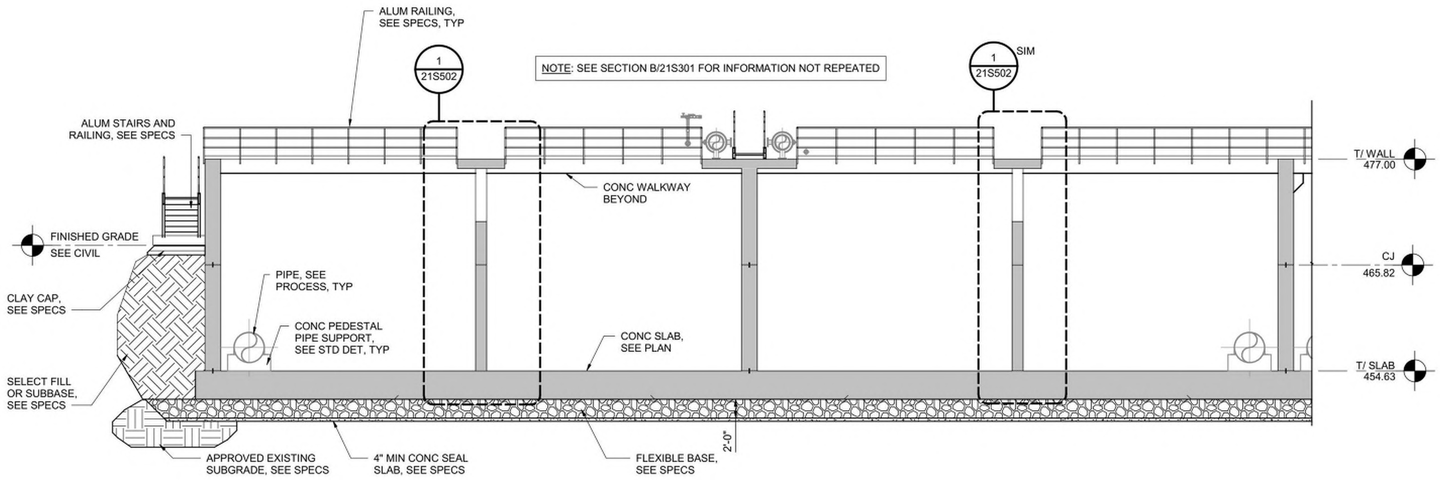
SHEET
21S301



A 21S102 SECTION
1/8" = 1'-0"



B 21S102 SECTION
1/8" = 1'-0"



C 21S102 SECTION
1/8" = 1'-0"

TEXAS P.E. FIRM
Registration No. F-754

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PROJECT NUMBER	10342803

STATE OF TEXAS
JASON C. NAVE
130766
10/16/25

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PRAIRIE CREEK

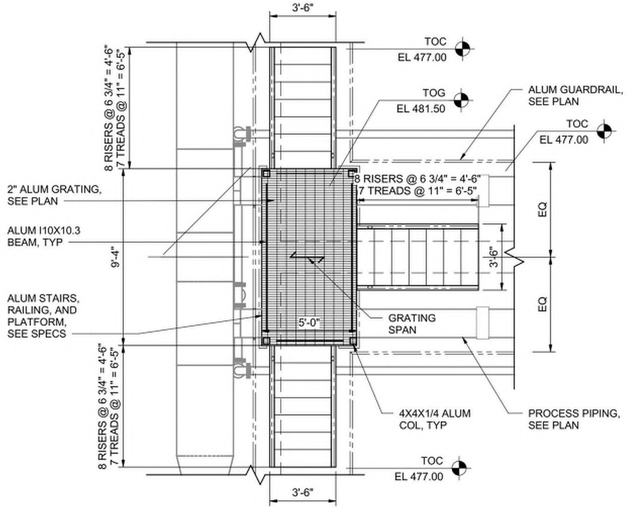
AERATION BASIN EXPANSION

PLANT II AERATION BASIN NOS. 5-8
STRUCTURAL
SECTIONS II

0 1" 2"

FILENAME HDRE_ALL_DISCIPLINES.rte
SCALE 1/8" = 1'-0"

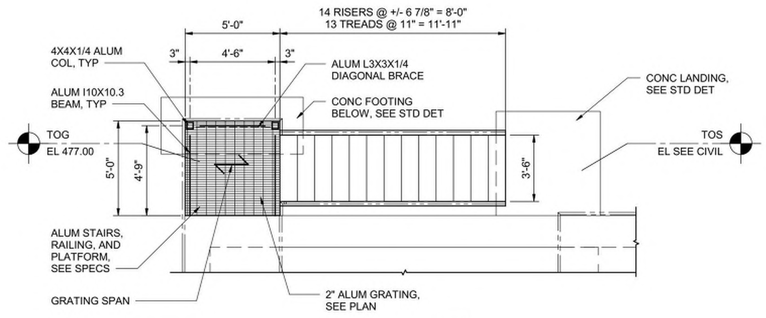
SHEET
21S302



NOTE:

1. SIZES SHOWN ARE FOR BIDDING PURPOSES ONLY AND ACTUAL SIZES SHALL BE DESIGNED AND DETAILED BY THE CONTRACTOR (DEFFERED DESIGN).

1 / 21S105 ENLARGED PLAN
1/4" = 1'-0"



NOTE:

1. SIZES SHOWN ARE FOR BIDDING PURPOSES ONLY AND ACTUAL SIZES SHALL BE DESIGNED AND DETAILED BY THE CONTRACTOR (DEFFERED DESIGN).

2 / 21S105 ENLARGED PLAN
1/4" = 1'-0"

TEXAS P.E. FIRM
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APPROVED BY	J. NAVE
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
JASON C. NAVE
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LEWISVILLE
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PRAIRIE CREEK

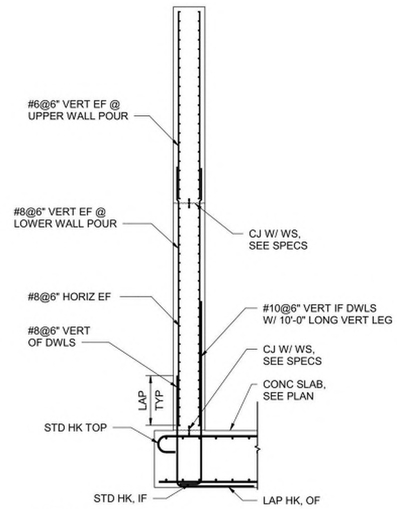
AERATION BASIN EXPANSION

PLANT II AERATION BASIN NOS. 5-8
STRUCTURAL
ENLARGED PLANS

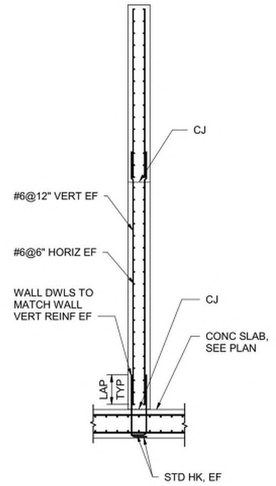
0 1" 2"

FILENAME HDRE_ALL_DISCIPLINES.rte
SCALE 1/4" = 1'-0"

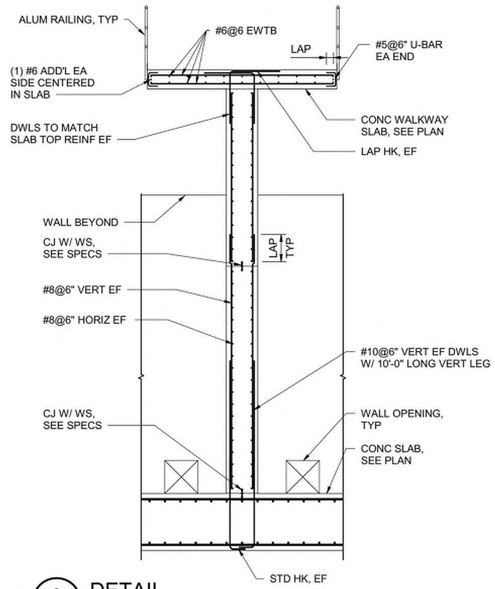
SHEET
21S401



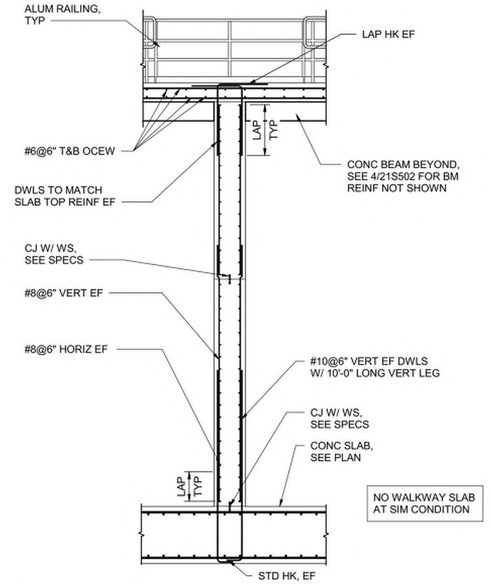
1 21S301 DETAIL 1/4" = 1'-0"



2 21S301 DETAIL 1/4" = 1'-0"



3 21S301 DETAIL 1/4" = 1'-0"

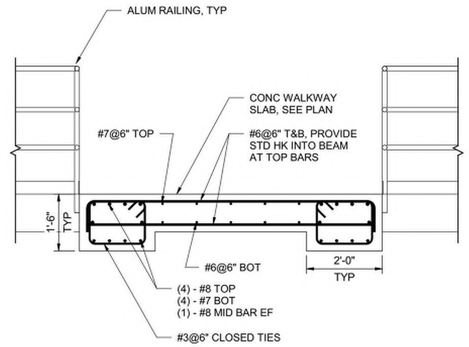


5 21S301 DETAIL 1/4" = 1'-0"

6 21S302 DETAIL 1/4" = 1'-0"

7 21S302 DETAIL 1/4" = 1'-0"

8 21S302 DETAIL 1/4" = 1'-0"



9 21S302 DETAIL 1/2" = 1'-0"

HDR
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Registration No. F-754

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DESIGNED BY	W. DONELAN
DRAWN BY	H. GARICA
CHECKED BY	C. ZIMMERMAN
APPROVED BY	J. NAVE
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
JASON C. NAVE
130766
10/16/25

LEWISVILLE
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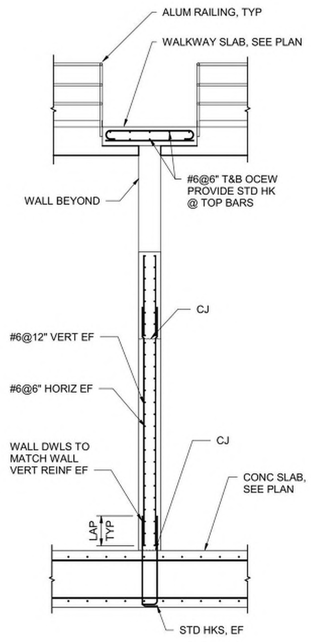
CITY OF LEWISVILLE
PRAIRIE CREEK

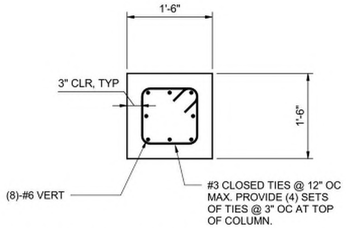
AERATION BASIN EXPANSION

PLANT II AERATION BASIN NOS. 5-8 STRUCTURAL DETAILS

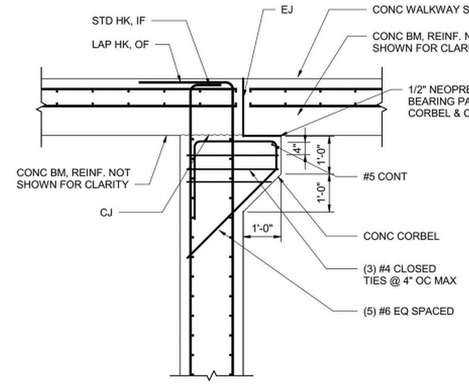
0 1" 2"

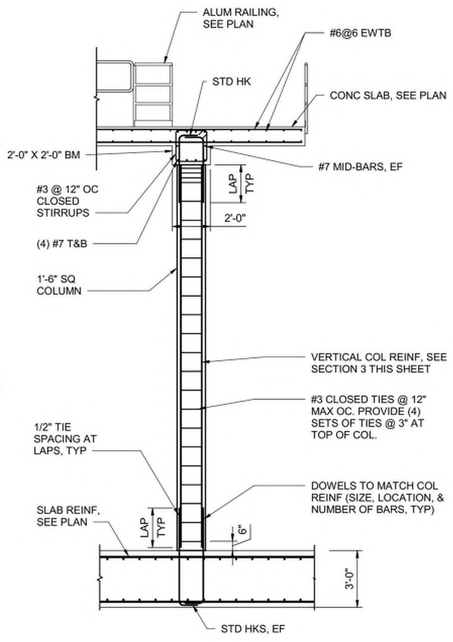
FILENAME HDRE_ALL_DISCIPLINES.rte
SCALE As indicated
SHEET 21S501

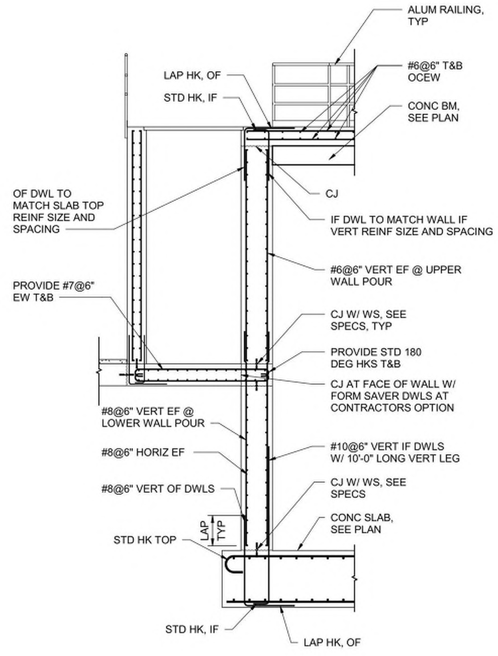




3 / 21S502 TYPICAL COLUMN
3/4" = 1'-0"





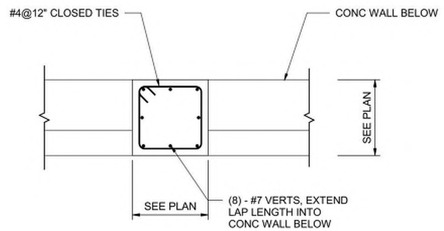


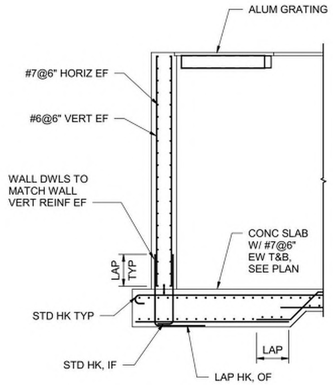
1 / 21S302 DETAIL
1/4" = 1'-0"

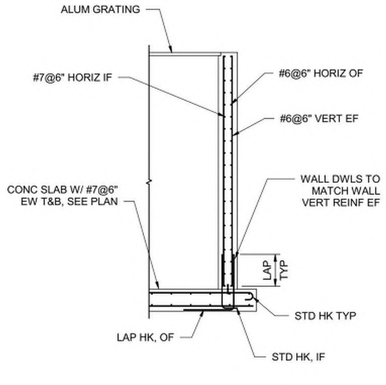
2 / 21S105 DETAIL
1/2" = 1'-0"

4 / 21S502 TYPICAL BEAM @ JIB CRANE PLATFORM
1/4" = 1'-0"

5 / 21S301 DETAIL
1/4" = 1'-0"







6 / 21S301 DETAIL
1/2" = 1'-0"

7 / 21S105 DETAIL
1/4" = 1'-0"

8 / 21S106 DETAIL
1/4" = 1'-0"

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
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DESIGNED BY	W. DONELAN
DRAWN BY	H. GARICA
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APPROVED BY	J. NAVE
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
JASON C. NAVE
130766
10/16/25

LEWISVILLE
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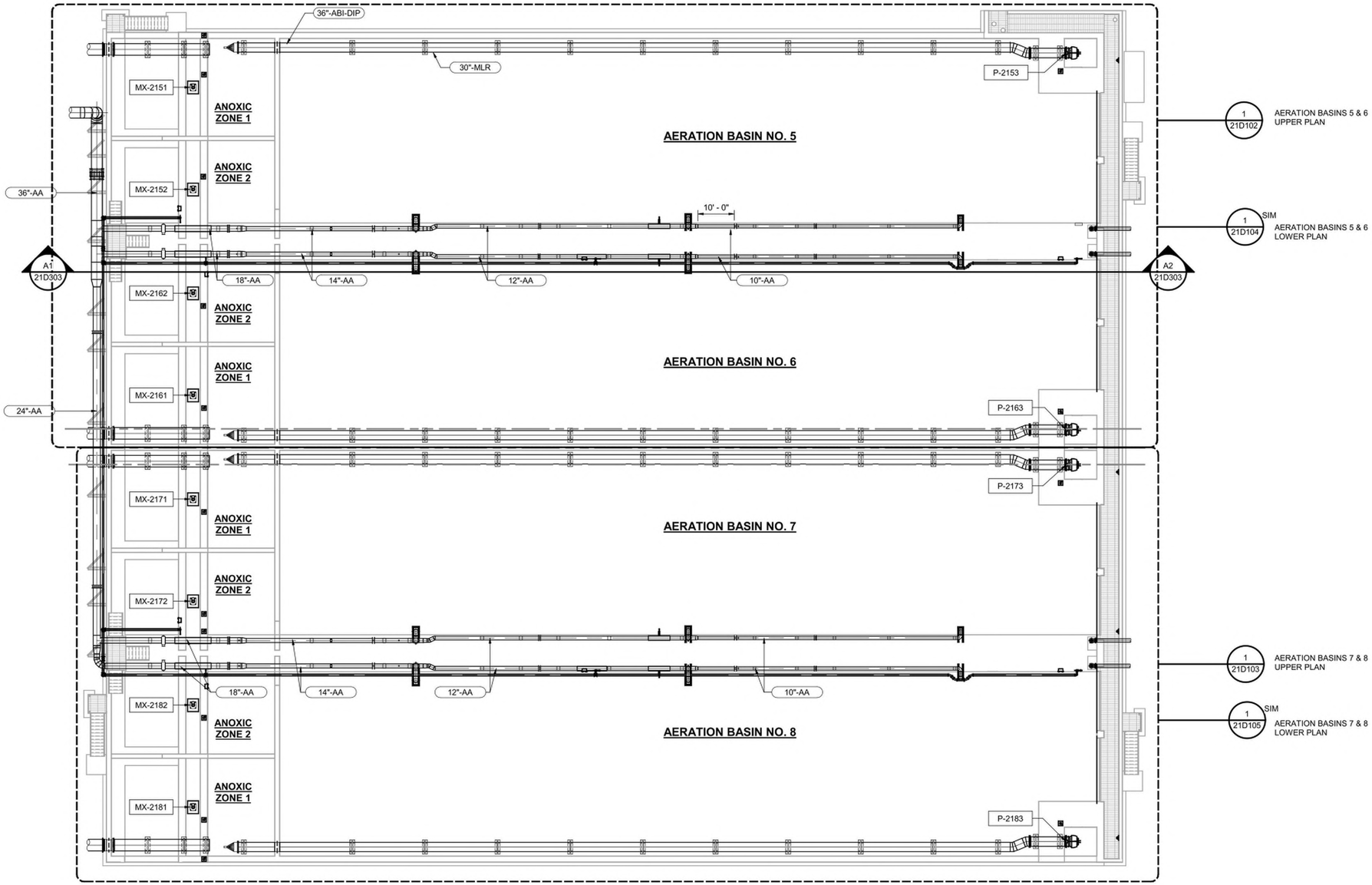
CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

PLANT II AERATION BASIN NOS. 5-8 STRUCTURAL DETAILS

0 1" 2"

FILENAME	HDRE_ALL_DISCIPLINES.rte
SCALE	As indicated
SHEET	21S502



OVERALL PLAN

1/16" = 1'-0"

Autodesk Docs://10342803_COL_PCWWT_AB_Expansion_2024/21 - Plant II Aeration Basin Nos 5-8 - PROCESS.rvt
10/15/2025 3:05:18 PM

HDR
TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
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PROJECT MANAGER	J. R. CANTWELL
DESIGNED BY	J. MACMANUS
DRAWN BY	A.FREEMON
CHECKED BY	M. BOND
APPROVED BY	T. PAULMANN
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
THOMAS A. PAULMANN
128794
LICENSED PROFESSIONAL ENGINEER
10/16/25

LEWISVILLE
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CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

N
0 1" 2"

PLANT II AERATION BASIN NOS. 5 - 8
PROCESS
OVERALL PLAN

FILENAME: 21 Plant Aeration Basin No. 5-8
SCALE: 1/16" = 1'-0"
SHEET: 21D101

AIR PIPE KEYNOTES: (X)

(ALL SUPPORTS ARE AS DEFINED ON THE PROCESS STANDARD DETAIL DRAWINGS)

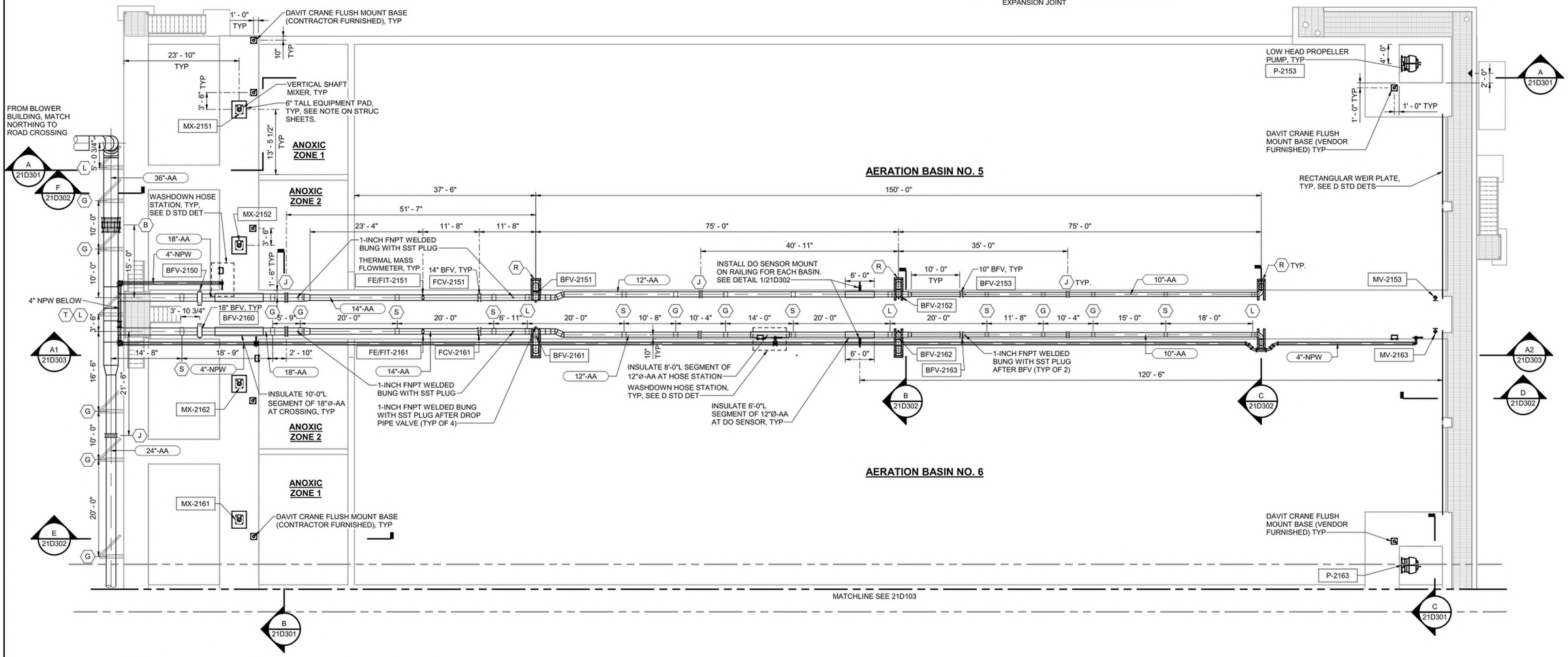
S	"H" SLIDE SUPPORT
G	"H" GUIDE SUPPORT
L	"H" GUIDE SUPPORT WITH LINESTOPS
T	"T" SLIDE HORIZONTAL THRUST BRACE
R	LUGGED PIPE RISER
J	ELASTOMETRIC BELLOWS EXPANSION JOINT
B	PRESSURE BALANCED ELASTOMETRIC BELLOWS EXPANSION JOINT

SEE STRUCTURAL DRAWINGS FOR SUPPORT FRAMING ASSOCIATED WITH SOME OF THE AIR PIPE SUPPORTS.

AIR PIPE SUPPORTS SHOWN FOR BASIN NO. 6 ARE TYPICAL FOR BASIN NO. 5.

NOTES:

1. ALL EXPOSED NPW PIPING (INCLUDING HOSE STATIONS) SHALL BE HEAT TRACED AND INSULATED. SEE SPECIFICATIONS FOR REQUIREMENTS.
2. SEE STRUCTURAL STANDARD DETAILS FOR DAVIT CRANE - WALL MOUNTED BASES.
3. CONTRACTOR SHALL VERIFY ALL DAVIT CRANE BASE LOCATIONS WITH FURNISHED PUMPS AND MIXERS. SUBMIT BASE LOCATIONS FOR APPROVAL AS INDICATED ON STRUCTURAL DRAWINGS.
4. CONTRACTOR-FURNISHED DAVIT CRANE BASES SHALL BE COMPATIBLE WITH DAVIT CRANE FURNISHED BY SECTION 43 23 24 VENDOR.



1 21D102 AERATION BASIN NOS. 5 & 6 UPPER PLAN

3/32" = 1'-0"

TEXAS P.E. FIRM
Registration No. F-754

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CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

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LICENSED PROFESSIONAL ENGINEER
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PRAIRIE CREEK

AERATION BASIN EXPANSION

PLANT II AERATION BASIN NOS. 5 - 8 PROCESS
BASIN NOS. 5 & 6 UPPER LEVEL PLAN

N

0 1" 2"

FILENAME	21 Plant Aeration Basin No. 5-8
SCALE	3/32" = 1'-0"
SHEET	21D102

Autodesk Docs://10342803_COL_PCWWT_AB_Expansion_2024/21 - Plant II Aeration Basin Nos 5-8 - PROCESS.rvt
10/15/2025 3:05:24 PM

AIR PIPE KEYNOTES: (X)

(ALL SUPPORTS ARE AS DEFINED ON THE PROCESS STANDARD DETAIL DRAWINGS)

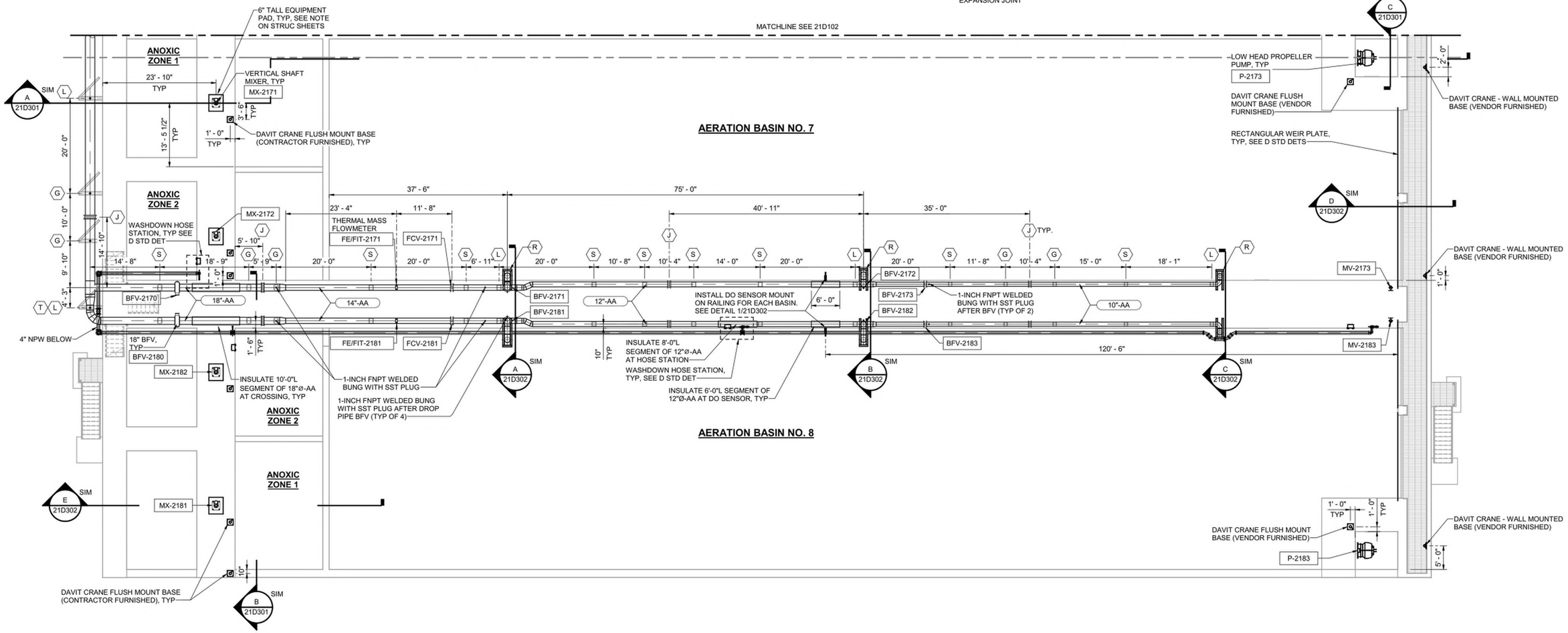
S	"H" SLIDE SUPPORT
G	"H" GUIDE SUPPORT
L	"H" GUIDE SUPPORT WITH LINESTOPS
T	"T" SLIDE HORIZONTAL THRUST BRACE
R	LUGGED PIPE RISER
J	ELASTOMETRIC BELLOWS EXPANSION JOINT
B	PRESSURE BALANCED ELASTOMETRIC BELLOWS EXPANSION JOINT

SEE STRUCTURAL DRAWINGS FOR SUPPORT FRAMING ASSOCIATED WITH SOME OF THE AIR PIPE SUPPORTS.

AIR PIPE SUPPORTS SHOWN FOR BASIN NO. 7 ARE TYPICAL FOR BASIN NO. 8.

NOTES:

1. ALL EXPOSED NPW PIPING (INCLUDING HOSE STATIONS) SHALL BE HEAT TRACED AND INSULATED. SEE SPECIFICATIONS FOR REQUIREMENTS.
2. SEE STRUCTURAL STANDARD DETAILS FOR DAVIT CRANE - WALL MOUNTED BASES.
3. CONTRACTOR SHALL VERIFY ALL DAVIT CRANE BASE LOCATIONS WITH FURNISHED PUMPS AND MIXERS. SUBMIT BASE LOCATIONS FOR APPROVAL AS INDICATED ON STRUCTURAL DRAWINGS.
4. CONTRACTOR-FURNISHED DAVIT CRANE BASES SHALL BE COMPATIBLE WITH DAVIT CRANE FURNISHED BY SECTION 43 23 24 VENDOR.



1 21D103 AERATION BASIN NOS. 7 & 8 UPPER PLAN
3/32" = 1'-0"

ISSUE	DATE	DESCRIPTION
100%	OCT 16/2025	ISSUED FOR BID

PROJECT MANAGER	J. R. CANTWELL
DESIGNED BY	J. MACMANUS
DRAWN BY	A.FREEMON
CHECKED BY	M. BOND
APPROVED BY	T. PAULMANN
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

TEXAS P.E. FIRM Registration No. F-754

STATE OF TEXAS · THOMAS A. PAULMANN · 128794 · LICENSED · ENGINEER · PROFESSIONAL · 10/16/25

LEWISVILLE Deep Roots. Broad Wings. Bright Future

CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

PLANT II AERATION BASIN NOS. 5 - 8 PROCESS
BASIN NOS. 7 & 8 UPPER LEVEL PLAN

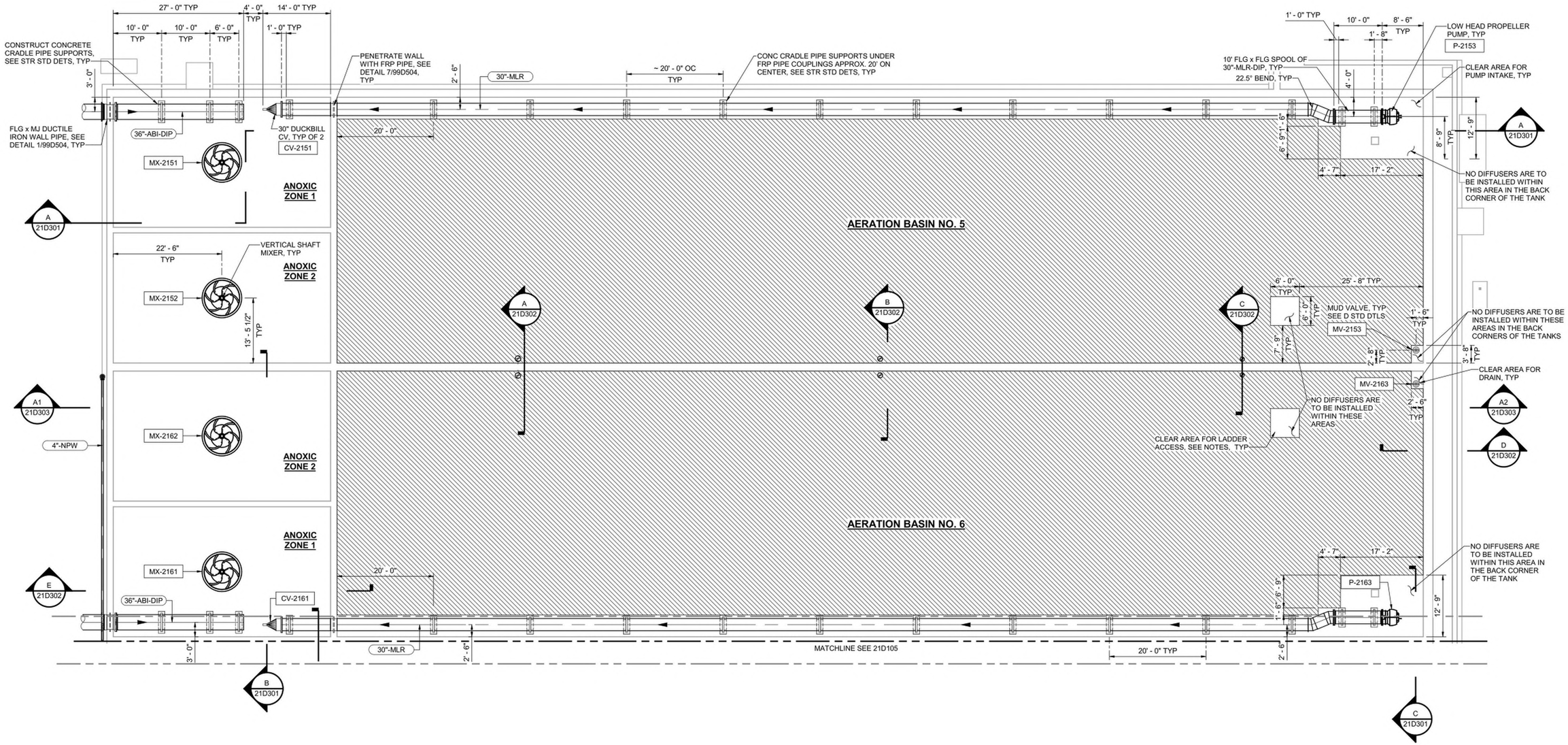
FILENAME: 21 Plant Aeration Basin No. 5-8
SCALE: 3/32" = 1'-0"
SHEET: 21D103

Autodesk Docs://10342803_COL_PCWWT_AB_Expansion_2024/21 - Plant II Aeration Basin Nos 5-8 - PROCESS.rvt
10/15/2025 3:05:29 PM

NOTES:

1. COORDINATE CLEAR AREAS FOR LADDER ACCESS TO BASIN FLOOR WITH PLATFORM ALUM SWING GATES ON STR DWGS.

APPROXIMATE DIFFUSER AREA



1 21D104 AERATION BASIN NOS. 5 & 6 LOWER PLAN

3/32" = 1'-0"

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10/15/2025 3:05:30 PM

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	OCT 16/2025	ISSUED FOR BID

PROJECT MANAGER	J. R. CANTWELL
DESIGNED BY	J. MACMANUS
DRAWN BY	A.FREEMON
CHECKED BY	M. BOND
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CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

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THOMAS A. PAULMANN
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10/16/25

LEWISVILLE
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CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

PLANT II AERATION BASIN NOS. 5 - 8 PROCESS
BASIN NO. 5 & 6 LOWER LEVEL PLAN

N

0 1" 2"

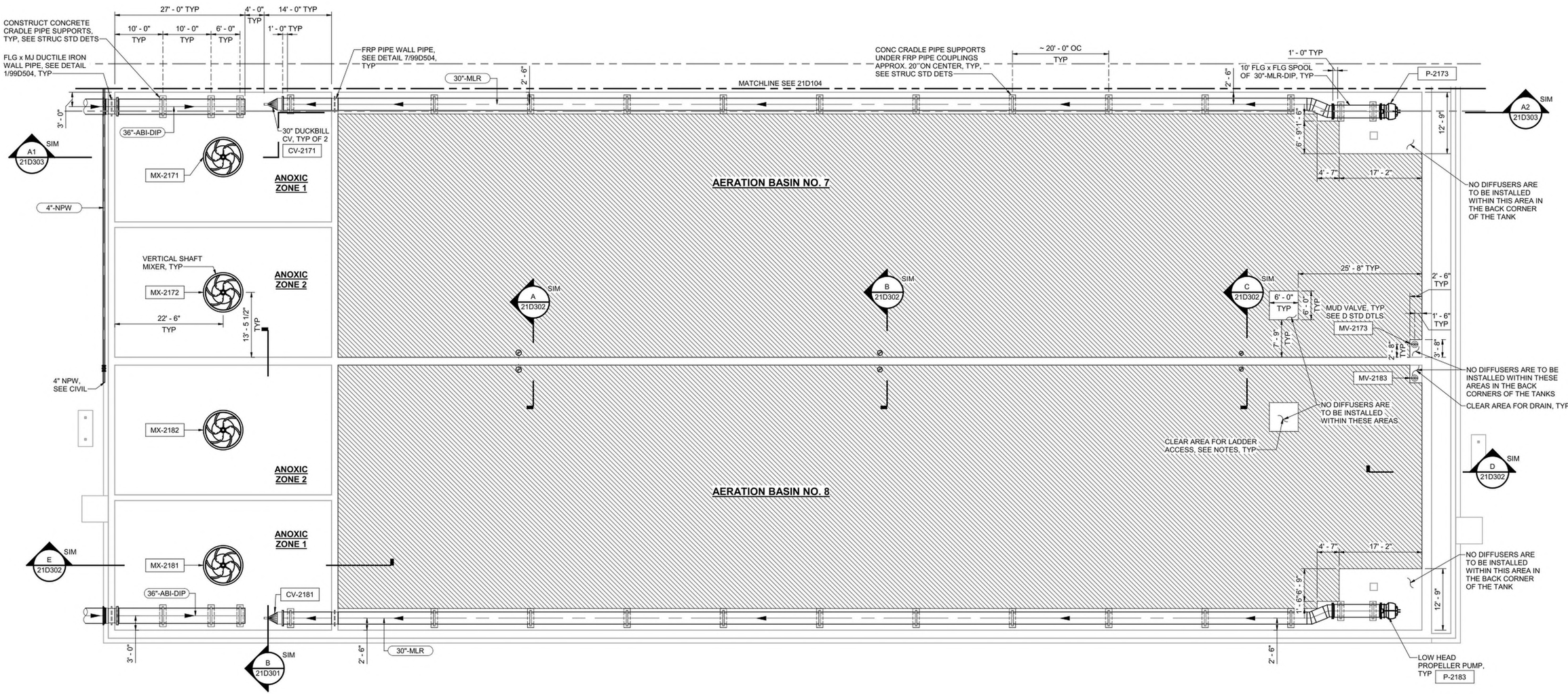
FILENAME: 21 Plant Aeration Basin No. 5-8
SCALE: As indicated

SHEET: 21D104

NOTES:

1. COORDINATE CLEAR AREAS FOR LADDER ACCESS TO BASIN FLOOR WITH PLATFORM ALUM SWING GATES ON STR DWGS.

APPROXIMATE DIFFUSER AREA



1 / 21D105 AERATION BASIN NOS. 7 & 8 LOWER PLAN

3/32" = 1'-0"

100%	OCT 16/2025	ISSUED FOR BID
ISSUE	DATE	DESCRIPTION

PROJECT MANAGER	J. R. CANTWELL
DESIGNED BY	J. MACMANUS
DRAWN BY	A.FREEMON
CHECKED BY	M. BOND
APPROVED BY	T. PAULMANN
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

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TEXAS P.E. FIRM
Registration No. F-754

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10/16/25

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PRAIRIE CREEK

AERATION BASIN EXPANSION

PLANT II AERATION BASIN NOS. 5 - 8 PROCESS BASIN NOS. 7 & 8 LOWER LEVEL PLAN

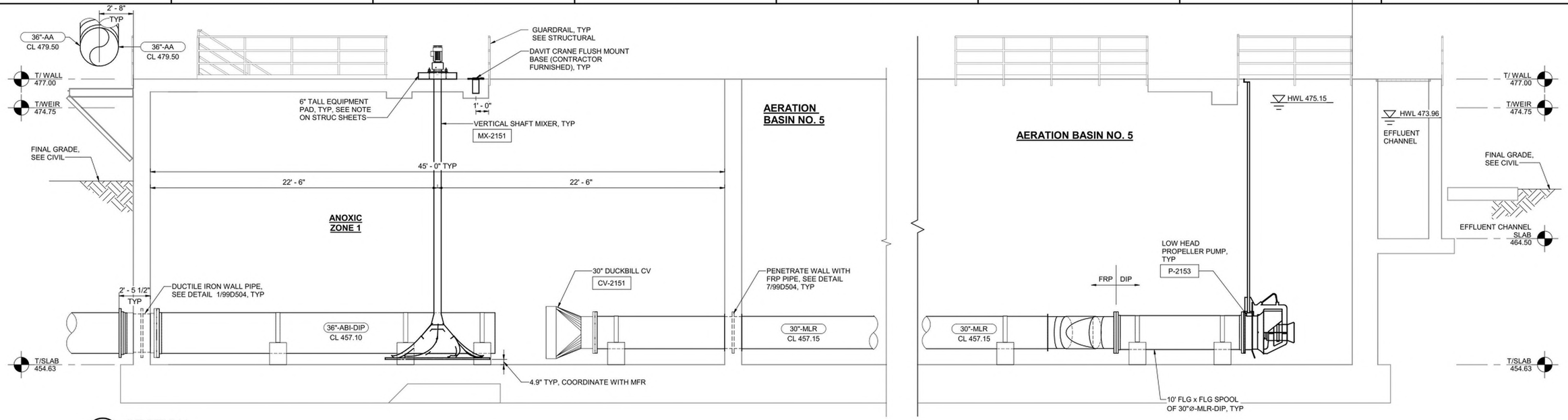
N

0 1" 2"

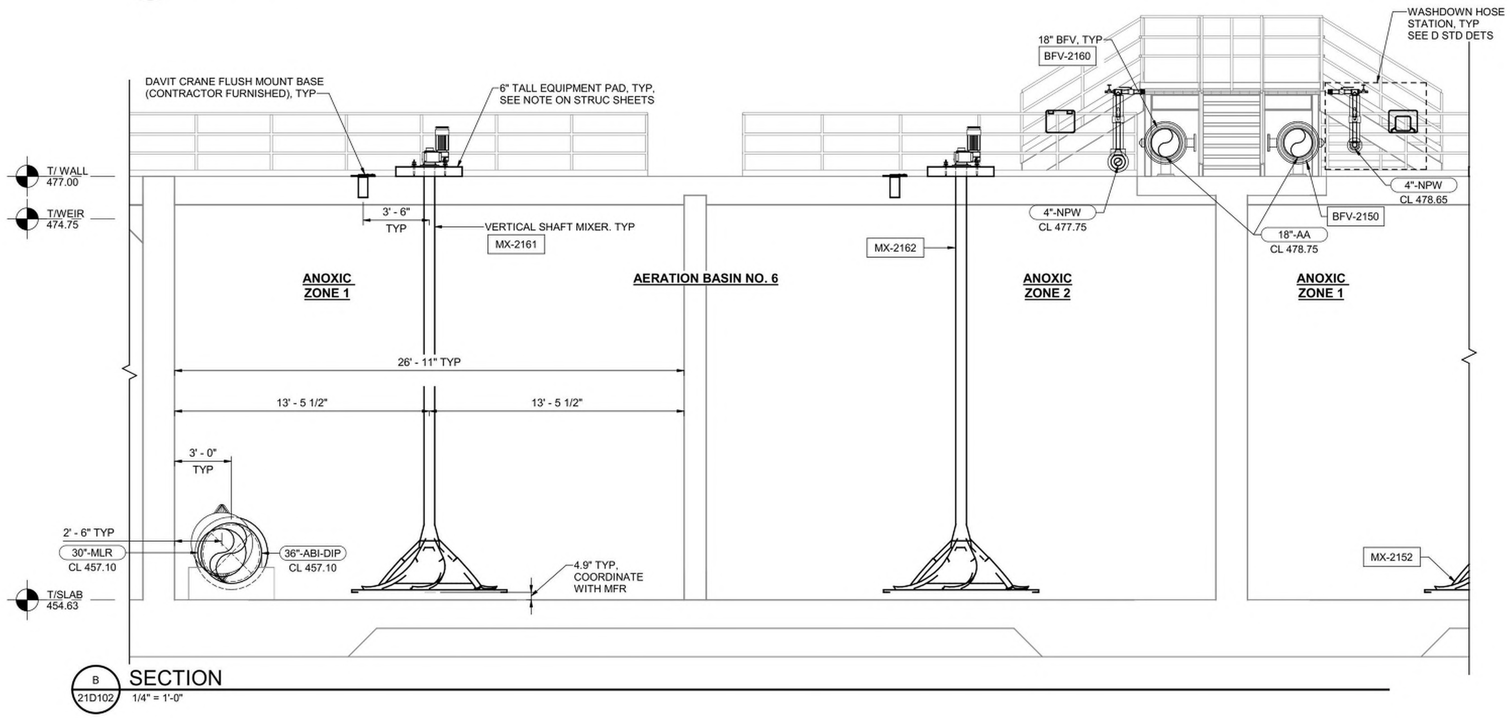
FILENAME: 21 Plant Aeration Basin No. 5-8
SCALE: As indicated

SHEET: 21D105

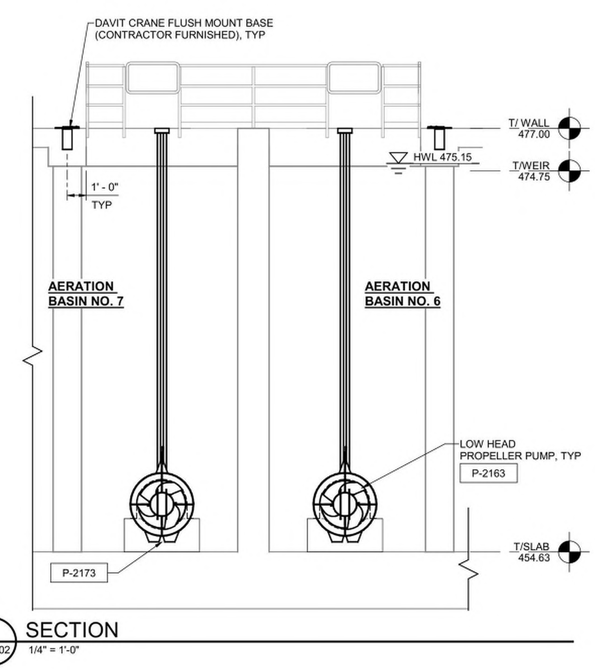
Autodesk Docs://10342803_COL_PCWWT_AB_Expansion_2024/21 - Plant II Aeration Basin Nos 5-8 - PROCESS.rvt
10/15/2025 3:05:31 PM



A 21D102 SECTION
1/4" = 1'-0"



B 21D102 SECTION
1/4" = 1'-0"



C 21D102 SECTION
1/4" = 1'-0"

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10/15/2025 3:05:35 PM

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	OCT 16/2025	ISSUED FOR BID

PROJECT MANAGER	J. R. CANTWELL
DESIGNED BY	J. MACMANUS
DRAWN BY	A.FREEMON
CHECKED BY	M. BOND
APPROVED BY	T. PAULMANN
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

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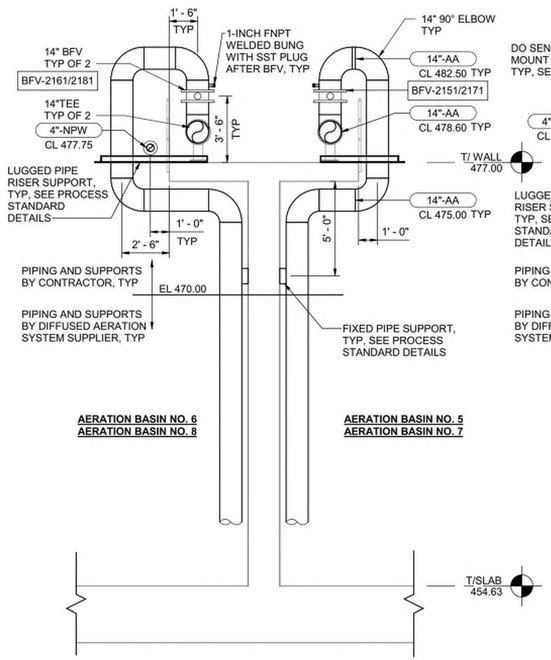
CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

PLANT II AERATION BASIN NOS. 5 - 8 PROCESS SECTIONS

FILENAME: 21 Plant Aeration Basin No. 5-8
SCALE: 1/4" = 1'-0"
0 1" 2"

SHEET
21D301



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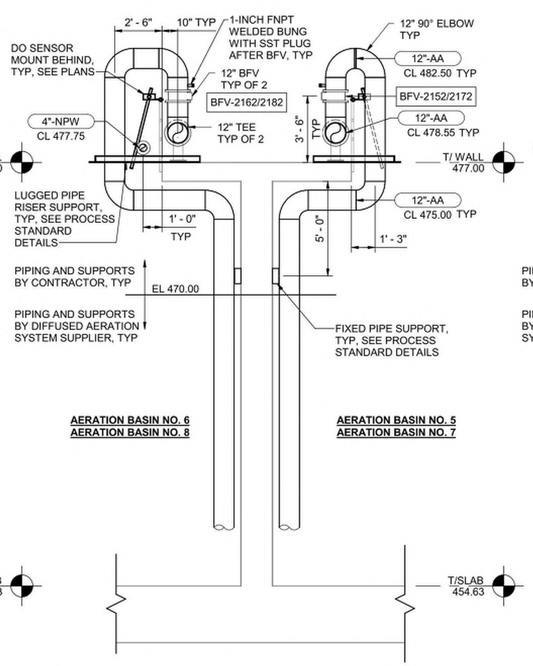
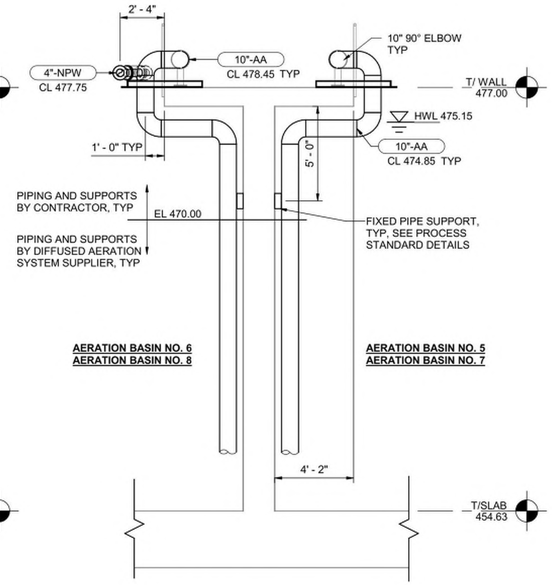
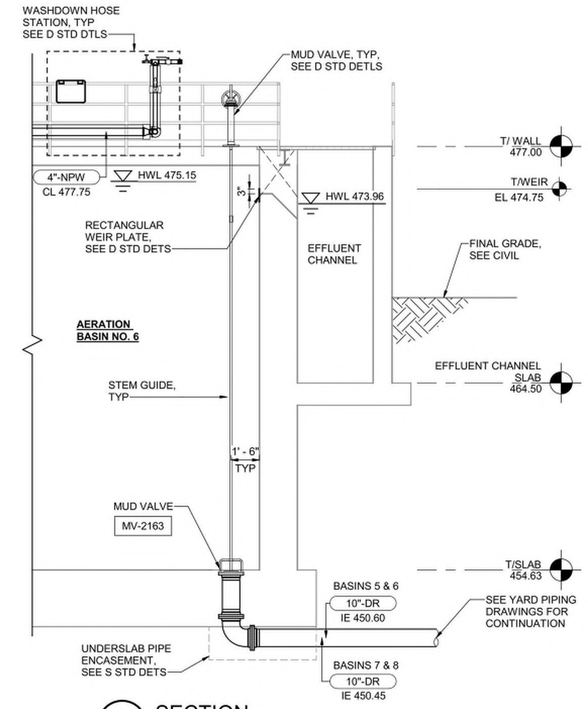
1/4" = 1'-0"



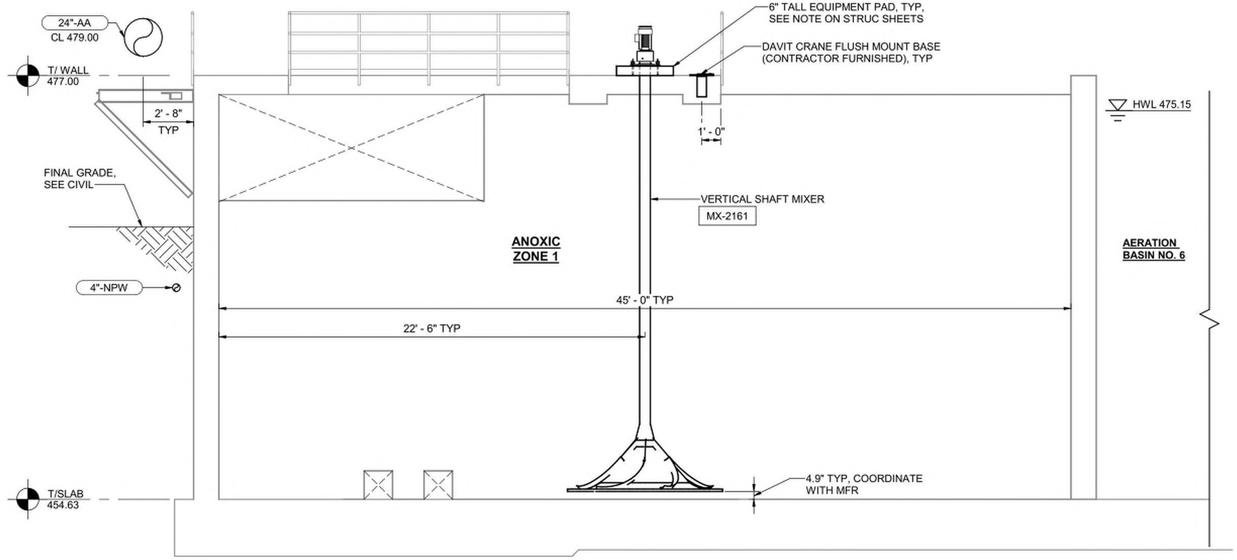
B 21D102 SECTION
1/4" = 1'-0"



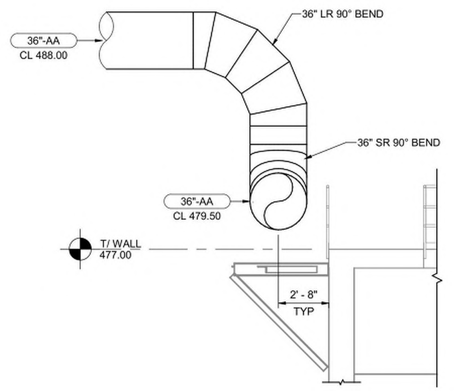
C 21D102 SECTION
1/4" = 1'-0"



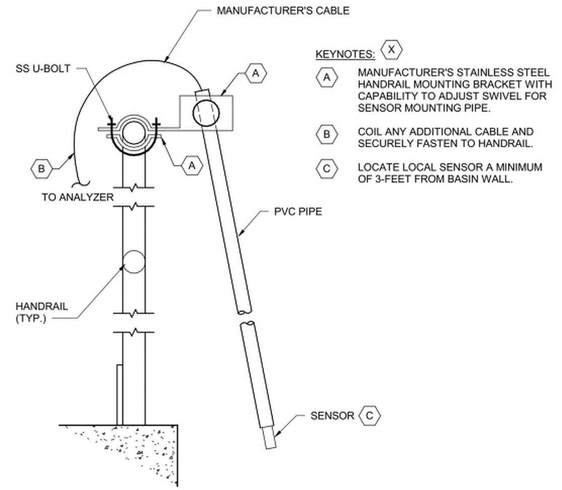
D 21D102 SECTION
1/4" = 1'-0"



E 21D102 SECTION
1/4" = 1'-0"



F 21D102 SECTION
1/4" = 1'-0"



1 DO SENSOR GUARDRAIL MOUNTING DETAIL
12" = 1'-0"

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10/15/2025 3:09:26 PM

HDR
TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	OCT 16/2025	ISSUED FOR BID

PROJECT MANAGER	J. R. CANTWELL
DESIGNED BY	J. MACMANUS
DRAWN BY	A.FREEMON
CHECKED BY	M. BOND
APPROVED BY	T. PAULMANN
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
THOMAS A. PAULMANN
128794
LICENSED
PROFESSIONAL ENGINEER
Thomas A. Paulmann Jr. 10/16/25

LEWISVILLE
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CITY OF LEWISVILLE
PRAIRIE CREEK

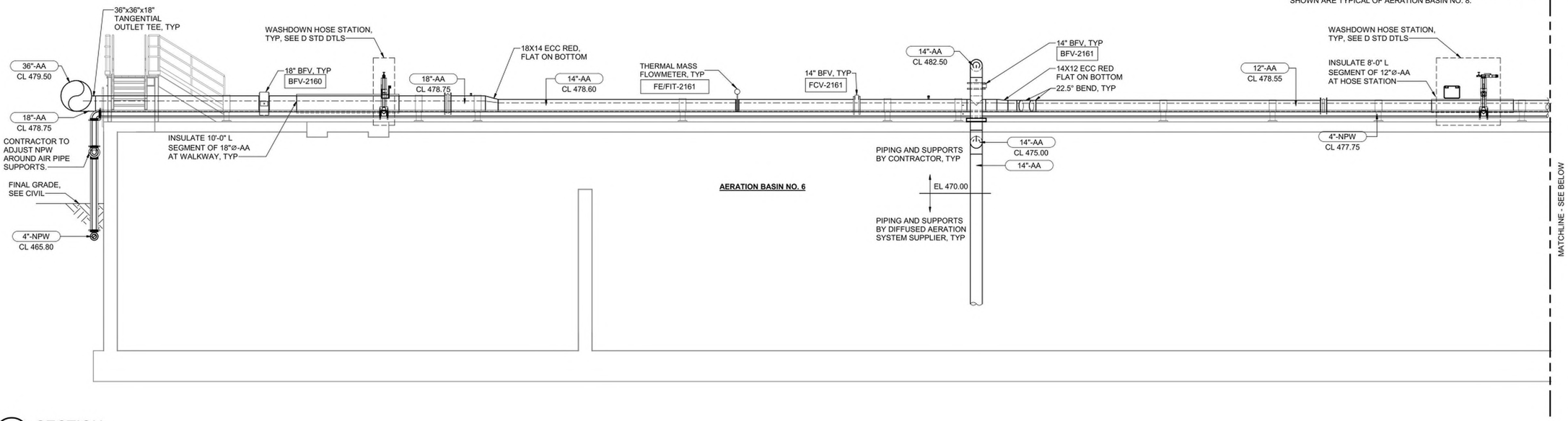
AERATION BASIN EXPANSION

PLANT II AERATION BASIN NOS. 5 - 8 PROCESS SECTIONS

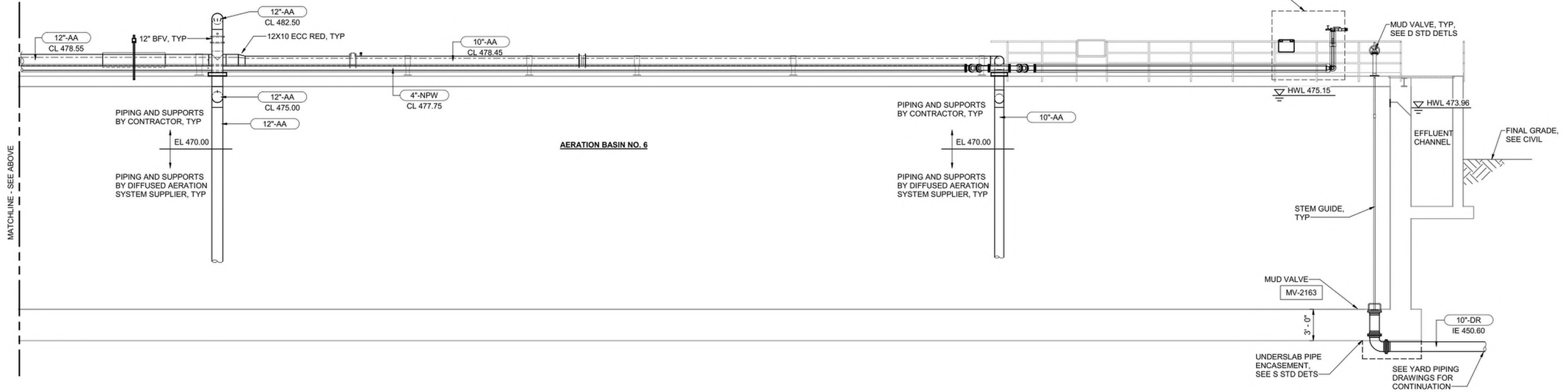
FILENAME: 21 Plant Aeration Basin No. 5-8
SCALE: As indicated
0 1" 2"
SHEET: 21D302

NOTES:

1. AERATION BASIN NO. 6 AIR PIPING SYSTEM SHOWN IS TYPICAL OF AERATION BASIN NOS. 5, 7, & 8. NPW PIPING AND APPURTENANCES SHOWN ARE TYPICAL OF AERATION BASIN NO. 8.



A1 / 21D101 SECTION
3/16" = 1'-0"



A2 / 21D101 SECTION
3/16" = 1'-0"

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10/15/2025 3:05:38 PM

HDR
TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	OCT 16/2025	ISSUED FOR BID

PROJECT MANAGER	J. R. CANTWELL
DESIGNED BY	J. MACMANUS
DRAWN BY	A.FREEMON
CHECKED BY	M. BOND
APPROVED BY	T. PAULMANN
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
THOMAS A. PAULMANN
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Thomas A. Paulmann Jr.
10/16/25

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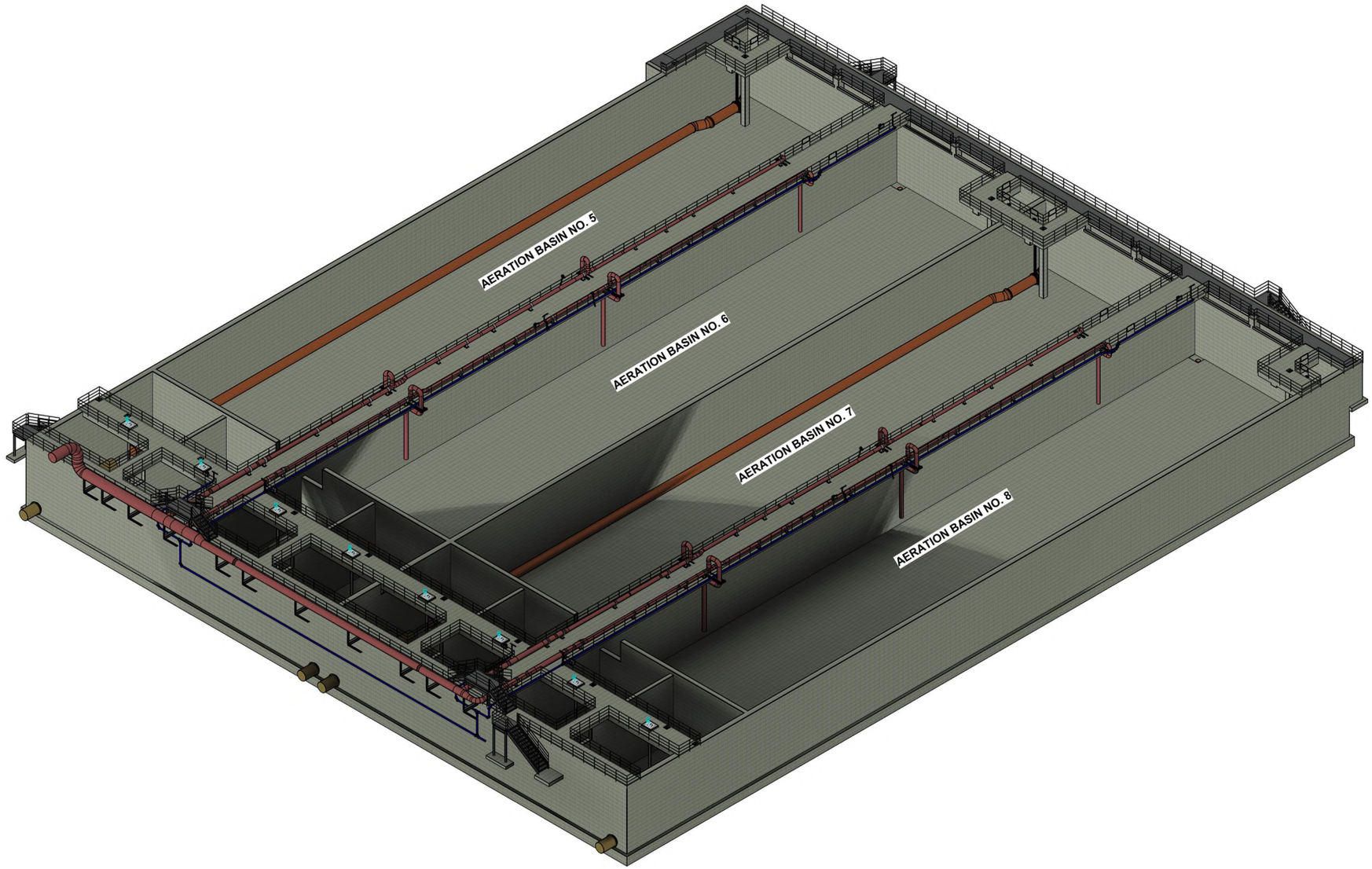
PRAIRIE CREEK

AERATION BASIN EXPANSION

PLANT II AERATION BASIN NOS. 5 - 8 PROCESS SECTIONS

FILENAME: 21 Plant Aeration Basin No. 5-8
SCALE: 3/16" = 1'-0"
0 1" 2"

SHEET
21D303



ISOMETRIC VIEW

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	OCT 16/2025	ISSUED FOR BID

PROJECT MANAGER	J. R. CANTWELL
DESIGNED BY	J. MACMANUS
DRAWN BY	A.FREEMON
CHECKED BY	M. BOND
APPROVED BY	T. PAULMANN
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
THOMAS A. PAULMANN
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LICENSED PROFESSIONAL ENGINEER
10/16/25

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PRAIRIE CREEK

AERATION BASIN EXPANSION

PLANT II AERATION BASIN NOS. 5 - 8 PROCESS ISOMETRIC

FILENAME: 21 Plant Aeration Basin No. 5-8
SCALE: 0 1" 2"

SHEET: 21D601

Autodesk Docs://10342803_COL_PCWWT_AB_Expansion_2024/21 - Plant II Aeration Basin Nos 5-8 - PROCESS.rvt
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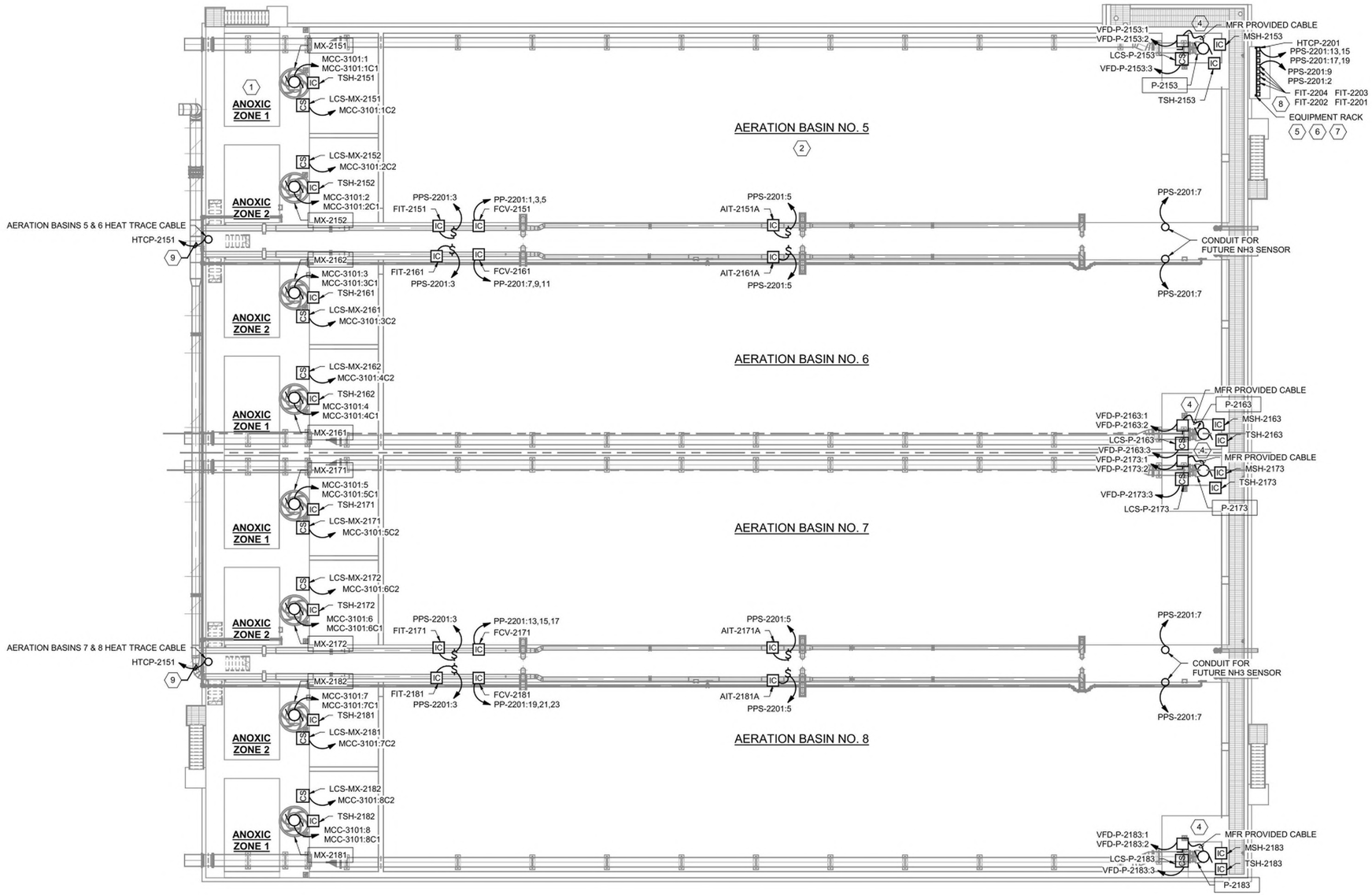

1 - AERATION BASIN NOS. 5-8 POWER PLAN

1/16" = 1'-0"

GENERAL NOTES:

1. REFER TO PLANT II BLOWER BUILDING ELECTRICAL SWITCHBOARD SWBD-3101 ONE-LINE DIAGRAM ON SHEET 31E601.
2. REFER TO PLANT II BLOWER BUILDING ELECTRICAL MCC-3101 ONE-LINE DIAGRAM ON SHEET 31E602.
3. REFER TO PPS-2201 SCHEDULE ON SHEET 22E601.
4. ROUTE EXPOSED CONDUIT CLEAR OF WALKING PATH AND AND MAINTAIN MAXIMUM PRACTICABLE OPEN FLOOR SPACE ESPECIALLY AROUND PUMPS/EQUIPMENT SO AS NOT TO CREATE A TRIPPING HAZARD OR INTERFERE WITH OPERATING EQUIPMENT.

KEY NOTES: (#)

1. AREA CLASSIFICATION IS CLASS 1 DIVISION 2. SEE NFPA 820 2020 TABLE 5.2.2, ROW 6, LINE C. TYPICAL OF ALL ANOXIC ZONES ON THIS SHEET.
2. AREA CLASSIFICATION IS CLASS 1 DIVISION 2. SEE NFPA 820 2020 TABLE 5.2.2, ROW 8. TYPICAL FOR ALL AERATION BASINS ON THIS SHEET.
3. AREA CLASSIFICATION IS OUTDOOR-WET/CORROSIVE.
4. PROVIDE 2" SLEEVE FOR PUMP MFR PROVIDED CABLE. PROVIDE A MINIMUM OF 24" AIR GAP BETWEEN SLEEVE AND DISCONNECT. PROVIDE NEMA 4X CABLE GLAND AND STRAIN RELIEF GRIP.
5. CONTRACTOR SHALL COORDINATE SIZE OF EQUIPMENT RACK WITH FINAL INSTRUMENT DIMENSIONS.
6. REFER TO 5/99E501 FOR MODULAR EQUIPMENT RACK ON CONCRETE PAD DETAIL AND TO INSTRUMENTATION STANDARD DETAILS SHEET 99Y503 FOR MORE INFORMATION.
7. EQUIPMENT RACK SHALL BE MOUNTED AT LEAST 11'-0" SOUTH OF SECONDARY CLARIFIER SPLITTER STRUCTURE.
8. PROVIDE TOGGLE SWITCH FOR ALL INSTRUMENTATION DEVICES REQUIRING 120V POWER. TOGGLE SWITCH TO BE WITHIN SIGHT OF INSTRUMENT FOR DISCONNECTING MEANS. TOGGLE SWITCHES NOT SHOWN FOR CLARITY.
9. 2#6, #10G, 1"C.

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	O. JONGUITUD
DRAWN BY	B. LOREDO
CHECKED BY	G. JAGLOWSKI
APPROVED BY	O. JONGUITUD
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342603

STATE OF TEXAS
OSCAR JONGUITUD
13057
LICENSED
PROFESSIONAL ENGINEER
6-13-25

LEWISVILLE
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PRAIRIE CREEK

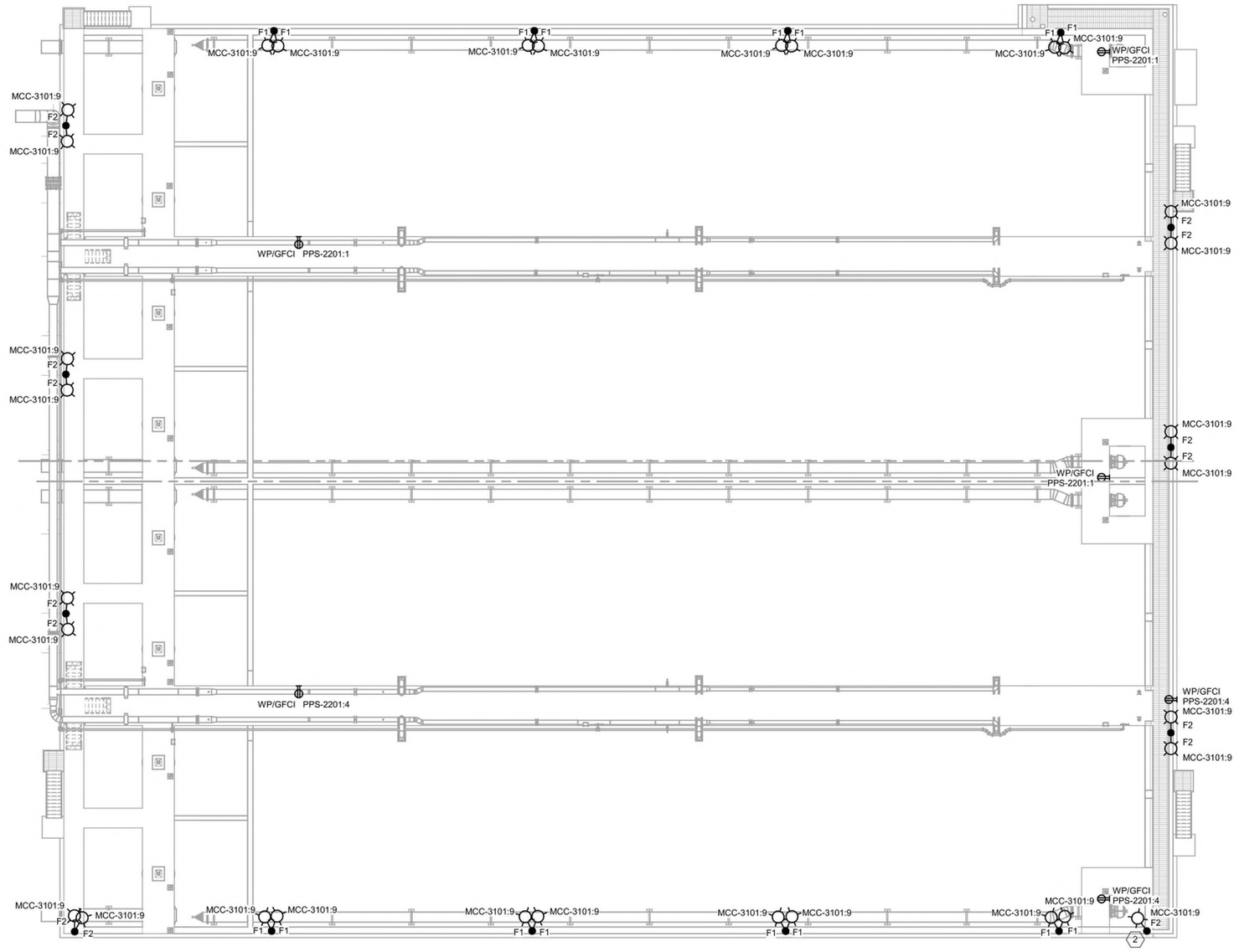
AERATION BASIN EXPANSION

PLANT II AERATION BASIN NOS. 5-8 ELECTRICAL POWER PLAN

0 1" 2"

FILENAME	21E101.dwg
SCALE	1/16" = 1'-0"

SHEET **21E101**



1 AERATION BASIN NOS. 5-8 LIGHTING AND RECEPTACLE PLAN
1/16" = 1'-0"

GENERAL NOTES:

1. REFER TO SHEET 21E101 FOR AREA CLASSIFICATIONS.
2. REFER TO SHEET 00E603 FOR LIGHT FIXTURE SCHEDULE.
3. REFER TO PLANT II BLOWER BUILDING ELECTRICAL MCC-3101 ONE-LINE DIAGRAM ON SHEET 31E602.
4. REFER TO PPS-2201 SCHEDULE ON SHEET 22E601.

KEY NOTES: (#)

1. MOUNT BOTTOM OF LIGHT FIXTURE AT APPROXIMATELY 20'-0" ABOVE TOP OF AERATION BASIN WALL. TYPICAL FOR ALL TYPE F1 AND F2 FIXTURES SHOWN ON THIS DRAWING.
2. SEE 4/99S504 LIGHTPOLE TOP MOUNTED DETAIL ON STRUCTURAL STANDARD DETAILS FOR MORE INFORMATION ON LIGHT POLE INSTALLATION. TYPICAL OF ALL LIGHT POLE SHOWN ON THIS DRAWING.

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	O. JONGUITUD
DRAWN BY	B. LOREDO
CHECKED BY	G. JAGLOWSKI
APPROVED BY	O. JONGUITUD
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342603

STATE OF TEXAS
OSCAR JONGUITUD
133057
LICENSED
PROFESSIONAL ENGINEER
6-13-25

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CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

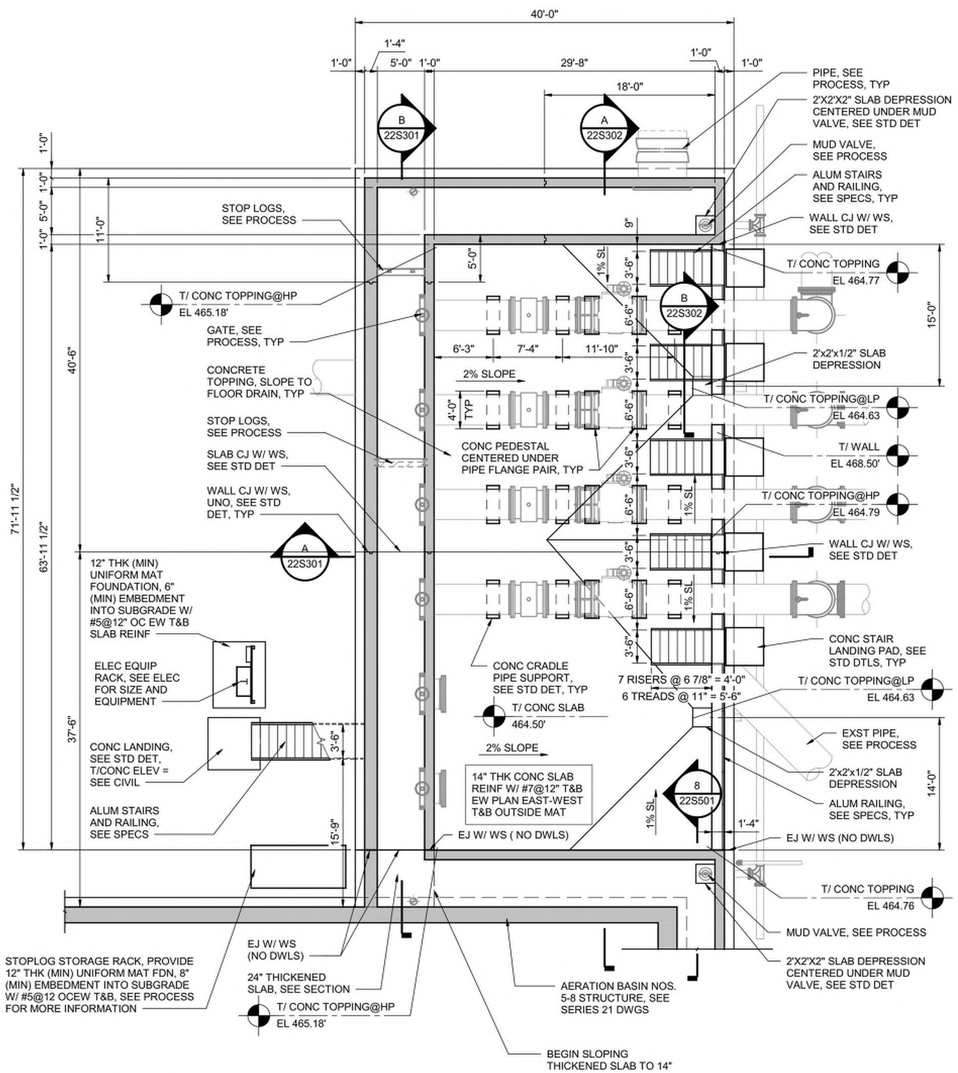
N

0 1" 2"

PLANT II AERATION BASIN NOS. 5-8
ELECTRICAL
LIGHTING AND RECEPTACLE PLAN

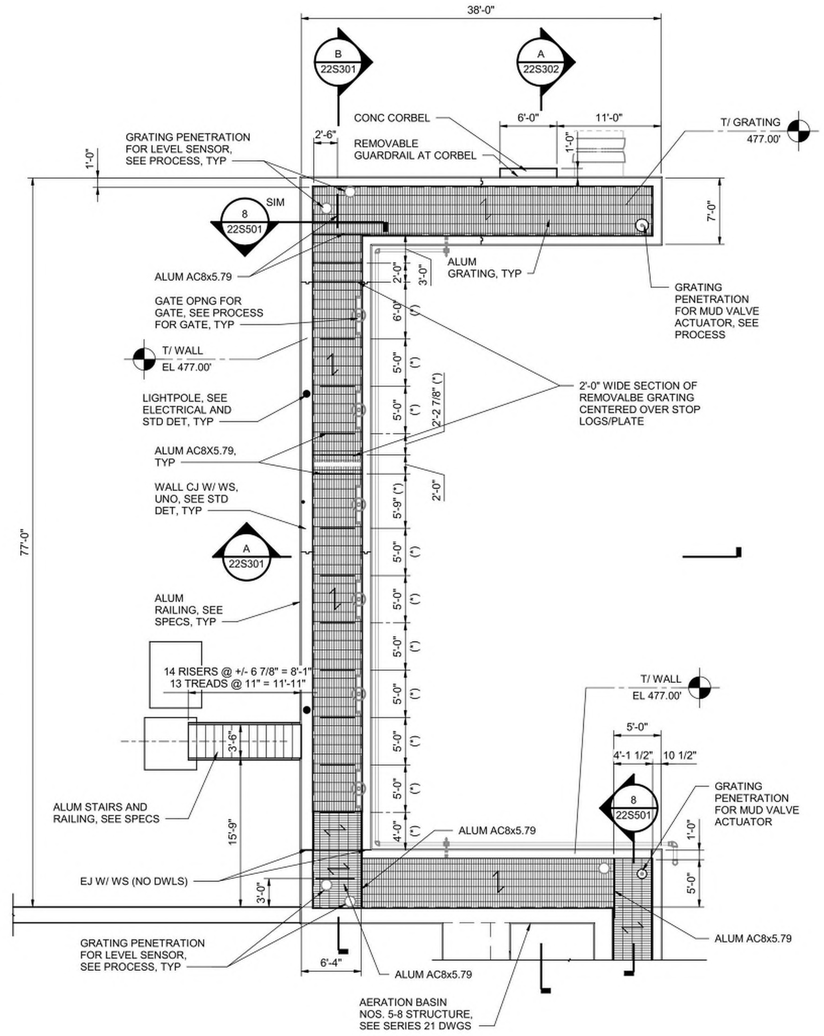
FILENAME 21E102.dwg
SCALE 1/16" = 1'-0"

SHEET
21E102



FOUNDATION PLAN

1/8" = 1'-0"



UPPER PLAN

1/8" = 1'-0"

PLAN NOTES

1. SEE STANDARD DRAWINGS FOR GENERAL STRUCTURAL NOTES AND STANDARD DETAILS.
2. SEE PROCESS/MECHANICAL DRAWINGS FOR ALL PIPE SIZES, LOCATIONS, AND PENETRATION DETAILS.
3. ALL GRATING AND RAILING SHALL BE ALUMINUM, SEE SPECIFICATIONS. ALL OPENINGS AND EDGES IN GRATING SHALL BE BANDED. GRATING DEPTH SHALL BE 2 IN, UNLESS OTHERWISE NOTED.
4. ALL FOUNDATION AND NON-WATER-BEARING CONCRETE SHALL CONTAIN CRYSTALLINE CEMENTITIOUS WATERPROOFING ADMIXTURE AND ALL WATER-BEARING CONCRETE ABOVE FOUNDATION SHALL CONTAIN XYPEX BIO-SAN C500 ANTIMICROBIAL CRYSTALLINE ADMIXTURE. REFERENCE SPECIFICATION 03 31 30.
5. DIMENSIONS INDICATED WITH AN ASTERISK (*) SHALL BE COORDINATED WITH EQUIPMENT PROVIDED.

LEGEND

SPAN DIRECTION

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	OCT 16/2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	W. DONELAN
DRAWN BY	H. GARCIA
CHECKED BY	C. ZIMMERMAN
APPROVED BY	J. NAVE
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
JASON C. NAVE
130766
10/16/25

LEWISVILLE
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CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

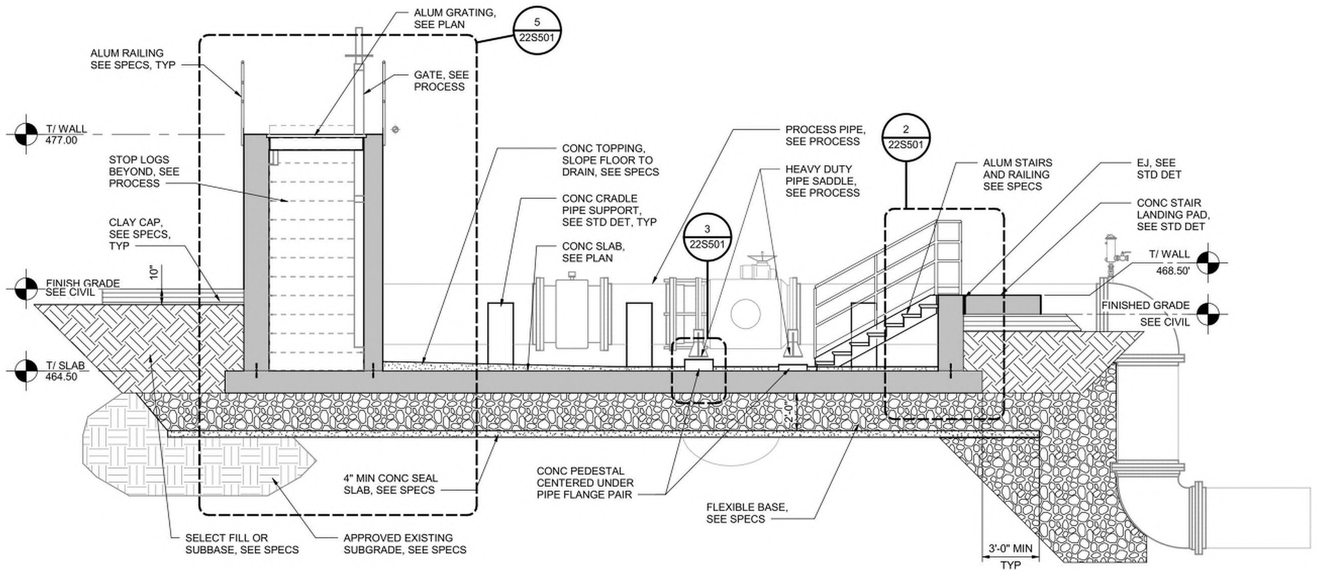
SECONDARY CLARIFIER SPLITTER STRUCTURE STRUCTURAL PLANS

N

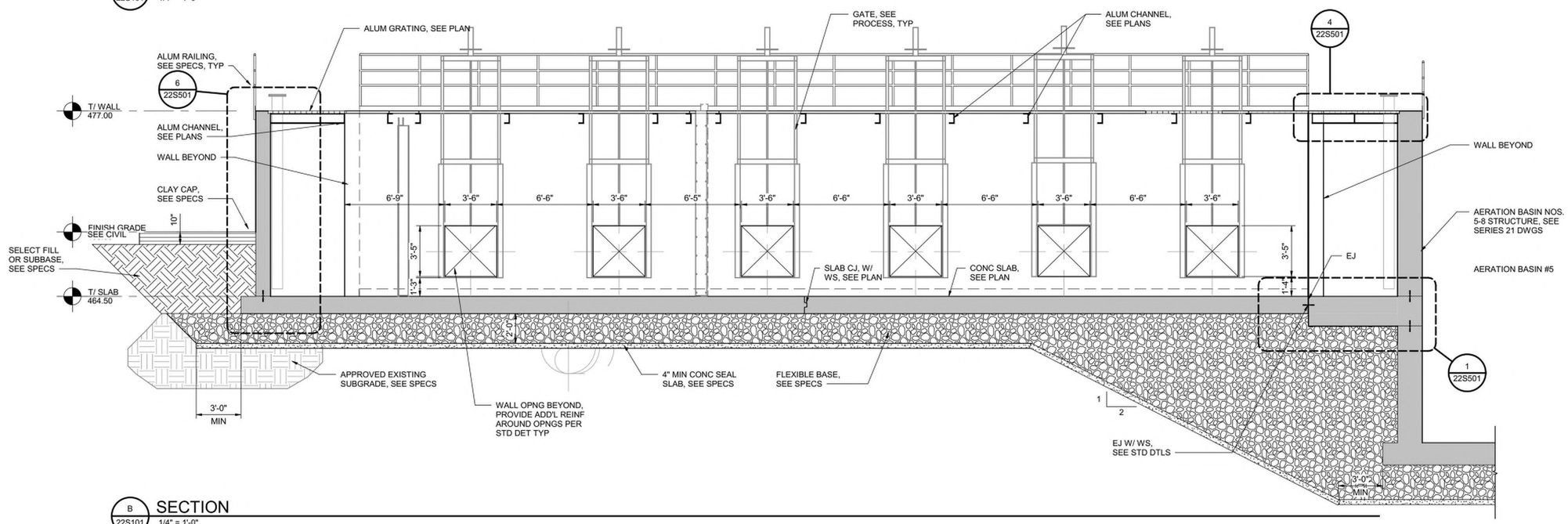
0 1" 2"

FILENAME: STRUCTURAL CONTAINER FILE.RVT
SCALE: 1/8" = 1'-0"

SHEET: **22S101**



A 22S101 **SECTION**
1/4" = 1'-0"



B 22S101 **SECTION**
1/4" = 1'-0"

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	OCT 16/2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	W. DONELAN
DRAWN BY	H. GARCIA
CHECKED BY	C. ZIMMERMAN
APPROVED BY	J. NAVE
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
JASON C. NAVE
130766
10/16/25

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

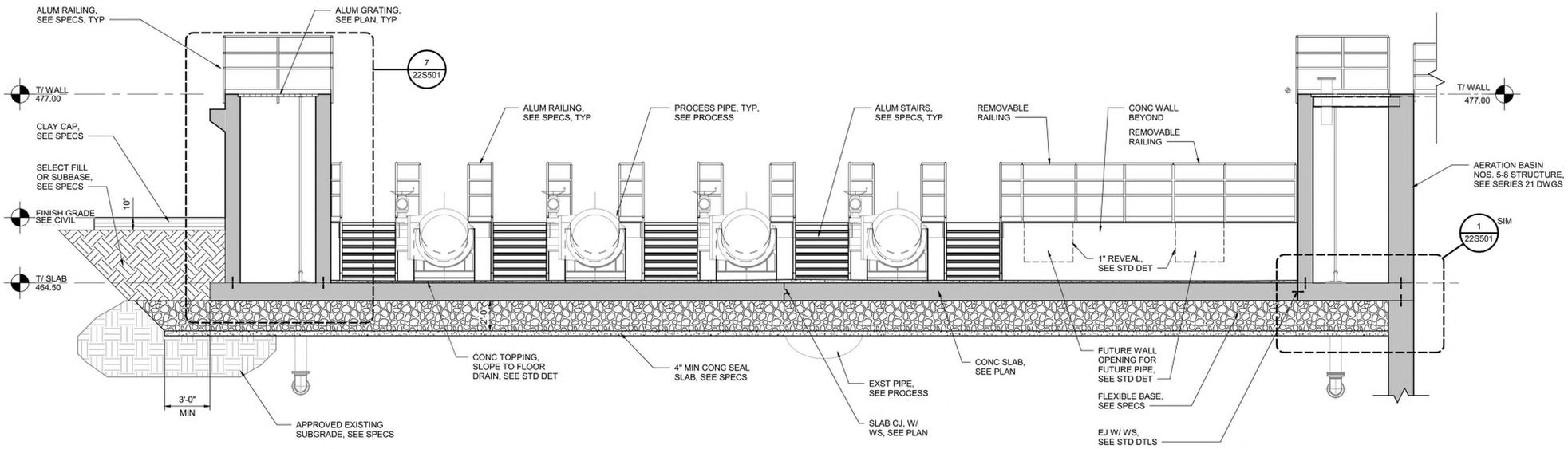
CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

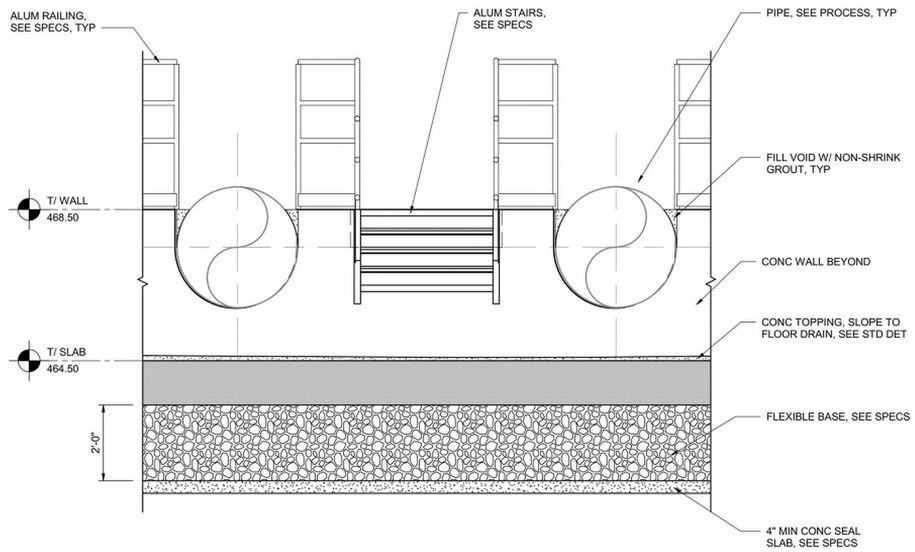
SECONDARY CLARIFIER SPLITTER STRUCTURE STRUCTURAL SECTIONS I

FILENAME	STRUCTURAL CONTAINER FILE.RVT
SCALE	1/4" = 1'-0"
SHEET	22S301

0 1" 2"



A 22S101 **SECTION**
1/4" = 1'-0"



B 22S101 **SECTION**
1/2" = 1'-0"

HDR
TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	OCT 16/2025	ISSUED FOR BID

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CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
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130766
10/16/25

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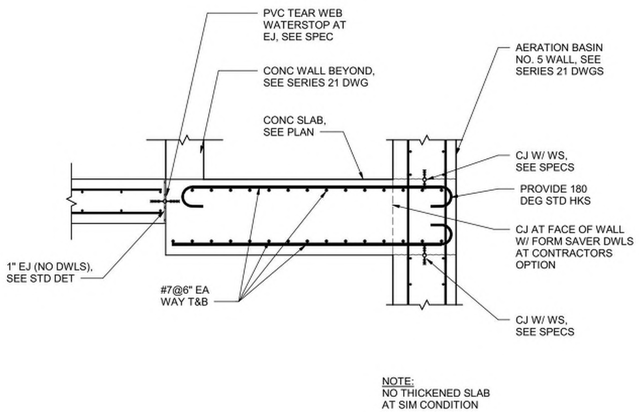
AERATION BASIN EXPANSION

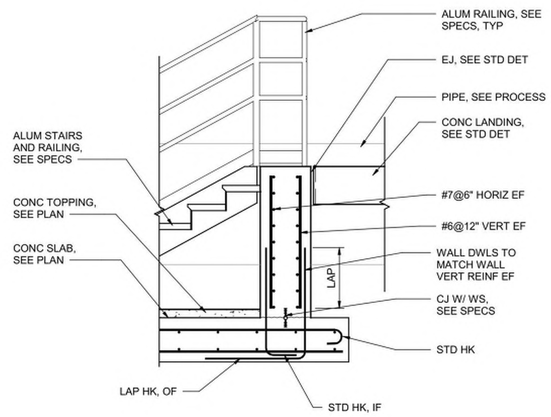
SECONDARY CLARIFIER SPLITTER STRUCTURE STRUCTURAL SECTIONS II

0 1" 2"

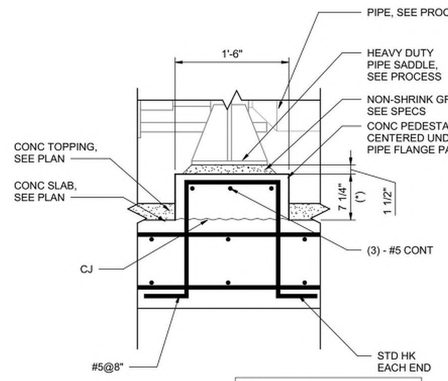
FILENAME: STRUCTURAL CONTAINER FILE.RVT
SCALE: As indicated
SHEET: 22S302



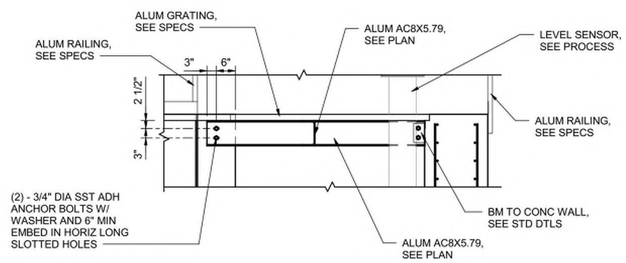
1 22S301 DETAIL 1/2" = 1'-0"



2 22S301 DETAIL 1/2" = 1'-0"



3 22S301 DETAIL 1" = 1'-0"



4 22S301 DETAIL 1/2" = 1'-0"

5 22S301 DETAIL 3/8" = 1'-0"

6 22S301 DETAIL 3/8" = 1'-0"

7 22S302 DETAIL 3/8" = 1'-0"

8 22S101 DETAIL 3/8" = 1'-0"

TEXAS P.E. FIRM
Registration No. F-754

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CHECKED BY	C. ZIMMERMAN
APPROVED BY	J. NAVE
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
JASON C. NAVE
130766
10/16/25

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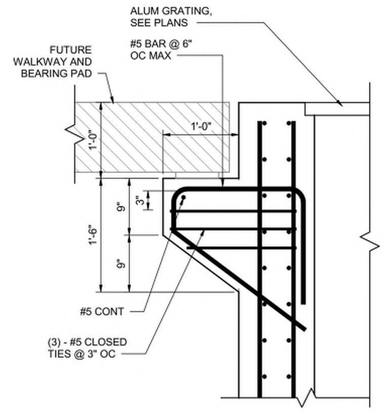
PRAIRIE CREEK

AERATION BASIN EXPANSION

SECONDARY CLARIFIER SPLITTER STRUCTURE STRUCTURAL DETAILS

FILENAME: STRUCTURAL CONTAINER FILE.RVT
SCALE: As indicated
0 1" 2"

SHEET: 22S501



1
22S501
DETAIL
1" = 1'-0"

ISSUE	DATE	DESCRIPTION
100%	OCT 16/2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	W. DONELAN
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CITY PROJECT NO.	U2100
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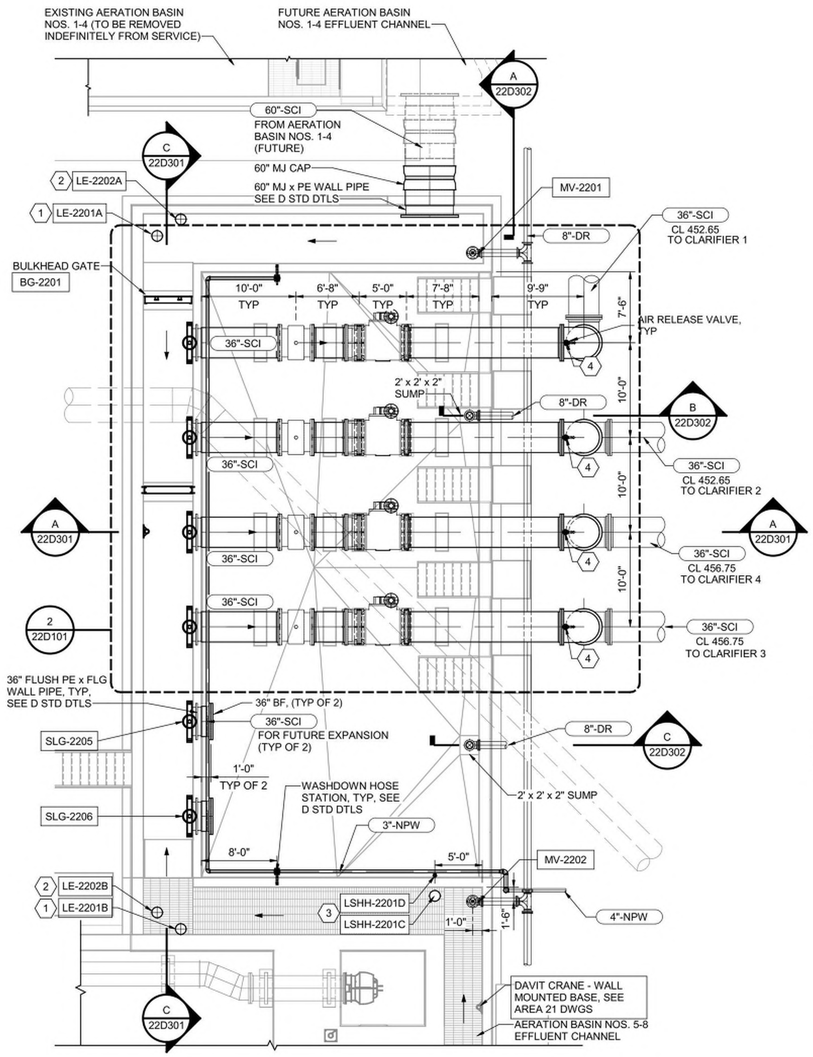
AERATION BASIN EXPANSION

SECONDARY CLARIFIER SPLITTER STRUCTURE STRUCTURAL DETAILS

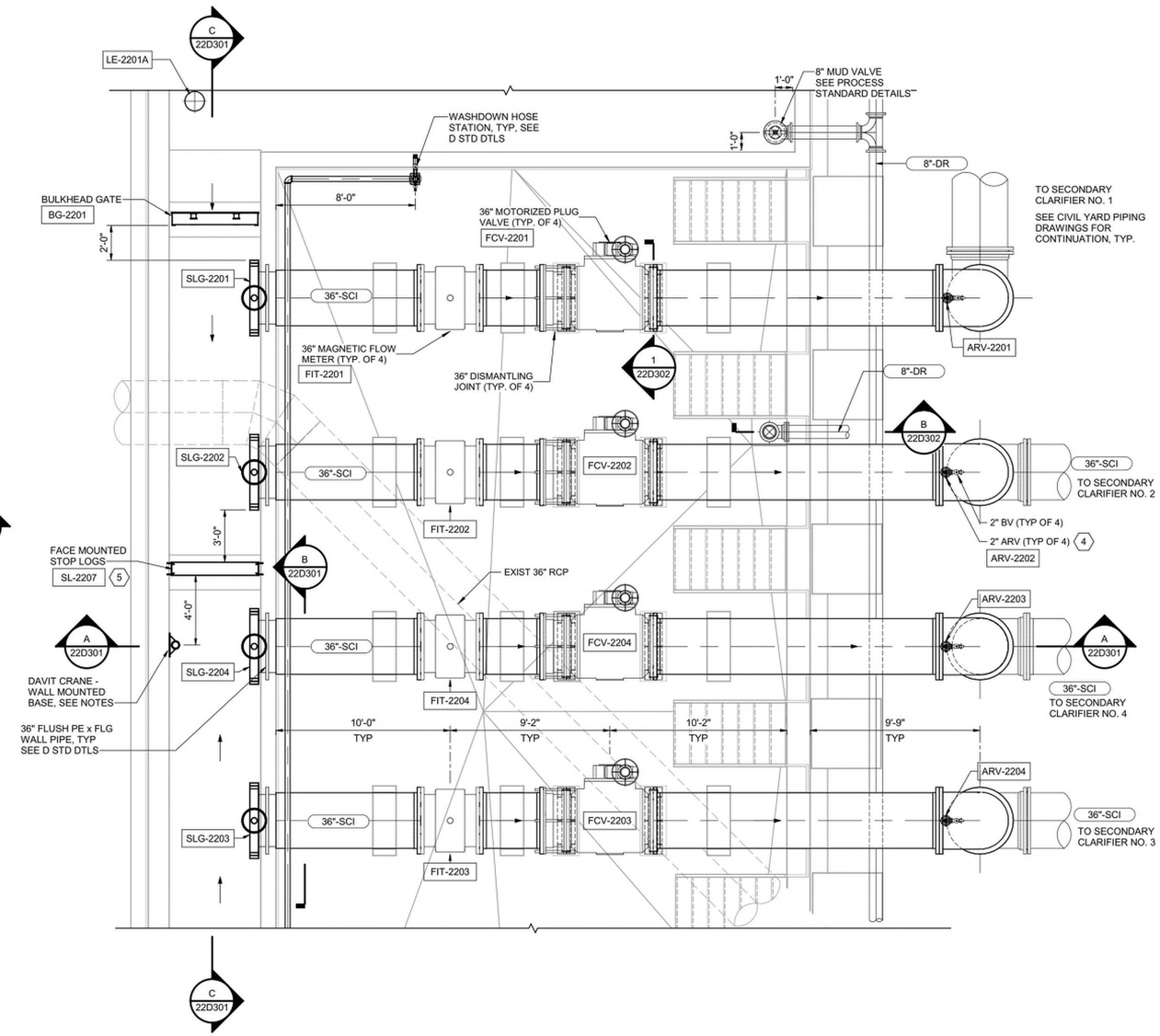
0 1" 2"

FILENAME	STRUCTURAL CONTAINER FILE.RVT
SCALE	1" = 1'-0"

SHEET 22S502



1 22D301 PLAN
1/8" = 1'-0"



2 22D101 ENLARGED PLAN
1/4" = 1'-0"

GENERAL NOTES:

1. ALL EXPOSED NPW PIPING (INCLUDING HOSE STATIONS) SHALL BE HEAT TRACED AND INSULATED. SEE SPECIFICATIONS FOR REQUIREMENTS.
2. SEE STRUCTURAL STANDARD DETAILS FOR DAVIT CRANE - WALL MOUNTED BASE. BASE TO BE FURNISHED UNDER SECTION 43 23 24 FOR COMPATIBILITY WITH PUMP VENDOR FURNISHED CRANE.
3. CONTRACTOR SHALL VERIFY ALL DAVIT CRANE BASE LOCATION WITH FURNISHED STOP LOGS. SUBMIT BASE LOCATION FOR APPROVAL AS INDICATED ON STRUCTURAL DRAWINGS.
4. CONTRACTOR SHALL FIELD ROUTE VENT PIPING FROM EACH ARV TO THE VALVE VAULT, PIPING SIZED PER VALVE OUTLET. HEAT TRACE AND INSULATE ARV, VENT PIPING, AND ALL ASSOCIATED VALVES.

KEYNOTES ⟨#⟩

1 SEE HYDROSTATIC LEVEL SENSOR DETAIL ON INSTRUMENTATION STANDARD DETAILS.

2 SEE RADAR LEVEL SENSOR DETAIL ON INSTRUMENTATION STANDARD DETAILS.

3 SEE LEVEL FLOAT DETAIL ON INSTRUMENTATION STANDARD DETAILS.

4 CONTRACTOR SHALL FIELD ROUTE VENT PIPING FROM EACH ARV TO THE METER VAULT, PIPING SIZED PER VALVE OUTLET. HEAT TRACE AND INSULATE ARV, VENT PIPING, AND ALL ASSOCIATED VALVES.

5 CONTRACTOR SHALL FURNISH STORAGE RACK FOR STOP LOGS IN SAME MATERIALS AS STOP LOGS AND FURNISHED BY SAME MANUFACTURER. RACK SHALL PROVIDE UV PROTECTION FOR STOP LOG SEALS. FURNISH CONCRETE FOUNDATION AS SHOWN ON STRUCTURAL DRAWINGS.

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TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13/2025	ISSUED FOR BID

PROJECT MANAGER	J. R. CANTWELL
DESIGNED BY	T. PAULMANN
DRAWN BY	A. FREEMON
CHECKED BY	M. BOND
APPROVED BY	T. PAULMANN
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

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THOMAS A. PAULMANN
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PROFESSIONAL ENGINEER
6/13/25

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AERATION BASIN EXPANSION

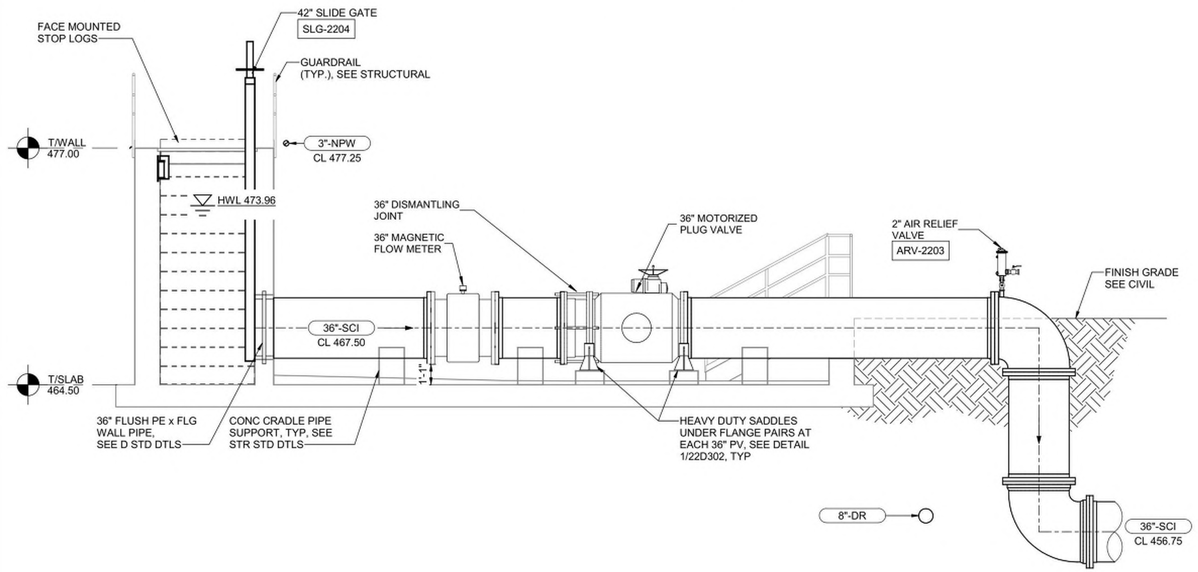
SECONDARY CLARIFIER SPLITTER STRUCTURE PROCESS PLAN

N

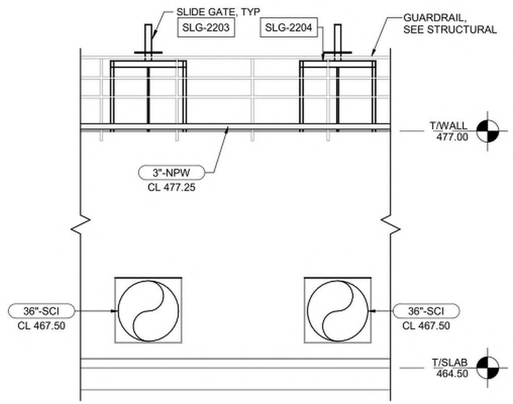
0 1" 2"

FILENAME: 22 - SECONDARY CLARIFIER SPLITTER STRUCTURE
SCALE: As indicated

SHEET: **22D101**



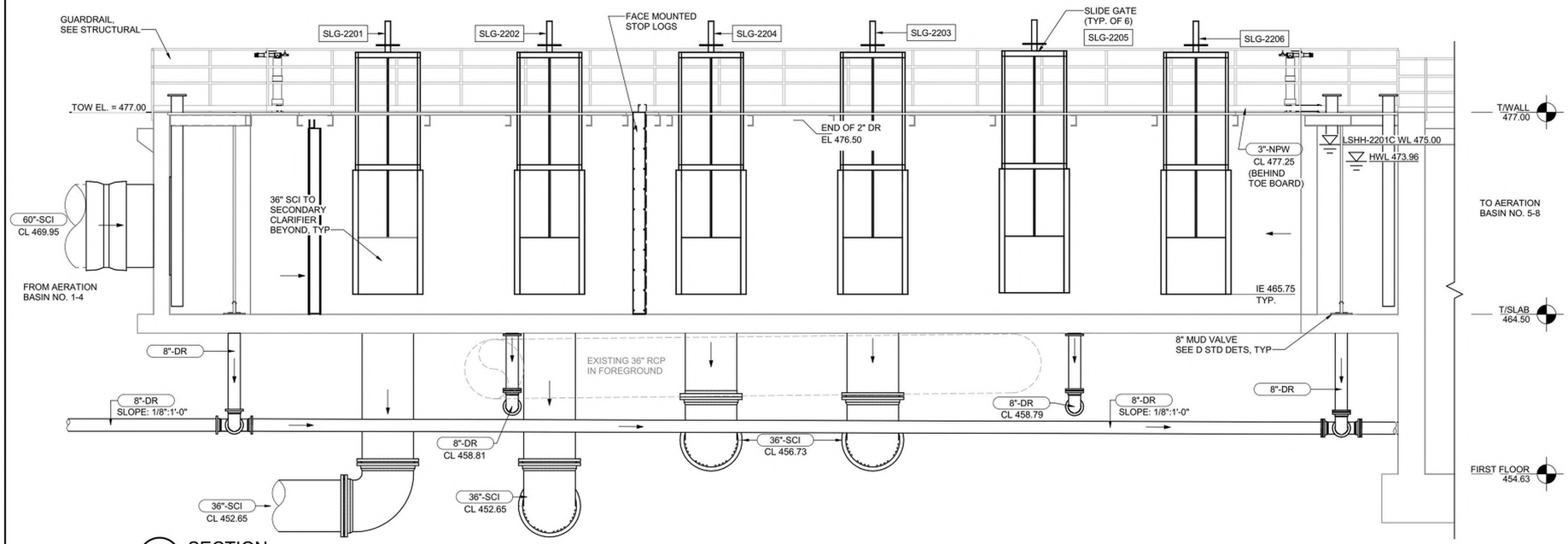
A 22D101 SECTION
1/4" = 1'-0"



B 22D101 SECTION
1/4" = 1'-0"

GENERAL NOTES:

1. CONTRACTOR SHALL FIELD ROUTE VENT PIPING FROM EACH ARV TO THE METER VAULT, PIPING SIZED PER VALVE OUTLET. HEAT TRACE AND INSULATE ARV, VENT PIPING, AND ALL ASSOCIATED VALVES.
2. ENCASE ALL DRAIN PIPE UNDER FOUNDATION SLAB PER UNDERSLAB PIPE ENCASEMENT DETAIL IN STRUCTURAL STANDARD DETAILS. NOT SHOWN.



C 22D101 SECTION
1/4" = 1'-0"

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TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13/2025	ISSUED FOR BID

PROJECT MANAGER	J. R. CANTWELL
DESIGNED BY	T. PAULMANN
DRAWN BY	A. FREEMON
CHECKED BY	M. BOND
APPROVED BY	T. PAULMANN
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
THOMAS A. PAULMANN
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LICENSED
PROFESSIONAL ENGINEER
6/13/25

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PRAIRIE CREEK

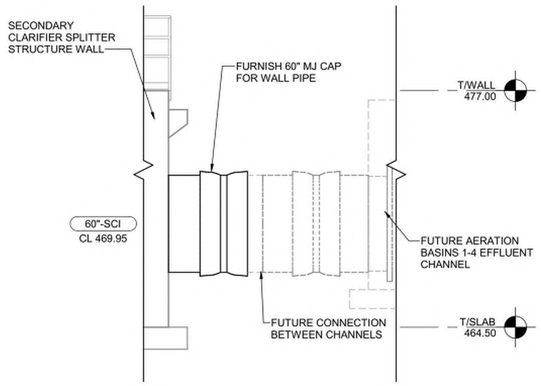
AERATION BASIN EXPANSION

SECONDARY CLARIFIER SPLITTER STRUCTURE PROCESS SECTIONS

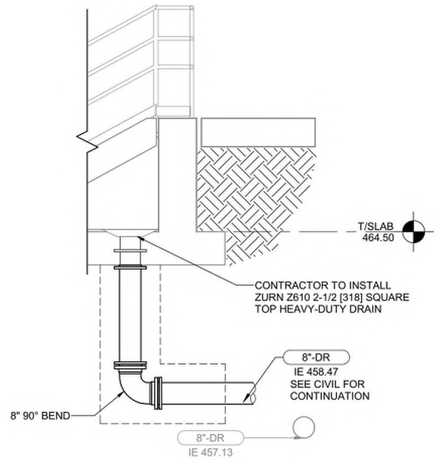
0 1" 2"

FILENAME: 22 - SECONDARY CLARIFIER SPLITTER STRUCTURE
SCALE: 1/4" = 1'-0"

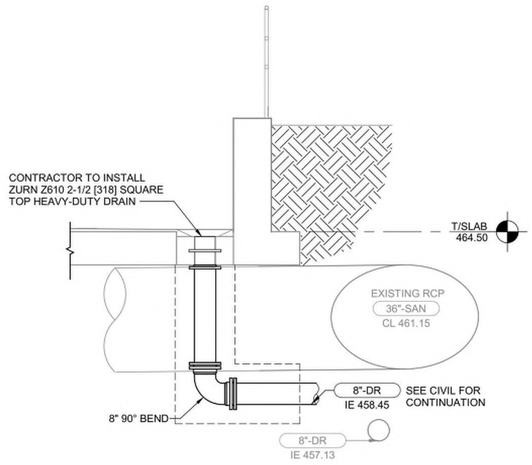
SHEET
22D301



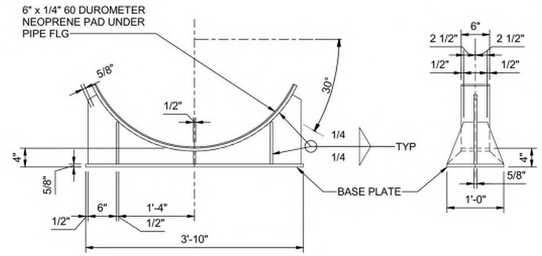
A 22D101 **SECTION**
1/4" = 1'-0"



B 22D101 **SECTION**
3/8" = 1'-0"



C 22D101 **SECTION**
3/8" = 1'-0"



NOTE:

1. FURNISH HEAVY DUTY SADDLE UNDER INDICATED PIPE FLANGES, PIPING TECH FIGURE 2000 OR EQUAL, DIMENSIONS MODIFIED FROM 48" PIPE SIZE VERSION TO SUIT FLANGE OD AS SHOWN.

1 22D101 **HEAVY DUTY PIPE SADDLE DETAIL**
3/4" = 1'-0"

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HDR
TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13/2025	ISSUED FOR BID

PROJECT MANAGER	J. R. CANTWELL
DESIGNED BY	T. PAULMANN
DRAWN BY	A. FREEMON
CHECKED BY	M. BOND
APPROVED BY	T. PAULMANN
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
THOMAS A. PAULMANN
128794
LICENSED
PROFESSIONAL ENGINEER
6/13/25

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PRAIRIE CREEK

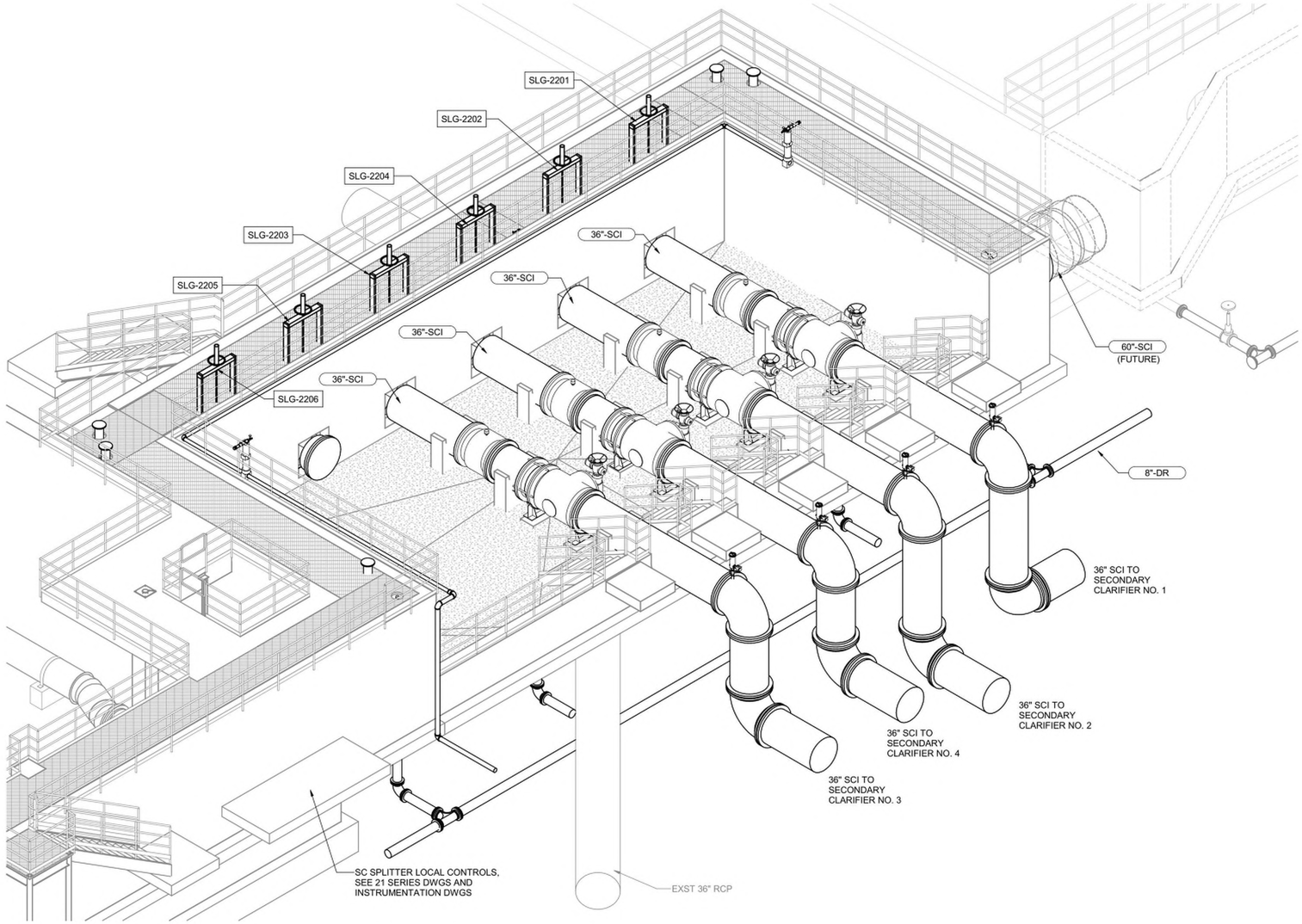
AERATION BASIN EXPANSION

SECONDARY CLARIFIER SPLITTER PROCESS SECTIONS AND DETAILS

0 1" 2"

FILENAME 22 - SECONDARY CLARIFIER SPLITTER STRUCTURE
SCALE As indicated

SHEET 22D302



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6/13/2025 11:24:41 AM

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Registration No. F-754

ISSUE	DATE	DESCRIPTION
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PROJECT MANAGER	J. R. CANTWELL
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DRAWN BY	A. FREEMON
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CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

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THOMAS A. PAULMANN
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6/13/25

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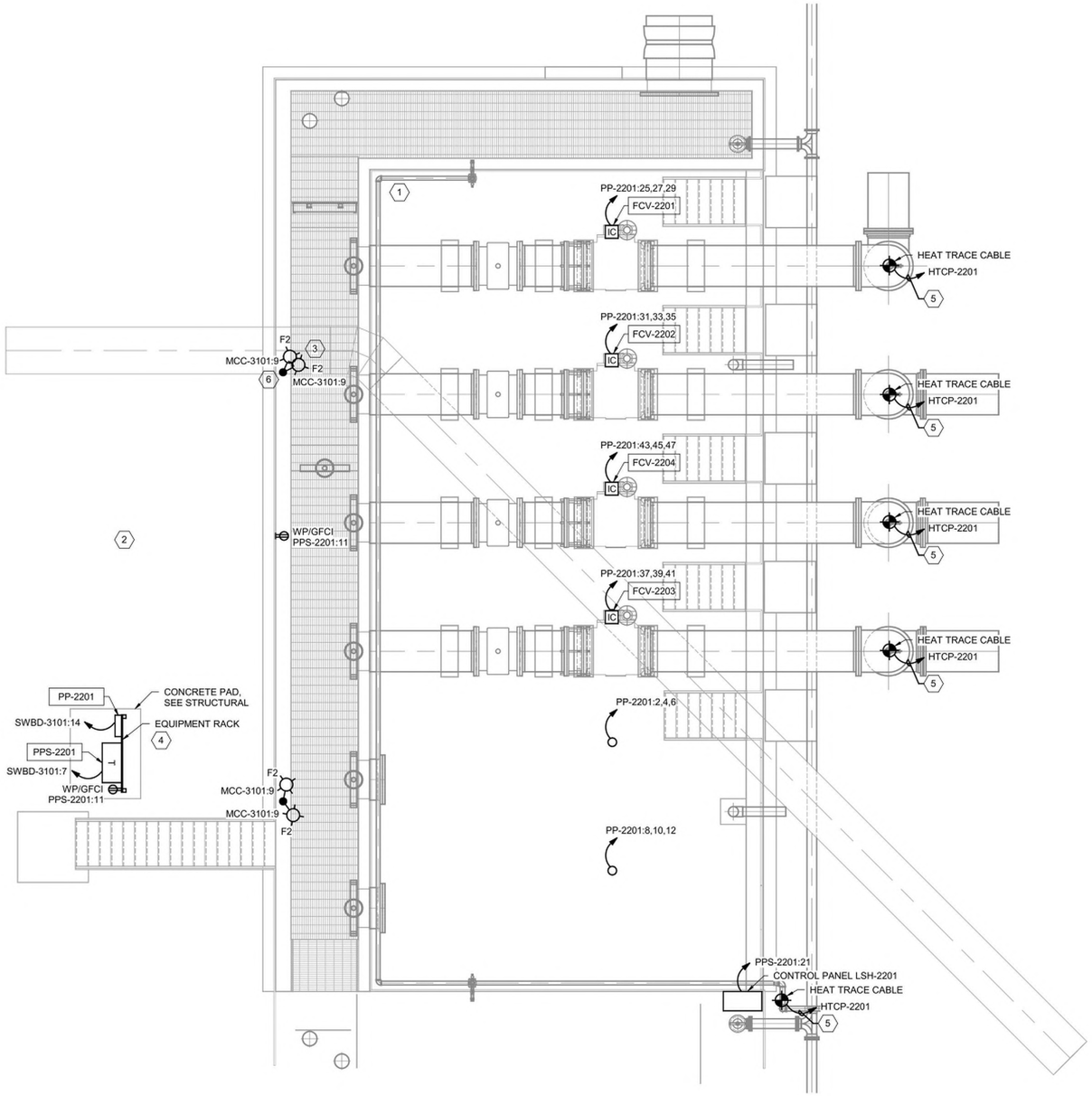
AERATION BASIN
EXPANSION

SECONDARY CLARIFIER SPLITTER PROCESS ISOMETRIC

FILENAME: 22 - SECONDARY CLARIFIER SPLITTER STRUCTURE
SCALE: 0 1" 2"

SHEET
22D601



1 / - SECONDARY CLARIFIER SPLITTER STRUCTURE ELECTRICAL PLAN

3/16" = 1'-0"

GENERAL NOTES:

1. REFER TO LIGHTING FIXTURE SCHEDULE ON SHEET 00E603.
2. REFER TO PLANT II BLOWER BUILDING ELECTRICAL SWITCHBOARD SWBD-3101 ONE-LINE DIAGRAM ON SHEET 31E601.
3. REFER TO PLANT II BLOWER BUILDING ELECTRICAL MCC-3101 ONE-LINE DIAGRAM ON SHEET 31E602.
4. REFER TO PPS-2201 SCHEDULE ON SHEET 22E601.
5. ROUTE EXPOSED CONDUIT CLEAR OF WALKING PATH AND AND MAINTAIN MAXIMUM PRACTICABLE OPEN FLOOR SPACE ESPECIALLY AROUND PUMPS/EQUIPMENT SO AS NOT TO CREATE A TRIPPING HAZARD OR INTERFERE WITH OPERATING EQUIPMENT.

KEY NOTES: (#)

1. AREA CLASSIFICATION CLASS 1, DIVISION 2. SEE NFPA 820 2020 TABLE 5.2.2, ROW 8 AND ROW 7, LINE C.
2. AREA CLASSIFICATION OUTDOOR-WET/CORROSIVE.
3. MOUNT BOTTOM OF LIGHT FIXTURES AT APPROXIMATELY 20'-0" A.F.F. TYPICAL FOR TYPE F2 FIXTURES SHOWN ON THIS DRAWING.
4. SEE 5/99E501 FOR MODULAR EQUIPMENT RACK ON CONCRETE PAD DETAIL.
5. 2#10, #10G, 3/4"C.
6. SEE 4/99S504 LIGHTPOLE TOP MOUNTED DETAIL ON STRUCTURAL STANDARD DETAILS FOR MORE INFORMATION ON LIGHT POLE INSTALLATION. TYPICAL OF ALL LIGHT POLE SHOWN ON THIS DRAWING.

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
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PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	O. JONGUITUD
DRAWN BY	B. LOREDO
CHECKED BY	G. JAGLOWSKI
APPROVED BY	O. JONGUITUD
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

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OSCAR JONGUITUD
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6-13-25

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PRAIRIE CREEK
AERATION BASIN EXPANSION

N

0 1" 2"

SECONDARY CLARIFIER SPLITTER STRUCTURE ELECTRICAL PLAN

FILENAME 22E101.dwg
SCALE 3/16" = 1'-0"

SHEET 22E101

KEYED NOTES: (1)

1. PROVIDE LOCKOUT MECHANISM ON CIRCUIT BREAKERS IN ACCORDANCE WITH NEC ARTICLE 110.25.

PANELBOARD 'PP-2201' (1)

LOCATION: EQUIP. RACK BY 2ND CLARIFIER SPLITTER. VOLTAGE: 480 V KAIC: 65 BUSSING SHALL BE FULLY RATED
MOUNTING: SURFACE PHASE: 3 P / 3W CODES: 0=EQPT, 1=RCPT, 2=LTG, 3=A/C, 4=HEAT
ENCLOSURE: NEMA 4X STYLE: PER SPEC BUSSING: 100 A 5=CONTINUOUS MOTORS, 6=LRGST MOTOR, 7=PANEL
BRKR MTG: BOLT-ON MCB: 100 A ACCESSORIES: GROUND BUS, 48 SPACE
BREAKERS: 60/75 DEGREE TERMINALS MLO: A

WIRING				CODE	BRKR	CIRCUIT USE	CKT	LOAD	A	B	C	LOAD	CKT	CIRCUIT USE	BRKR	CODE	WIRING			
PHASE	NEUT.	GND	CONDUIT														PHASE	NEUT.	GND	CONDUIT
#12	-	#12	3/4"	0			1	582	X			-	2	SPARE FOR FUTURE SECONDARY CLARIFIER SPLITTER		-				
				0	15/3	AERATION BASIN 5 MOTORIZED VALVE FCV-2151	3	582		X		-	4	STRUCTURE MOTORIZED VALVE	15/3	-	-	-	-	3/4"
				0			5	582			X	-	6	FCV-2205		-				
#12	-	#12	3/4"	0			7	582	X			-	8	SPARE FOR FUTURE SECONDARY CLARIFIER SPLITTER		-				
				0	15/3	AERATION BASIN 6 MOTORIZED VALVE FCV-2161	9	582		X		-	10	STRUCTURE MOTORIZED VALVE	15/3	-	-	-	-	3/4"
				0			11	582			X	-	12	FCV-2206		-				
#12	-	#12	3/4"	0			13	582	X			-	14			-				
				0	15/3	AERATION BASIN 7 MOTORIZED VALVE FCV-2171	15	582		X		-	16	SPARE	15/3	-	-	-	-	-
				0			17	582			X	-	18			-				
#12	-	#12	3/4"	0			19	582	X			-	20			-				
				0	15/3	AERATION BASIN 8 MOTORIZED VALVE FCV-2181	21	582		X		-	22	SPARE	15/3	-	-	-	-	-
				0			23	582			X	-	24			-				
#12	-	#12	3/4"	0			25	638	X			-	26			-				
				0	15/3	SECONDARY CLARIFIER SPLITTER STRUCTURE MOTORIZED VALVE FCV-2201	27	638		X		-	28	SPARE	20/3	-	-	-	-	-
				0			29	638			X	-	30			-				
#12	-	#12	3/4"	0			31	638	X			-	32			-				
				0	15/3	SECONDARY CLARIFIER SPLITTER STRUCTURE MOTORIZED VALVE FCV-2202	33	638		X		-	34	SPARE	20/3	-	-	-	-	-
				0			35	638			X	-	36			-				
#12	-	#12	3/4"	0			37	638	X			-	38			-				
				0	15/3	SECONDARY CLARIFIER SPLITTER STRUCTURE MOTORIZED VALVE FCV-2203	39	638		X		-	40	SPARE	30/3	-	-	-	-	-
				0			41	638			X	-	42			-				
#12	-	#12	3/4"	0			43	638	X			-	44			-				
				0	15/3	SECONDARY CLARIFIER SPLITTER STRUCTURE MOTORIZED VALVE FCV-2204	45	638		X		-	46	SPD	PER MFR	-	-	-	-	-
				0			47	638			X	-	48			-				

	EQPT VA	RCPT VA	LTG VA	AC/HEAT VA	MOTORS	CONN VA	FTL VA	PANEL VA	PHASE AMP
PHASE A	4880	0	0	0	0	4880		4880	18
PHASE B	4880	0	0	0	0	4880		4880	18
PHASE C	4880	0	0	0	0	4880		4880	18
TOTAL	14640	0	0	0	0	14640		14640	

PANEL DEMAND KVA: 14.64 PANEL DEMAND AMPACITY: 18 AMPS
RESERVE KVA: 3.66 RESERVE AMPACITY: 4 AMPS
DESIGN KVA: 18.30 DESIGN AMPACITY: 22 AMPS

(1) - POWER PANEL 'PP-2201' SCHEDULE
SCALE: NONE

PACKAGED POWER SUPPLY 'PPS-2201'

LOCATION: EQUIP. RACK BY 2ND CLARIFIER SPLITTER. VOLTAGE: 208/120 V KAIC: 22 BUSSING SHALL BE FULLY RATED
MOUNTING: SURFACE PHASE: 3 P / 4W CODES: 0=EQPT, 1=RCPT, 2=LTG, 3=A/C, 4=HEAT
ENCLOSURE: NEMA 4X STYLE: PER SPEC BUSSING: 100 A 5=CONTINUOUS MOTORS, 6=LRGST MOTOR, 7=PANEL
BRKR MTG: BOLT-ON MCB: 50 A ACCESSORIES: GROUND BUS, 24 SPACE
BREAKERS: 60/75 DEGREE TERMINALS MLO: A

WIRING				CODE	BRKR	CIRCUIT USE	CKT	LOAD	A	B	C	LOAD	CKT	CIRCUIT USE	BRKR	CODE	WIRING			
PHASE	NEUT.	GND	CONDUIT														PHASE	NEUT.	GND	CONDUIT
#12	#12	#12	3/4"	1	20/1	AERATION BASINS 5-6 RECEPTACLES	1	540	X			-	2	SPARE FOR FUTURE FIT-2205 & FIT-2206	20/1	-	-	-	-	3/4"
#12	#12	#12	3/4"	0	20/1	FIT-2151, FIT-2161, FIT-2171, FIT-2181	3	480		X		540	4	AERATION BASINS 7-8 RECEPTACLES	20/1	1	#12	#12	#12	3/4"
#12	#12	#12	3/4"	0	20/1	AIT-2151A, AIT-2161A, AIT-2171A, AIT-2181A	5	480			X	-	6	SPARE	20/1	-	-	-	-	-
-	-	-	3/4"	0	20/1	FUTURE AB NOS. 5, 6, 7, AND 8 NH3 SENSORS	7	-	X			-	8	SPARE	20/1	-	-	-	-	-
#12	#12	#12	3/4"	0	20/1	FIT-2201, FIT-2202, FIT-2203, FIT-2204	9	480		X		-	10	SPARE	20/1	-	-	-	-	-
#12	#12	#12	3/4"	1	20/1	SECONDARY CLARIFIER SPLITTER. STRUCT. RECEPT.	11	360			X	-	12	SPARE	20/1	-	-	-	-	-
#10	-	#10	3/4"	0	30/2	SECONDARY SPLITTER HEAT TRACE CIRCUIT 1	13	1,120	X				14	SPACE						
				0			15	1,120		X			16	SPACE						
#10	-	#10	3/4"	0	30/2	SECONDARY SPLITTER HEAT TRACE CIRCUIT 2	17	1,120			X		18	SPACE						
				0			19	1,120	X			-	20			-				
#12	#12	#12	3/4"	0	20/1	CONTROL PANEL LSH-2201	21	600		X		-	22	SPD	PER MFR	-	-	-	-	-
-	-	-	-	-	20/1	SPARE	23				X	-	24			-				

	EQPT VA	RCPT VA	LTG VA	AC/HEAT VA	MOTORS	CONN VA	FTL VA	PANEL VA	PHASE AMP
PHASE A	2240	540	0	0	0	2780		2780	23
PHASE B	2680	540	0	0	0	3220		3220	27
PHASE C	1600	360	0	0	0	1960		1960	16
TOTAL	6520	1440	0	0	0	7960		7960	

PANEL DEMAND KVA: 7.96 PANEL DEMAND AMPACITY: 22 AMPS
RESERVE KVA: 1.99 RESERVE AMPACITY: 6 AMPS
DESIGN KVA: 9.95 DESIGN AMPACITY: 28 AMPS

(2) - PACKAGED POWER SUPPLY 'PPS-2201' SCHEDULE
SCALE: NONE

HDR
TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER JOEL R. CANTWELL

DESIGNED BY	O. JONGUITUD
DRAWN BY	B. LOREDO
CHECKED BY	G. JAGLOWSKI
APPROVED BY	O. JONGUITUD
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
OSCAR JONGUITUD
133057
LICENSED
PROFESSIONAL ENGINEER
6-13-25

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

SECONDARY CLARIFIER SPLITTER STRUCTURE ELECTRICAL PANEL SCHEDULES

0 1" 2"
FILENAME 22E601.dwg
SCALE NONE
SHEET 22E601

CODE REVIEW ANALYSIS

1.0 INTRODUCTION

THE FOLLOWING CODE REVIEW NARRATIVE IS PROVIDED TO SERVE AS A BASIS OF UNDERSTANDING FOR THE DEVELOPMENT OF THE DESIGN, DRAWINGS AND SPECIFICATIONS FOR THE PLANNED EXPANSION OF THE PRAIRIE CREEK WASTEWATER TREATMENT PLANT IN THE CITY OF LEWISVILLE, TEXAS. THE FOLLOWING ANALYSIS REVIEWS THE APPLICABLE BUILDING AND LIFE SAFETY CODES.

THE AUTHORITIES HAVING JURISDICTION (AHJ'S) FOR THIS PROJECT INCLUDE THE CITY OF LEWISVILLE TEXAS CODE ENFORCEMENT DIVISION AND THE LEWISVILLE FIRE DEPARTMENT.

1.1 DESIGN CODES

BUILDING CODE	2021 INTERNATIONAL BUILDING CODE (IBC)
EXISTING BUILDING CODE	2021 INTERNATIONAL EXISTING BUILDING CODE (IEBC)
FIRE CODE	2021 INTERNATIONAL FIRE CODE (IFC)
PLUMBING CODE	2021 INTERNATIONAL PLUMBING CODE (IPC)
ENERGY CONSERVATION CODE	2021 INTERNATIONAL ENERGY CONSERVATION CODE (STATE REQUIRED) (IECC)
MECHANICAL CODE	2021 INTERNATIONAL MECHANICAL CODE (IMC)
ELECTRICAL CODE	2020 NATIONAL ELECTRICAL CODE (NEC), NFPA 70 (STATE REQUIRED)

CODE DATA TABLE

2.0 PRAIRIE CREEK WASTEWATER TREATMENT PLANT - BLOWER BUILDING #2

2.1 DESCRIPTION

THE FOLLOWING CODE REVIEW NARRATIVE IS PROVIDED TO SERVE AS A BASIS OF UNDERSTANDING FOR THE DEVELOPMENT OF THE DESIGN, DRAWINGS AND SPECIFICATIONS FOR THE PROPOSED NEW BLOWER BUILDING #2 TO BE BUILT AS PART OF THE PRAIRIE CREEK WASTEWATER TREATMENT PLANT (PCWWTP) EXPANSION.

2.2 GENERAL BUILDING DATA SUMMARY

OCCUPANCY CLASSIFICATION(S)	GROUP F-1 OCCUPANCY
BUILDING AREA	3,035 SF
FIRE AREA	3,035 SF
HEIGHT	19'-4" (1 STORY ABOVE GRADE)
TYPE OF CONSTRUCTION	II-B (NON-COMBUSTIBLE)
FIRE SEPARATION DISTANCE	10' ≤ X < 30'; WHERE X REPRESENTS THE ACTUAL FSD
FIRE PROTECTION SYSTEMS	FIRE EXTINGUISHERS FIRE HYDRANT
OCCUPANT LOAD (TOTAL)	11 (SEE 2.10 FOR CALCULATION)

2.3 USE & OCCUPANCY CLASSIFICATION:		IBC	IFC
OCCUPANCY GROUP(S):	GROUP F-1 MODERATE-HAZARD FACTORY INDUSTRIAL	§306	-
ACCESS. OCCUPANCY (<10%)	N/A	§508.2	-
HAZARDOUS MATERIALS	N/A	§307	-
CLASSIFICATION OF HAZARDS	N/A	§307	
2.4 SPECIAL REQUIREMENTS:		**IBC**	**IFC**
AREAS WITH HAZARDOUS MATERIALS	N/A - NO HAZARDOUS MATERIAL STORAGE	§414	-
EMERGENCY EYE WASH / EMERGENCY SHOWER (EEW/ES) STATIONS	N/A	[29 CODE OF FEDERAL REGULATIONS, OSHA 1910.151]	-

2.5 BUILDING HEIGHTS & AREAS:		IBC	IFC
ACTUAL HEIGHT & AREA	19'-4" AND ONE STORY TOTAL AREA OF 3,035 SF	-	-
FIRE AREA	3,035 SF	-	-
ALLOWABLE AREA/STORY;	GROUP F-1: 15,500 SF	TABLE 506.2	-
ALLOWABLE HEIGHT	55'-0" AND TWO STORIES	TABLE 504.3, TABLE 504.4	-
MEZZANINE AREA (%)	N/A	§505	-
EQUIPMENT PLATFORM AREA (%)	N/A	§505	-
FRONTAGE INCREASE	N/A	§506.3	-
UNLIMITED AREA BUILDINGS	N/A	§507	-
MIXED-USE & OCCUPANCY	N/A	§508	-
INCIDENTAL USES	N/A	§509	-
SPECIAL PROVISIONS	N/A	§510	-
2.6 TYPES OF CONSTRUCTION:		**IBC**	**IFC**
CONSTRUCTION TYPE	II-B	§602	-
GENERAL BUILDING FIRE-RESISTANCE RATINGS (PRIMARY STRUCTURAL FRAME, BEARING AND NONBEARING WALLS AND PARTITIONS, FLOOR, ROOF)	0-HR	TABLE 601	-
FIRE SEPARATION DISTANCE (FSD)	GROUP F: 10' ≤ X < 30'	TABLE 602	-
FIRE-RESISTANCE RATING REQUIREMENTS FOR EXTERIOR WALLS BASED UPON FSD	0-HR	TABLE 602	-
2.7 FIRE & SMOKE PROTECTION:		**IBC**	**IFC**
SHAFT ENCLOSURES FIRE-RESISTANCE RATINGS	N/A	§707.3.1 & §713.4	-
VERTICAL EXIT ENCLOSURE FIRE-RESISTANCE RATINGS	N/A	§707.3.2 & §1023.2	-
OPENING PROTECTIVES	N/A (NO FIRE-RATED BARRIERS, PARTITIONS, ASSEMBLIES, ETC.)	§716	-
DUCT AND AIR TRANSFER OPENINGS	N/A (NO FIRE-RATED BARRIERS, PARTITIONS, ASSEMBLIES, ETC.)	§717	-
EXTERIOR WALLS	NO LIMIT	TABLE 705.8	-
CORRIDORS	N/A (NO FIRE-RATED BARRIERS, PARTITIONS, ASSEMBLIES, ETC.)	§1020	-
2.8 INTERIOR FINISHES:		**IBC**	**IFC**
CEILING & WALL (EXIT ENCLOSURES)	NON-SPRINKLERED F-1: CLASS A OR B	TABLE 803.13	-
CEILING & WALL (CORRIDORS)	NON-SPRINKLERED F-1: CLASS A, B OR C		
CEILING & WALL (ROOMS AND ENCL. SPACES)	NON-SPRINKLERED F-1: CLASS A, B OR C		
FLOOR	CLASS I OR II MATERIALS COMPLYING WITH DOC FF-1 "PILL TEST" (CPSC 16 CFR PART 1630) OR WITH ASTM D2859	§804.4	
2.9 FIRE PROTECTION SYSTEMS:		**IBC**	**IFC**
AUTOMATIC SPRINKLER SYSTEM	NOT REQUIRED	§903	§903
PORTABLE FIRE EXTINGUISHERS	REQUIRED; PROVIDED THROUGHOUT	-	§906
FIRE ALARM AND DETECTION	NOT REQUIRED	§907.2.4	§907.2.4
FIRE-FLOW REQUIREMENT	1,500 GPM (@20 PSI) FOR 2 HOURS	-	§B105, TABLE B105.1(2)
MINIMUM NUMBER OF HYDRANTS	1 HYDRANT (SEE SITE CIVIL PLANS FOR LOCATIONS)	-	TABLE C102.1
2.10 MEANS OF EGRESS:		**IBC**	**IFC**
ACCESSORY STORAGE AREAS, MECHANICAL EQUIPMENT ROOMS, BUSINESS AREAS	11 OCCUPANTS	§1004	-
EQUIPMENT SPACES (WTP)	3,035 SF @ 1:300 SF (GROSS) = 11		
EGRESS CAPACITY PER OCCUPANT LOAD	0.3 (STAIRS) & 0.2 (OTHER)	§1005.3	-
EXIT ACCESS - COMMON PATH	NON-SPRINKLERED GROUP F: 75 FT	TABLE 1006.2.1	-
EXIT ACCESS - TRAVEL DISTANCE	NON-SPRINKLERED GROUP F-1: 200 FT	TABLE 1017.2	-
MIN. EXIT DOORS	2; SEE LIFE SAFETY PLANS FOR EXITING	§1006	-
ACCESSIBLE MEANS OF EGRESS	NOT REQUIRED (SEE 2.11 ACCESSIBILITY)	§1009	-
EXIT DISCHARGE; ACCESS TO PUBLIC WAY	PUBLIC WAY	§1028.5	-
2.11 ACCESSIBILITY:		**IBC**	**IFC**
SCOPING REQUIREMENTS	EQUIPMENT SPACES ARE EXEMPT	§1103.2.9 [2010 ADA §203.5]	-

Autodesk Docs://10342803_COL_PCWWT_AB_Expansion_2024/31 -PLANT II BLOWER BUILDING (PROPOSED) - ARCH.rvt
6/11/2025 1:26:28 PM

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13/2025	ISSUED FOR BID

PROJECT MANAGER	J.R. CANTWELL
DESIGNED BY	J. BELON
DRAWN BY	J. BELON
CHECKED BY	Z. SACHSENMAIER
APPROVED BY	
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
ZACHARY J. SACHSENMAIER
112524
6/11/2025
PROFESSIONAL ENGINEER

LEWISVILLE
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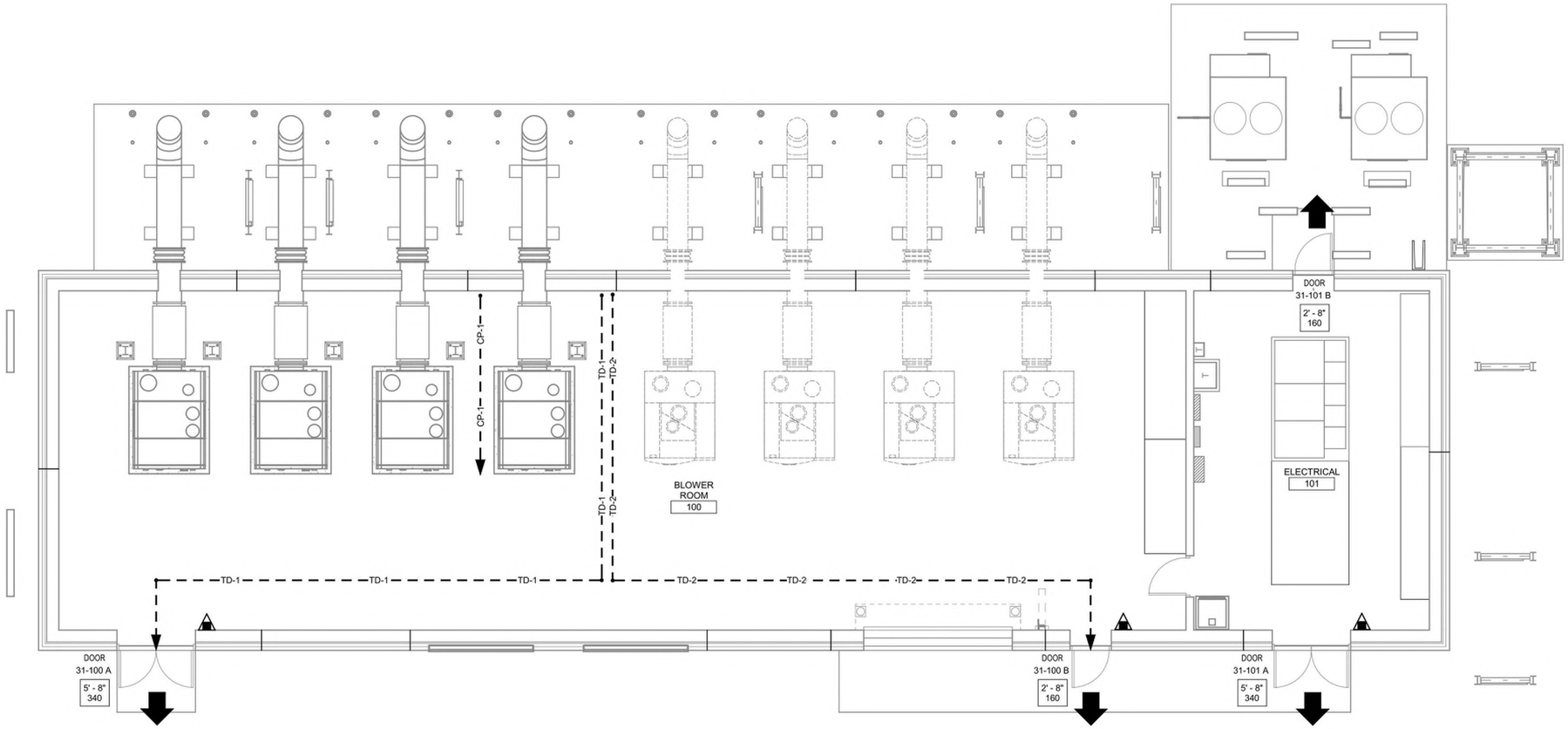
CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

PLANT II BLOWER BUILDING (PROPOSED) GENERAL CODE ANALYSIS

FILENAME	HDRE_ALL_DISCIPLINES.rte
SCALE	NONE
SHEET	31G001

0 1" 2"



LIFE SAFETY PLAN

3/16" = 1'-0"

LIFE SAFETY NOTES:

1. FOR EXIT LIGHTS AND EMERGENCY LIGHTING, SEE ELECTRICAL LIGHTING DRAWINGS (E SERIES).

LIFE SAFETY SYMBOLS:

EXIT DOOR TAG

A	CLEAR DOOR WIDTH [FEET - INCHES]
B	OCCUPANT LOAD CAPACITY [NO.OF PEOPLE]

OTHERS

FIRE EXTINGUISHER

LINE TYPES FOR MEANS OF EGRESS:

COMPONENT	SYMBOL
TRAVEL DISTANCE	TD
COMMON PATH	CP

EXIT DISCHARGE

EXIT DISCHARGE ARROW

MEANS OF EGRESS ARRANGEMENT DISTANCE SCHEDULE - BUILDING SUMMARY

EGRESS PATH ID	EGRESS DISTANCE	
	PROVIDED	MAXIMUM PERMITTED
CP-1	14' - 6"	75' - 0"
TD-1	64' - 6"	200' - 0"
TD-2	67' - 6"	200' - 0"

MEANS OF EGRESS WIDTH CAPACITY - LEVEL 1

EXIT ID	PROVIDED EGRESS CAPACITY - LEVEL COMPONENTS & RAMPS		
	EGRESS CAPACITY FACTOR	CLEAR WIDTH	OCCUPANT LOAD CAPACITY
31-100 A	0.2	5' - 8"	340
31-100 B	0.2	2' - 8"	160
31-101 A	0.2	5' - 8"	340
31-101 B	0.2	2' - 8"	160

Autodesk Docs://10342803_COL_PCWWT_AB_Expansion_2024/31 -PLANT II BLOWER BUILDING (PROPOSED) - ARCH.rvt
6/11/2025 1:26:29 PM

HDR
TEXAS P.E. FIRM
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CITY PROJECT NO.	U2100
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STATE OF TEXAS
ZACHARY J. SACHSENMAIER
112524
LICENSED
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6/13/2025

LEWISVILLE
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CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

PLANT II BLOWER BUILDING (PROPOSED)
GENERAL
LIFE SAFETY PLAN

0 1" 2"

FILENAME: HDRE_ALL_DISCIPLINES.rte
SCALE: As indicated
SHEET: 31G002

BLOWER BUILDING STRUCTURAL NOTES

COORDINATION:

A. THE CONTRACTOR SHALL COMPARE THE ARCHITECTURAL, STRUCTURAL, MECHANICAL, ELECTRICAL, PLUMBING, AND OTHER SERIES DRAWINGS AND REPORT ANY DISCREPANCIES BETWEEN EACH SET OF DRAWINGS AND WITHIN EACH SET OF DRAWINGS PRIOR TO FABRICATION AND INSTALLATION OF ANY STRUCTURAL MEMBERS.

B. ONLY LARGER SLEEVE OPENINGS AND FRAMED OPENINGS IN STRUCTURAL FRAMING COMPONENT MEMBERS ARE INDICATED ON THE STRUCTURAL DRAWINGS. HOWEVER, ALL SLEEVES, INSERTS AND OPENINGS, INCLUDING FRAMES AND/OR SLEEVES SHALL BE PROVIDED FOR PASSAGE, PROVISION AND/OR INCORPORATION OF THE WORK OF THE CONTRACT, INCLUDING BUT NOT LIMITED TO MECHANICAL, ELECTRICAL AND PLUMBING WORK. THIS WORK SHALL INCLUDE THE COORDINATION OF SIZES, ALIGNMENT, DIMENSIONS, POSITION, LOCATIONS, ELEVATIONS AND GRADES AS REQUIRED TO SERVE THE INTENDED PURPOSE. OPENINGS NOT INDICATED ON THE STRUCTURAL DRAWINGS, BUT REQUIRED AS NOTED ABOVE, SHALL BE SUBMITTED TO THE ENGINEER FOR REVIEW.

C. REFER TO ARCHITECTURAL, MECHANICAL, ELECTRICAL AND PLUMBING DRAWINGS FOR FLOOR ELEVATIONS, SLOPES, DRAINS AND LOCATION OF DEPRESSED AND ELEVATED FLOOR AREAS.

D. COMPATIBILITY OF THE STRUCTURE AND PROVISIONS FOR BUILDING EQUIPMENT SUPPORTED ON OR FROM STRUCTURAL COMPONENTS SHALL BE VERIFIED AS TO SIZE, DIMENSIONS, CLEARANCES, ACCESSIBILITY, WEIGHTS AND REACTION WITH THE EQUIPMENT FOR WHICH THE STRUCTURE HAS BEEN DESIGNED PRIOR TO SUBMISSION OF SHOP DRAWINGS AND DATA FOR EACH PIECE OF EQUIPMENT AND FOR STRUCTURAL COMPONENTS. DIFFERENCES SHALL BE NOTED ON THE SUBMITTALS.

E. SHOP DRAWINGS SHALL BE PREPARED FOR ALL STRUCTURAL ITEMS AND SUBMITTED FOR REVIEW BY THE ENGINEER. STRUCTURAL DRAWINGS SHALL NOT BE REPRODUCED AND USED AS SHOP DRAWINGS. ALL ITEMS DEVIATING FROM THE STRUCTURAL DRAWINGS OR FROM PREVIOUSLY SUBMITTED SHOP DRAWINGS SHALL BE CLOUDED.

F. THE DETAILS DESIGNATED AS "TYPICAL DETAILS" APPLY GENERALLY TO THE STRUCTURAL DRAWINGS IN ALL AREAS WHERE CONDITIONS ARE SIMILAR TO THOSE DESCRIBED IN THE DETAILS.

G. ALL STRUCTURAL ELEMENTS OF THE PROJECT HAVE BEEN DESIGNED BY THE ENGINEER TO RESIST THE REQUIRED CODE VERTICAL AND LATERAL FORCES THAT COULD OCCUR IN THE FINAL COMPLETED STRUCTURE ONLY. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO PROVIDE ALL REQUIRED BRACING DURING CONSTRUCTION TO MAINTAIN THE STABILITY AND SAFETY OF ALL STRUCTURAL ELEMENTS DURING THE CONSTRUCTION PROCESS UNTIL THE LATERAL-LOAD RESISTING OR STABILITY-PROVIDING SYSTEM IS COMPLETELY INSTALLED AND THE STRUCTURE IS COMPLETELY TIED TOGETHER. TEMPORARY SUPPORTS SHALL NOT RESULT IN THE OVERSTRESS OR DAMAGE OF THE ELEMENTS TO BE BRACED NOR ANY ELEMENTS USED AS BRACE SUPPORTS.

H. THE CONTRACT STRUCTURAL DRAWINGS AND SPECIFICATIONS REPRESENT THE FINISHED STRUCTURE, AND EXCEPT WHERE SPECIFICALLY SHOWN, DO NOT INDICATE THE MEANS OR METHODS OF CONSTRUCTION. THE CONTRACTOR AND THEIR SUB-CONTRACTORS SHALL SUPERVISE AND DIRECT THE WORK AND SHALL BE SOLELY RESPONSIBLE FOR ALL CONSTRUCTION MEANS, METHODS, PROCEDURES, TECHNIQUES, SEQUENCES AND SAFETY MEASURES INCLUDING, BUT NOT LIMITED TO, ADHERENCES TO ALL OSHA GUIDELINES. THE ENGINEER SHALL NOT HAVE CONTROL OF, AND SHALL NOT BE RESPONSIBLE FOR, CONSTRUCTION MEANS, METHODS, TECHNIQUES, SEQUENCES OR PROCEDURES, FOR SAFETY PRECAUTIONS AND PROGRAMS IN CONNECTION WITH THE WORK, FOR THE ACTS OR OMISSIONS OF THE CONTRACTOR, SUBCONTRACTORS, OR ANY OTHER PERSON PERFORMING ANY OF THE WORK, OR FOR THE FAILURE OF ANY OF THESE PERSONS TO CARRY OUT THE WORK IN ACCORDANCE WITH THE STRUCTURAL CONTRACT DOCUMENTS.

I. WHERE CONFLICT EXISTS AMONG THE VARIOUS PARTS OF THE STRUCTURAL CONTRACT DOCUMENTS, STRUCTURAL DRAWINGS, GENERAL NOTES, AND SPECIFICATIONS, THE STRICTEST REQUIREMENTS, AS INDICATED BY THE ENGINEER, SHALL GOVERN.

J. PERIODIC SITE OBSERVATION BY FIELD REPRESENTATIVES OF JQ IS SOLELY FOR THE PURPOSE OF DETERMINING IF THE WORK IS PROCEEDING IN ACCORDANCE WITH THE STRUCTURAL CONTRACT DOCUMENTS. THIS LIMITED SITE OBSERVATION IS NOT INTENDED TO BE A CHECK OF THE QUALITY OR QUANTITY OF THE WORK, BUT RATHER A PERIODIC CHECK IN AN EFFORT TO INFORM THE OWNER AGAINST DEFECTS AND DEFICIENCIES IN THE WORK OF THE CONTRACTOR.

DRILLED PIERS:

A. PIER DESIGN IS BASED ON THE FOLLOWING DESIGN CRITERIA:

1.	ALLOWABLE END BEARING:	20,000 PSF
2.	SIDE FRICTION:	3,300 PSF
3.	UPLIFT SIDE FRICTION:	2,600 PSF
4.	SIDE FRICTION (UPLIFT RESISTANCE):	2,600 PSF
5.	MINIMUM PENETRATION INTO BEARING STRATUM:	2'-0"

B. PIER DESIGN IS IN ACCORDANCE WITH THE RECOMMENDATIONS IN THE FOLLOWING GEOTECHNICAL REPORT.

GEOTECHNICAL ENGINEER:	KLEINFELDER
REPORT NUMBER:	20233850.001A
DATE:	JUNE 1, 2025 (REVISION 1)

DRILLED PIERS (CONT):

C. BEARING STRATUM SHOWN ON THE PIER DETAILS IS DARK GRAY AND GRAY SHALE.

D. PIERS NOT SPECIFICALLY LOCATED ON THE PLAN SHALL BE LOCATED ON CENTERLINE OF COLUMN ABOVE. WHERE NO COLUMN OCCURS, LOCATE ON CENTERLINE OF WALL OR BEAM.

E. PROVIDE DOWELS FROM PIERS INTO CONCRETE ABOVE USING SAME BAR SIZE AND NUMBER AS SHOWN FOR PILASTER ABOVE. WHERE NO PILASTER OCCURS, USE DOWELS OF SAME SIZE AND NUMBER AS PIER REINFORCING STEEL. EXTEND DOWELS 30 BAR DIAMETERS INTO PIER AND BEAM, WALL, PILASTER OR COLUMN, UNLESS NOTED OTHERWISE ON THE STRUCTURAL DRAWINGS.

F. ELEVATION OF TOP OF PIERS, UNLESS NOTED OTHERWISE ON THE STRUCTURAL DRAWINGS, IS AT THE BOTTOM OF THE DEEPEST INTERSECTING BEAM OR WALL SUPPORTED BY THE PIER.

G. REINFORCING CAGE SHALL BE HELD SECURELY AWAY FROM EARTH AT SIDES AND BOTTOM BY SETS OF 3 SPACERS AT A MAXIMUM SPACING OF 8 FT. ALONG THE LENGTH OF THE CAGE AND 1'-0" FROM THE BOTTOM.

H. PIER REINFORCING AND CONCRETE SHALL BE PLACED IMMEDIATELY AFTER DRILLING OPERATIONS ARE COMPLETE; IN NO CASE SHALL A PIER BE DRILLED THAT CANNOT BE PLACED BY THE END OF THE WORKDAY.

I. SEE PLANS FOR PIER SIZES, REINFORCING, AND DEPTH.

J. THE CONTRACTOR SHALL VERIFY DEPTHS OF PIERS BEFORE PIER STEEL IS CUT. PIER STEEL MAY BE DELIVERED TO THE JOBSITE IN STANDARD LENGTHS AND CUT AS REQUIRED. PROVIDE 64 BAR DIAMETER LAPS IN ALL VERTICAL PIER REINFORCING.

K. REINFORCING STEEL SHOP DRAWINGS SHALL INCLUDE PLACING DRAWINGS FOR TEMPLATES TO SET DOWELS IN PIERS.

L. TOP OF PIER SHALL BE OF THE SPECIFIED DIAMETER. FORM TOP OF PIER IF REQUIRED TO MAINTAIN THE SPECIFIED DIAMETER. ANY CONCRETE EXTENDING BEYOND THE SPECIFIED DIAMETER SHALL BE REMOVED.

M. TEMPORARY STEEL CASING MAY BE REQUIRED DURING PIER DRILLING OPERATIONS. PRIOR TO THE PLACEMENT OF CONCRETE, ANY SEEPAGE WATER SHALL BE REMOVED FROM THE PIER HOLES. SPECIAL CONSTRUCTION PROCEDURES IN ACCORDANCE WITH ACI 336.1 AND ACI 336.3R AND SPECIFICATIONS SHALL BE FOLLOWED DURING EXTRACTION OF THE CASING AND DURING CONCRETE PLACEMENT.

N. CONTRACTOR SHALL INCLUDE IN BID DOCUMENTS, UNIT-COSTS FOR CASING IF REQUIRED AND UNIT-COST FOR GREATER AND LESSER DEPTH OF DRILLING FOR EACH PIER SIZE.

O. ALL PIERS SHALL BE INSPECTED BY A REPRESENTATIVE OF [XX] IN ORDER TO ENSURE THAT THE PROPOSED BEARING MATERIAL HAS BEEN REACHED IN ACCORDANCE WITH THE RECOMMENDATIONS GIVEN IN THE GEOTECHNICAL REPORT.

P. THE CONTRACTOR SHALL MAKE AND MAINTAIN ACCURATE RECORDS OF THE DRILLED PIER DEPTHS, BEARING STRATUM, DEPTH OF PENETRATION INTO BEARING STRATUM, DIAMETER AND LOCATION (INCLUDING OFF CENTER ECCENTRICITIES), AND SHALL SUBMIT THIS INFORMATION TO THE ENGINEER.

STRUCTURAL MASONRY:

A. MINIMUM COMPRESSIVE STRENGTH OF THE MASONRY (f'm) SHALL BE 1,500 POUNDS PER SQUARE INCH.

B. MORTAR SHALL CONFORM TO ASTM C270, TYPE S. MASONRY CEMENT SHALL NOT BE USED.

C. CONCRETE MASONRY UNITS SHALL BE HOLLOW LOAD BEARING UNITS WHICH CONFORM TO ASTM C90, WITH A MINIMUM NET COMPRESSIVE STRENGTH AS FOLLOWS:

f'm (PSI)	NET AREA COMPRESSIVE STRENGTH OF CMU BLOCK (PSI)
2000	1900

D. CHASES SHALL BE BUILT IN AND NOT CUT IN. CHASES SHALL BE PLUMB AND SHALL BE MINIMUM ONE-UNIT LENGTH FROM JAMBS OF OPENINGS. ANCHORS, WALL PLUGS, ACCESSORIES AND OTHER ITEMS TO BE BUILT IN SHALL BE INSTALLED AS THE MASONRY WORK PROGRESSES. ALL CUTTING AND FITTING OF MASONRY, INCLUDING THAT REQUIRED TO ACCOMMODATE THE WORK OF OTHER SECTIONS SHALL BE DONE BY MASONS WITH MASONRY SAWS.

E. COARSE GROUT SHALL CONFORM TO ASTM C476, WITH A MAXIMUM AGGREGATE SIZE OF 1/2" AND A MINIMUM COMPRESSIVE STRENGTH EQUAL TO THE SPECIFIED MINIMUM COMPRESSIVE STRENGTH, f'm, BUT NOT LESS THAN 2000 PSI. COURSE GROUT SHALL BE PLACED IN ACCORDANCE WITH ACI 530.01 3.5.

F. REINFORCE CONCRETE MASONRY UNIT JOINTS WITH LADDER TYPE HOT DIP GALVANIZED COLD-DRAWN STEEL CONFORMING TO ANSI/ASTM A82, WITH W1.7 SIDE RODS WITH W1.7 CROSS RODS.
1. SPACE JOINT REINFORCING AT 16 INCHES OC UNLESS NOTED OTHERWISE.
2. LAP JOINT REINFORCING 14 INCHES AT SPLICES.
3. PROVIDE PREFABRICATED JOINT REINFORCING CORNER PIECES AT ALL WALL CORNERS AND INTERSECTIONS.
4. JOINT REINFORCING SHALL BE DISCONTINUOUS AT CONTROL AND EXPANSION JOINTS.

G. LAP REINFORCING BARS IN GROUTED MASONRY AS NOTED BELOW. SPLICES IN REINFORCING SHALL BE STAGGERED SO THAT NOT MORE THAN 1/2 OF ALL BARS ARE SPLICED AT THE SAME LOCATION.

1.	VERTICAL BARS:	60 BAR DIAMETERS
2.	BOND BEAMS:	40 BAR DIAMETERS
3.	LINTEL:	DO NOT SPLICE

H. REFER TO SPECIFICATION SECTION 04 22 00 FOR ADDITIONAL INFORMATION.

STRUCTURAL STEEL:

A. MATERIAL
1. ALL HOT ROLLED STEEL MEMBERS SHALL BE NEW AND CONFORM TO ASTM SPECIFICATION A6.
2. ASTM SPECIFICATION AND GRADE - CLEARLY MARK THE GRADE ON EACH MEMBER.
   a. UNLESS NOTED OTHERWISE ON THE STRUCTURAL DRAWINGS, STRUCTURAL

B. FABRICATION
1. SPLICING OF STRUCTURAL STEEL MEMBERS IS PROHIBITED WITHOUT PRIOR APPROVAL OF THE ENGINEER AS TO LOCATION AND TYPE OF SPLICE TO BE MADE. ANY MEMBER HAVING SPLICE NOT SHOWN AND DETAILED ON SHOP DRAWINGS WILL BE REJECTED.

C. ERECTION
1. ERECTION TOLERANCES OF ANCHOR BOLTS, EMBEDDED ITEMS, AND ALL STRUCTURAL STEEL UNLESS SPECIFIED OTHERWISE ON THE STRUCTURAL DRAWINGS SHALL CONFORM TO THE AISC CODE OF STANDARD PRACTICE.
2. FIELD CUTTING OF STRUCTURAL STEEL OR ANY FIELD MODIFICATIONS TO STRUCTURAL STEEL SHALL NOT BE MADE WITHOUT PRIOR APPROVAL OF THE ENGINEER.
3. CONTRACTOR SHALL PROTECT ANY UNPRIMED STRUCTURAL STEEL FROM DETRIMENTAL EFFECTS OF CORROSION, AS REQUIRED, UNTIL THE STEEL IS ENCLOSED AND PROTECTED BY THE NEW CONSTRUCTION.
4. HOT DIP GALVANIZE AFTER FABRICATION ALL STRUCTURAL STEEL ITEMS AND CONNECTIONS PERMANENTLY EXPOSED TO THE WEATHER, WHETHER SPECIFIED ON THE STRUCTURAL DRAWINGS OR NOT. SUCH ITEMS INCLUDE, BUT ARE NOT LIMITED TO:
   a. SHELF ANGLES
   b. PARAPET WALL SUPPORTING MEMBERS
   c. ALL EMBEDDED PLATES IN CONCRETE
   d. BUILDING CLADDING SUPPORT STEEL IN SPACE NOT AIR CONDITIONED AND/OR EXPOSED TO MOISTURE OUTSIDE THE EXTERIOR WATERPROOFING SURFACE IF ANY.
   e. RAILING EXPOSED TO WEATHER
   f. EXAMINE THE ARCHITECTURAL AND STRUCTURAL DRAWINGS FOR OTHER ITEMS REQUIRED TO BE HOT DIPPED GALVANIZED. GALVANIZE ALL NUTS, BOLTS, AND WASHERS USED IN CONNECTION WITH SUCH STEEL. FIELD WELDED CONNECTIONS SHALL HAVE WELDS PROTECTED WITH "ZRC COLD GALVANIZING COMPOUND" AS MANUFACTURED BY ZRC COMPANY.

D. REFER TO DWG 00S001 FOR ADDITIONAL NOTES AND SPECIFICATIONS 05 50 00 FOR ADDITIONAL INFORMATION.

STRUCTURAL STEEL CONNECTIONS:

A. WELDED CONNECTIONS
1. ALL WELDING SHALL CONFORM TO ANSI/AWS D1.1, LATEST EDITION.
2. FILLET WELDS WITH NO SIZE SPECIFIED SHALL BE 3/16 INCH OR MINIMUM SIZE REQUIRED BY AISC, WHICHEVER IS LARGER.

B. BOLTED CONNECTIONS
1. UNLESS NOTED OTHERWISE ON THE STRUCTURAL DRAWINGS, BOLTS SHALL BE 3/4 INCH DIAMETER AND CONFORM TO ASTM F3125, GRADE A325. BOLTS SHALL BE DESIGNED USING VALUES FOR BEARING TYPE BOLTS WITH THREAD ALLOWED IN THE SHEAR PLANE.

C. STRUCTURAL STEEL CONNECTIONS NOT SPECIFICALLY DETAILED ON THE STRUCTURAL DRAWINGS SHALL BE DESIGNED AND DETAILED BY THE CONTRACTOR UNDER THE DIRECT SUPERVISION OF A PROFESSIONAL ENGINEER LICENSED IN THE STATE HAVING JURISDICTION AT THE PROJECT SITE. SEALED CALCULATIONS FOR ALL CONNECTIONS DESIGNED BY THE CONTRACTOR SHALL BE SUBMITTED FOR THE ARCHITECT'S FILES.

D. BEAM CONNECTIONS SHALL BE DESIGNED AND DETAILED AS FOLLOWS, UNLESS NOTED OTHERWISE ON THE STRUCTURAL DRAWINGS:
1. CONNECTIONS SHALL BE AISC TYPE 2 SIMPLE FRAMING CONNECTIONS. SHEAR TAB CONNECTIONS SHALL NOT BE USED UNLESS SPECIFICALLY DETAILED ON THE STRUCTURAL DRAWINGS, OR CONNECTIONS ARE DESIGNED AND DETAILED BY THE FABRICATOR'S REGISTERED PROFESSIONAL ENGINEER LICENSED IN THE STATE OF TEXAS AND SEALED CALCULATIONS ARE SUBMITTED.
2. IN GENERAL, SHOP CONNECTIONS SHALL BE BOLTED OR WELDED AND FIELD CONNECTIONS SHALL BE BOLTED.
3. IF NOT INDICATED ON THE STRUCTURAL DRAWINGS, CONNECTIONS SHALL BE DESIGNED FOR 55 PERCENT OF THE TOTAL LOAD CAPACITY FOR THE BEAM SPAN SHOWN IN THE BEAM TABLES IN THE AISC MANUAL REFERENCED IN THE "CODES & REFERENCED REPORTS" NOTES.
4. SHORT SLOTTED HOLES SHALL BE PERMITTED PROVIDED WASHERS ARE INSTALLED IN ACCORDANCE WITH AISC REQUIREMENTS. WASHERS SHALL BE HARDENED WHERE A325 BOLTS ARE UTILIZED.

E. ALL BEAM SHEARS, REACTIONS, MEMBER FORCES, MOMENTS, ETC. SHOWN ON THE STRUCTURAL DRAWINGS ARE UNFACTORED LOADS CONFORMING TO THE REQUIREMENTS OF AISC ALLOWABLE STRESS DESIGN (ASD).

F. ROOF EDGE ANGLES SHALL BE CONTINUOUS AND SHALL BE SPLICED ONLY AT SUPPORTS. SPLICES SHALL BE BUTT WELDED TO DEVELOP FULL CAPACITY OF THE MEMBER.

G. BASE PLATES
1. COLUMN BASE PLATES SHALL BE SET TO THE ELEVATION INDICATED ON THE STRUCTURAL DRAWINGS AND LEVELED USING SHIMS OR BY DOUBLE NUTS ON ANCHOR BOLTS. BASE PLATES SHALL THEN BE GROUTED WITH A NON-SHRINK, HIGH STRENGTH NONMETALLIC GROUT. TIGHTEN ANCHOR BOLTS AFTER SUPPORTED MEMBERS HAVE BEEN POSITIONED AND PLUMBED.
2. HOLE SIZES IN BASE PLATES SHALL BE OVERSIZED WITH PLATE WASHERS PER AISC TABLE 14-2.

H. ANCHOR RODS SHALL BE:
1. TYPICAL: ASTM F1554 GR. 55, WELDABLE.

I. FOR CONNECTIONS NOT SPECIFICALLY ADDRESSED BY THESE NOTES OR THE STRUCTURAL DRAWINGS, PROVIDE FILLET WELDS AT ALL CONTACT SURFACES SUFFICIENT TO DEVELOP THE TENSILE STRENGTH OF THE SMALLER MEMBER AT THE JOINT.

OPEN WEB STEEL JOISTS:

A. OPEN WEB STEEL JOISTS SHALL CONFORM TO THE STANDARD SPECIFICATIONS OF THE STEEL JOIST INSTITUTE (SJI). CHORDS OF JOISTS SHALL BE ANGLES OR TEES.

B. PROVIDE BRIDGING IN ACCORDANCE WITH SJI SPECIFICATIONS AND OSHA STANDARD 29 CFR-1926.757(C). BRIDGING SHALL BE CONTINUOUS THROUGH STRUCTURAL STEEL MEMBERS, AND SHALL BE ANCHORED TO SPANDREL MEMBERS OR WALLS. PROVIDE ADDITIONAL BRIDGING WHERE REQUIRED FOR UPLIFT.

C. SEE DESIGN LOADS SECTION OF THE STRUCTURAL NOTES FOR JOIST DESIGN WIND PRESSURES.

D. JOIST MANUFACTURER SHALL DESIGN CHORDS OF JOISTS TO SUPPORT A NOMINAL CONCENTRICALLY-APPLIED LOAD OF 100 POUNDS BETWEEN ALL PANEL POINTS WITHOUT REQUIRING ADDITIONAL REINFORCING. THIS ADDITIONAL LOAD HAS BEEN ACCOUNTED FOR IN THE OVERALL DESIGN LOADS AND IS NOT ADDITIVE TO THOSE SPECIFIED.

E. ALL HANGERS OR ATTACHMENTS TO JOISTS SHALL BE PLACED CONCENTRIC WITH THE TOP AND BOTTOM CHORD(S). HANGERS WITH REACTIONS IN EXCESS OF 100 POUNDS MUST BE LOCATED AT THE PANEL POINTS OF THE JOIST, OR THE CHORD(S) SHALL BE REINFORCED IN ACCORDANCE WITH THE "TYPICAL DETAILS."

F. PROVIDE FLAT BEARING FOR ALL JOISTS. BEAR JOISTS ON SUPPORTS IN ACCORDANCE WITH SJI SPECIFICATIONS.

G. JOISTS SHALL BE CONNECTED TO THEIR SUPPORTS IN ACCORDANCE WITH SJI SPECIFICATIONS AND AS INDICATED BY THE JOIST MANUFACTURER.

H. REFER TO SPECIFICATION SECTION 05 21 00 FOR ADDITIONAL INFORMATION.

METAL DECKS:

A. METAL ROOF DECK
1. METAL ROOF DECK SCHEDULE:

LOCATION	GAUGE	SDI DECK TYPE	DECK DEPTH (IN)	SHEET WIDTH (IN)	MIN Ix (IN⁴)	MIN Sp (IN³)	MIN Sn (IN³)
TYP UNO	20	WR	1.5	36	0.212	0.234	0.245

Sp = POSITIVE SECTION MODULUS IN³
Sn = NEGATIVE SECTION MODULUS IN³
I = MOMENT OF INERTIA IN⁴

2. ROOF DECK SHALL BE GALVANIZED.
3. SHEET STEEL FOR GALVANIZED ROOD DECK AND ACCESSORIES SHALL CONFORM TO ASTM A653, STRUCTURAL QUALITY, WITH A MINIMUM YIELD STRENGTH OF 33 KSI. GALVANIZING SHALL CONFORM TO ASTM A653 WITH A MINIMUM COATING OF G90 AS DEFINED IN A653.
4. ROOF DECK SHALL BE CONTINUOUS OVER FOUR OR MORE SUPPORTS.
5. PLACE DECK PANELS ON STRUCTURAL SUPPORTS AND ADJUST TO FINAL POSITION WITH ENDS LAPPED 2 INCHES OVER STRUCTURAL SUPPORTS. PROVIDE MINIMUM END BEARING OF 2 INCHES.
6. ROOF DECK CONNECTIONS SHALL BE AS FOLLOWS:

LOCATION	SUPPORT CONN PATTERN	SUPPORT FASTENER	SIDELAP FASTENER/NO PER SPAN
TYPICAL BUILDING:			
INTERIOR FIELD	36/4	5/8 PW	#10 TEK/2
PERIMETER BAND	36/7	5/8 PW	#10 TEK/3
CORNER ZONES	36/7	5/8 PW	#10 TEK/5

SEE DESIGN WIND LOAD INFORMATION OR PLANS FOR "A" DIMENSION AND INTERIOR FIELDS, PERIMETER BAND, RIDGE BAND, AND CORNER ZONE WIND LOADS.
PW = PUDDLE WELD
7. POWER DRIVEN FASTENERS SHALL BE SELECTED BY THE CONTRACTOR FOR THE COMBINATIONS OF DECK GAUGE AND DECK SUPPORT MEMBER THICKNESS. SUBMIT PROPOSED FASTENERS WITH COMPLETE MANUFACTURER'S INFORMATION, INCLUDING DIAPHRAGM SHEAR VALUES FOR THE ENGINEER TO REVIEW.
8. PUDDLE WELDS SHALL BE 5/8" MINIMUM DIAMETER AND SHALL BE MADE THROUGH WELD WASHERS FOR DECKING LIGHTER THAN 22 GAUGE.
9. MECHANICAL, ELECTRICAL AND PLUMBING SYSTEMS SHALL NOT BE SUPPORTED BY THE METAL ROOF DECK.
10. REFER TO SPECIFICATION SECTION 05 30 00 FOR ADDITIONAL INFORMATION.

DELEGATED DESIGN:

A. IN ACCORDANCE WITH THE SPECIFICATIONS THE ITEMS LISTED BELOW ARE NOT INCLUDED IN THE CONTRACT DOCUMENTS. DESIGN OF THESE ELEMENTS SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR, AND SHALL BE DESIGNED AND SEALED BY A REGISTERED PROFESSIONAL ENGINEER LICENSED IN THE STATE HAVING JURISDICTION AT THE PROJECT SITE.
1. STEEL CONNECTIONS
2. EMBEDDED ASSEMBLIES AND INSERTS, CLAMPS, HANGERS, TRAPEZES, UNISTRUT, ETC. FOR THE SUPPORT OF MEP SYSTEMS.
3. OPEN WEB STEEL JOISTS

B. DESIGN OF THE ITEMS LISTED ABOVE SHALL BE IN ACCORDANCE WITH THE GENERAL BUILDING CODE, AND SHALL INCLUDE ALL ATTACHMENTS TO THE STRUCTURE.

NOTE:
REFER TO DWG 00S001 FOR ADDITIONAL STRUCTURAL NOTES NOT SHOWN HERE FOR CLARITY

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PROJECT NO: 4220184 TBPE FIRM F-7986
TEXAS P.E. FIRM Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13/2025	ISSUED FOR BID

PROJECT MANAGER	J. R. CANTWELL
DESIGNED BY	C. DECKER
DRAWN BY	J. RENDON
CHECKED BY	C. STORY
APPROVED BY	M. KARIYARVEEDU
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS · MURALI K. KARIYARVEEDU · 95735 · LICENSED PROFESSIONAL ENGINEER
6/13/2025

LEWISVILLE
Deep Roots. Broad Wings. Bright Future

CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

PLANT II BLOWER BUILDING (PROPOSED)
STRUCTURAL
BLOWER BUILDING STRUCTURAL NOTES

0 1" 2"

FILENAME	STRUCTURAL CONTAINER FILE.RVT
SCALE	NTS
SHEET	31S001

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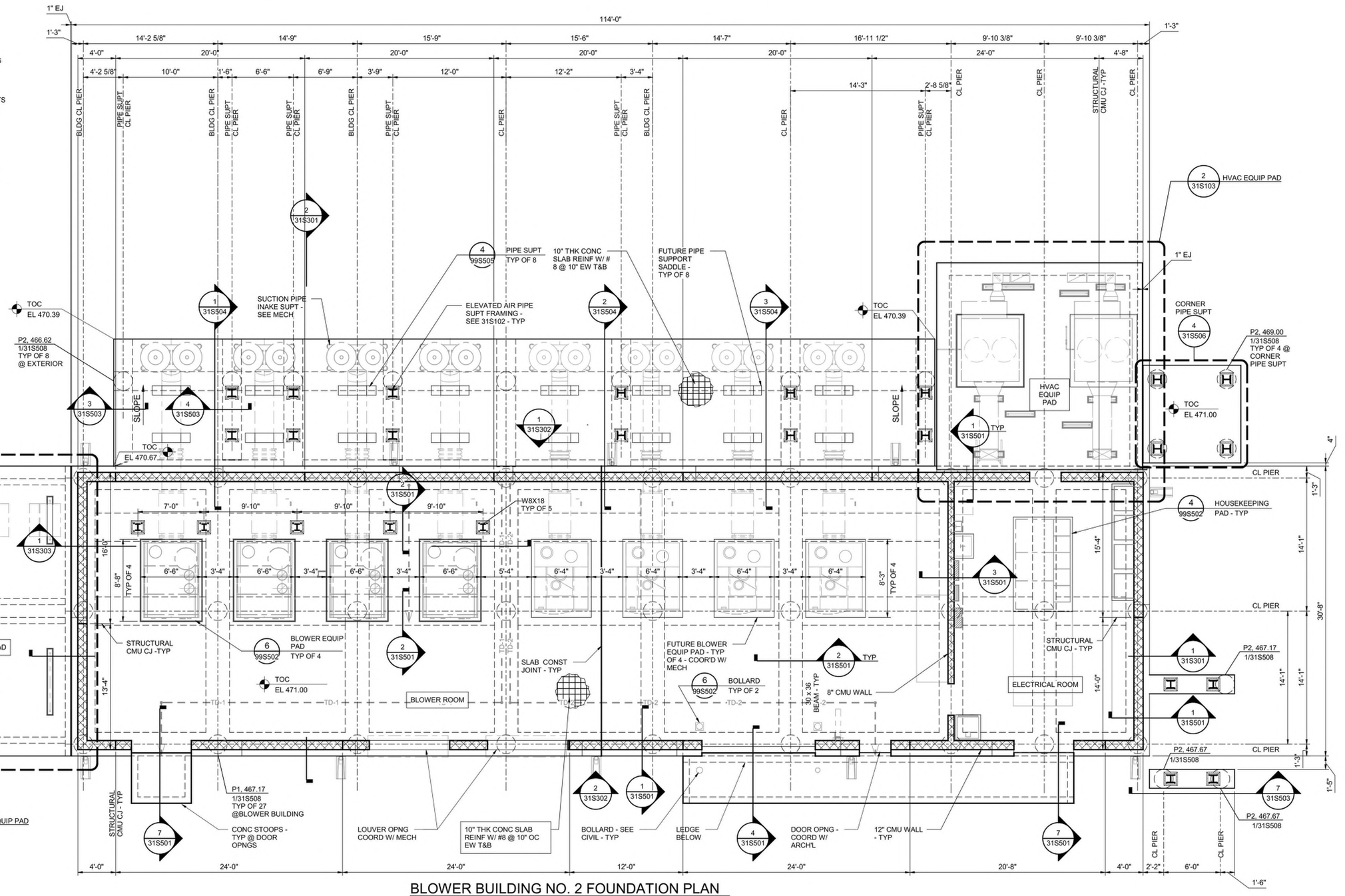
PLAN NOTES:

1. TOP OF STRUCTURAL CONCRETE ELEVATION= FINISH FLOOR.
2. COORDINATE WITH ARCHITECTURAL FOR DOOR OPENING SIZE AND LOCATIONS AND MASONRY CONTROL JOINT LOCATIONS.
3. COORDINATE WITH MECHANICAL, ELECTRICAL AND PLUMBING DRAWINGS FOR ADDITIONAL SLEEVES, INSERTS AND OPENINGS.
4. COORDINATE EQUIPMENT HOUSEKEEPING PAD DIMENSIONS AND ELEVATIONS WITH MECH/ELEC & W/ APPROVED EQUIPMENT SUBMITTALS.
5. COORDINATE DIMENSIONS/LOCATIONS OF FLOOR SLAB BLOCKOUTS WITH APPROVED ELECTRICAL EQUIPMENT SUBMITTALS. SUBMIT PROPOSED BLOCKOUT LOCATIONS FOR ENGINEER'S REVIEW PRIOR TO SUBMITTAL OF SLAB REBAR.
6. DRILLED PIERS ARE NOTED ON PLAN:

PX, TO PIER EL
TO PIER DTL

SEE SHEET 1/31S508 FOR DRILLED PIER SCHEDULE.

7. COORDINATE WITH CIVIL AND MECHANICAL FOR AIR PIPING LAYOUT AND SUPPORT LOCATIONS.



BLOWER BUILDING NO. 2 FOUNDATION PLAN

3/16" = 1'-0"

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AERATION BASIN EXPANSION

PLANT II BLOWER BUILDING (PROPOSED)
STRUCTURAL
FOUNDATION PLAN

FILENAME	STRUCTURAL CONTAINER FILE.RVT
SCALE	As indicated

SHEET 31S101

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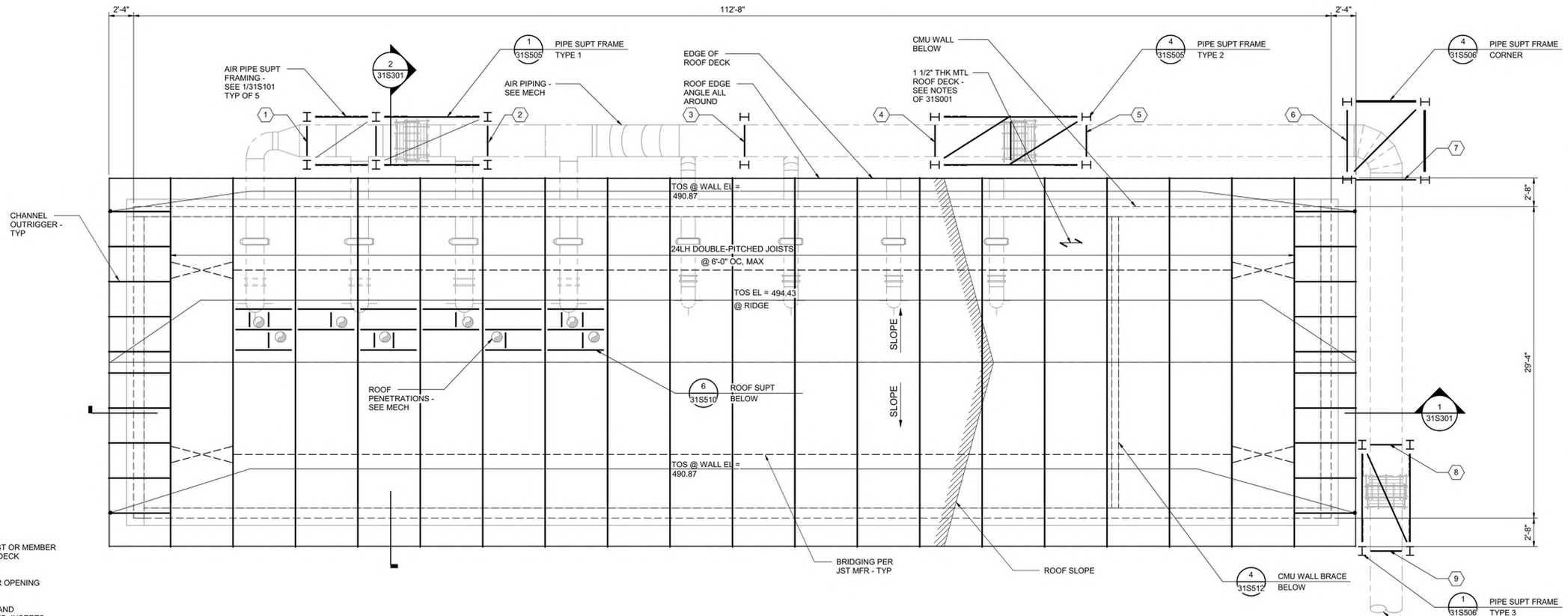
6/13/2025 11:27:51 AM

NOTES BY SYMBOL:

(X) DENOTES ELEVATED AIR PIPE SUPPORT. REFER TO DWG 3/31S507 FOR SUPPORT TYPES.

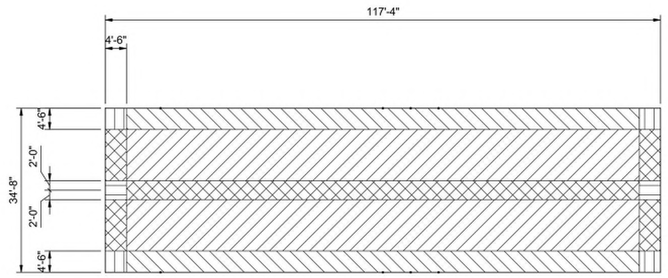


PLAN NOTES:

1. TOP OF STEEL ELEVATION = TOP OF BEAM, JOIST OR MEMBER SUPPORTING ROOF DECK = BOTTOM OF ROOF DECK ELEVATION.
2. COORDINATE WITH ARCHITECTURAL FOR DOOR OPENING SIZE AND LOCATIONS.
3. COORDINATE WITH MECHANICAL, ELECTRICAL AND PLUMBING DRAWINGS FOR ADDITIONAL SLEEVES, INSERTS AND OPENINGS.

BLOWER BUILDING NO. 2 ROOF FRAMING PLAN

3/16" = 1'-0"



UPLIFT WIND LOAD LEGEND (STRENGTH LEVEL LOADS)

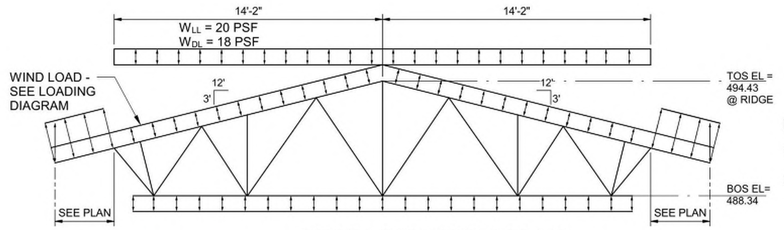
- 67 PSF
- 138 PSF
- 80.2 PSF
- 122 PSF
- 107 PSF

NOTES:

1. WIND UPLIFT LOADS SHOWN ARE GROSS UPLIFT LOADS BASED ON A TRIBUTARY AREA OF 10 SQ FT.
2. CONTRACTOR SHALL CALCULATE NET WIND LOADS ON THE STRUCTURAL MEMBERS BASED ON THEIR TRIBUTARY AREAS, FOR COMPONENTS AND CLADDINGS.

ROOF WIND LOADING DIAGRAM

NOT TO SCALE



NOTES:

1. UNIFORM LOADS ARE UNFACTORED.
2. WEB MEMBER CONFIGURATION PER JOINT MANUFACTURER.

JOIST LOADING DIAGRAM

1/4" = 1'-0"

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PRAIRIE CREEK
AERATION BASIN EXPANSION

PLANT II BLOWER BUILDING (PROPOSED)
STRUCTURAL
ROOF FRAMING PLAN

Z
0 1" 2"

FILENAME	STRUCTURAL CONTAINER FILE.RVT
SCALE	As indicated
SHEET	31S102

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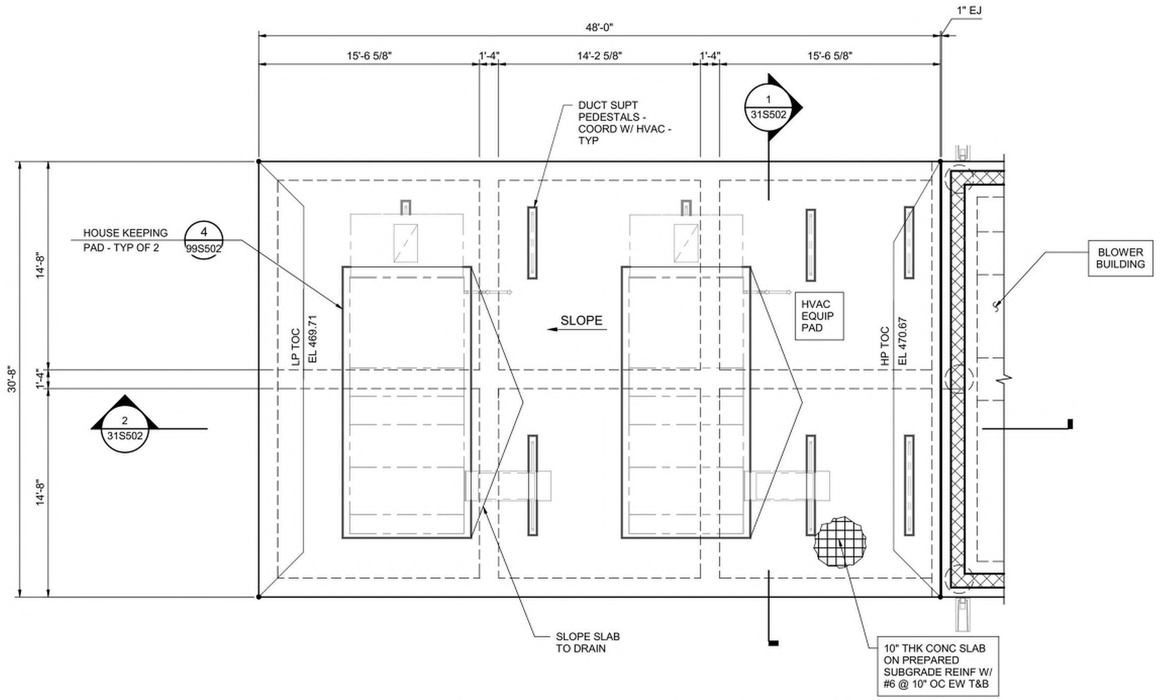
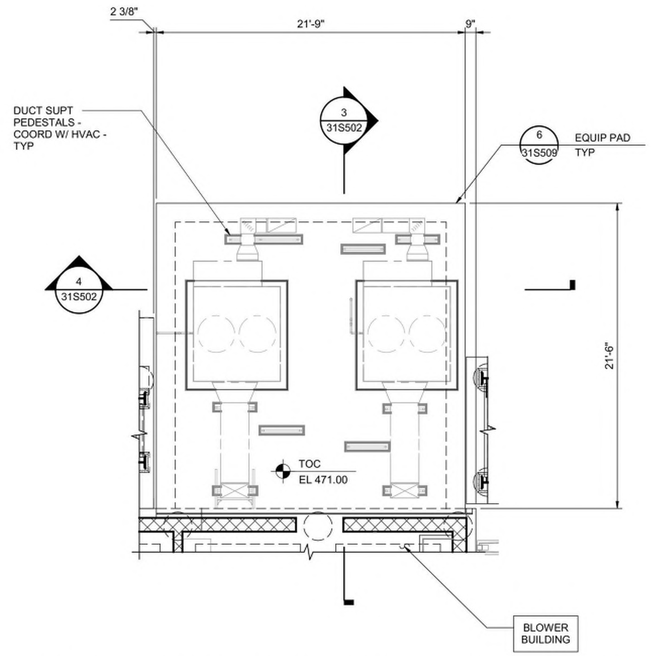


BLOWER BUILDING HVAC EQUIPMENT PAD FOUNDATION PLAN

3/16" = 1'-0"



ELECTRICAL ROOM HVAC EQUIPMENT PAD FOUNDATION PLAN

3/16" = 1'-0"

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PROJECT NUMBER	10342803

STATE OF TEXAS
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LEWISVILLE
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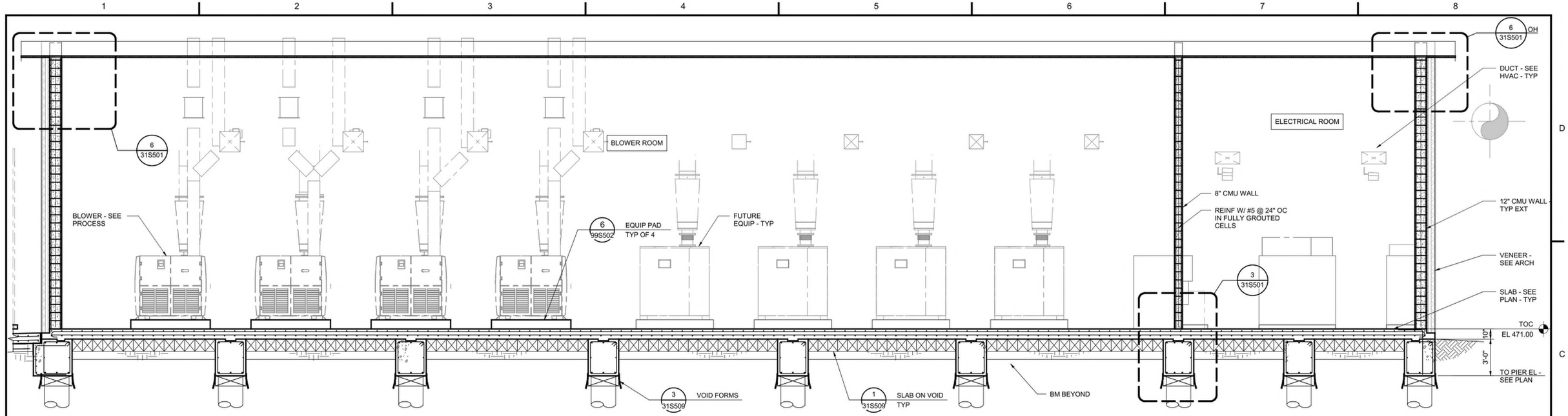
PRAIRIE CREEK
AERATION BASIN EXPANSION

PLANT II BLOWER BUILDING (PROPOSED)
STRUCTURAL
HVAC EQUIPMENT FOUNDATION PLANS

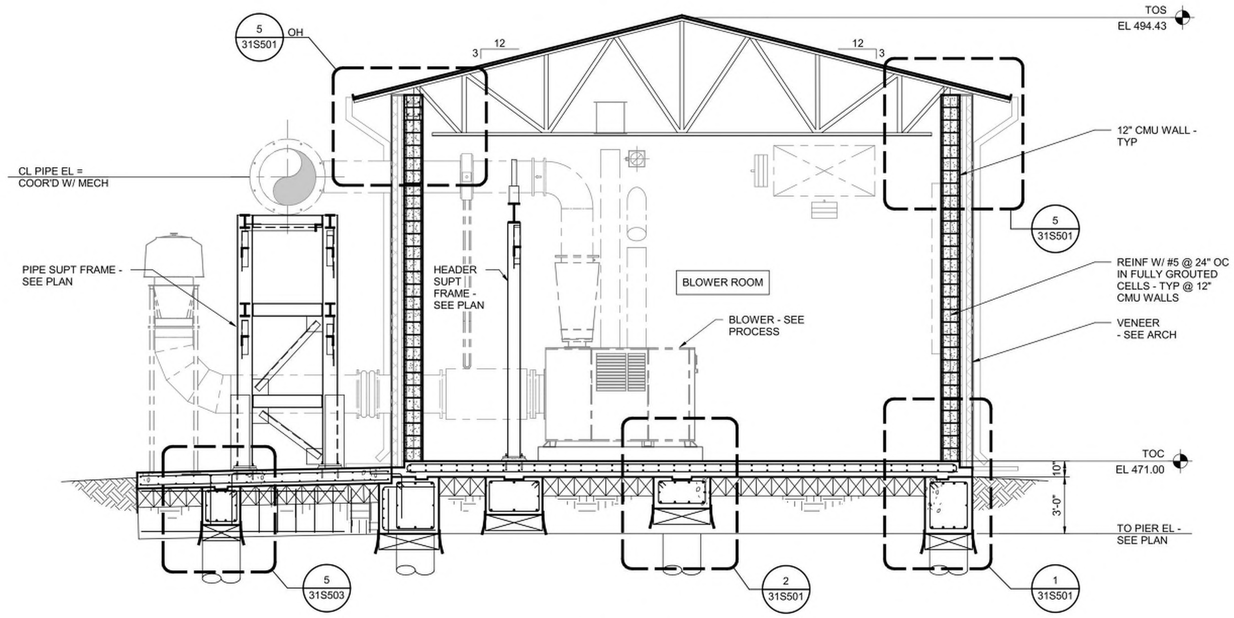
0 1" 2"

FILENAME: STRUCTURAL CONTAINER FILE.RVT
SCALE: 3/16" = 1'-0"

SHEET: **31S103**



1 31S101 BLOWER BUILDING - OVERALL SECTION
1/4" = 1'-0"



2 31S101 BLOWER BUILDING - OVERALL SECTION
1/4" = 1'-0"

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PRAIRIE CREEK

AERATION BASIN EXPANSION

PLANT II BLOWER BUILDING (PROPOSED)
STRUCTURAL
OVERALL SECTIONS

0 1" 2"

FILENAME: STRUCTURAL CONTAINER FILE.RVT
SCALE: 1/4" = 1'-0"

SHEET
31S301

Autodesk Docs://10342803_COL_PCWWT_AB_Expansion_2024/31 - PLANT II BLOWER BUILDING (PROPOSED) - STRUCT.rvt
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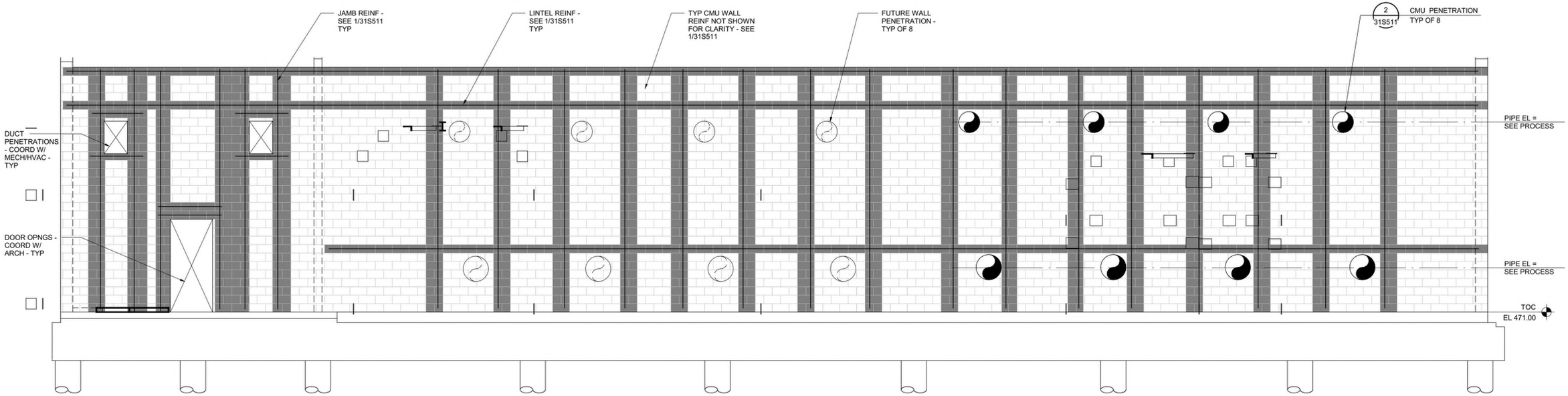
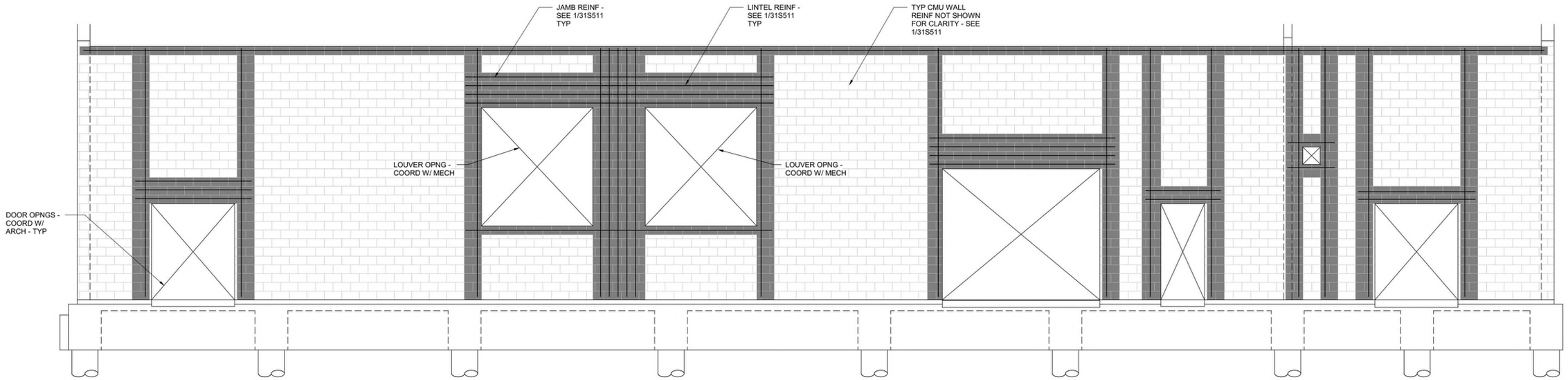


1 / 31S101 WEST EXTERIOR CMU WALL ELEVATION

1/4" = 1'-0"

NOTE:
COTROL JOINTS NOT SHOWN FOR CLARITY. REFER TO 31S101 FOR JOINT LOCTAIONS.



2 / 31S101 EAST EXTERIOR CMU WALL ELEVATION

1/4" = 1'-0"

shaping the built environment
JQ INFRASTRUCTURE, LLC
100 GLASS STREET, SUITE 201 DALLAS, TEXAS 75207
972.392.7340 JQENG.COM
PROJECT NO: 4220184 TBPE FIRM F-7986

HDR
TEXAS P.E. FIRM Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13/2025	ISSUED FOR BID

PROJECT MANAGER	J. R. CANTWELL
DESIGNED BY	C. DECKER
DRAWN BY	J. RENDON
CHECKED BY	C. STORY
APPROVED BY	M. KARIYARVEEDU
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
MURALI K. KARIYARVEEDU
95735
LICENSED
PROFESSIONAL ENGINEER
6/18/2025

LEWISVILLE
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CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

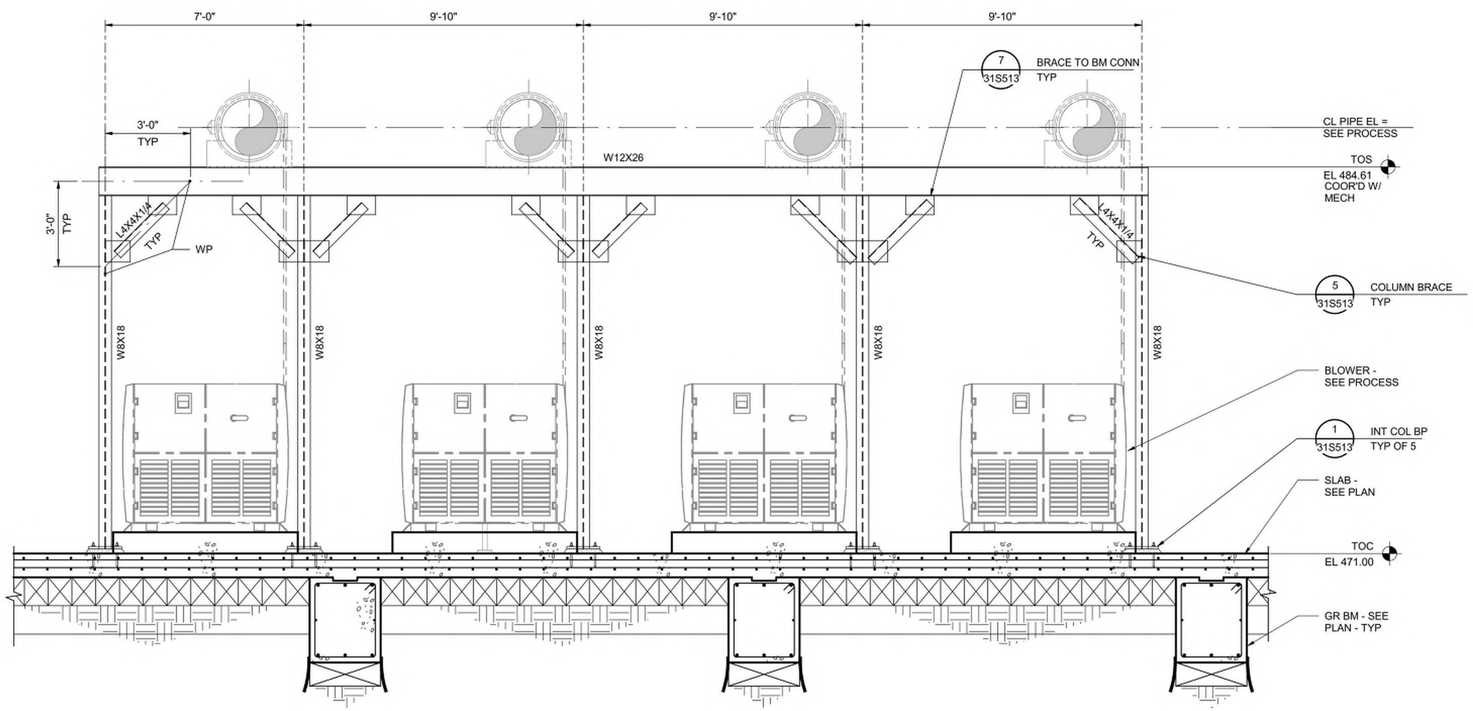
PLANT II BLOWER BUILDING (PROPOSED) STRUCTURAL EXTERIOR CMU WALL ELEVATIONS

0 1" 2"

FILENAME: STRUCTURAL CONTAINER FILE.RVT
SCALE: 1/4" = 1'-0"

SHEET: 31S302

Autodesk Docs://10342803_COL_PCWWT_AB_Expansion_2024/31 - PLANT II BLOWER BUILDING (PROPOSED) - STRUCT.rvt
6/13/2025 11:27:55 AM



1 / 31S101 INTERIOR PIPE SUPPORT FRAME ELEVATION

3/8" = 1'-0"

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6/13/2025 11:27:56 AM

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JQ Infrastructure
JQ INFRASTRUCTURE, LLC
100 GLASS STREET, SUITE 201
DALLAS, TEXAS 75207
972.392.7340
JQENG.COM
PROJECT NO: 4220184
TBPE FIRM F-7986

HDR
TEXAS P.E. FIRM
Registration No. F-754

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APPROVED BY	M. KARIYARVEEDU
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
MURALI K. KARIYARVEEDU
95735
LICENSED
PROFESSIONAL ENGINEER
6/13/2025

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PRAIRIE CREEK

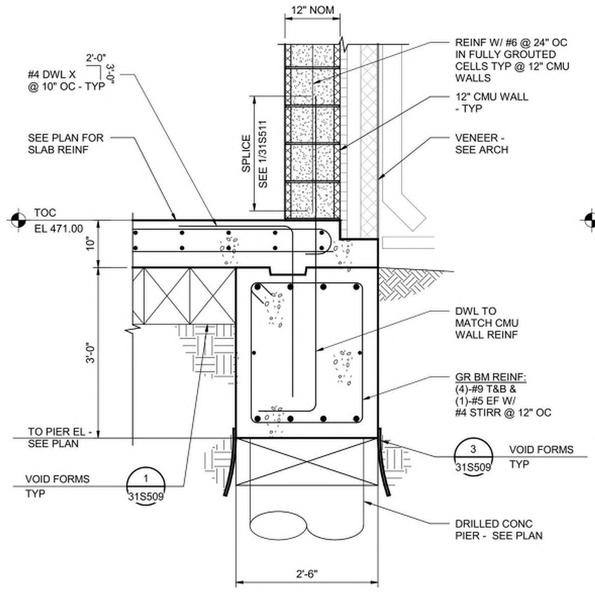
AERATION BASIN EXPANSION

PLANT II BLOWER BUILDING (PROPOSED)
STRUCTURAL
INTERIOR PIPE SUPPORT ELEVATION

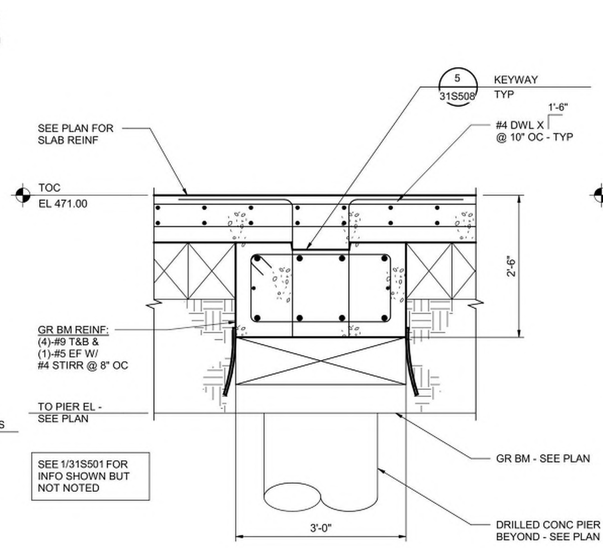
0 1" 2"

FILENAME: STRUCTURAL CONTAINER FILE.RVT
SCALE: 3/8" = 1'-0"

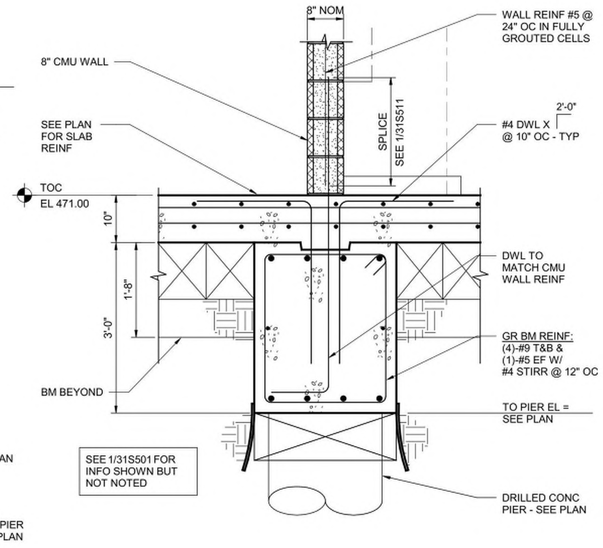
SHEET: 31S303



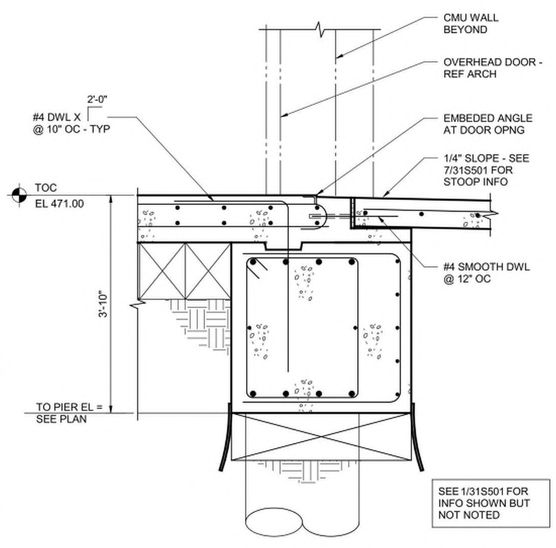
1 31S101 TYPICAL EXTERIOR GRADE BEAM SECTION
3/4" = 1'-0"



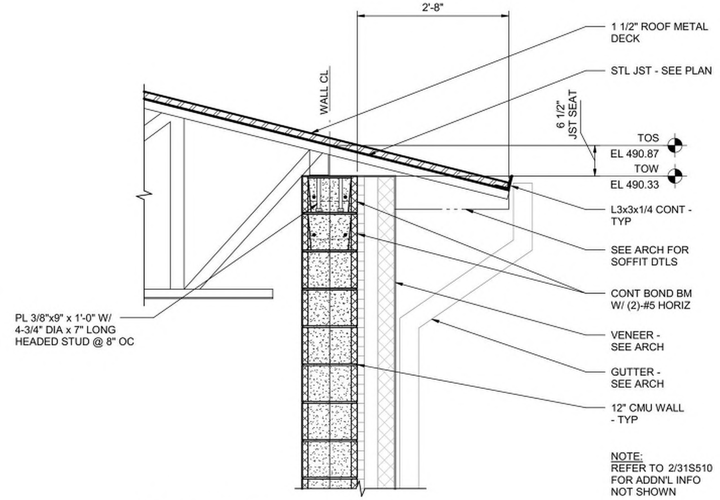
2 31S101 TYPICAL INTERIOR GRADE BEAM SECTION
3/4" = 1'-0"



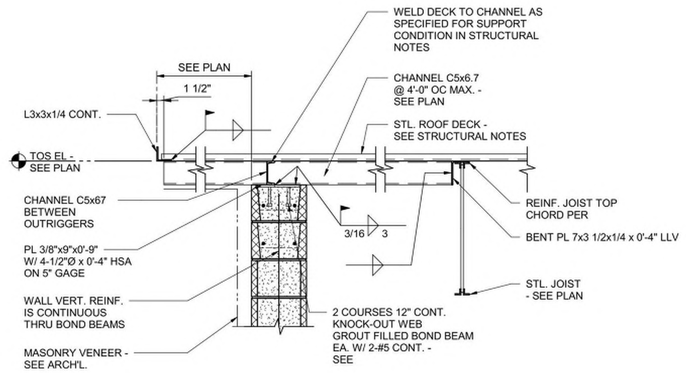
3 31S101 INTERIOR GRADE BEAM UNDER CMU SECTION
3/4" = 1'-0"



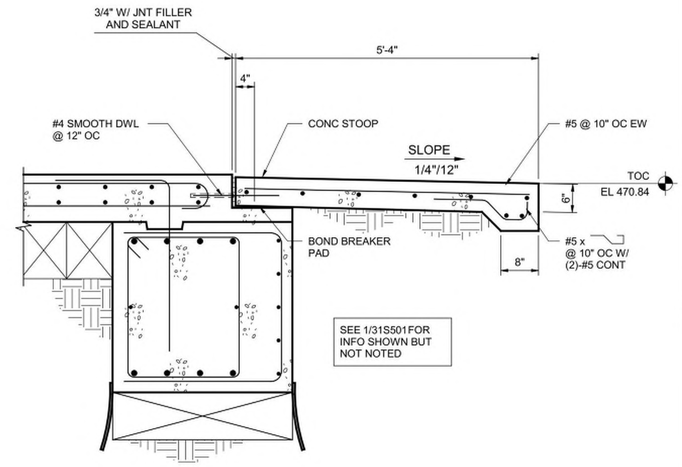
4 31S101 TYPICAL GRADE BEAM AT OVERHEAD DOORS SECTION
3/4" = 1'-0"



5 31S301 SECTION
3/4" = 1'-0"



6 31S301 TYPICAL OUTRIGGER BEARING ON EXTERIOR MASONRY WALL DETAIL
3/4" = 1'-0"



7 31S101 TYPICAL CONCRETE SLAB AT DOOR OPENING SECTION
NOT TO SCALE

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JQ Infrastructure
JQ INFRASTRUCTURE, LLC
100 GLASS STREET, SUITE 201
DALLAS, TEXAS 75207
972.392.7340
JQENG.COM
PROJECT NO: 4220184
TBPE FIRM F-7986

HDR
TEXAS P.E. FIRM
Registration No. F-754

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CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
MURALI K. KARIYARVEEDU
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LICENSED PROFESSIONAL ENGINEER
6/18/2025

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CITY OF LEWISVILLE
PRAIRIE CREEK

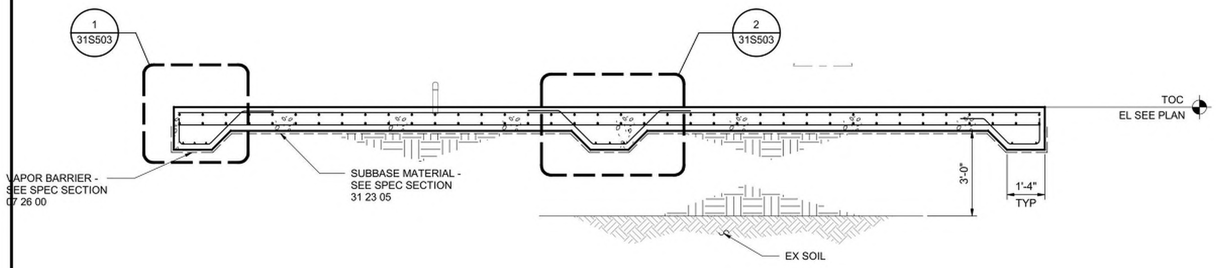
AERATION BASIN EXPANSION

PLANT II BLOWER BUILDING (PROPOSED)
STRUCTURAL
SECTIONS AND DETAILS I

0 1" 2"

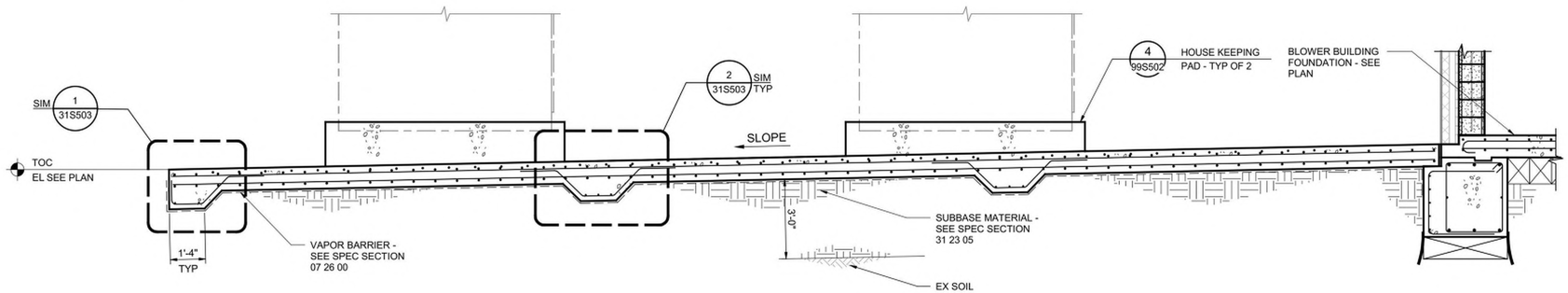
FILENAME	STRUCTURAL CONTAINER FILE.RVT
SCALE	3/4" = 1'-0"

SHEET
31S501



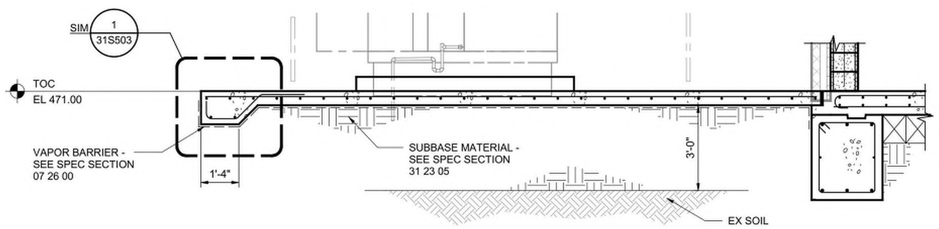
1 / 31S103 HVAC EQUIPMENT PAD SECTION

3/8" = 1'-0"



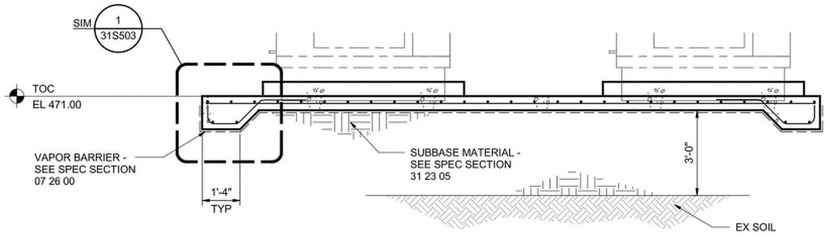
2 / 31S103 HVAC EQUIPMENT PAD SECTION

3/8" = 1'-0"



3 / 31S103 HVAC EQUIPMENT PAD SECTION

3/8" = 1'-0"



4 / 31S103 HVAC EQUIPMENT PAD SECTION

3/8" = 1'-0"

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JQ Infrastructure
JQ INFRASTRUCTURE, LLC
100 GLASS STREET, SUITE 201
DALLAS, TEXAS 75207
972.392.7340
JQENG.COM
PROJECT NO: 4220184
TBPE FIRM F-7986

HDR
TEXAS P.E. FIRM
Registration No. F-754

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CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
MURALI K. KARIYARVEEDU
95735
LICENSED
PROFESSIONAL ENGINEER
6/13/2025

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PRAIRIE CREEK

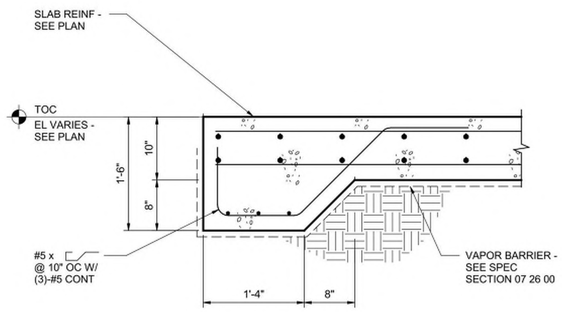
AERATION BASIN EXPANSION

PLANT II BLOWER BUILDING (PROPOSED)
STRUCTURAL
SECTIONS AND DETAILS II

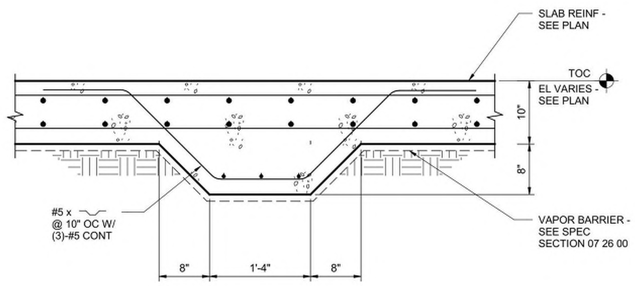
0 1" 2"

FILENAME: STRUCTURAL CONTAINER FILE.RVT
SCALE: 3/8" = 1'-0"

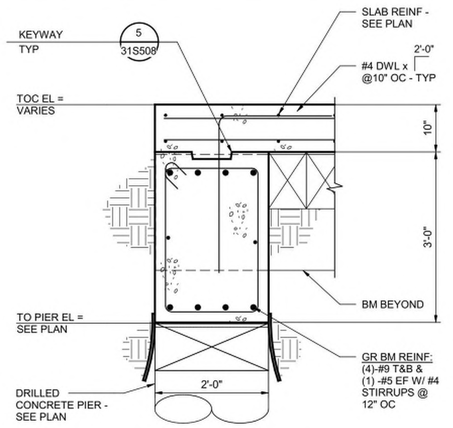
SHEET: **31S502**



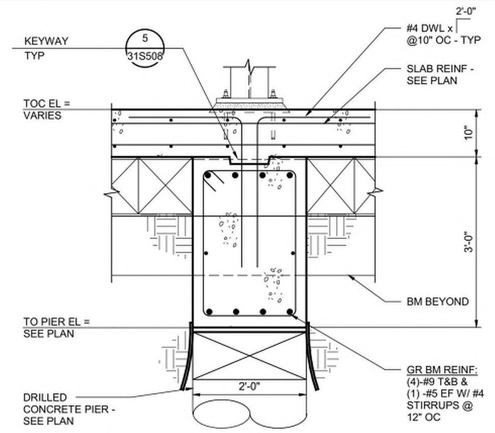
1 / 31S502 HVAC EQUIPMENT PAD FOUNDATION DETAIL
NOT TO SCALE



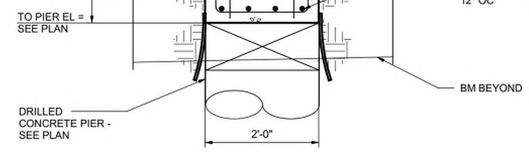
2 / 31S502 HVAC EQUIPMENT PAD FOUNDATION DETAIL
NOT TO SCALE



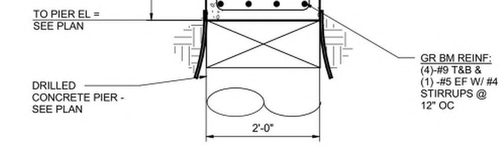
3 / 31S101 GRADE BEAM AT EXTERIOR SLAB
3/4" = 1'-0"



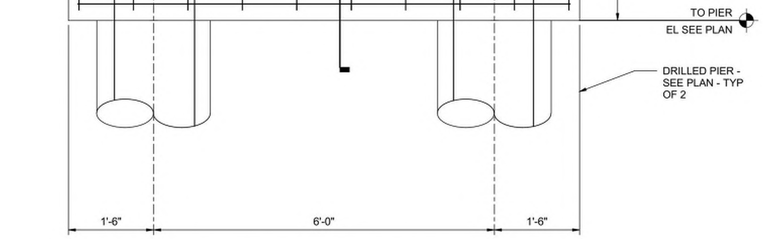
4 / 31S101 GRADE BEAM AT EXTERIOR SLAB
3/4" = 1'-0"



5 / 31S301 GRADE BEAM AT EXTERIOR SLAB
3/4" = 1'-0"



6 / 31S503 GRADE BEAM AT PIPE SUPPORT
3/4" = 1'-0"



7 / 31S101 GRADE BEAM AT PIPE SUPPORT
3/4" = 1'-0"

shaping the built environment
JQ INFRASTRUCTURE, LLC
100 GLASS STREET, SUITE 201
DALLAS, TEXAS 75207
972.392.7340
JQENG.COM
PROJECT NO: 4220184
TBPE FIRM F-7986
TEXAS P.E. FIRM
Registration No. F-754

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100%	JUNE 13/2025	ISSUED FOR BID

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APPROVED BY	M. KARIYARVEEDU
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
MURALI K. KARIYARVEEDU
95735
LICENSED PROFESSIONAL ENGINEER
6/18/2025

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CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

PLANT II BLOWER BUILDING (PROPOSED)
STRUCTURAL
SECTIONS AND DETAILS III

0 1" 2"

FILENAME: STRUCTURAL CONTAINER FILE.RVT
SCALE: As indicated

SHEET: 31S503

Autodesk Docs://10342803_COL_PCWWT_AB_Expansion_2024/31 - PLANT II BLOWER BUILDING (PROPOSED) - STRUCT.rvt
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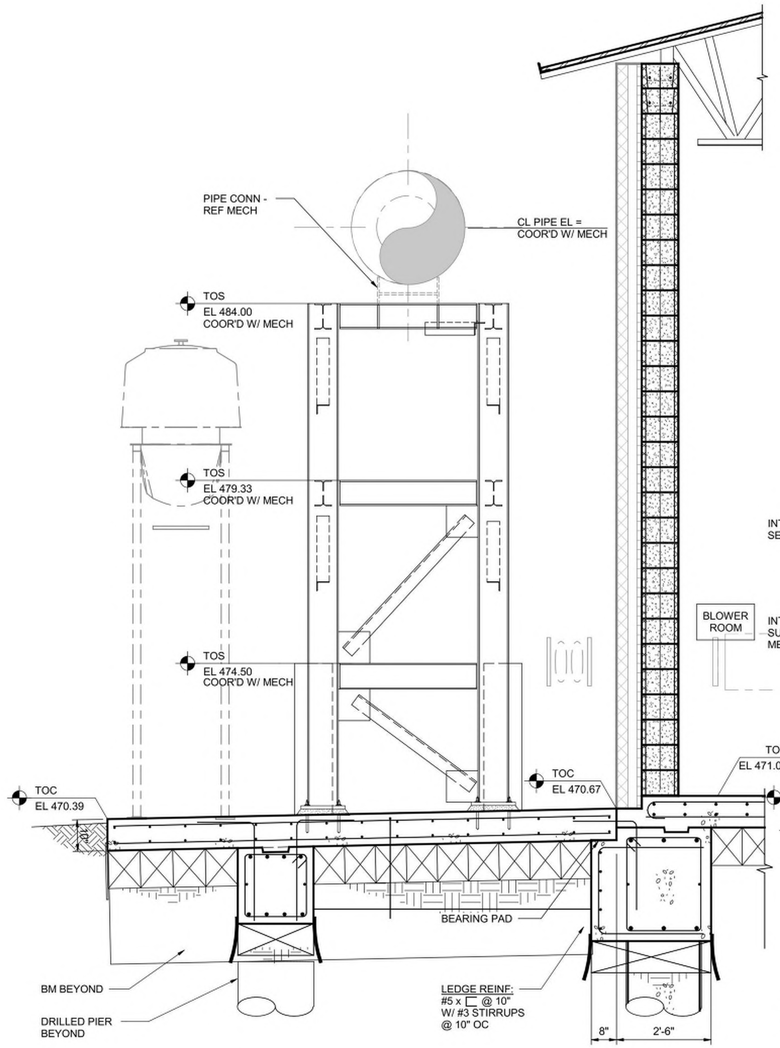
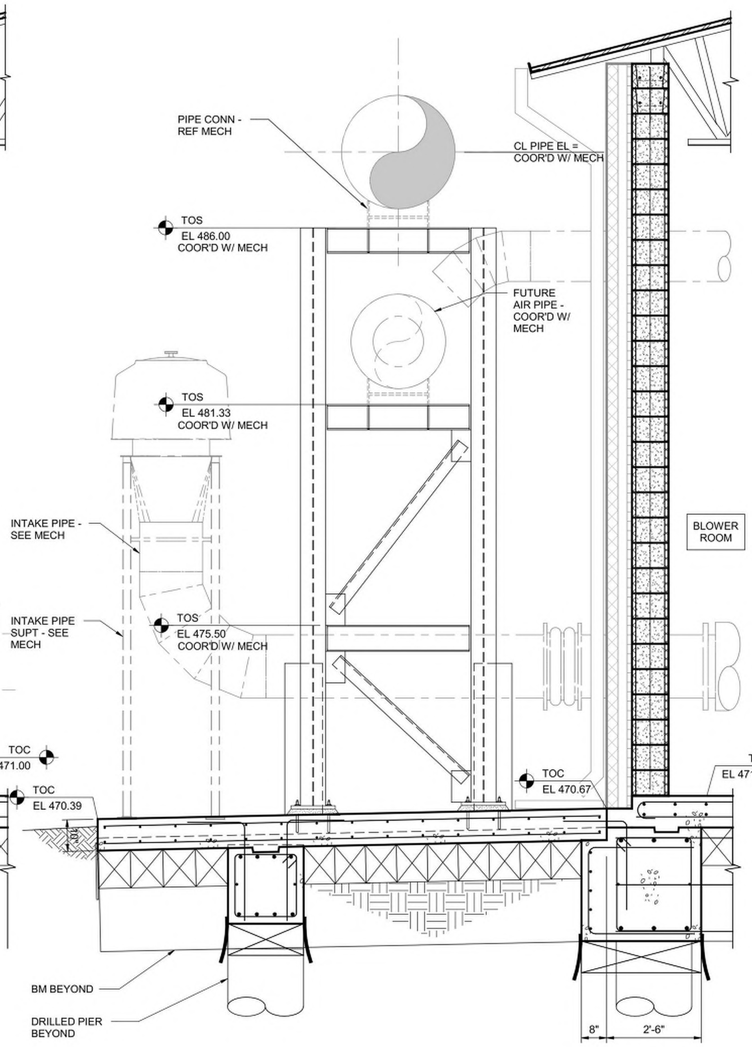
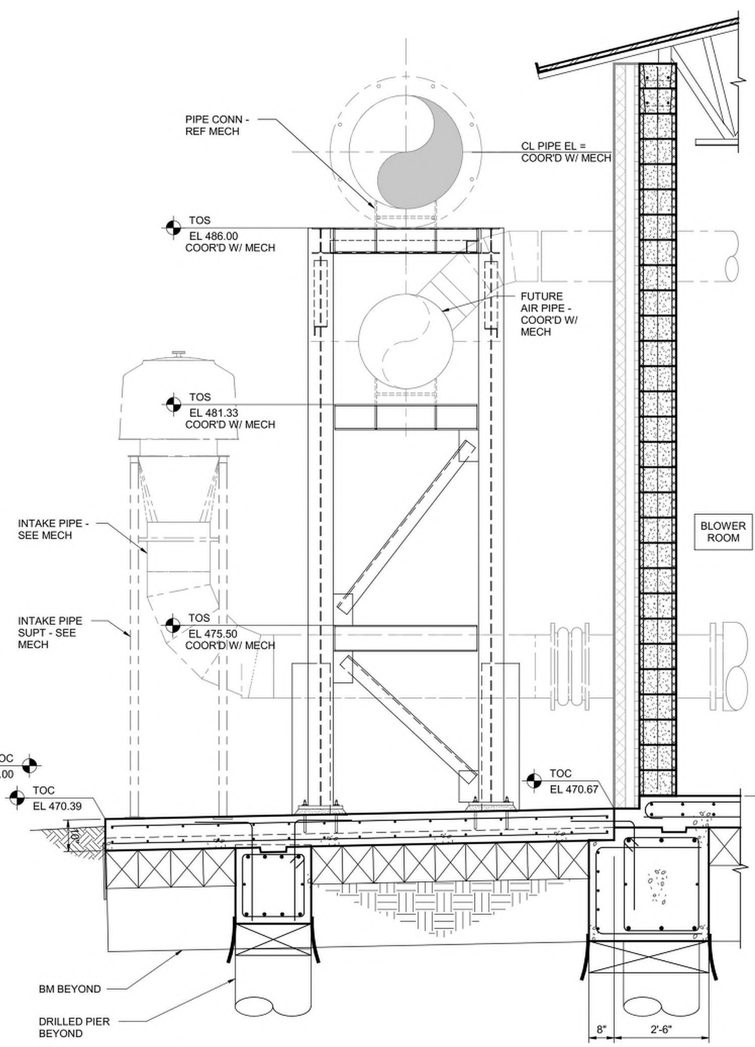


1 / 31S101 TYPICAL ELEVATED PIPE SUPPORT DETAIL I
1/2" = 1'-0"



TYPICAL ELEVATED PIPE SUPPORT DETAIL II
1/2" = 1'-0"



3 / 31S101 TYPICAL ELEVATED PIPE SUPPORT DETAIL II
1/2" = 1'-0"

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6/13/2025 11:28:01 AM

shaping the built environment
JQ INFRASTRUCTURE, LLC
100 GLASS STREET, SUITE 201 DALLAS, TEXAS 75207
972.392.7340 JQENG.COM
PROJECT NO: 4220184 TBPE FIRM F-7986

TEXAS P.E. FIRM
Registration No. F-754

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APPROVED BY	M. KARIYARVEEDU
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
MURALI K. KARIYARVEEDU
95735
LICENSED PROFESSIONAL ENGINEER
6/13/2025

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CITY OF LEWISVILLE
PRAIRIE CREEK

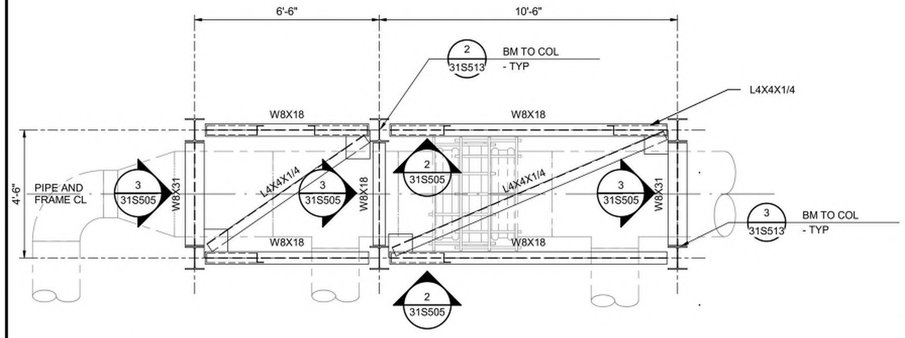
AERATION BASIN EXPANSION

PLANT II BLOWER BUILDING (PROPOSED)
STRUCTURAL
SECTIONS AND DETAILS IV

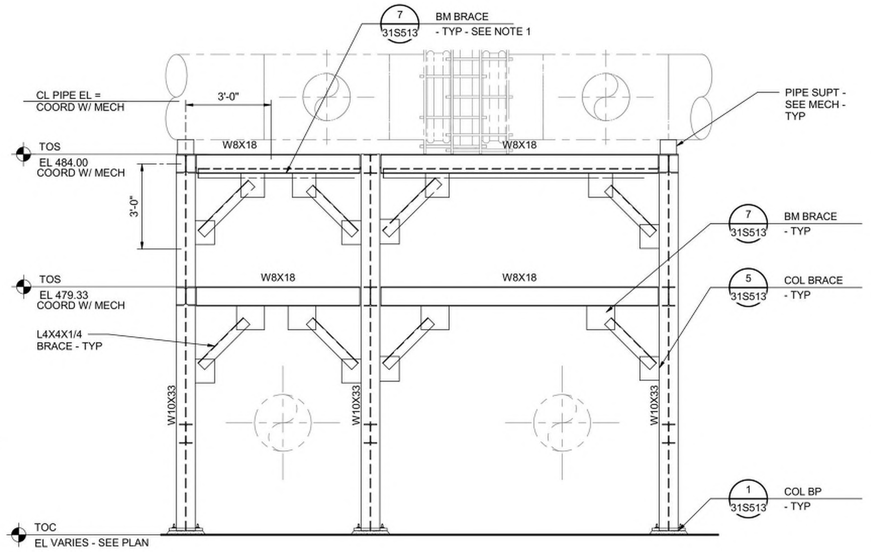
0 1" 2"

FILENAME: STRUCTURAL CONTAINER FILE.RVT
SCALE: 1/2" = 1'-0"

SHEET: 31S504

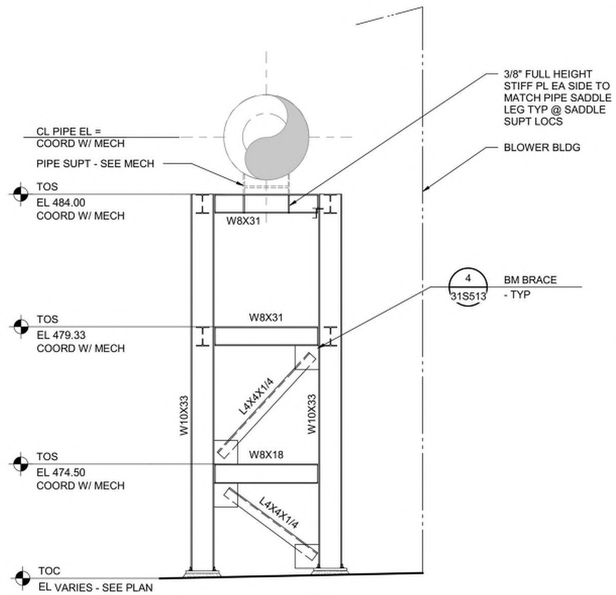


1 ELARGED PIPE SUPPORT TYPE 1 PLAN
NOT TO SCALE



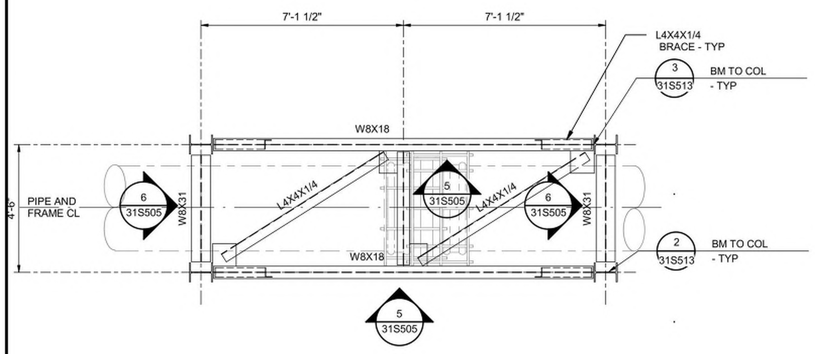
2 PIPE SUPPORT TYPE 1 ELEVATION
31S505 NOT TO SCALE

NOTE:
1. DETAIL 4/31S513 MAY BE USED IN LUEU OF 7/31S513 AT SHOWN LOCATIONS

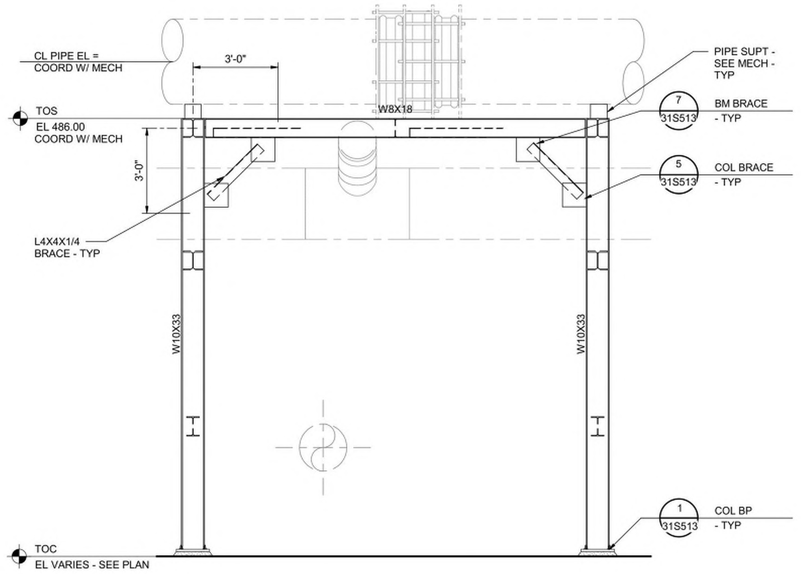


3 PIPE SUPPORT TYPE 1 ELEVATION
31S505 NOT TO SCALE

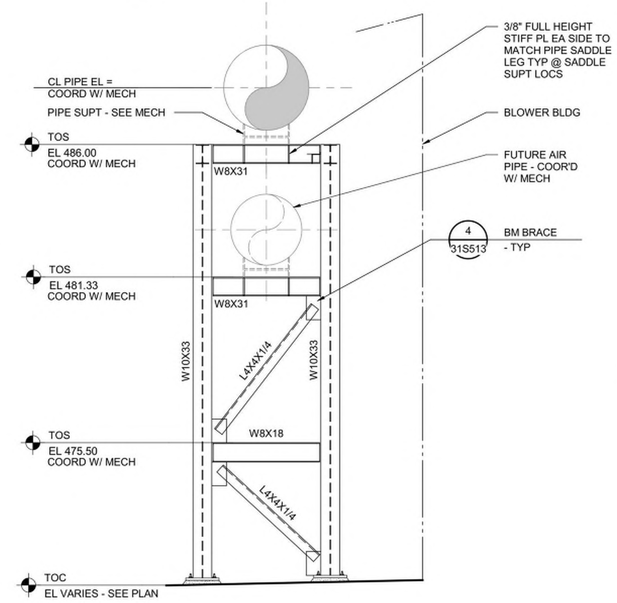
NOTE:
ALL EXTRERIOR PIPE SUPPORT FRAMING METALS SHALL BE HD GALV UNO



4 ELARGED PIPE SUPPORT TYPE 2 PLAN
NOT TO SCALE



5 PIPE SUPPORT TYPE 2 ELEVATION
31S505 NOT TO SCALE



6 PIPE SUPPORT TYPE 2 ELEVATION
31S505 NOT TO SCALE

shaping the built environment
JQ INFRASTRUCTURE, LLC
100 GLASS STREET, SUITE 201
DALLAS, TEXAS 75207
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PRAIRIE CREEK

AERATION BASIN EXPANSION

PLANT II BLOWER BUILDING (PROPOSED)
STRUCTURAL
SECTIONS AND DETAILS V

Z
0 1" 2"

FILENAME STRUCTURAL CONTAINER FILE.RVT
SCALE As indicated

SHEET 31S505

Autodesk Docs://10342803_COL_PCWWT_AB_Expansion_2024/31 - PLANT II BLOWER BUILDING (PROPOSED) - STRUCT.rvt
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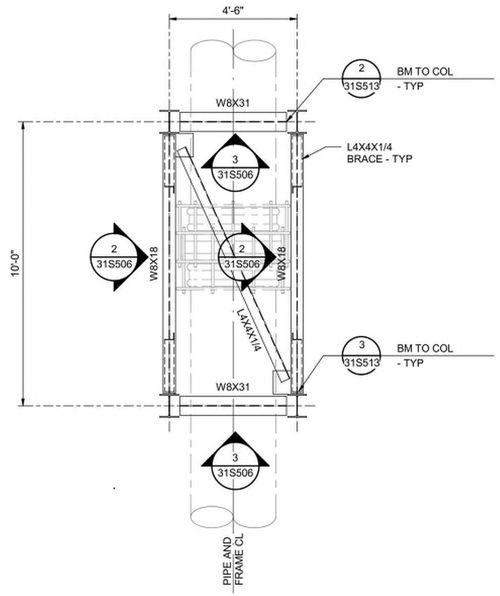
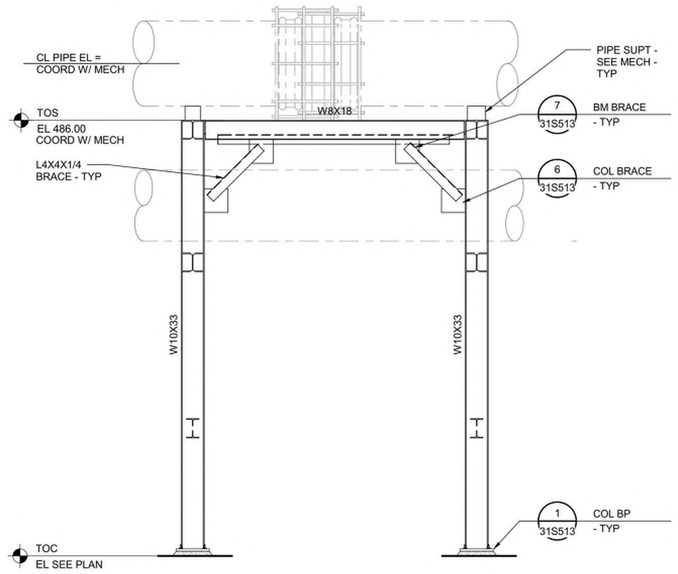
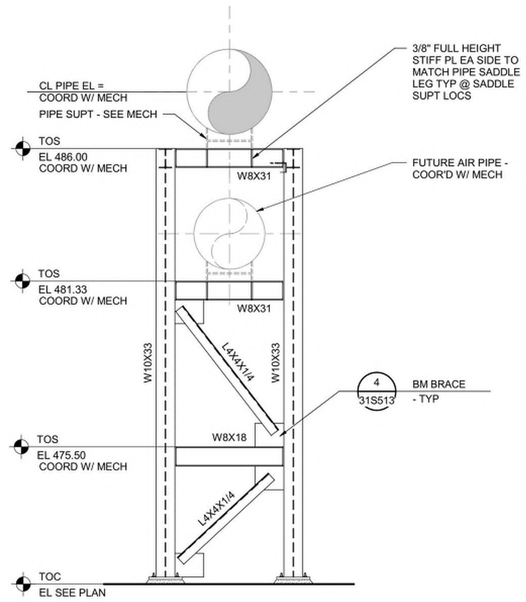


1 PIPE SUPPORT TYPE 3 PLAN
NOT TO SCALE

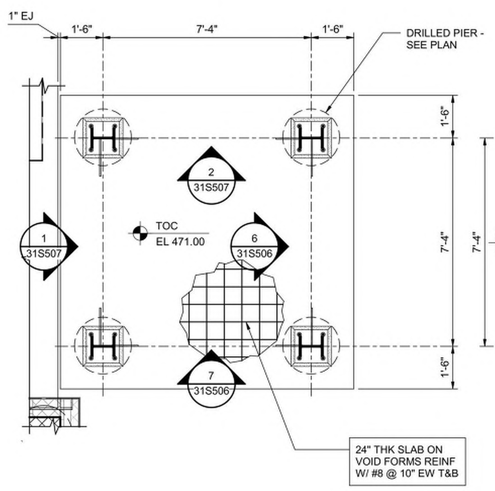


2 31S506 PIPE SUPPORT TYPE 3 ELEVATION
NOT TO SCALE



3 31S506 PIPE SUPPORT TYPE 3 ELEVATION
NOT TO SCALE

NOTE:
ALL EXTRERIOR PIPE SUPPORT FRAMING METALS SHALL BE HD GALV UNO



4 31S101 CORNER PIPE SUPPORT FOUNDATION PLAN
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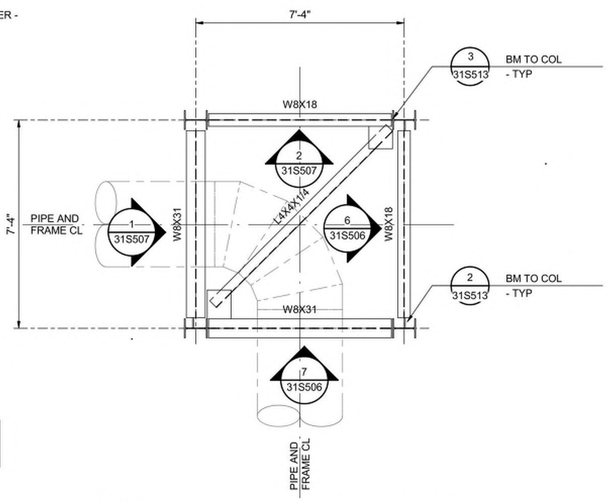

5 CORNER PIPE SUPPORT UPPER PLAN
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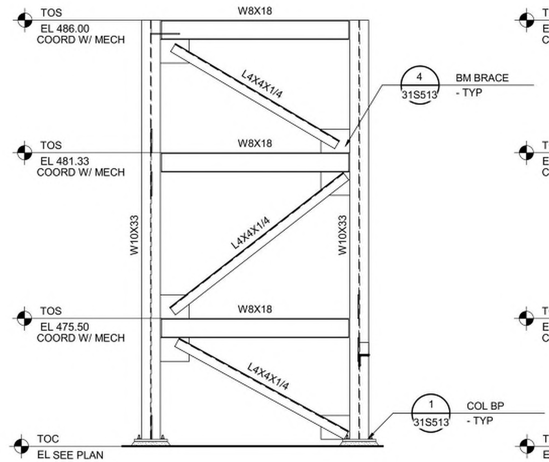
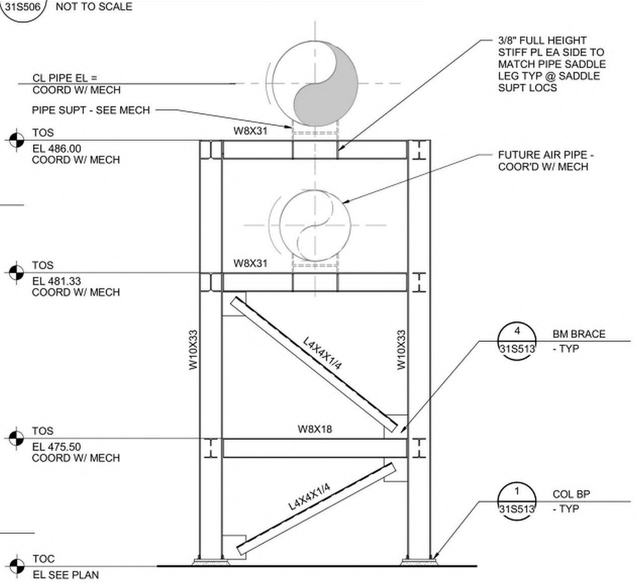


6 31S506 CORNER PIPE SUPPORT ELEVATION
NOT TO SCALE



7 31S506 CORNER PIPE SUPPORT ELEVATION
NOT TO SCALE

shaping the built environment
JQ Infrastructure
JQ INFRASTRUCTURE, LLC
100 GLASS STREET, SUITE 201
DALLAS, TEXAS 75207
972.392.7340
JQENG.COM
PROJECT NO: 4220184
TBPE FIRM F-7986
HDR
TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13/2025	ISSUED FOR BID

PROJECT MANAGER	J. R. CANTWELL
DESIGNED BY	C. DECKER
DRAWN BY	J. RENDON
CHECKED BY	C. STORY
APPROVED BY	M. KARIYARVEEDU
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
MURALI K. KARIYARVEEDU
95735
LICENSED
PROFESSIONAL ENGINEER
6/13/2025

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

PLANT II BLOWER BUILDING (PROPOSED)
STRUCTURAL
SECTIONS AND DETAILS VI

Z

0 1" 2"

FILENAME: STRUCTURAL CONTAINER FILE.RVT
SCALE: As indicated

SHEET
31S506

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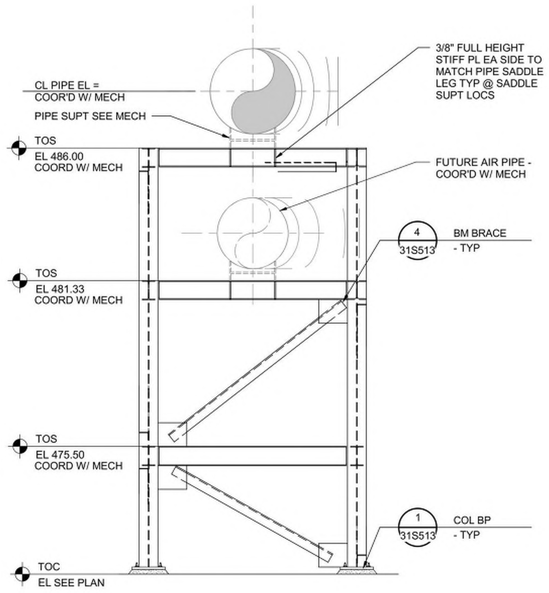
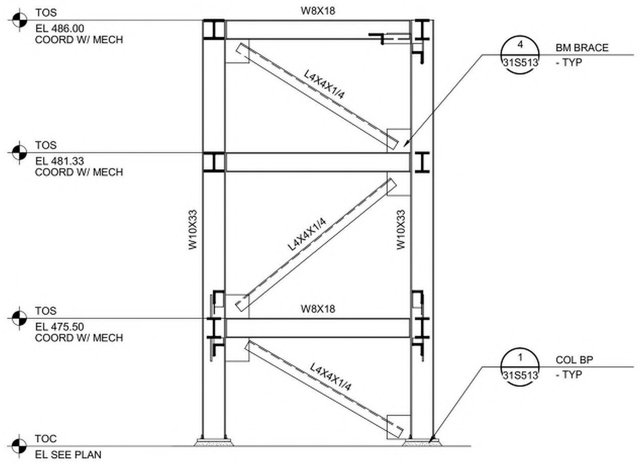
6/13/2025 11:28:04 AM



1 31S506 CORNER PIPE SUPPORT ELEVATION
3/8" = 1'-0"



2 31S506 CORNER PIPE SUPPORT ELEVATION
3/8" = 1'-0"

AIR PIPE SUPPORT SCHEDULE	
SUPPORT NO.	SUPPORT TYPE
1	H GUIDE SUPPORT WITH LINE STOP
2	H GUIDE SUPPORT WITH LINE STOP
3	SHOE SUPPORT
4	H GUIDE SUPPORT
5	H GUIDE SUPPORT
6	H GUIDE SUPPORT
7	H GUIDE SUPPORT
8	H GUIDE SUPPORT
9	H GUIDE SUPPORT

3 NBS TABLE
NOT TO SCALE

NOTE:
ALL EXTRERIOR PIPE SUPPORT FRAMING METALS SHALL BE HD GALV UNO

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shaping the built environment
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100 GLASS STREET, SUITE 201
DALLAS, TEXAS 75207
972.392.7340
JQENG.COM
PROJECT NO: 4220184
TBPE FIRM F-7986
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CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
MURALI K. KARIYARVEEDU
95735
LICENSED PROFESSIONAL ENGINEER
6/18/2025

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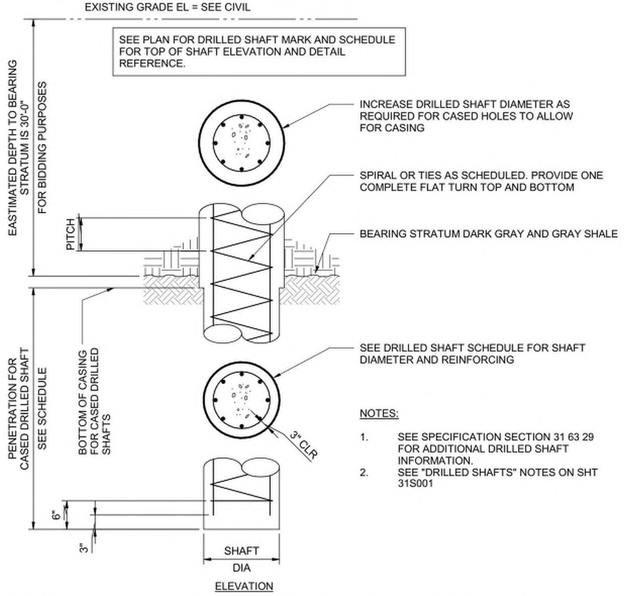
CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

PLANT II BLOWER BUILDING (PROPOSED)
STRUCTURAL
SECTIONS AND DETAILS VII

0 1" 2"

FILENAME: STRUCTURAL CONTAINER FILE.RVT
SCALE: As indicated
SHEET: 31S507



ELEVATION

NOTES:

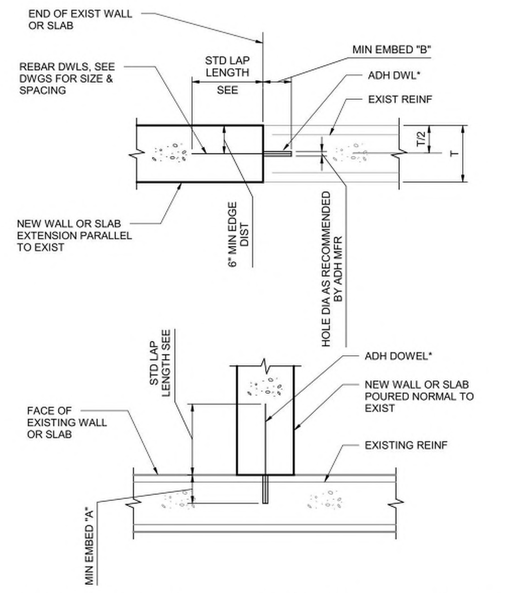
1. SEE SPECIFICATION SECTION 31 63 29 FOR ADDITIONAL DRILLED SHAFT INFORMATION.
2. SEE "DRILLED SHAFTS" NOTES ON SHT 31S001

NOTE:
ROUND TIES THUS: ◯ MAY BE USED IN LIEU OF SPIRALS. BAR SIZE WILL REMAIN THE SAME SPACING OF TIES SHALL BE 12" OC.

DRILLED SHAFT TYPE SCHEDULE

TYPE	DRILLED SHAFT DIA (INCHES)	VERTICAL BARS	SPIRALS	PENETRATION (SEE NOTE 2) (FT)
P1	24	(8)-#8	#3@12	20'-0"
P2	24	(8)-#8	#3@12	15'-0"

1 TYPICAL DRILLED SHAFTS DETAIL
NTS

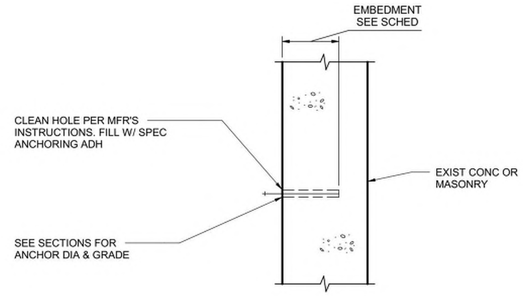


DOWEL SIZE	MIN EDGE DIST	MIN EMBEDMENT "A"	MIN EMBEDMENT "B"
#3	2"	3 1/2"	6"
#4	2 1/2"	5"	8"
#5	3"	6 1/2"	10"
#6	4"	9"	13"
#7	5"	10 1/2"	16"
#8	6"	12"	19"

NOTE:

1. CONFORM TO THE REQUIREMENTS OF SPECIFICATION SECTION 03 21 00, CONCRETE REINFORCEMENT.
2. FOLLOW ADHESIVE MANUFACTURER'S INSTRUCTIONS FOR INSTALLATION.
3. USE MIN EMBEDMENTS SHOWN, EXCEPT USE MANUFACTURER'S MIN RECOMMENDED EMBEDMENT IF GREATER.
4. "*" LOCATE DOWELS CENTERED IN WALL OR SLAB UNLESS OTHERWISE NOTED ON DRAWINGS. WHERE 2 ROWS OF DOWELS INDICATED, STAGGER SPACING & LOCATE ALTERNATING DOWELS AT MINIMUM EDGE DISTANCE FROM OPPOSITE FACES.
5. REFER TO SPECIFICATION SECTION 03 15 19 FOR ADD'L INFO

2 TYPICAL ADHESIVE DOWELS DETAIL
NTS

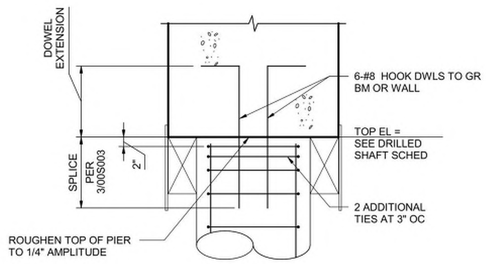


ADHESIVE ANCHOR NOTES

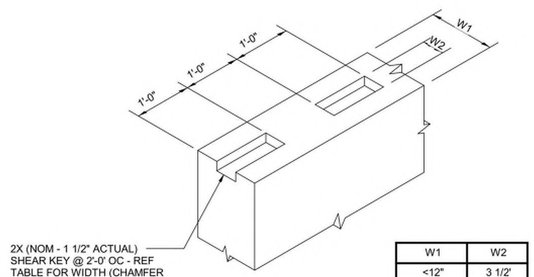
1. ADHESIVE ANCHORS SHALL BE AS SPECIFIED IN SPEC SECTION 03 15 19
2. LOCATE EXISTING REINFORCING STEEL IN THE CONCRETE USING NON-DESTRUCTIVE METHODS AND POSITION ANCHOR LOCATIONS TO AVOID CONFLICTS WITH EXISTING REINFORCING. ANCHOR LOCATIONS CAN BE ADJUSTED BY A MAXIMUM OF 1 1/2" FROM DETAILED LOCATIONS TO AVOID CONFLICTS, UNLESS NOTED OTHERWISE.
3. BASED ON FIELD VERIFIED LOCATIONS OF REINFORCING STEEL AND EMBEDDED ITEMS, THE CONTRACTOR SHALL CREATE TEMPLATES FOR EACH ANCHOR GROUP.
4. CLEAN ALL DRILLED HOLES PER MFR RECOMMENDATIONS.
5. ALL ABANDONED HOLES SHALL BE FILLED WITH NONSHRINK GROUT.
6. HOLES IN CONNECTION PLATES SHALL BE NO MORE THAN 1/16" LARGER THAN THE ANCHOR DIAMETER. IF LARGER HOLES ARE REQUIRED FOR ERECTION PURPOSES, PROVIDE 1/4" X 3" X 3" PLATE WASHERS CONTINUOUSLY WELDED TO THE CONNECTION PLATE.

ANCHOR INSTALLATION INFORMATION			
ANCHOR DIAMETER	1/2"	5/8"	3/4"
HOLE DIAMETER	9/16"	11/16"	13/16"
EMBEDMENT FOR SS, A307 OR A36 THIRD ROD HIT-TZ	4 1/4" 3 1/2"	5 1/2" 4"	6 3/4" 5 1/4"
MAX TORQUE (FT LBS) SS, A307, A36 THIRD ROD HIT-TZ	30 20	75 50	150 105

3 TYPICAL ADHESIVE ANCHOR FOR SOLID & GROUTED MASONRY AND CONCRETE DETAIL
NTS



4 TYPICAL PIER TO BEAM DOWEL DETAIL
NTS



W1	W2
<12"	3 1/2'
12"-16"	5 1/2"
>16"	7 1/4"

5 TYPICAL ABOVE GRADE WALL SHEAR KEY AT HORIZONTAL JOINT

shaping the built environment

JQ INFRASTRUCTURE, LLC
100 GLASS STREET, SUITE 201 DALLAS, TEXAS 75207
972.392.7340 JQIENG.COM
PROJECT NO: 4220184 TBPE FIRM F-7986

HDR
TEXAS P.E. FIRM Registration No. F-754

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CITY PROJECT NO.	U2100
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STATE OF TEXAS · MURALI K. KARIYARVEEDU · 95735 · LICENSED PROFESSIONAL ENGINEER
6/18/2025

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CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

PLANT II BLOWER BUILDING (PROPOSED)
STRUCTURAL
TYPICAL STRUCTURAL DETAILS I

0 1" 2"

FILENAME: STRUCTURAL CONTAINER FILE.RVT
SCALE: NTS
SHEET: 31S508

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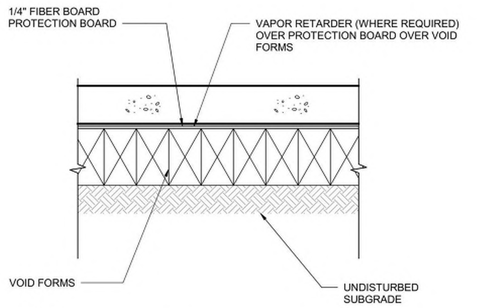


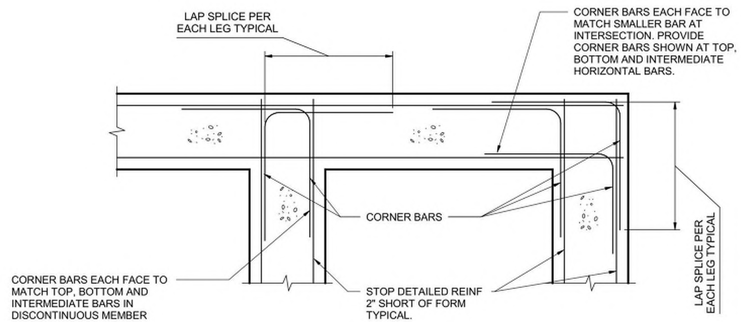
NOTES:

1. REPLACE VOID FORMS THAT HAVE BEEN DAMAGED OR IF THEY BECOME SATURATED. TAKE SPECIAL CARE TO PREVENT CRUSHING OF VOID FORMS DURING PLACEMENT OF REINFORCING AND CONCRETE.
2. CONTRACTOR TO MONITOR AND LOG CALCULATED CONCRETE CUBIC YARDAGE AND ACTUAL CUBIC YARDAGE PLACED FOR EACH PLACEMENT TO IDENTIFY POTENTIAL COLLAPSED FORMS.
3. REFER TO SPECIFICATION SECTION 03 11 13 FOR ADDITIONAL INFORMATION.

1 TYPICAL SLAB-ON-VOID DETAIL
NTS

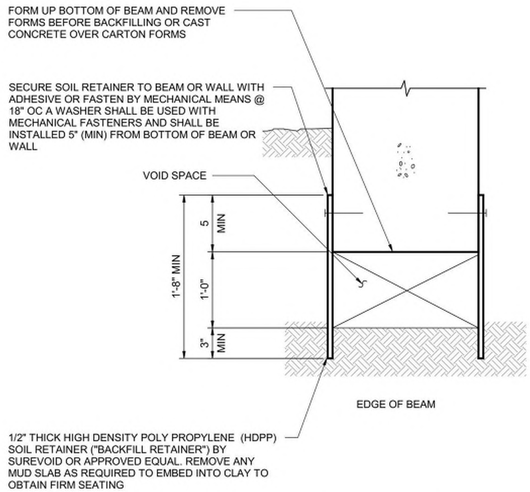
NOTES:

1. WHERE 90 DEGREE HOOKS ARE SCHEDULED OR DETAILED FOR TOP BARS, CORNER BARS MAY BE OMITTED.
2. MATCH SIZE, LOCATION AND NUMBER OF HORIZONTAL BEAM AND WALL BARS, EXCEPT THAT WHERE THERE ARE MORE THAN 2 TOP OR BOTTOM BARS, ONLY THE INSIDE AND OUTSIDE BARS MUST BE MATCHED.



PLAN

2 TYPICAL CORNER BARS AT BEAM DETAIL
NTS



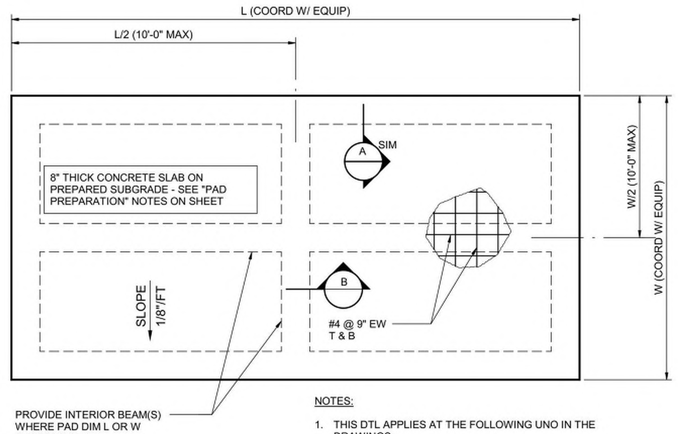
NOTES:

1. FORM VOID SPACE WITH SOIL RETAINERS UNDER ALL STRUCTURAL CONCRETE DRILLED SHAFT CAPS, PILASTERS, GRADE BEAMS, AND WALLS BELOW GRADE.
2. INSTALL SOIL RETAINERS AS FOLLOWS:
   A. PLACE BASE OF SOIL RETAINER IN A 3" DEEP TRENCH CUT IN UNDISTURBED SOIL OR COMPACTED FILL.
   B. STARTING AT END OF BEAM OR WALL PANEL, LAY BOTTOM FLANGE OF SOIL RETAINER IN TRENCH AND PLACE VERTICAL AGAINST BEAM OR WALL PANEL. OVERLAP ENDS OF ADJACENT SOIL RETAINERS 6" MIN. & SECURE TO BEAM OR WALL THROUGH OVERLAP.
   C. CUT TO FIT ENDS OF BEAMS OR WALL PANELS. CUT LENGTHS LESS THAN 1'-0" IN LENGTH SHALL NOT BE USED.
   D. PLACE BACKFILL AS SPECIFIED AFTER COMPLETION OF SOIL RETAINER INSTALLATION. TAKE NECESSARY PRECAUTIONS TO PROTECT SOIL RETAINERS FROM DAMAGE FROM COMPACTION EQUIPMENT.
   E. COORDINATE WITH MFR FOR ADDITIONAL INSTALLATION REQUIREMENTS.
3. STORE RETAINERS FLAT AND PROTECTED FROM DIRECT SUNLIGHT TO AVOID WARPAGE.
4. IF CARTON FORMS ARE USED TO FORM THE VOID:
   A. SEAL ALL ENDS AND JOINTS OF CARTON FORMS TO KEEP CONCRETE OUT.
   B. AT DRILLED SHAFTS USE PREMANUFACTURED FORMS WITH CURVED ENDS. PLACE FORMS SUCH THAT THEY DO NOT INTRUDE INTO THE AREA OF THE DRILLED SHAFT.
   C. REPLACE CARTON FORMS THAT HAVE BEEN DAMAGED OR IF THEY BECOME SATURATED AND WEAK. TAKE SPECIAL CARE TO PREVENT CRUSHING OF CARTON FORMS DURING PLACEMENT OF REINFORCING AND CONCRETE.
5. SEE SPECIFICATION SECTION 03 11 13 FOR ADDITIONAL INFORMATION.

3 TYPICAL FOUNDATION VOID SPACE DETAIL
NTS

SECTION "A"

SECTION "B"



NOTES:

1. THIS DTL APPLIES AT THE FOLLOWING UNO IN THE DRAWINGS:
   A. SITE ELECTRICAL EQUIP PADS
   B. SITE MECH EQUIP PADS
2. REFER TO ELEC/MECH DWGS FOR EXACT SITE LOCATIONS OF PADS.
3. COORD W/ EQUIP MFR FOR ANY OPNGS AND PENETRATIONS REQ'D IN SITE PADS.

6 TYPICAL MECHANICAL OR ELECTRICAL YARD PAD
NTS

shaping the built environment
JQ INFRASTRUCTURE, LLC
100 GLASS STREET, SUITE 201
DALLAS, TEXAS 75207
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JQENG.COM
PROJECT NO: 4220184
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STATE OF TEXAS — MURALI K. KARIYARVEEDU — 95735 — LICENSED PROFESSIONAL ENGINEER
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PRAIRIE CREEK

AERATION BASIN EXPANSION

PLANT II BLOWER BUILDING (PROPOSED)
STRUCTURAL
TYPICAL STRUCTURAL DETAILS II

0 1" 2"

FILENAME: STRUCTURAL CONTAINER FILE.RVT
SCALE: NTS
SHEET: 31S509

Autodesk Docs://10342803_COL_PCWWT_AB_Expansion_2024/31 - PLANT II BLOWER BUILDING (PROPOSED) - STRUCT.rvt
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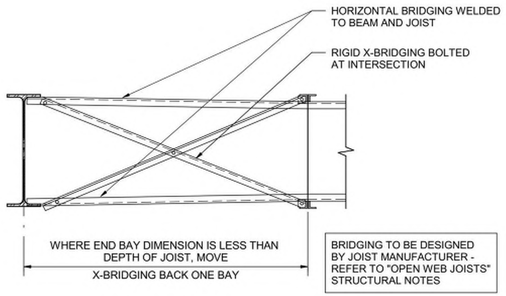
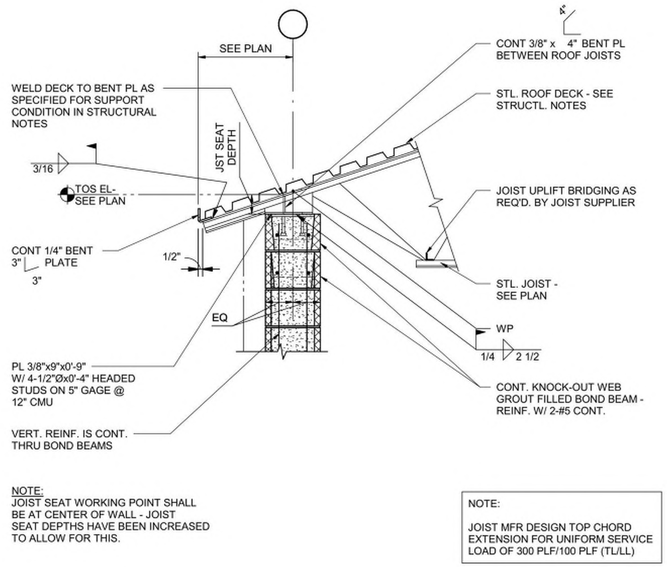


1 TYPICAL CROSS-BRIDGING AT END BAY FOR K AND KCS SERIES JOISTS DETAIL

3/4" = 1'-0"



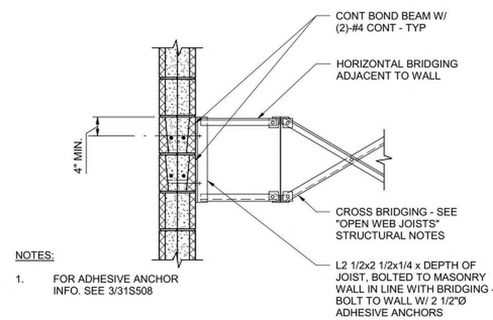
NOTE:
JOIST SEAT WORKING POINT SHALL BE AT CENTER OF WALL - JOIST SEAT DEPTHS HAVE BEEN INCREASED TO ALLOW FOR THIS.

NOTE:

JOIST MFR DESIGN TOP CHORD EXTENSION FOR UNIFORM SERVICE LOAD OF 300 PLF/100 PLF (TL/LL)

2 TYPICAL JOIST BEARING ON EXTERIOR MASONRY WALL DETAIL

3/4" = 1'-0"

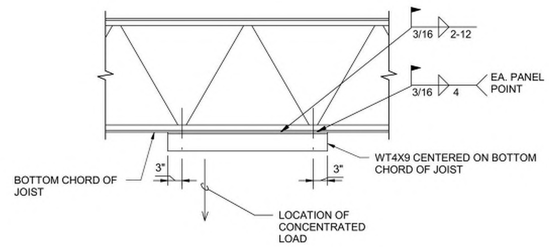


NOTES:

1. FOR ADHESIVE ANCHOR INFO. SEE 3/31S508

3 TYPICAL CROSS BRIDGING TO MASONRY WALL ANCHOR DETAIL

3/4" = 1'-0"

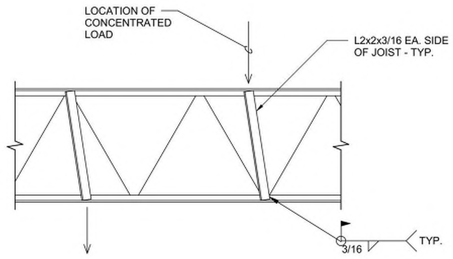


NOTES:

1. THIS DETAIL APPLIES WHEREVER A CONCENTRATED LOAD GREATER THAN 100 POUNDS DOES NOT OCCUR WITHIN 4" OF A JOIST BOTTOM CHORD PANEL POINT. MAXIMUM LOAD TO BE APPLIED WITHOUT CONSULTATION WITH ENGINEER IS 250 POUNDS. DO NOT PLACE CONCENTRATED LOADS CLOSER THAN 4'-0" O.C.
2. ALL HANGERS OR ATTACHMENTS TO JOISTS SHALL BE PLACED CONCENTRIC WITH THE BOTTOM CHORD.

4 TYPICAL JOIST BOTTOM CHORD REINFORCEMENT DETAIL

3/4" = 1'-0"



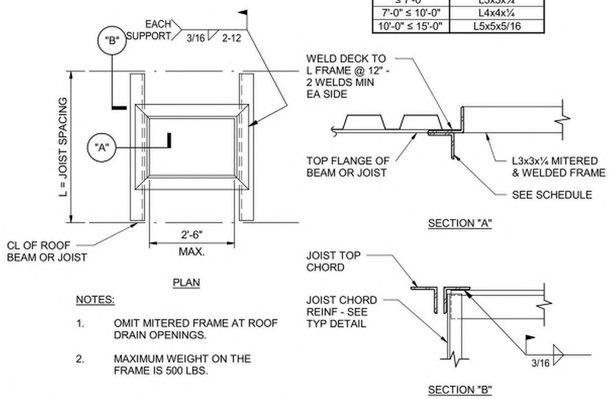
NOTES:

1. THIS DETAIL APPLIES WHEREVER A CONCENTRATED LOAD GREATER THAN 100 POUNDS OCCURS MORE THAN 4" AWAY FROM A JOIST TOP OR BOTTOM CHORD PANEL POINT. MAXIMUM LOAD TO BE APPLIED WITHOUT CONSULTATION WITH ENGINEER IS 250 POUNDS. DO NOT PLACE CONCENTRATED LOADS CLOSER THAN 4'-0" O.C.
2. ALL HANGERS OR ATTACHMENTS TO JOISTS SHALL BE PLACED CONCENTRIC WITH THE TOP AND BOTTOM CHORD(S) AND SHALL NOT ATTACH TO ONLY ONE ANGLE OF CHORD.

5 TYPICAL JOIST CHORD REINFORCEMENT DETAIL

3/4" = 1'-0"

L	ANGLE SIZE
≤ 7'-0"	L3x3x¼
7'-0" ≤ 10'-0"	L4x4x¼
10'-0" ≤ 15'-0"	L5x5x5/16



NOTES:

1. OMIT MITERED FRAME AT ROOF DRAIN OPENINGS.
2. MAXIMUM WEIGHT ON THE FRAME IS 500 LBS.

6 TYPICAL ROOF OPENING DETAIL

3/4" = 1'-0"

Autodesk Docs://10342803_COL_PCWWT_AB_Expansion_2024/31 - PLANT II BLOWER BUILDING (PROPOSED) - STRUCT.rvt
6/13/2025 11:28:06 AM

shaping the built environment
JQ INFRASTRUCTURE, LLC
100 GLASS STREET, SUITE 201 DALLAS, TEXAS 75207
972.392.7340 JQENG.COM
PROJECT NO: 4220184 TBPE FIRM F-7986
TEXAS P.E. FIRM Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13/2025	ISSUED FOR BID

PROJECT MANAGER	J. R. CANTWELL
DESIGNED BY	C. DECKER
DRAWN BY	J. RENDON
CHECKED BY	C. STORY
APPROVED BY	M. KARIYARVEEDU
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS · MURALI K. KARIYARVEEDU · 95735 · LICENSED PROFESSIONAL ENGINEER
6/13/2025

LEWISVILLE
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CITY OF LEWISVILLE
PRAIRIE CREEK

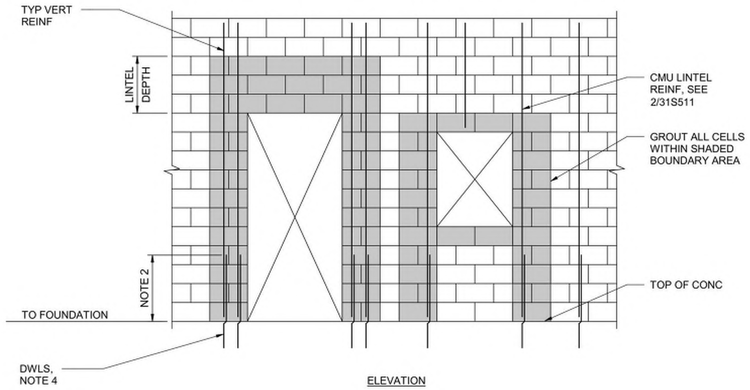
AERATION BASIN EXPANSION

PLANT II BLOWER BUILDING (PROPOSED)
STRUCTURAL
TYPICAL STRUCTURAL DETAILS III

0 1" 2"

FILENAME: STRUCTURAL CONTAINER FILE.RVT
SCALE: 3/4" = 1'-0"

SHEET: 31S510



ELEVATION

NOTES:

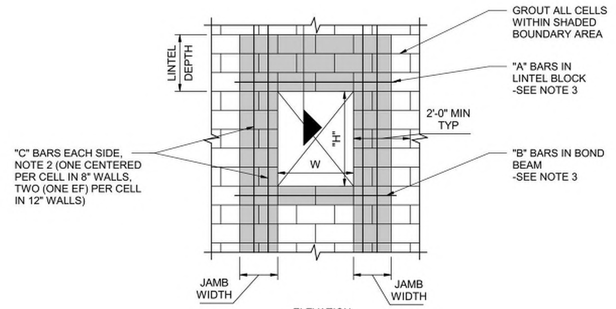
1. FOR TYP WALL REINF, SEE WALL SECTS AND DTLS FOR EA FACILITY.
2. LAP ALL REINF 48 BAR DIAMETERS (2'-0" MIN), EXCEPT LAP VERT BARS IN MID HALF OF WALL HT 72 BAR DIAMETERS.
3. STAGGER SPLICES IN ADJ HORIZ BARS IN THE SAME COURSE BY 2'-0".
4. PROVIDE DWL BARS IN FOUNDATION TO MATCH ALL VERT REINF PER 3/31S511.
5. FOR ADDED REINF @ WALL INTERSECTIONS AND CORNERS, SEE 4/31S511.
6. GROUT EA SIDE OF OPENING AS NOTED IN TYP OPENING REINF DETAIL 2/31S511.

1 TYPICAL REINFORCED CMU WALL DETAIL
NTS

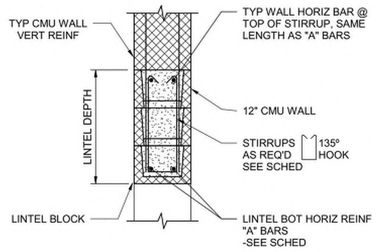
12" WALLS						
W	NOMINAL DEPTH	STIRRUP SIZE, SPA	"A" BARS	"B" BARS	"C" BARS	JAMB WIDTH
<2'-8"	8"	-	2-#4	2	2	8"
>2'-8" <4'-0"	16"	-	2-#4	2	2	8"
>4'-0" <6'-0"	24"	#3 @ 8"	2-#5	2	4	16"
>6'-0" <8'-0"	32"	#3 @ 8"	2-#5	2	6	24"
>8'-0" <10'-0"	48"	#3 @ 16"	2-#5	2	6	24"
>10'-0" <12'-0"	48"	#3 @ 16"	2-#5	2	6	24"

NOTES:

1. USE BAR QUANTITIES AND SIZES GIVEN IN LINTEL SCHED UNO ON THE DWGS.
2. EXTEND "C" BARS 48 BAR DIAMETERS OR 2'-0" MIN BEYOND T&B OF OPENING EXCEPT THAT WHEN "H" OR "W" EXCEEDS 2'-0", "C" BARS SHALL EXTEND FULL HT.
3. "A" AND "B" BARS SHALL EXTEND 48 BAR DIAMETERS OR 2'-0" MIN EA SIDE OF THE OPNGS, WHICHEVER IS GREATER.
4. FOR BAR SIZES NOT SHOWN, MATCH TYP WALL REINF AS SHOWN ON THE BLDG WALL SECT.

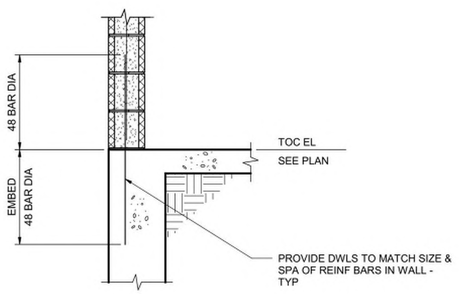


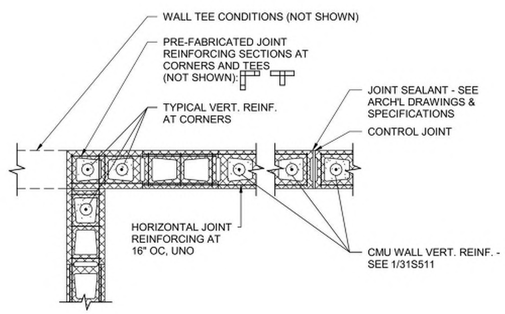
ELEVATION



12" LINTEL SECTION

2 TYPICAL CMU OPENING REINFORCING DETAIL
NTS

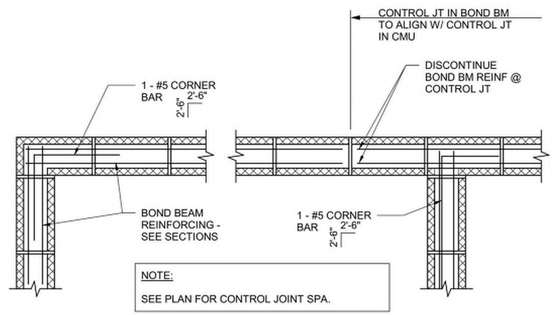




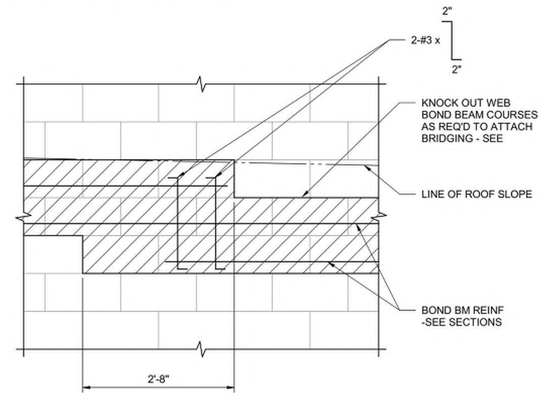
PLAN

3 TYPICAL MASONRY FOUNDATION DOWELS DETAIL
NTS

4 TYPICAL CMU BAR PLACEMENT DETAIL
NTS



5 TYPICAL CORNER BARS AT BOND BEAMS DETAIL
NTS



ELEVATION

6 TYPICAL STEP IN BOND BEAM DETAIL
NTS

shaping the built environment
JQ INFRASTRUCTURE, LLC
100 GLASS STREET, SUITE 201 DALLAS, TEXAS 75207
972.392.7340 JQENG.COM
PROJECT NO: 4220184 TBPE FIRM F-7986

HDR
TEXAS P.E. FIRM
Registration No. F-754

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CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
MURALI K. KARIYARVEEDU
95735
LICENSED
PROFESSIONAL ENGINEER
6/13/2025

LEWISVILLE
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CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

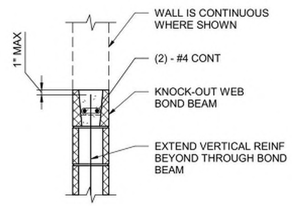
PLANT II BLOWER BUILDING (PROPOSED)
STRUCTURAL
TYPICAL STRUCTURAL DETAILS IV

0 1" 2"

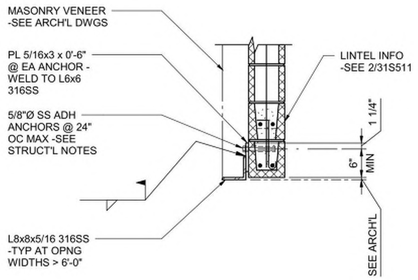
FILENAME: STRUCTURAL CONTAINER FILE.RVT
SCALE: NTS

SHEET: 31S511

Autodesk Docs://10342803_COL_PCWWT_AB_Expansion_2024/31 - PLANT II BLOWER BUILDING (PROPOSED) - STRUCT.rvt
6/13/2025 11:28:06 AM



1 TYPICAL CMU BOND BEAM DETAIL
NTS



NOTES:

1. FOR VENEER SUPPORT AT OPENINGS EQUAL TO OR LESS THAN 6'-0" PROVIDE LOOSE LINTEL ANGLES PER 3/31S512.
2. ADHESIVE ANCHORS SHALL NOT BE INSTALLED WITHIN 2" OF A MASONRY HEAD JOINT.
3. STEEL LEDGE ANGLE LENGTH SHALL BE LIMITED TO 20'-0". PROVIDE 3/8" CONTROL JOINT BETWEEN LEDGE ANGLE SECTIONS.

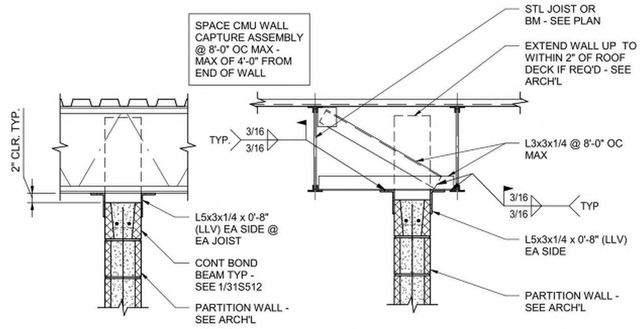
2 TYPICAL MASONRY VENEER SUPPORT AT CMU BACK-UP DETAIL
NTS

MASONRY LOOSE LINTEL SCHEDULE	
OPENING	LINTEL SIZE
UP TO 5'-0"	L4x4X1/4
5'-0" TO 6'-0"	L6x4X5/16 LLV

NOTES:

1. LINTEL ANGLES SHALL BE 316SS UNO.
2. PROVIDE 3/8" GAP IN MORTAR AT ENDS OF ANGLE. FORM GAP WITH BACKER ROD.
3. PROVIDE 4" BEARING AT EACH END OF LINTEL ANGLE.

3 TYPICAL LOOSE LINTEL SCHEDULE
NTS



OPEN WEB JOISTS

4 TYPICAL CMU PARTITION WALL BRACE DETAIL - STEEL STRUCTURE
NOT TO SCALE

Autodesk Docs://10342803_COL_PCWWT_AB_Expansion_2024/31 - PLANT II BLOWER BUILDING (PROPOSED) - STRUCT.rvt
6/13/2025 11:28:07 AM

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CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
MURALI K. KARIYARVEEDU
95735
LICENSED PROFESSIONAL ENGINEER
6/18/2025

LEWISVILLE
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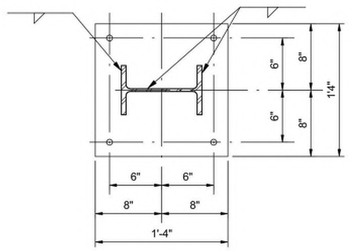
CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

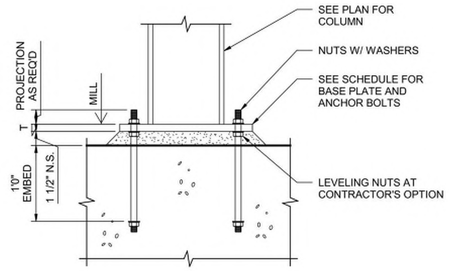
PLANT II BLOWER BUILDING (PROPOSED)
STRUCTURAL
TYPICAL STRUCTURAL DETAILS V

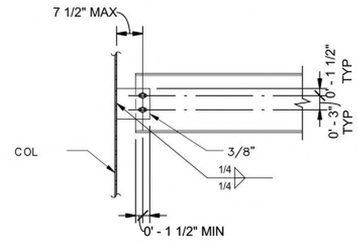
0 1" 2"

FILENAME: STRUCTURAL CONTAINER FILE.RVT
SCALE: 3/4" = 1'-0"

SHEET
31S512

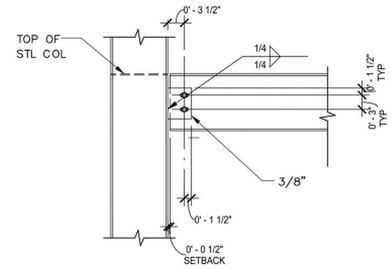






AT COLUMN WEB

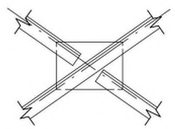
NOTES:
1. WELDS ARE PROVIDED WITH 70 KSI FILLER METAL.
2. BEAMS SHALL HAVE STD. HOLES AND PLATES SHALL HAVE HORIZONTAL SSL HOLES. REFERENCE AISC SPEC. J3.3 FOR HOLE SIZES.



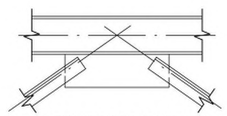
WF COLUMN

NOTES:
1. WELDS ARE PROVIDED WITH 70 KSI FILLER METAL.
2. BEAMS SHALL HAVE STD. HOLES AND PLATES SHALL HAVE HORIZONTAL SSL HOLES. REFERENCE AISC SPEC. J3.3 FOR HOLE SIZES.

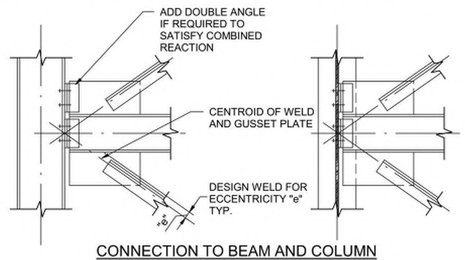
1 TYPICAL COLUMN BASE PLATE DETAIL
3/4" = 1'-0"



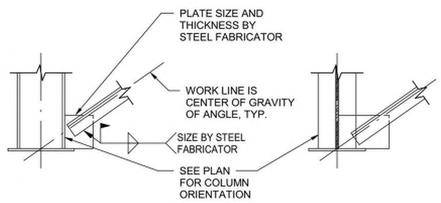
CONNECTION AT INTERSECTION



CONNECTION AT BEAM



CONNECTION TO BEAM AND COLUMN



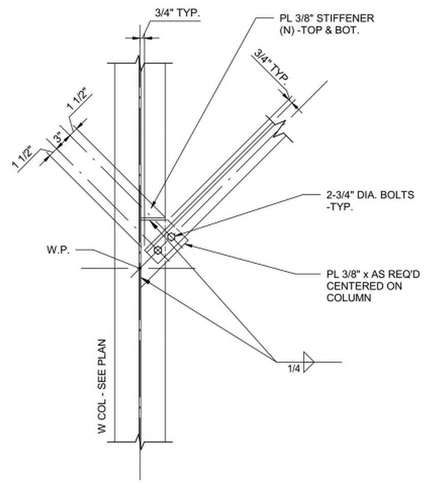
CONNECTION TO COLUMN BASE

WIND BRACE DESIGN NOTES:

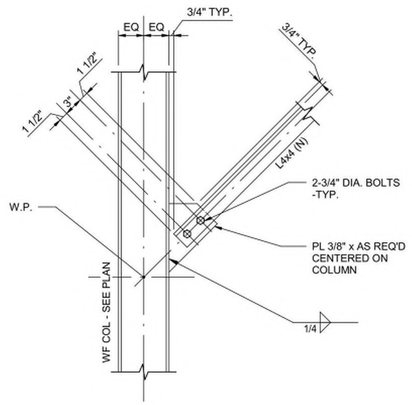
1. DESIGN CONNECTIONS FOR CAPACITY OF WIND BRACE.
2. SIZE WELDS FOR SHEAR, TENSION AND ECCINTRICITY OF C.G. WELD AND C.G. FORCE
3. CHECK NET TENSILE AND SHEAR CAPACITY OF GUSSET PLATES.
4. CALCULATIONS SHALL BE PREFORMED AND SEALED BY A LICENSED PROFESSIONAL ENGINEER AND SHALL BE SUBMITTED TO THE ARCHITECT PER SPECIFICATIONS.

4 TYPICAL WIND BRACE CONNECTION DETAILS
3/4" = 1'-0"

2 TYPICAL BEAM TO COLUMN CONNECTION
3/4" = 1'-0"

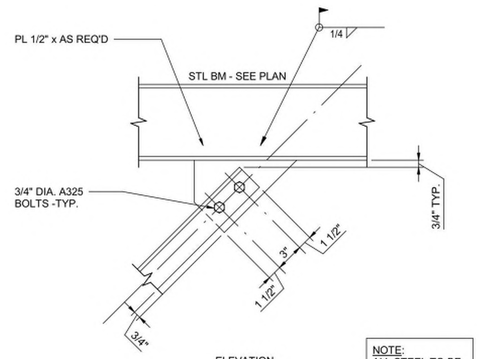


5 TYPICAL COLUMN BRACE DETAIL
1" = 1'-0"



6 TYPICAL COLUMN BRACE DETAIL
1" = 1'-0"

3 TYPICAL BEAM TO WF COLUMN CONNECTION
3/4" = 1'-0"



ELEVATION

NOTE:
ALL STEEL TO BE GALVANIZED UNO

7 TYPICAL BRACE TO CHANNEL CONNECTION DETAIL
1 1/2" = 1'-0"

shaping the built environment
JQ INFRASTRUCTURE, LLC
100 GLASS STREET, SUITE 201
DALLAS, TEXAS 75207
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CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
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95735
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LEWISVILLE
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CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

PLANT II BLOWER BUILDING (PROPOSED)
STRUCTURAL
TYPICAL STRUCTURAL DETAILS VI

0 1" 2"

FILENAME: STRUCTURAL CONTAINER FILE.RVT
SCALE: As indicated
SHEET: 31S513

Autodesk Docs://10342803_COL_PCWWT_AB_Expansion_2024/31 - PLANT II BLOWER BUILDING (PROPOSED) - STRUCT.rvt
6/13/2025 11:28:07 AM

GENERAL NOTES:

1. REFER TO PROCESS, ELECTRICAL & MECHANICAL DRAWINGS FOR EQUIPMENT NOT SHOWN ON THIS DRAWING.
2. REFER TO OTHER DISCIPLINES FOR ANY ADDITIONAL PENETRATIONS NEEDED THAT ARE NOT SHOWN ON FLOOR PLAN.
3. SEE SHEET 31A601 FOR ROOM FINISH & DOOR SCHEDULES.
4. COORDINATE FINAL LOCATION OF SAFETY BOLLARDS WITH CIVIL AND STRUCTURAL.
5. REFER TO EXTERIOR ELEVATIONS FOR MASONRY CONTROL JOINTS.

KEYNOTES

1	FUTURE PROCESS BLOWER EQUIPMENT, TYP.
2	PRE-FINISHED METAL DOWNSPOUT WITH PRECAST SPLASH BLOCK, TYP.
3	PROCESS BLOWER EQUIPMENT, TYP.
4	CONCRETE STOOP. REFER STRUCTURAL AND CIVIL.
5	SAFETY BOLLARD, BOLLARDS TO BE CLEAR OF DOOR OPENINGS. REFER TO CIVIL FOR EXTERIOR BOLLARDS.
6	AIR HANDLING UNIT, REFER TO MECH. DWGS.
7	MECH. LOUVER, REFER TO MECH. DWGS. FOR EXACT SIZE.
8	SAFETY BOLLARD, BOLLARDS TO BE CLEAR OF DOOR OPENINGS. REFER TO STRUCTURAL FOR INTERIOR BOLLARDS.
9	FUTURE PROCESS PIPING, TYP.
10	DUCT SUPPORT, TYP. REFER TO MECH. DETAILS.
11	NOMINAL 3' X 3' WALL BLOCKOUT FOR FUTURE WALL PENETRATION. REFER TO DETAIL 4/31A503 AND STRUCTURAL DRAWINGS FOR ADDITIONAL INFORMATION.
12	PROCESS PIPE SUPPORT, TYP.
13	DUCT, VERIFY SIZES WITH MECH. DWGS.

PLAN LEGEND

- CAVITY WALL SYSTEM, COMPRISED OF NOMINAL 4-INCH THICK SPLIT-FACE CMU VENEER OVER RIGID POLY-ISO INSULATION AND BACK-UP STANDARD 12" CMU WALL.
- 8" CONCRETE MASONRY UNIT WITH INSULATION INSERTS

BLOWER ROOM 100

ELECTRICAL 101

1 / 31A201 FLOOR PLAN
3/16" = 1'-0"

TEXAS P.E. FIRM
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DRAWN BY	A. VEGA
CHECKED BY	R. ANDREW
APPROVED BY	
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

REGISTERED ARCHITECT — HADLEY J. WARD — 15033 — STATE OF TEXAS — 6/13/25

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PRAIRIE CREEK

AERATION BASIN EXPANSION

PLANT II BLOWER BUILDING (PROPOSED)
ARCHITECTURAL
FLOOR PLAN

FILENAME	HDRE_ALL_DISCIPLINES.rte	SHEET	31A101
SCALE	As indicated		

0 1" 2"

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6/12/2025 5:45:38 PM

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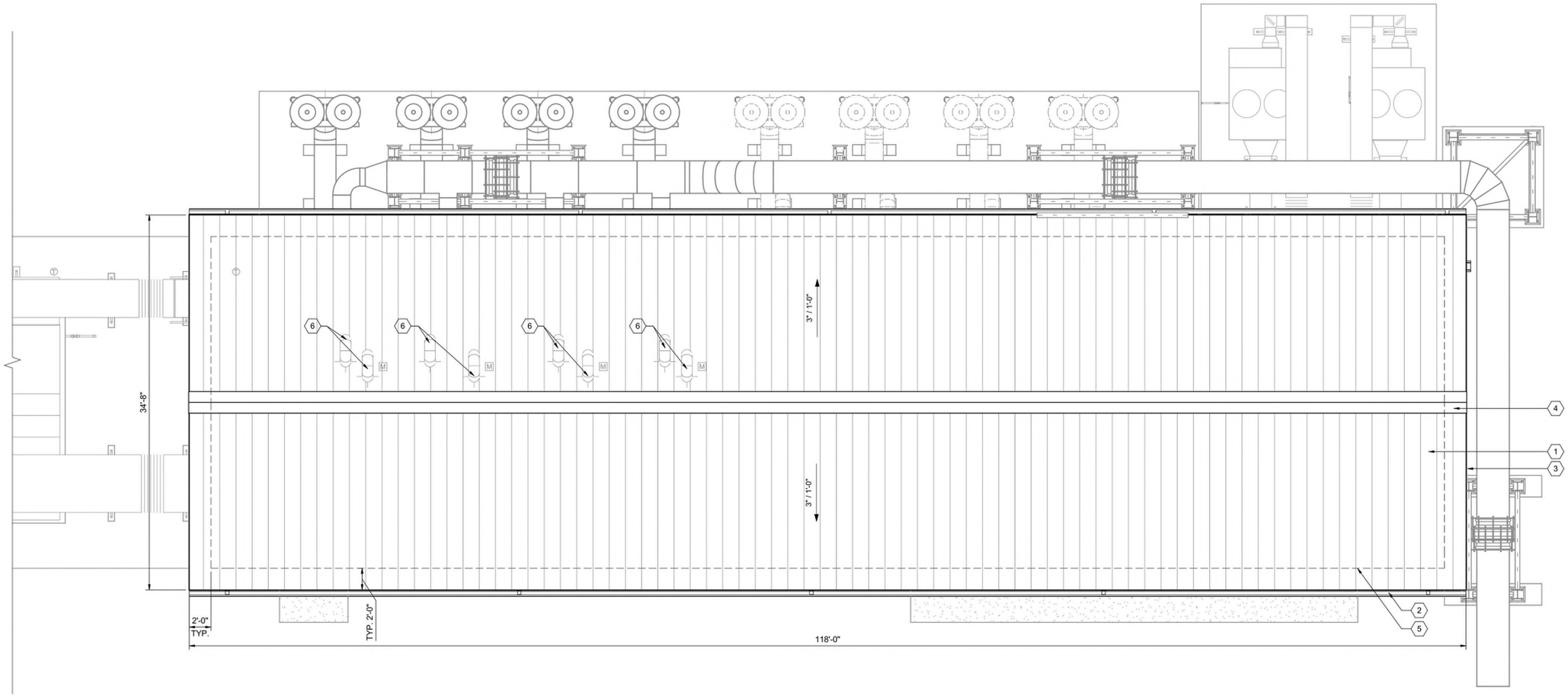
3. SEE SHEET 31A601 FOR ROOM FINISH & DOOR SCHEDULES.
4. COORDINATE FINAL LOCATION OF SAFETY BOLLARDS WITH CIVIL AND STRUCTURAL.
5. REFER TO EXTERIOR ELEVATIONS FOR MASONRY CONTROL JOINTS.

KEYNOTES

1	PRE-FINISHED STANDING SEAM METAL ROOF.
2	PRE-FINISHED METAL GUTTER, TYP.
3	PRE-FINISHED METAL RAKE TRIM
4	PRE-FINISHED METAL RIDGE CAP
5	BUILDING OUTLINE BELOW
6	MECH. EXHAUST, REFER TO MECH. DWGS.



1 / 31A201 ROOF PLAN
3/16" = 1'-0"

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REGISTERED ARCHITECT WESLEY J. WARD 19303 STATE OF TEXAS
6/13/25

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PRAIRIE CREEK
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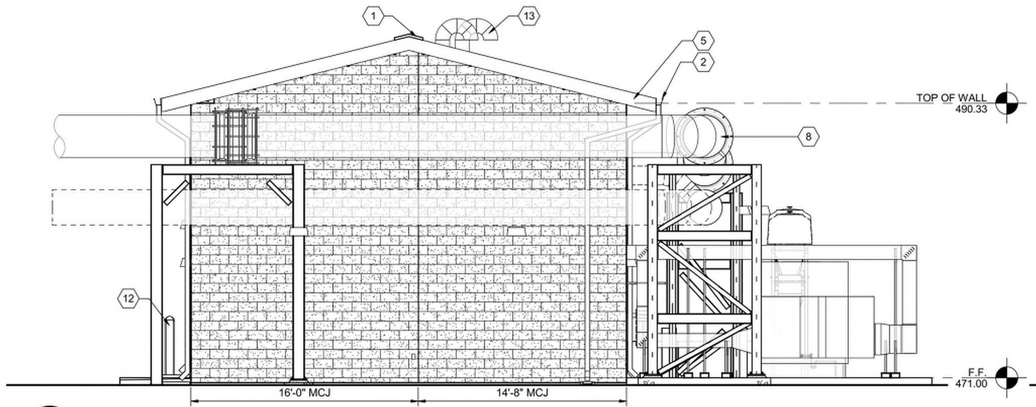
PLANT II BLOWER BUILDING (PROPOSED)
ARCHITECTURAL
ROOF PLAN

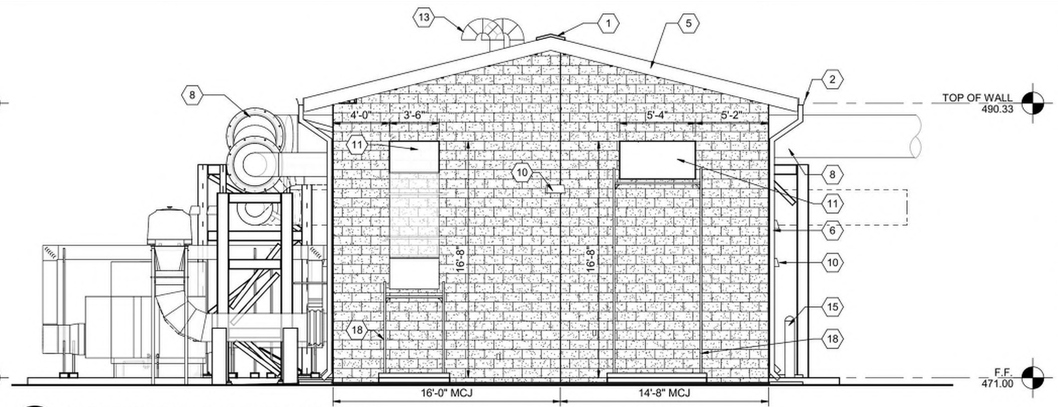
N
0 1" 2"

FILENAME HDRE_ALL_DISCIPLINES.rte
SCALE As indicated
SHEET 31A102

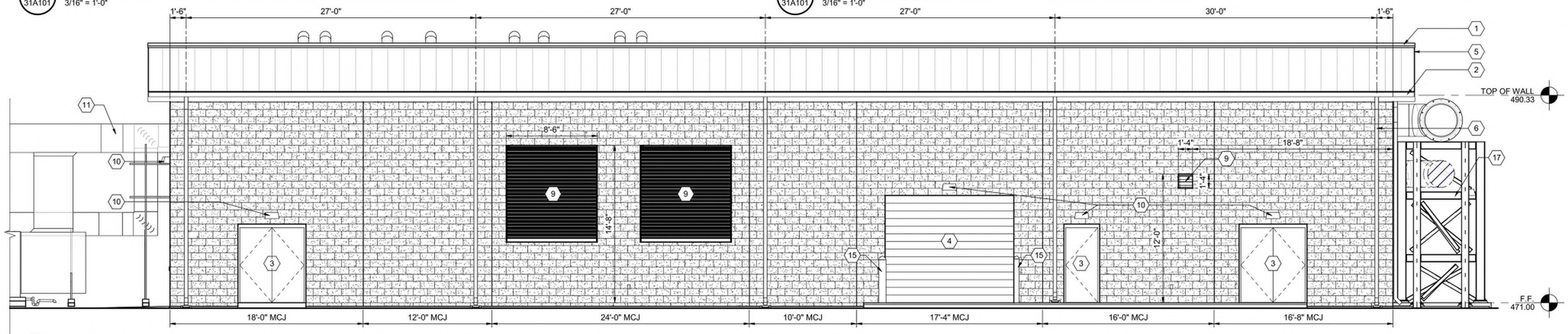
Autodesk Docs://10342803_COL_PCWWT_AB_Expansion_2024/31 - PLANT II BLOWER BUILDING (PROPOSED) - ARCH.rvt
6/12/2025 5:45:40 PM



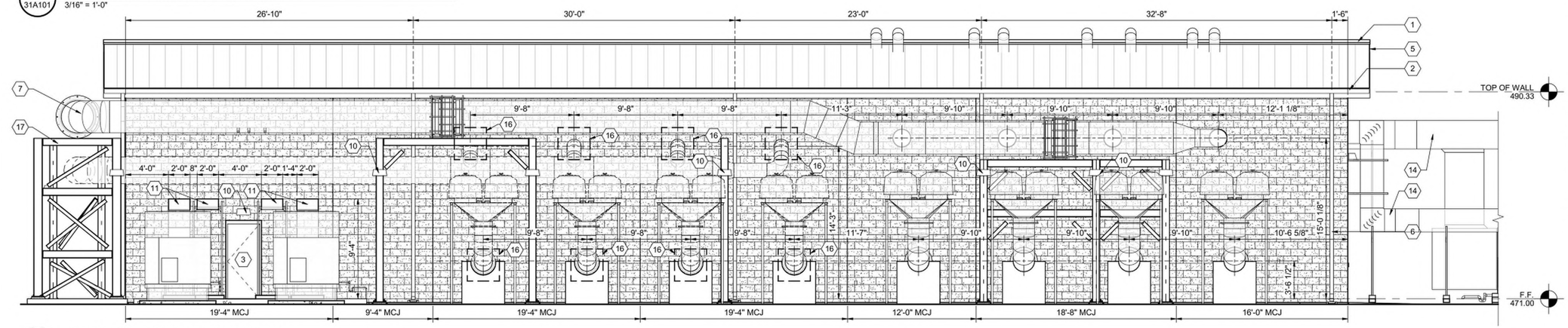
1 31A101 NORTH EXTERIOR ELEVATION
3/16" = 1'-0"



3 31A101 SOUTH EXTERIOR ELEVATION
3/16" = 1'-0"



2 31A101 EAST EXTERIOR ELEVATION
3/16" = 1'-0"



4 31A101 WEST EXTERIOR ELEVATION
3/16" = 1'-0"

GENERAL NOTES:
1. REFER TO PROCESS, ELECTRICAL & MECHANICAL DRAWINGS FOR EQUIPMENT NOT SHOWN ON THIS DRAWING.
2. REFER TO OTHER DISCIPLINES FOR ANY ADDITIONAL PENETRATIONS NEEDED THAT ARE NOT SHOWN ON ELEVATIONS.
3. SEE SHEET 31A601 FOR DOOR SCHEDULE.

KEYNOTES

1	PRE-FINISHED METAL RIDGE CAP
2	PRE-FINISHED METAL GUTTER, TYP.
3	GALV H.M. DOOR/FRAME, AS SCHEDULED. TYP.
4	PRE-FINISHED INSULATED METAL COILING O.H. DOOR AS SCHEDULED
5	PRE-FINISHED METAL RAKE TRIM
6	PRE-FINISHED METAL DOWNSPOUT WITH PRECAST SPLASH BLOCK, TYP.
7	PROCESS PIPE WALL PENETRATION
8	PROCESS PIPING, TYP.
9	MECH. LOUVER, REFER TO MECH. DWGS. FOR EXACT SIZE.
10	LIGHTING FIXTURES, TYP.
11	DUCT, VERIFY PENETRATION SIZES WITH MECH. DWGS.
12	SAFETY BOLLARD, BOLLARDS TO BE CLEAR OF DOOR OPENINGS. REFER TO STRUCTURAL FOR INTERIOR BOLLARDS.
13	MECH. EXHAUST, REFER TO MECH. DWGS.
14	DUCT, VERIFY SIZES WITH MECH. DWGS.
15	SAFETY BOLLARD, BOLLARDS TO BE CLEAR OF DOOR OPENINGS. REFER TO CIVIL FOR EXTERIOR BOLLARDS.
16	NOMINAL 3' X 3' WALL BLOCKOUT FOR FUTURE WALL PENETRATION. REFER TO DETAIL 4/31A503 AND STRUCTURAL DRAWINGS FOR ADDITIONAL INFORMATION.
17	PROCESS PIPE SUPPORT, TYP.
18	DUCT SUPPORT, TYP. REFER TO MECH. DETAILS.

LEGEND

NOMINAL 4-INCH THICK SPLIT-FACE CMU VENEER.

PRE-FINISHED STANDING SEAM METAL ROOF.

FUTURE PROCESS PIPING/EQUIPMENT (SEMI-TRANSPARENT/DASHED OUTLINE)

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6/12/2025 5:45:54 PM

HDR
TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13/2025	ISSUED FOR BID

PROJECT MANAGER	J.R. CANTWELL
DESIGNED BY	W. WARD
DRAWN BY	A. VEGA
CHECKED BY	R. ANDREW
APPROVED BY	
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

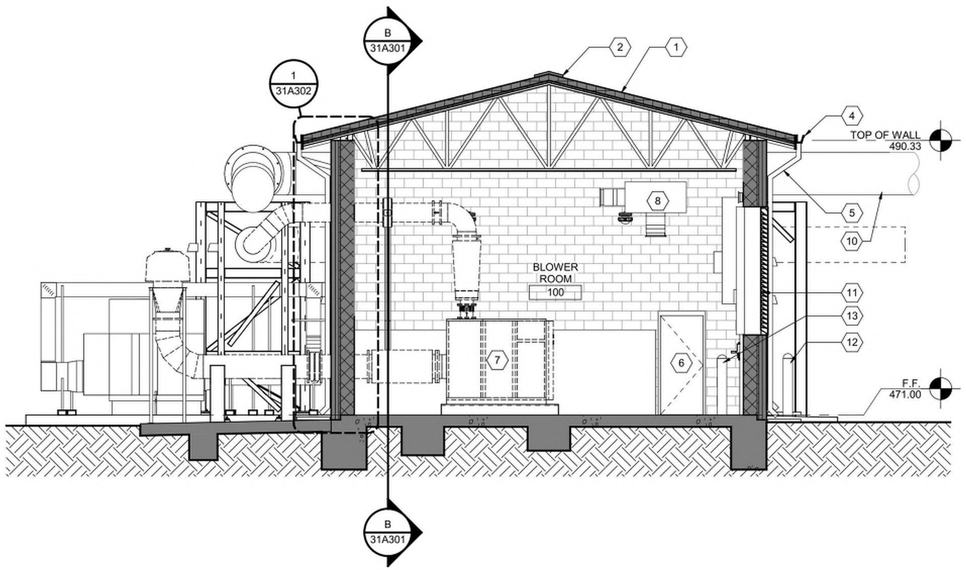
REGISTERED ARCHITECT
WESLEY A. WARD
13503
STATE OF TEXAS
6/13/25

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

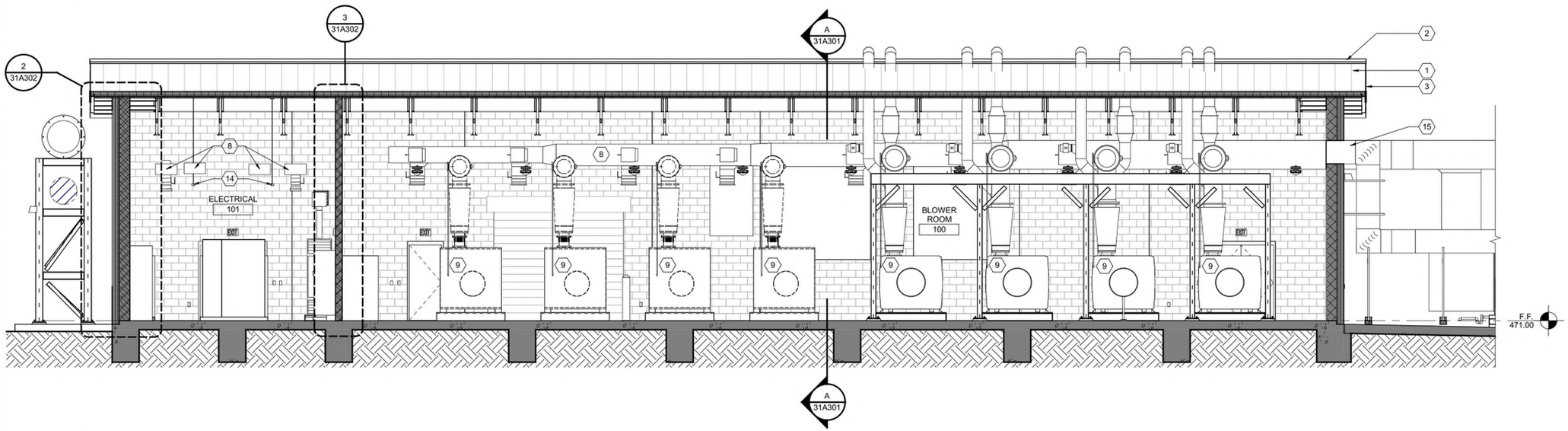
CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN
EXPANSION

PLANT II BLOWER BUILDING (PROPOSED)
ARCHITECTURAL
EXTERIOR ELEVATIONS

FILENAME HDRE_ALL_DISCIPLINES.rte
SCALE As indicated
0 1" 2"
SHEET 31A201



A 31A101 BUILDING SECTION
3/16" = 1'-0"



B 31A101 BUILDING SECTION
3/16" = 1'-0"

GENERAL NOTES:
1. REFER STRUCTURAL FOR LINTEL & WALL REINFORCEMENT INFORMATION.
2. REFER TO PROCESS, ELECTRICAL & MECHANICAL DRAWINGS FOR EQUIPMENT NOT SHOWN ON THIS DRAWING.
3. REFER TO OTHER DISCIPLINES FOR ANY ADDITIONAL PENETRATIONS NEEDED THAT ARE NOT SHOWN ON ELEVATIONS.
4. SEE SHEET 31A301 FOR ROOM FINISH & DOOR SCHEDULES.
5. COORDINATE FINAL LOCATION OF EXTERIOR SAFETY BOLLARDS WITH CIVIL AND STRUCTURAL.
6. REFER TO SPECS FOR WALL TIES.

KEYNOTES

1	PRE-FINISHED STANDING SEAM METAL ROOF.
2	PRE-FINISHED METAL RIDGE CAP
3	NOMINAL 4 1/2" POLY-ISO RIGID INSULATION.
4	PRE-FINISHED METAL GUTTER, TYP.
5	PRE-FINISHED METAL DOWNSPOUT WITH PRECAST SPLASH BLOCK, TYP.
6	GALV H.M. DOOR/FRAME, AS SCHEDULED. TYP.
7	FUTURE PROCESS BLOWER EQUIPMENT, TYP.
8	DUCT, VERIFY SIZES WITH MECH. DWGS.
9	PROCESS BLOWER EQUIPMENT, TYP.
10	PROCESS PIPING, TYP.
11	MECH. LOUVER, REFER TO MECH. DWGS. FOR EXACT SIZE.
12	SAFETY BOLLARD, BOLLARDS TO BE CLEAR OF DOOR OPENINGS. REFER TO CIVIL FOR EXTERIOR BOLLARDS.
13	SAFETY BOLLARD, BOLLARDS TO BE CLEAR OF DOOR OPENINGS. REFER TO STRUCTURAL FOR INTERIOR BOLLARDS.
14	LIGHTING FIXTURES, TYP.
15	DUCT, VERIFY PENETRATION SIZES WITH MECH. DWGS.

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6/12/2025 5:45:56 PM

HDR
TEXAS P.E. FIRM
Registration No. F-754

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100%	JUNE 13/2025	ISSUED FOR BID

PROJECT MANAGER	J.R. CANTWELL
DESIGNED BY	W. WARD
DRAWN BY	A. VEGA
CHECKED BY	R. ANDREW
APPROVED BY	
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

REGISTERED ARCHITECT
WESLEY J. WARD
15033
STATE OF TEXAS
6/13/25

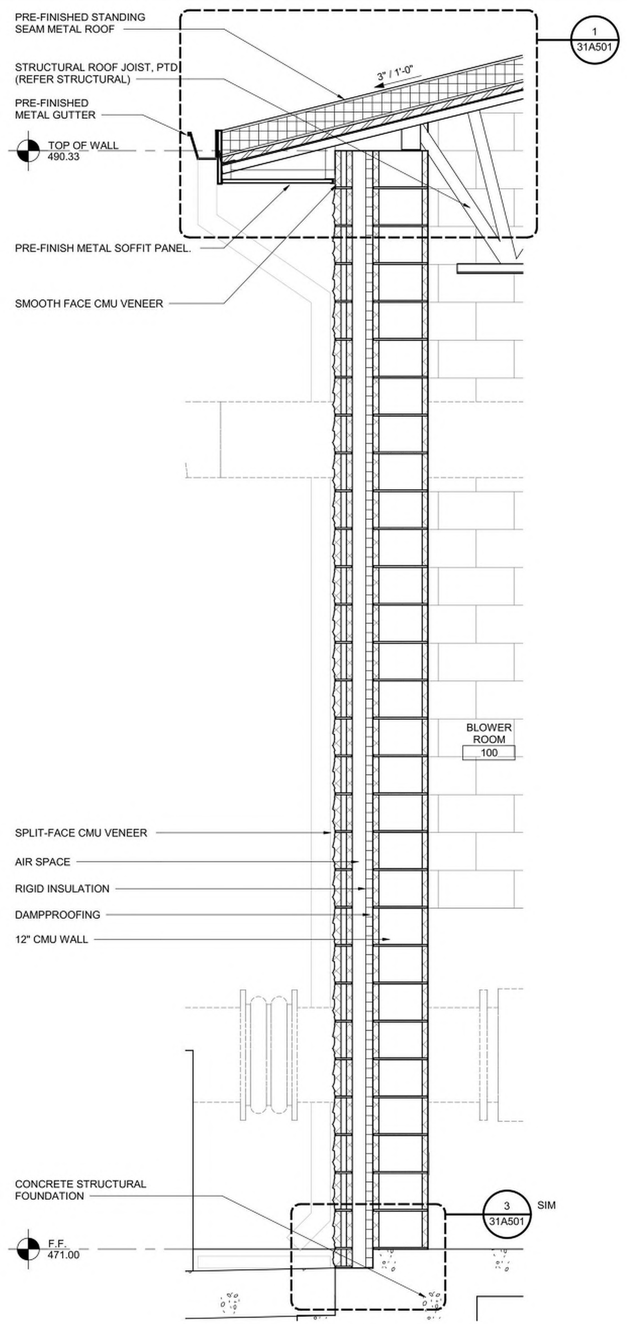
LEWISVILLE
Deep Roots. Broad Wings. Bright Future

CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

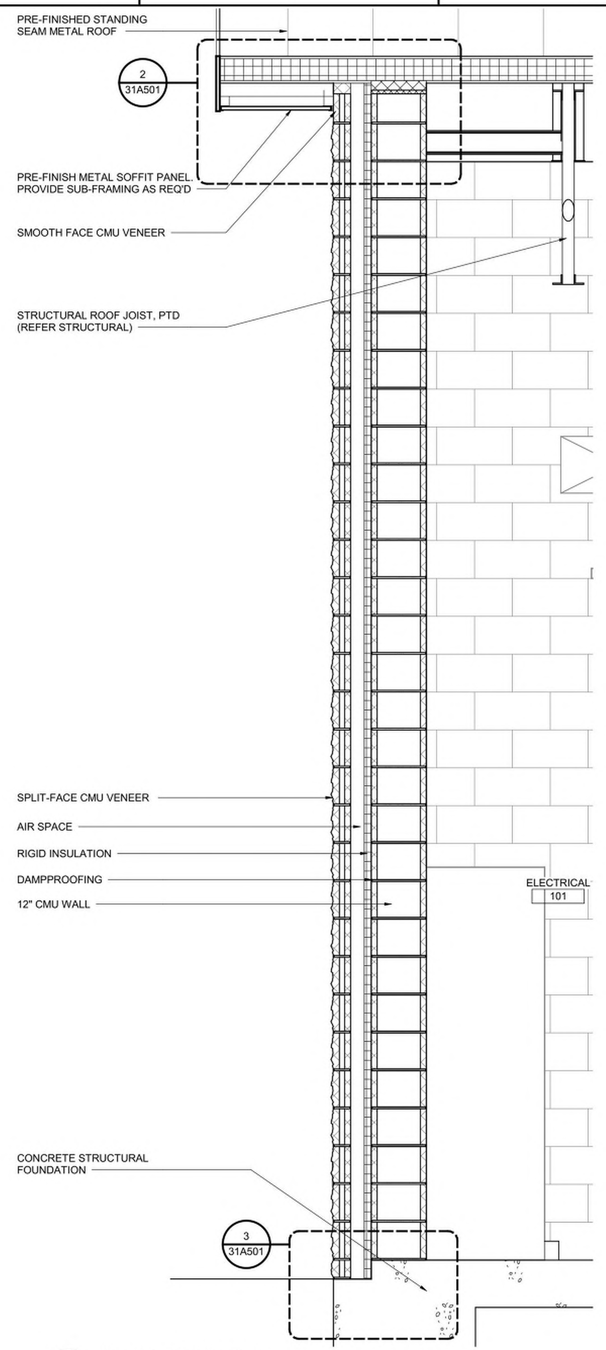
PLANT II BLOWER BUILDING (PROPOSED)
ARCHITECTURAL
BUILDING SECTIONS

0 1" 2"

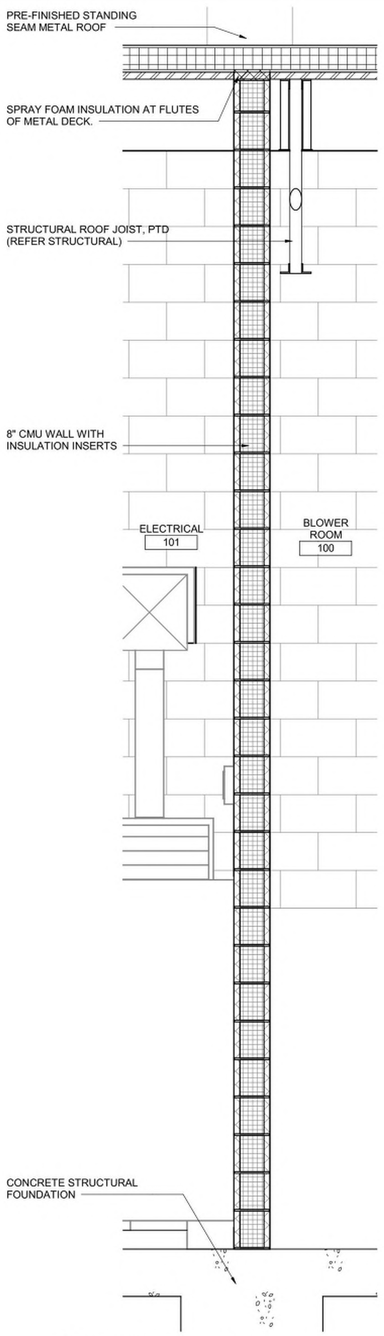
FILENAME	HDRE_ALL_DISCIPLINES.rte	SHEET	31A301
SCALE	As indicated		



1 31A302 WALL SECTION 3/4" = 1'-0"



2 31A302 WALL SECTION 3/4" = 1'-0"



3 31A302 WALL SECTION 3/4" = 1'-0"

GENERAL NOTES:

1. REFER STRUCTURAL FOR LINTEL & WALL REINFORCEMENT INFORMATION.
2. REFER TO PROCESS, ELECTRICAL & MECHANICAL DRAWINGS FOR EQUIPMENT NOT SHOWN ON THIS DRAWING.
3. REFER TO OTHER DISCIPLINES FOR ANY ADDITIONAL PENETRATIONS NEEDED THAT ARE NOT SHOWN ON ELEVATIONS.
4. SEE SHEET 31A301 FOR ROOM FINISH & DOOR SCHEDULES.
5. COORDINATE FINAL LOCATION OF EXTERIOR SAFETY BOLLARDS WITH CIVIL AND STRUCTURAL.
6. REFER TO SPECS FOR WALL TIES.

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6/12/2025 5:45:56 PM

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13/2025	ISSUED FOR BID

PROJECT MANAGER	J.R. CANTWELL
DESIGNED BY	W. WARD
DRAWN BY	A. VEGA
CHECKED BY	R. ANDREW
APPROVED BY	
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

REGISTERED ARCHITECT WESLEY J. WARD 19503 STATE OF TEXAS
6/13/25

LEWISVILLE
Deep Roots. Broad Wings. Bright Future

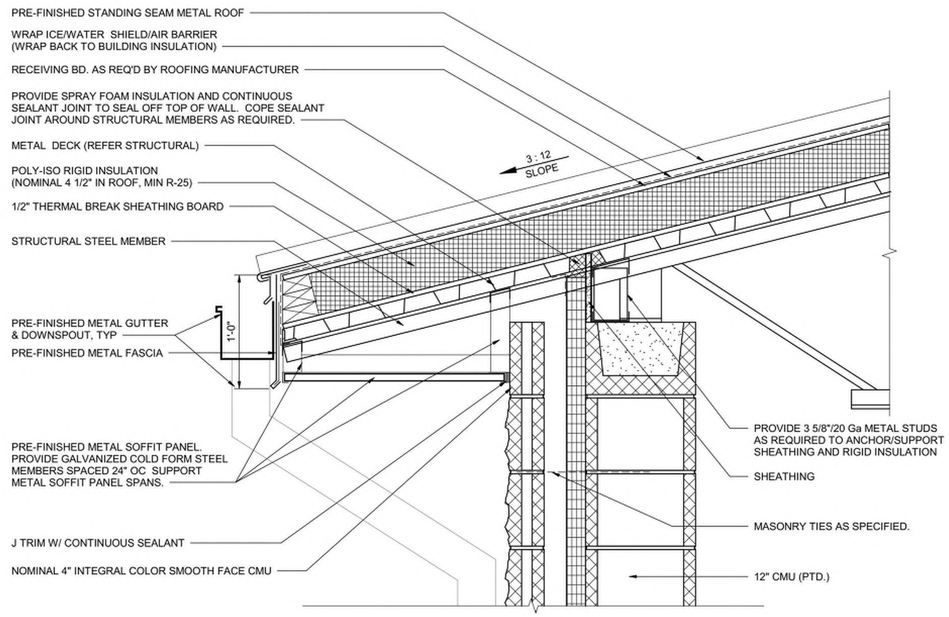
CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

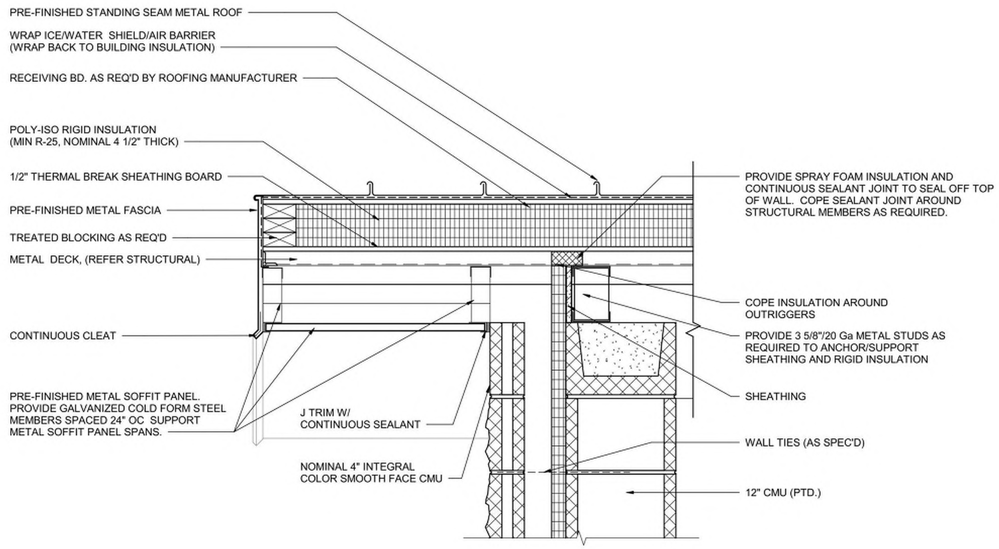
PLANT II BLOWER BUILDING (PROPOSED) ARCHITECTURAL WALL SECTIONS

0 1" 2"

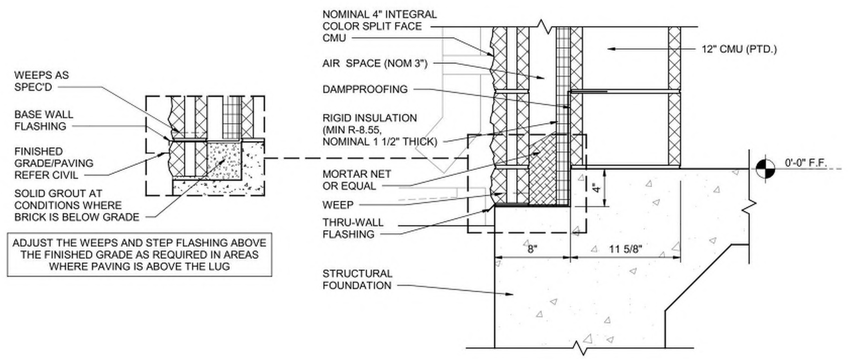
FILENAME: HDRE_ALL_DISCIPLINES.rte
SCALE: As indicated
SHEET: 31A302



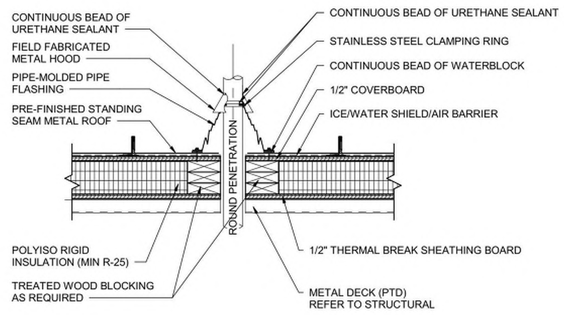
1 31A302 **EAVE DETAIL**
1 1/2" = 1'-0"



2 31A302 **RAKE DETAIL**
1 1/2" = 1'-0"



3 31A302 **WALL BASE DETAIL**
1 1/2" = 1'-0"



4 **TYP. ROOF PIPE PENETRATION**
1 1/2" = 1'-0"

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6/12/2025 5:45:56 PM

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
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PROJECT MANAGER	J.R. CANTWELL
DESIGNED BY	W. WARD
DRAWN BY	A. VEGA
CHECKED BY	R. ANDREW
APPROVED BY	
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

REGISTERED ARCHITECT WESLEY J. WARD 19303 STATE OF TEXAS
6/13/25

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

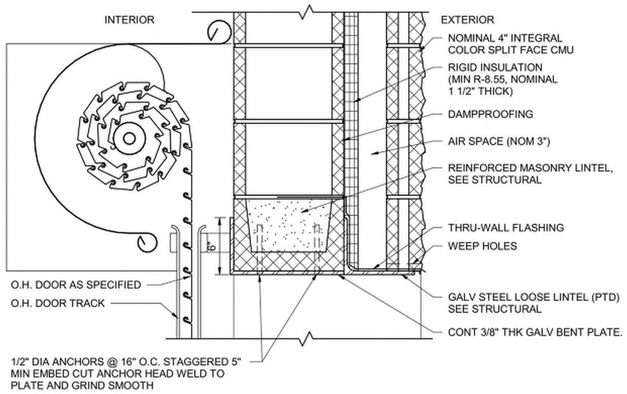
CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

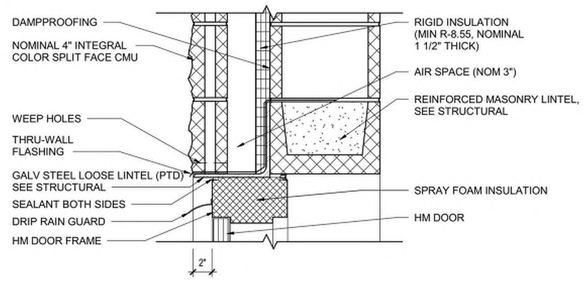
PLANT II BLOWER BUILDING (PROPOSED)
ARCHITECTURAL
DETAILS I

0 1" 2"

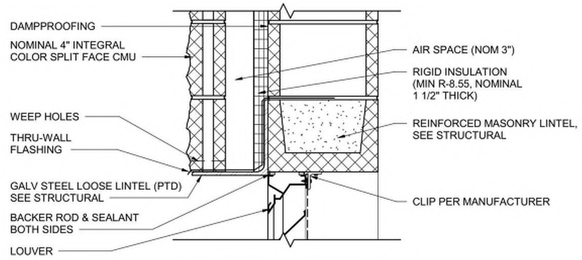
FILENAME HDRE_ALL_DISCIPLINES.rte
SCALE 1 1/2" = 1'-0"
SHEET 31A501



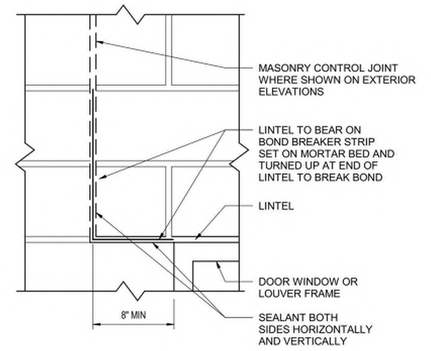
1 O.H. DOOR HEAD DETAIL1
1 1/2" = 1'-0"



2 DOOR HEAD DETAIL
1 1/2" = 1'-0"

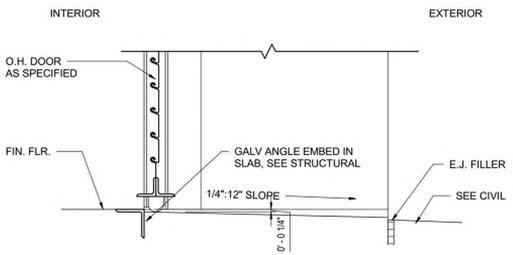


3 LOUVER HEAD DETAIL / JAMB SIM
1 1/2" = 1'-0"

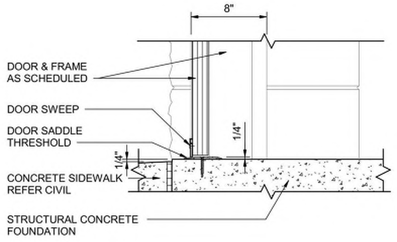


NOTE:
1. TYPICAL ALL EXTERIOR DOOR, WINDOW AND LOUVER OPENINGS.

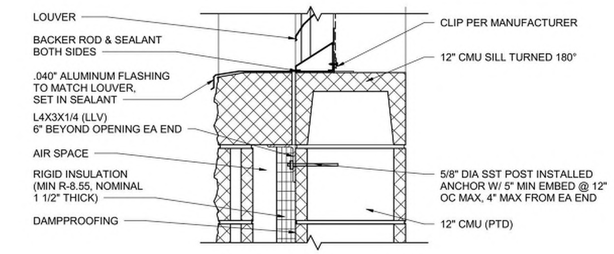
4 TYP. LINTEL DETAIL
1 1/2" = 1'-0"



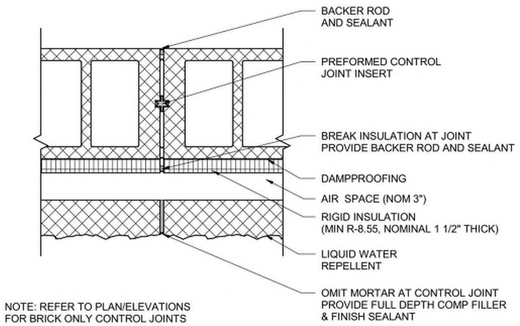
5 O.H. DOOR THRESHOLD1
1 1/2" = 1'-0"



6 DOOR THRESHOLD
1 1/2" = 1'-0"

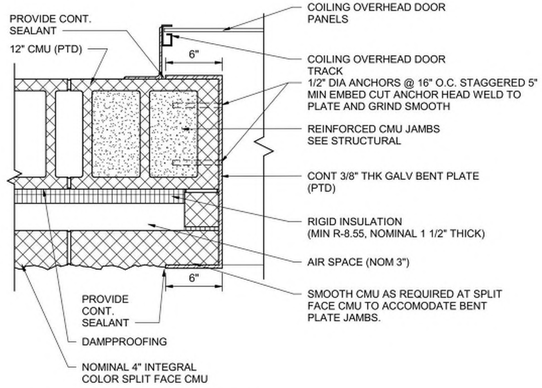


7 LOUVER SILL DETAIL
1 1/2" = 1'-0"

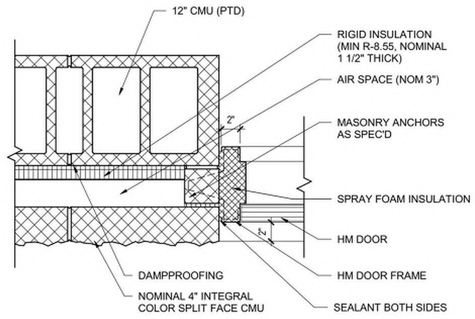


NOTE: REFER TO PLAN/ELEVATIONS FOR BRICK ONLY CONTROL JOINTS

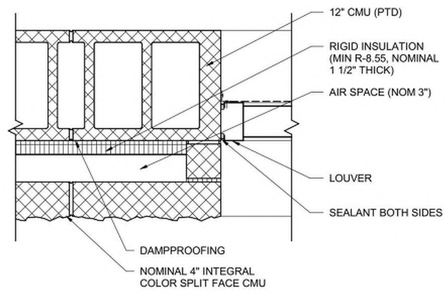
8 MASONRY CONTROL JOINT
1 1/2" = 1'-0"



9 O.H. DOOR JAMB CMU1
1 1/2" = 1'-0"



10 DOOR JAMB DETAIL
1 1/2" = 1'-0"



11 LOUVER JAMB DETAIL
1 1/2" = 1'-0"

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6/12/2025 5:45:57 PM

HDR
TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13/2025	ISSUED FOR BID

PROJECT MANAGER	J.R. CANTWELL
DESIGNED BY	W. WARD
DRAWN BY	A. VEGA
CHECKED BY	R. ANDREW
APPROVED BY	
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

REGISTERED ARCHITECT WESLEY J. WARD 15203 STATE OF TEXAS
6/13/25

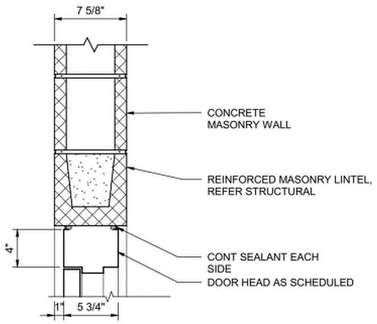
LEWISVILLE
Deep Roots. Broad Wings. Bright Future

CITY OF LEWISVILLE
PRAIRIE CREEK

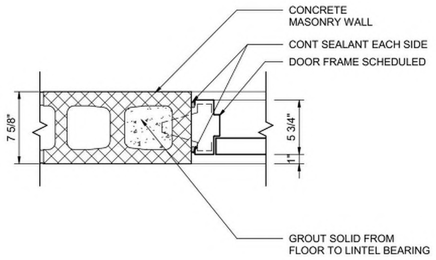
AERATION BASIN EXPANSION

PLANT II BLOWER BUILDING (PROPOSED)
ARCHITECTURAL
DETAILS II

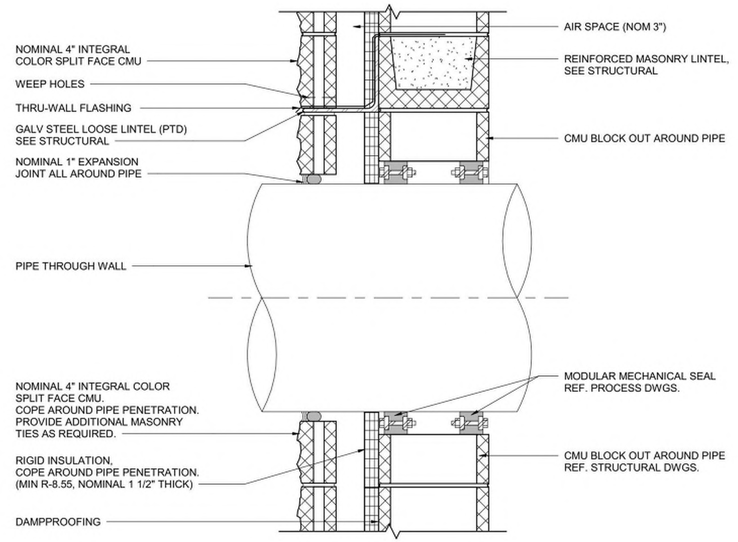
FILENAME: HDRE_ALL_DISCIPLINES.rte
SCALE: 1 1/2" = 1'-0"
0 1" 2"
SHEET: 31A502



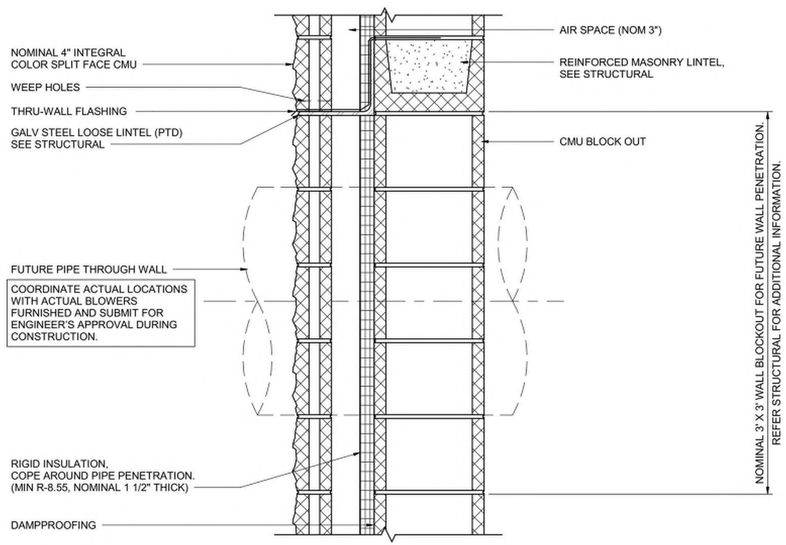
1 INTERIOR HM DOOR HEAD CMU DETAIL
1 1/2" = 1'-0"



2 INTERIOR HM DOOR JAMB IN CMU DETAIL
1 1/2" = 1'-0"



3 TYP. PIPE WALL PENETRATION
1 1/2" = 1'-0"



4 TYP. FUTURE PIPE WALL PENETRATION/BLOCKOUT
1 1/2" = 1'-0"

Autodesk Docs://10342803_COL_PCWWT_AB_Expansion_2024/31 -PLANT II BLOWER BUILDING (PROPOSED) - ARCH.rvt
6/12/2025 5:45:57 PM

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
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PROJECT MANAGER	J.R. CANTWELL
DESIGNED BY	W. WARD
DRAWN BY	A. VEGA
CHECKED BY	R. ANDREW
APPROVED BY	
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

REGISTERED ARCHITECT WESLEY J. WARD 15233 STATE OF TEXAS
6/13/25

LEWISVILLE
Deep Roots. Broad Wings. Bright Future

CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

PLANT II BLOWER BUILDING (PROPOSED)
ARCHITECTURAL
DETAILS III

FILENAME: HDRE_ALL_DISCIPLINES.rte
SCALE: 1 1/2" = 1'-0"
0 1" 2"
SHEET: 31A503

ROOM FINISH SCHEDULE

ROOM NUMBER	ROOM NAME	FLOOR	BASE	WALLS				CEILING		*REMARKS
				NORTH	EAST	SOUTH	WEST	HEIGHT	FINISH	
100	BLOWER ROOM	SCONC	N	CMU / PTD	CMU / PTD	CMU / PTD	CMU / PTD	18'-0"	ES	
101	ELECTRICAL	SCONC	N	CMU / PTD	CMU / PTD	CMU / PTD	CMU / PTD	18'-0"	ES	

MATERIAL AND FINISH LEGEND

FLOOR		BASE	
SCONC	SEALED CONCRETE	N	NONE

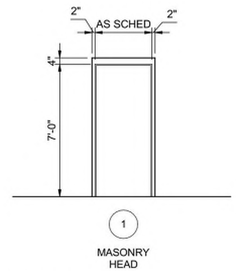
WALLS		CEILING	
PTD	PAINTED	ES	EXPOSED STRUCTURE (PTD)
CMU	CONCRETE MASONRY UNITS		

DOOR SCHEDULE

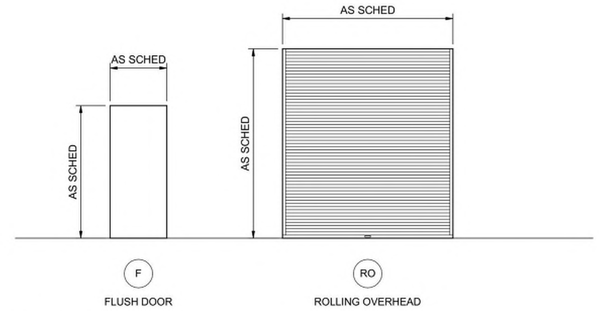
DOOR NUMBER		WIDTH	HEIGHT	DOOR			FRAME			HARDWARE SET	DETAILS			*REMARKS
				TYPE	MATERIAL	FINISH	TYPE	MATERIAL	FINISH		HEAD	JAMB	SILL	
31-100 A	PR	3' - 0"	7' - 0"	F/F	HM	PTD	1	HM	PTD	2	2/31A502	10/31A502	6/31A502	
31-100 B		3' - 0"	7' - 0"	F	HM	PTD	1	HM	PTD	1	2/31A502	10/31A502	6/31A502	
31-100 C		12' - 0"	10' - 0"	RO	ST	FAPC	-	ST	FAPC	-	1/31A502	5/31A502	9/31A502	
31-100 D		3' - 0"	7' - 0"	F	HM	PTD	1	HM	PTD	3	1/31A503	2/31A503	-	
31-101 A	PR	3' - 0"	7' - 0"	F/F	HM	PTD	1	HM	PTD	2	2/31A502	10/31A502	6/31A502	
31-101 B		3' - 0"	7' - 0"	F	HM	PTD	1	HM	PTD	1	2/31A502	10/31A502	6/31A502	

MATERIAL AND FINISH LEGEND

MATERIAL		FINISH	
HM	HOLLOW METAL	PTD	ARCHITECTURAL PAINT
ST	STEEL	FAPC	FACTORY APPLIED POWDER COATING



FRAME TYPES
1/4" = 1'-0"



DOOR TYPES
1/4" = 1'-0"

HDR
TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13/2025	ISSUED FOR BID

PROJECT MANAGER	J.R. CANTWELL
DESIGNED BY	W. WARD
DRAWN BY	A. VEGA
CHECKED BY	R. ANDREW
APPROVED BY	
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

REGISTERED ARCHITECT
WESLEY J. WARD
15203
STATE OF TEXAS
6/13/25

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

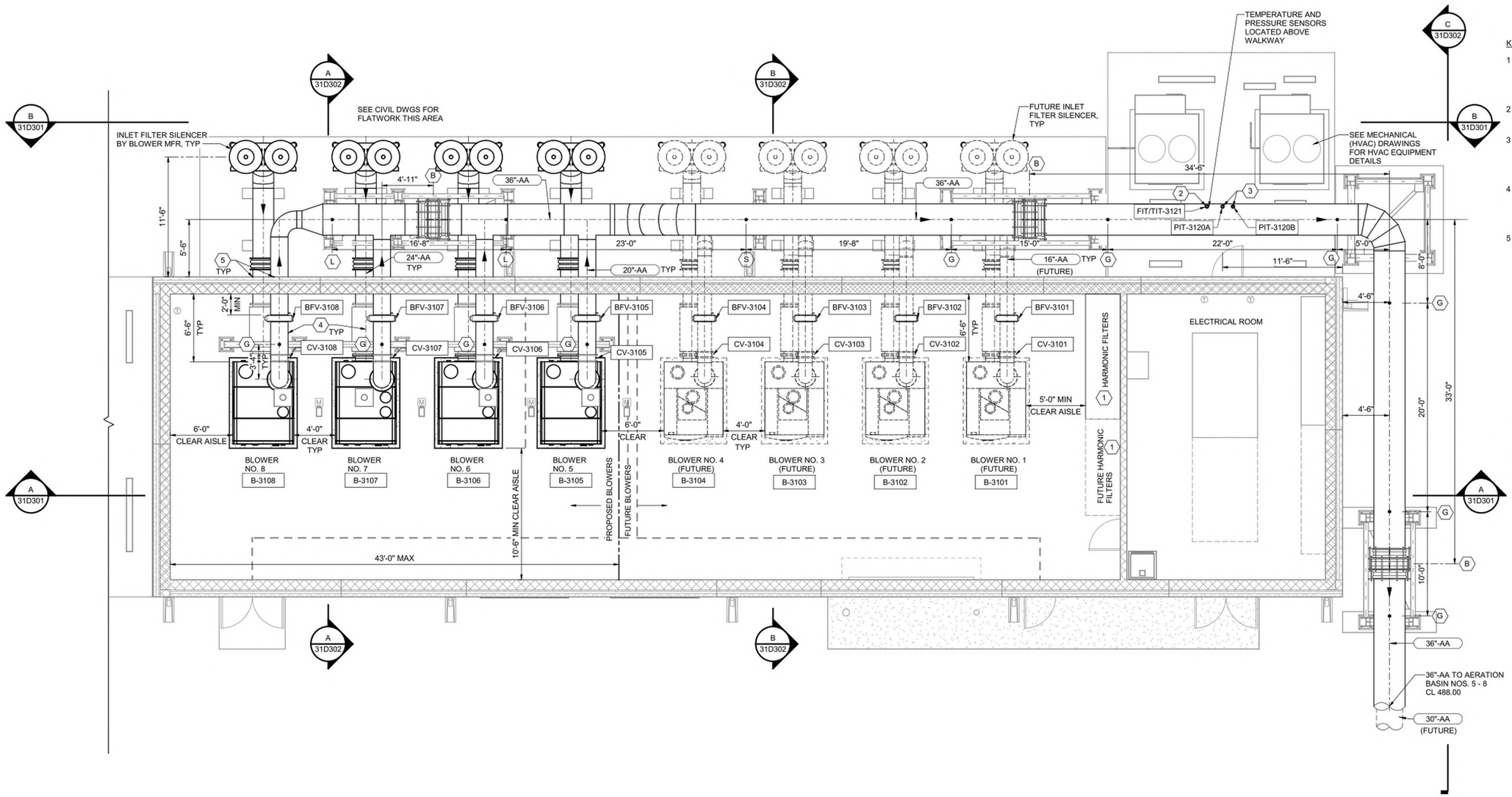
CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

PLANT II BLOWER BUILDING (PROPOSED) ARCHITECTURAL ROOM FINISH & DOOR SCHEDULES

FILENAME: HDRE_ALL_DISCIPLINES.rte
SCALE: As indicated
0 1" 2"
SHEET: 31A601

Autodesk Docs://10342803_COL_PCWWT_AB_Expansion_2024/31 -PLANT II BLOWER BUILDING (PROPOSED) - ARCH.rvt
6/12/2025 5:45:57 PM



A 31D301 PLAN
3/16" = 1'-0"

GENERAL NOTES:

1. BLOWER UNITS SHOWN ARE BASED ON ABS SULZER BLOWERS. COORDINATE PIPING LOCATIONS, ARRANGEMENT, AND EXTENTS FOR OTHER SPECIFIED BLOWER MANUFACTURERS.

KEYNOTES (#)

1 40" x 12' RESERVED AREA FOR BLOWERS 5-8 HARMONIC FILTERS FURNISHED BY BLOWER MANUFACTURER (IF SHIPPED LOOSE).

2 WELDED THERMOWELL 45 DEG WEST OF PIPE INVERT FOR TIT-3112.

3 PIT-3111A & PIT-3111B INSTALLED 45 DEG WEST OF PIPE INVERT. PRESSURE TRANSMITTER WITHOUT DIAPHRAGM SEAL, SEE INST STANDARD DETAILS.

4 BLOWER DISCHARGE PIPING SHALL BE INSULATED WITHIN THE BLOWER ROOM ONLY (NOT SHOWN). SEE SECTION A / 31D302.

5 PIPE WALL PENETRATION (MASONRY WALL), SEE PROCESS STANDARD DETAILS. SEE ARCHITECTURAL DRAWINGS FOR ADDITIONAL REQUIREMENTS AT PIPE WALL PENETRATIONS.

AIR PIPE KEYNOTES: (X)

(ALL SUPPORTS ARE AS DEFINED ON THE PROCESS STANDARD DETAIL DRAWINGS)

S "H" SLIDE SUPPORT

G "H" GUIDE SUPPORT

L "H" GUIDE SUPPORT WITH LINESTOPS

J ELASTOMETRIC BELLOWS EXPANSION JOINT

B PRESSURE BALANCED ELASTOMETRIC BELLOWS EXPANSION JOINT

SEE STRUCTURAL DRAWINGS FOR SUPPORT FRAMING ASSOCIATED WITH SOME OF THE AIR PIPE SUPPORTS.

TEXAS P.E. FIRM Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13/2025	ISSUED FOR BID

PROJECT MANAGER	J. R. CANTWELL
DESIGNED BY	J. MACMANUS
DRAWN BY	A. FREEMON
CHECKED BY	M. BOND
APPROVED BY	T. PAULMANN
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS THOMAS A. PAULMANN 128794 LICENSED PROFESSIONAL ENGINEER 6/13/25

LEWISVILLE Deep Roots. Broad Wings. Bright Future

CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

PLANT II BLOWER BUILDING (PROPOSED)
PROCESS
PLAN

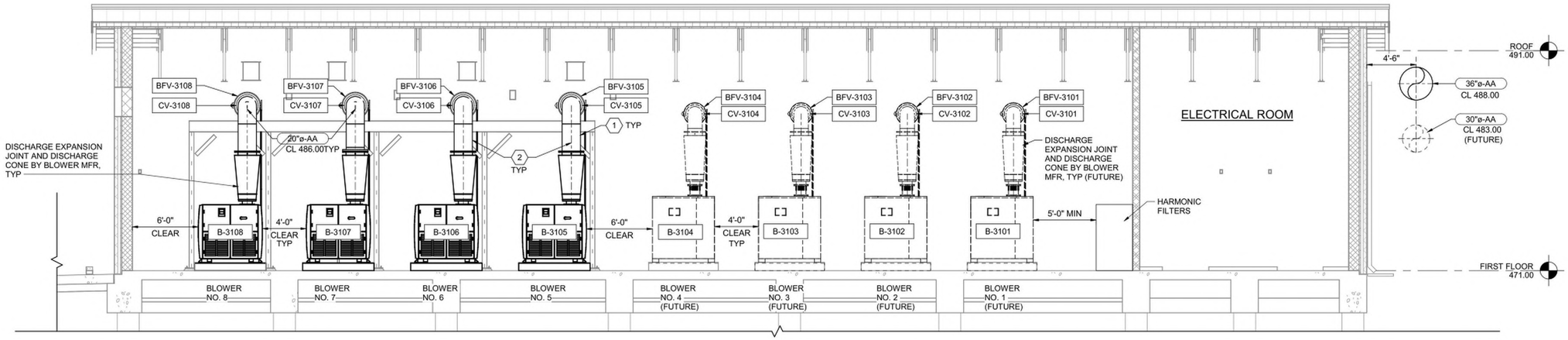
N

0 1" 2"

FILENAME 31 - PLANT II BLOWER BUILDING (PROPOSED)
SCALE 3/16" = 1'-0"

SHEET 31D101

Autodesk Docs://10342803_COL_PCWWT_AB_Expansion_2024/31 - PLANT II BLOWER BUILDING (PROPOSED) - PROCESS.rvt
6/13/2025 9:44:21 AM



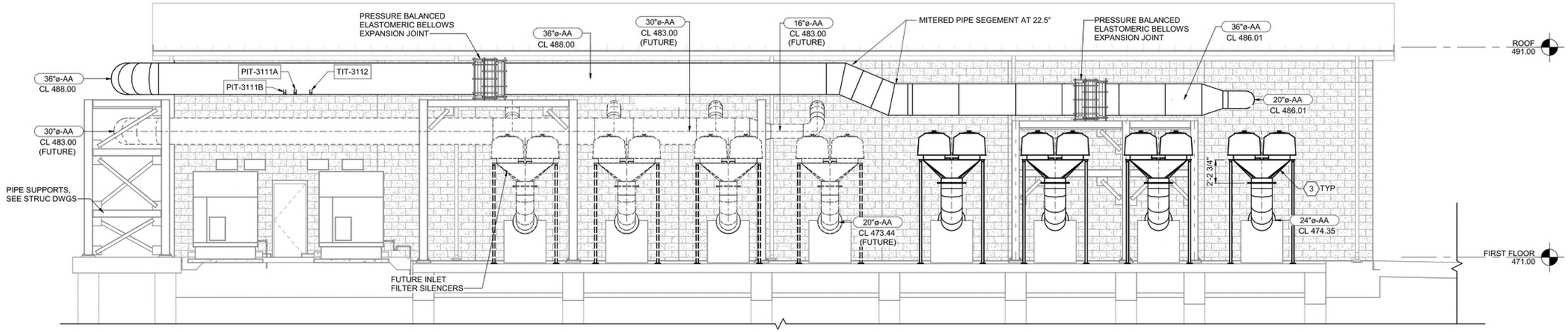
A 31D101 SECTION
3/16" = 1'-0"

KEYNOTES ⟨#⟩

1 CONTRACTOR SHALL FURNISH PIPE REDUCER IN RISER IF BLOWER DISCHARGE IS <20"DIA. LAYOUT SHOWN IS BASED ON ABS SULZER BLOWERS. COORDINATE INLET AND DISCHARGE PIPING WITH RECOMMENDATIONS OF FURNISHED MANUFACTURER.

2 BLOWER DISCHARGE PIPING SHALL BE INSULATED WITHIN THE BLOWER ROOM ONLY (NOT SHOWN). SEE SECTION A / 31D302.

3 INLET FILTER SILENCER FURNISHED BY BLOWER MANUFACTURER INCLUDING SUPPORT LEGS AS SHOWN. ENDUSTRA TKT INLET FILTER SILENCER SHOWN. ADJUST PIPE RISER AS REQUIRED TO MATCH OVERALL HEIGHT INDICATED IF OTHER FILTER MANUFACTURER IS FURNISHED.



B 31D101 SECTION
3/16" = 1'-0"

Autodesk Docs://10342803_COL_PCWWT_AB_Expansion_2024/31 - PLANT II BLOWER BUILDING (PROPOSED) - PROCESS.rvt
6/13/2025 9:44:24 AM

HDR
TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13/2025	ISSUED FOR BID

PROJECT MANAGER	J. R. CANTWELL
DESIGNED BY	J. MACMANUS
DRAWN BY	A. FREEMON
CHECKED BY	M. BOND
APPROVED BY	T. PAULMANN
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
THOMAS A. PAULMANN
128794
LICENSED PROFESSIONAL ENGINEER
6/13/25

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

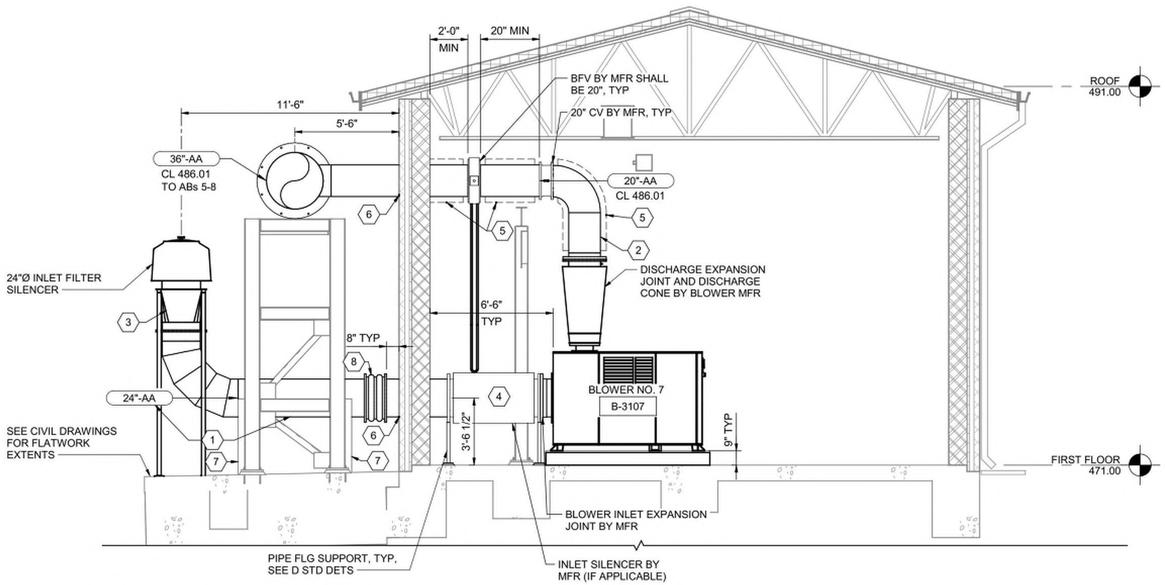
CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

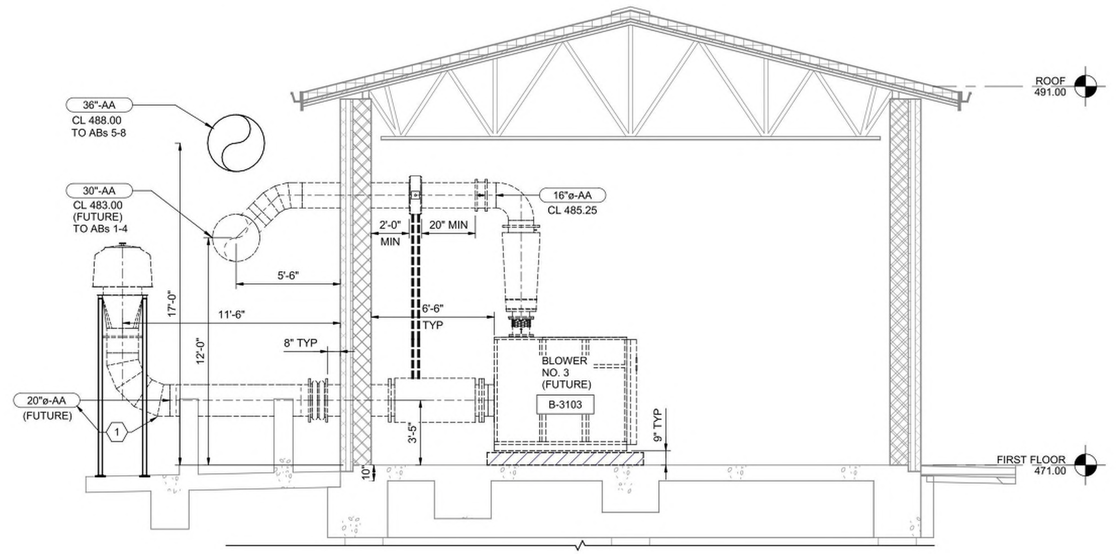
PLANT II BLOWER BUILDING (PROPOSED)
PROCESS
SECTIONS

FILENAME: 31 - PLANT II BLOWER BUILDING (PROPOSED)
SCALE: 3/16" = 1'-0"
0 1" 2"

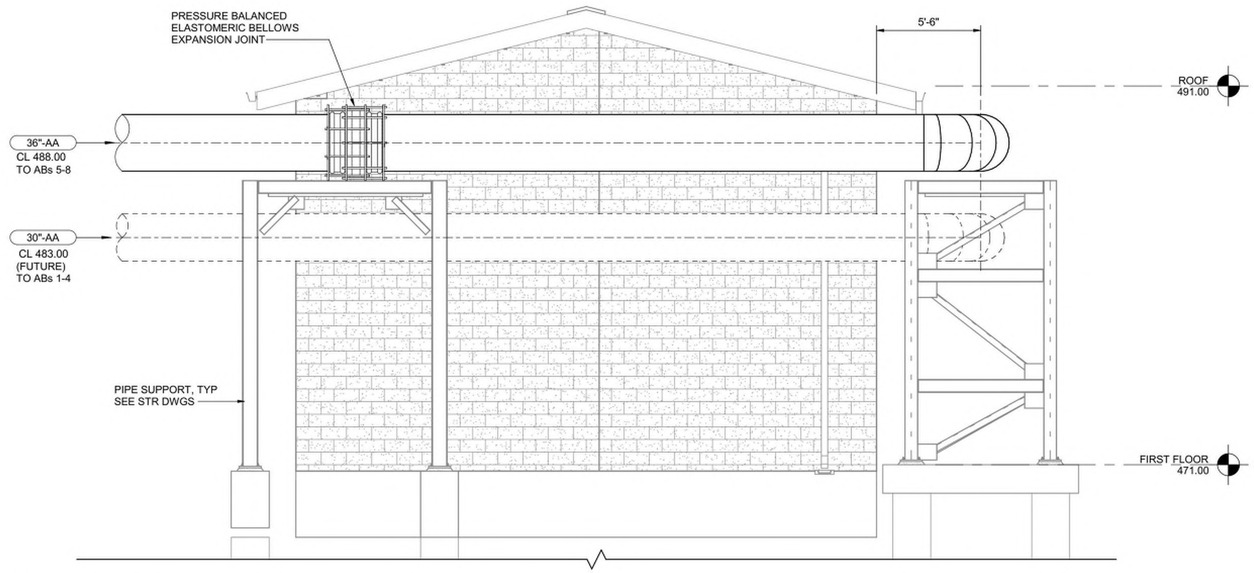
SHEET
31D301



A 31D101 **SECTION**
1/4" = 1'-0"



B 31D101 **SECTION (FUTURE BLOWERS 1 - 4)**
1/4" = 1'-0"



C 31D101 **SECTION**
1/4" = 1'-0"

KEYNOTES ⟨#⟩

1 CONTRACTOR TO COORDINATE BLOWER INLET PIPING ELEVATION TO MATCH FURNISHED BLOWER INLET.

2 CONTRACTOR SHALL FURNISH PIPE REDUCER IN RISER IF BLOWER DISCHARGE IS <20"DIA. LAYOUT SHOWN IS BASED ON ABS SULZER BLOWERS. COORDINATE INLET AND DISCHARGE PIPING WITH RECOMMENDATIONS OF FURNISHED MANUFACTURER.

3 INLET FILTER SILENCER FURNISHED BY BLOWER MANUFACTURER INCLUDING SUPPORT LEGS AS SHOWN. ENDUSTRA TKT INLET FILTER SILENCER SHOWN. ADJUST PIPE RISER AS REQUIRED TO MATCH OVERALL HEIGHT INDICATED IF OTHER FILTER MANUFACTURER IS FURNISHED.

4 IF AN INLET SILENCER IS FURNISHED AT THE BLOWER INLET (IN ADDITION TO OUTDOOR FILTER SILENCER), CONTRACTOR SHALL FURNISH 304 SST SUPPORTS FOR SILENCER IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS.

5 INSULATE ALL BLOWER DISCHARGE PIPING WITHIN THE BLOWER ROOM AS SHOWN. DO NOT INSULATE BLOWER MANUFACTURER FURNISHED APPURTENANCES SUCH AS SILENCERS OR VALVES. TERMINATE INSULATION SHORT OF APPURTENANCE FLANGES TO ALLOW DISASSEMBLY WITHOUT DISTURBING INSULATION.

6 PIPE WALL PENETRATION (MASONRY WALL). SEE PROCESS STANDARD DETAILS. SEE ARCHITECTURAL DRAWINGS FOR ADDITIONAL REQUIREMENTS AT PIPE WALL PENETRATIONS.

7 CONCRET CRADEL PIPE SUPPORT, SEE STRUCTURAL STANDARD DETAILS.

8 24" SINGLE ARCH ELASTOMERIC BELLOWS EXPANSION JOINT, TYPICAL.

Autodesk Docs://10342803_COL_PCWWT_AB_Expansion_2024/31 - PLANT II BLOWER BUILDING (PROPOSED) - PROCESS.rvt
6/13/2025 9:44:25 AM

HDR
TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13/2025	ISSUED FOR BID

PROJECT MANAGER	J. R. CANTWELL
DESIGNED BY	J. MACMANUS
DRAWN BY	A. FREEMON
CHECKED BY	M. BOND
APPROVED BY	T. PAULMANN
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
THOMAS A. PAULMANN
128794
LICENSED
PROFESSIONAL ENGINEER
6/13/25

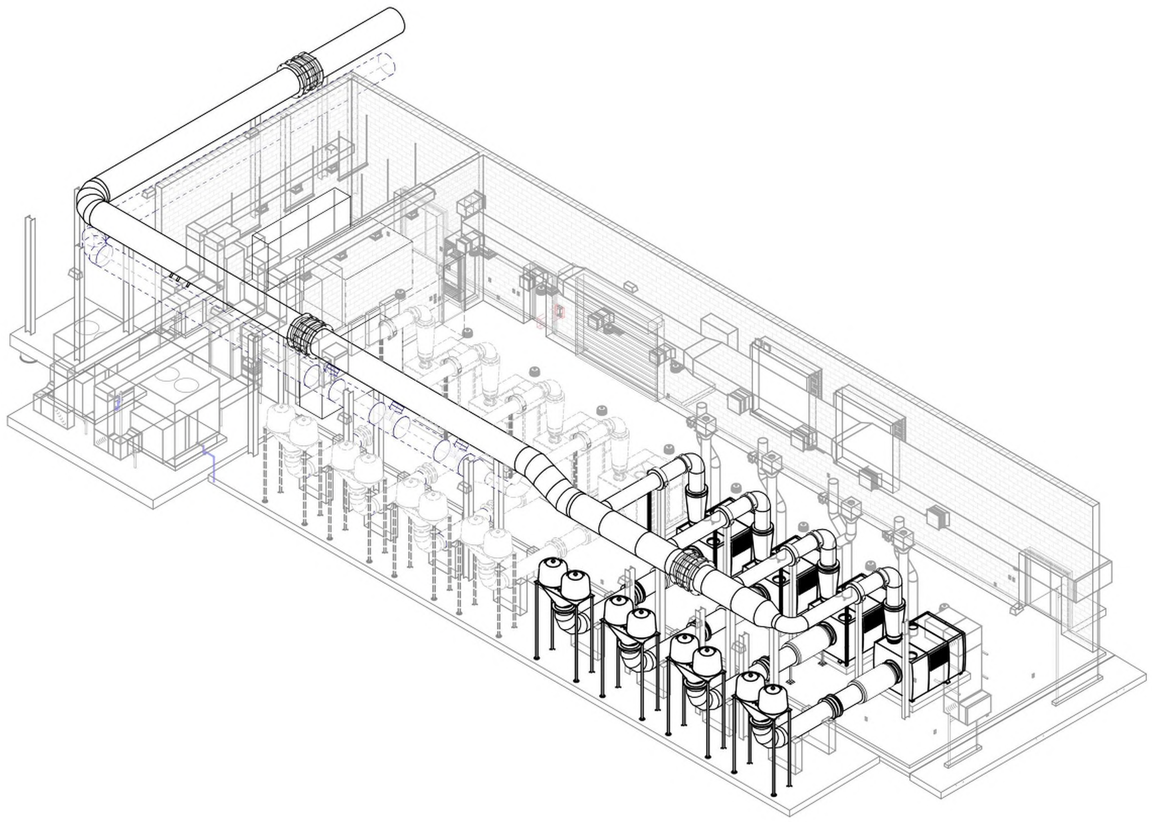
LEWISVILLE
Deep Roots. Broad Wings. Bright Future

CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

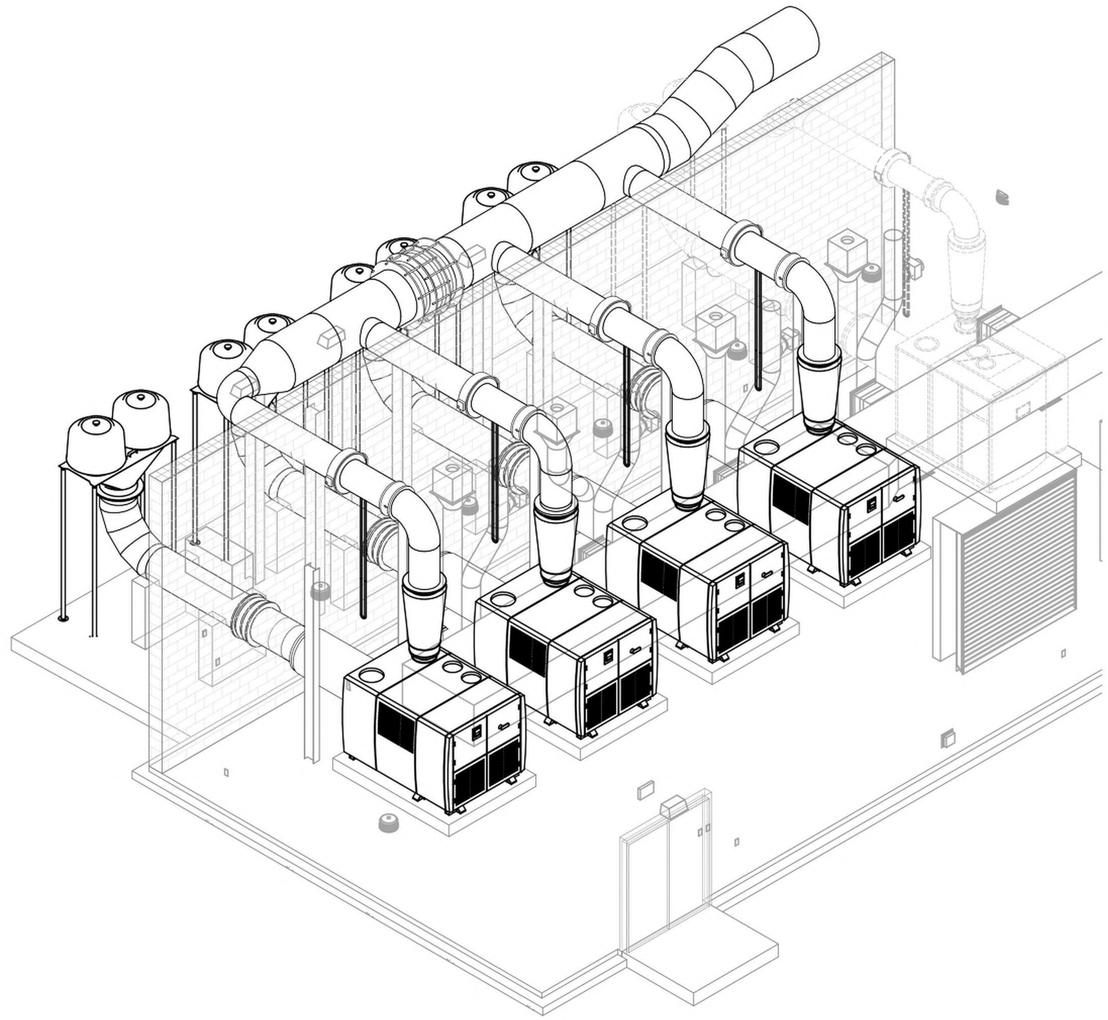
PLANT II BLOWER BUILDING (PROPOSED)
PROCESS
SECTIONS

FILENAME: 31 - PLANT II BLOWER BUILDING (PROPOSED)
SCALE: 1/4" = 1'-0"
0 1" 2"

SHEET
31D302



ISOMETRIC VIEW - SOUTH WEST
NOT TO SCALE



ISOMETRIC VIEW - SOUTH EAST
NOT TO SCALE

Autodesk Docs://10342803_COL_PCWWT_AB_Expansion_2024/31 - PLANT II BLOWER BUILDING (PROPOSED) - PROCESS.rvt
6/13/2025 9:44:27 AM

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13/2025	ISSUED FOR BID

PROJECT MANAGER	J. R. CANTWELL
DESIGNED BY	J. MACMANUS
DRAWN BY	A. FREEMON
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APPROVED BY	T. PAULMANN
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
THOMAS A. PAULMANN
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6/13/25

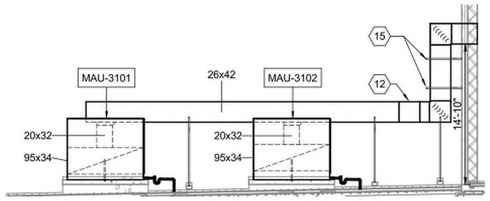
LEWISVILLE
Deep Roots. Broad Wings. Bright Future

CITY OF LEWISVILLE
PRAIRIE CREEK

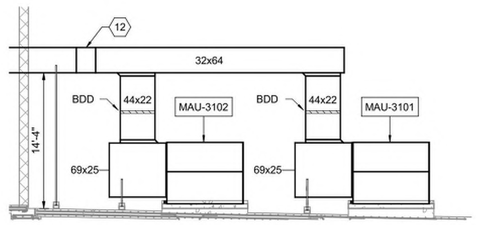
AERATION BASIN EXPANSION

PLANT II BLOWER BUILDING (PROPOSED)
PROCESS
ISOMETRIC

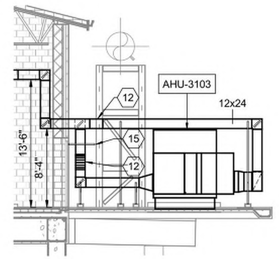
FILENAME: 31 - PLANT II BLOWER BUILDING (PROPOSED)
SCALE: 0 1" 2"
SHEET: 31D601



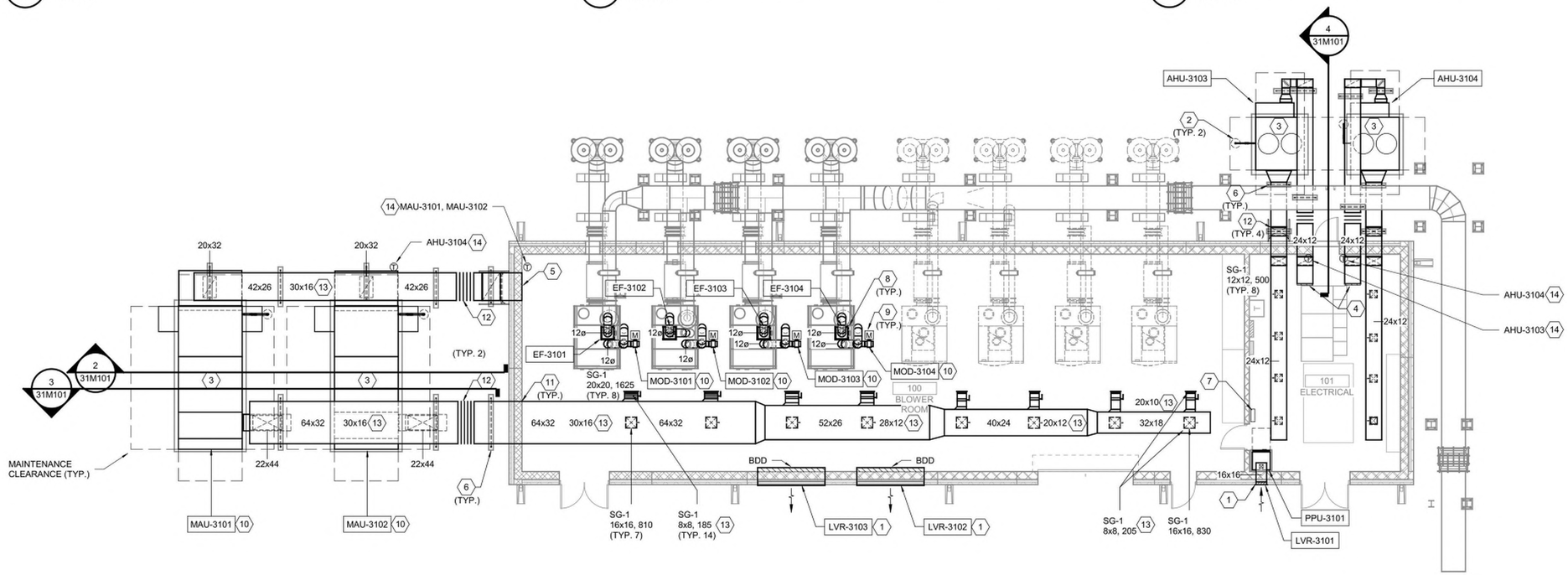
2 / 31M101 MAU-3101, MAU-3102 RETURN SECTION
1/8" = 1'-0"



3 / 31M101 MAU-3101, MAU-3102 SUPPLY SECTION
1/8" = 1'-0"



4 / 31M101 AHU-3103 SECTION
1/8" = 1'-0"



1 / 31M101 PLANT II BLOWER BUILDING (PROPOSED) MECHANICAL PLAN
1/8" = 1'-0"

GENERAL NOTES (APPLY TO ALL M SHEETS)

1. REFER TO 00M001 FOR ADDITIONAL GENERAL NOTES.

2. REFER TO 00M501 FOR STANDARD DUCT CONSTRUCTION, AND BOOT TAP DETAILS. REFER TO 00M502 FOR DUCT PENETRATION THRU NON-RATED ROOF/WALL/FLOOR DETAIL.

3. BRANCH DUCTWORK SIZES SERVING GRILLES SHALL BE SAME AS GRILLE SIZE UNLESS NOTED OTHERWISE.

4. ALL ROOFING WORK SHALL BE DONE SO NOT TO VOID ANY EXISTING ROOFING WARRANTIES.

5. REFER TO M500 SERIES FOR DETAILS, M600 SERIES FOR SCHEDULES, AND M700 SERIES FOR CONTROLS.

KEYNOTES

1 REF: 00M501 FOR LOUVER IN WALL DETAIL.

2 ROUTE CONDENSATE DRAIN TO DRYWELL. REF: 00M501 FOR CONDENSATE DRAIN TRAP DETAIL AND 00M502 FOR CONDENSATE DRYWELL DETAIL.

3 PROVIDE CONCRETE PAD UNDER EQUIPMENT. REFER TO STRUCTURAL PLANS FOR REQUIREMENTS.

4 PROVIDE 20"x30" OPENING IN TOP OF DUCT COVERED BY ALUMINUM BIRD SCREEN.

5 REF: 00M502 FOR DUCT PENETRATION THRU NON-RATED WALLS/FLOOR/ROOF DETAIL. PROVIDE ALUMINUM BIRD SCREEN OVER DUCT OPENING AT WALL PENETRATION.

6 REF: 00M502 FOR DUCT SUPPORT DETAIL.

7 BLOWER ROOM HVAC CONTROL PANEL.

8 CONNECT VERTICAL DUCT TO BLOWER'S CONTROL CABINET HEAT REJECTION OUTLET. VERTICAL DUCT SHALL BE SAME AS CONNECTION SIZE. PROVIDE EF IN VERTICAL DUCT. PROVIDE 12" TALL SPOOL PIECE AT CONNECTION TO BLOWER THAT CAN BE REMOVED TO ALLOW FOR BLOWER TO BE REMOVED. ROUTE VERTICAL DUCT THRU ROOF AND TERMINATE WITH DOWNTURNED ELBOW WITH STAINLESS STEEL BIRD SCREEN. VERIFY EXACT CONTROL CABINET CONNECTION WITH BLOWER MFR PRIOR TO STARTING ANY WORK.

9 CONNECT VERTICAL DUCT TO BLOWER'S MOTOR CABINET HEAT REJECTION OUTLET. VERTICAL DUCT SHALL BE SAME AS CONNECTION SIZE. PROVIDE 12" TALL SPOOL PIECE AT CONNECTION TO BLOWER THAT CAN BE REMOVED TO ALLOW FOR BLOWER TO BE REMOVED. INSTALL MOD IN SIDE OF DUCT DOWNSTREAM OF THE SPOOL PIECE. ROUTE VERTICAL DUCT THRU ROOF AND TERMINATE WITH DOWNTURNED ELBOW WITH STAINLESS STEEL BIRD SCREEN. VERIFY EXACT MOTOR CABINET CONNECTION WITH BLOWER MFR PRIOR TO STARTING ANY WORK.

10 MAU-3101, MAU-3102, AND MOD-3101 THRU 3104 SHALL BE PROVIDED ONLY IF SULZER BLOWERS ARE PROVIDED. IF NEUROS BLOWERS ARE PROVIDED, MAU-3101 AND MAU-3102 ARE REPLACED WITH AHU-3101 AND AHU-3102 AND MOD-3101 THRU 3104 ARE NOT NEEDED.

11 PROVIDE BALANCING DAMPER IN DUCT BEFORE GRILLE. REF: 00M502 FOR DUCT PENETRATION THRU NON-RATED WALL/FLOOR/ROOF DETAIL.

12 PROVIDE FLEXIBLE DUCT CONNECTION. REF: 00M501 FOR FLEXIBLE DUCT CONNECTION DETAIL.

13 AHU OPTION DUCT SIZE AND GRILLE SIZE/AIRFLOW. EXACT CONNECTION SIZE TO EACH AHU SHALL MATCH AHU CONNECTION SIZE.

14 PROVIDE INSULATION INSERT BEHIND THERMOSTAT.

15 REF: 00M502 FOR SUPPORT FOR VERTICAL DUCT DETAIL.

HDR
TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13/2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	B. PERLBERG
DRAWN BY	J. VALLES
CHECKED BY	K. CHAUDHARI
APPROVED BY	B. PERLBERG
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
BRIAN R. PERLBERG
115197
LICENSED
PROFESSIONAL ENGINEER
06/13/2025

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN
EXPANSION

PLANT II BLOWER BUILDING (PROPOSED)
MECHANICAL
PLAN

N
0 1" 2"

FILENAME 31 - Plant II BLOWER BLDG (PROPOSED)- MECH.RVT
SCALE 1/8" = 1'-0"
SHEET 31M101

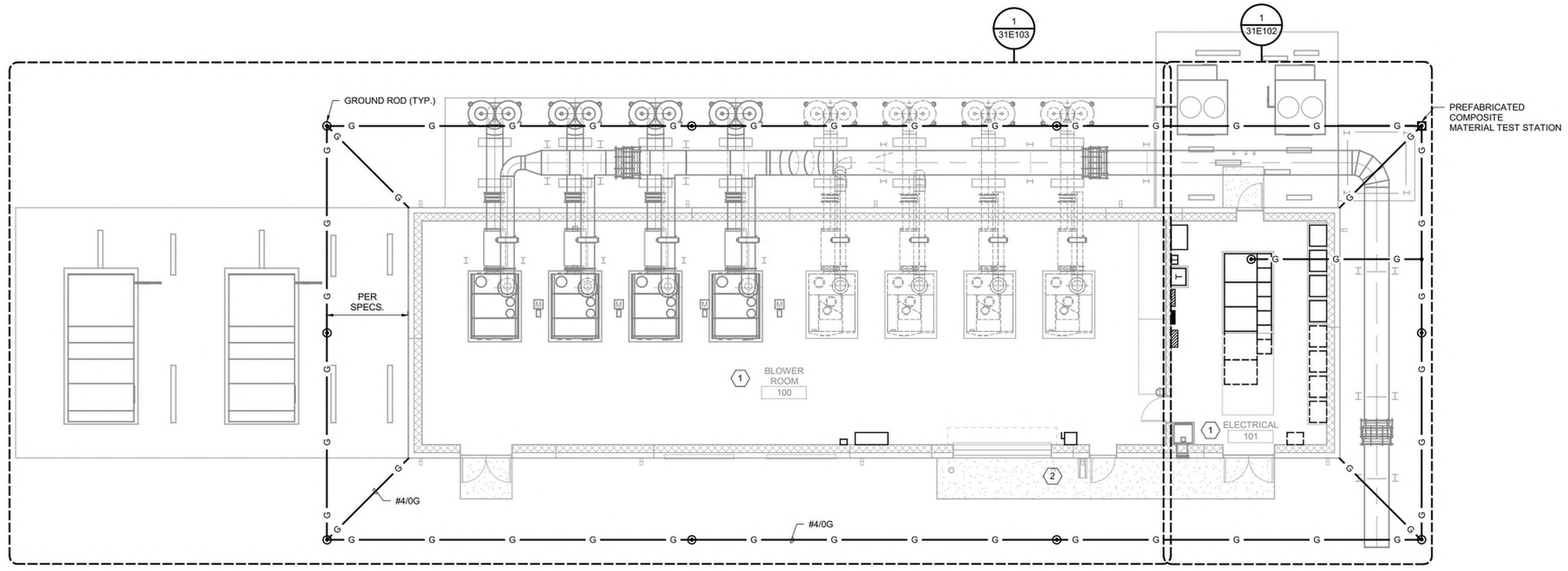
Autodesk Docs://10342803_COL_PCWWT_AB_Expansion_2024/31 - Plant II BLOWER BLDG (PROPOSED)- MECH.rvt
6/12/2025 10:57:56 PM

GENERAL NOTES:

1. RUN CONDUIT BETWEEN BLOWERS AND SWBD-3101 CONCEALED UNDER FLOOR SLAB.

KEY NOTES: (#)

1. AREA CLASSIFICATION IS INDOOR-DRY.
2. AREA CLASSIFICATION IS OUTDOOR-WET/CORROSIVE.



1 BLOWER BUILDING OVERALL POWER PLAN
1/8" = 1'-0"

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	O. JONGUITUD
DRAWN BY	B. LOREDO
CHECKED BY	G. JAGLOWSKI
APPROVED BY	O. JONGUITUD
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342603

STATE OF TEXAS
OSCAR JONGUITUD
133057
LICENSED
PROFESSIONAL ENGINEER
6-13-25

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

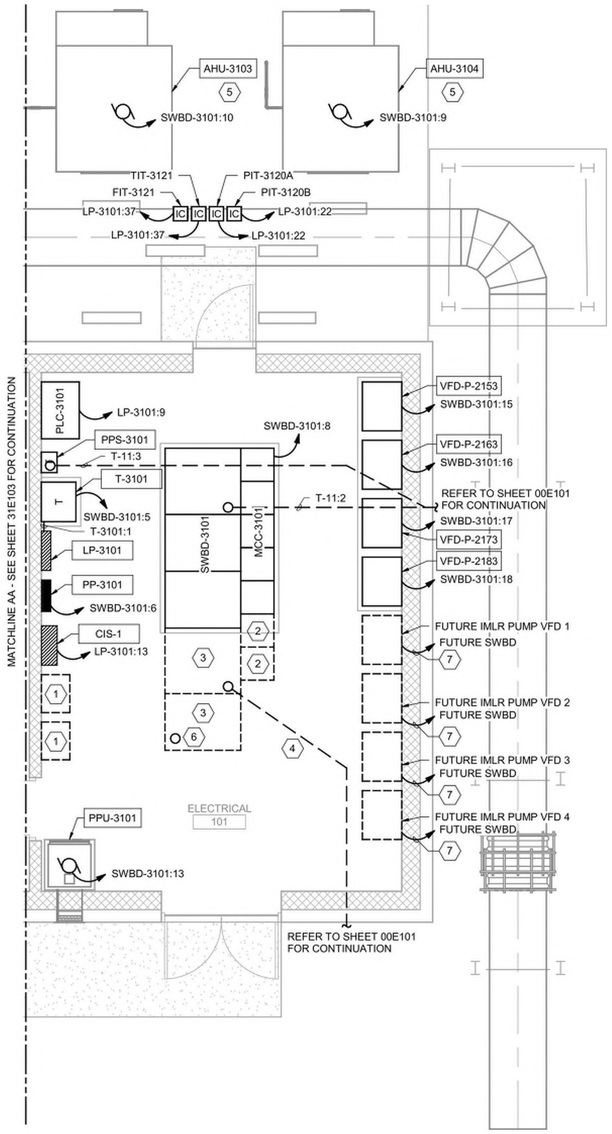
CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

PLANT II BLOWER BUILDING (PROPOSED)
ELECTRICAL
OVERALL POWER PLAN

N
0 1" 2"

FILENAME 31E101.dwg
SCALE 1/8" = 1'-0"

SHEET
31E101



1 / - ENLARGED ELECTRICAL ROOM POWER PLAN
1/4" = 1'-0"

GENERAL NOTES:

1. RUN CONDUIT BETWEEN BLOWERS AND SWITCHBOARD CONCEALED UNDER FLOOR SLAB.
2. REFER TO PLANT II BLOWER BUILDING ELECTRICAL SWITCHBOARD SWBD-3101 ONE-LINE DIAGRAM ON SHEET 31E601.
3. REFER TO TRANSFORMER T-11 ONE-LINE DIAGRAM ON SHEET 00E602.
4. REFER TO LP-3101 SCHEDULE ON SHEET 31E603.
5. PROVIDE TOGGLE SWITCH FOR ALL INSTRUMENTATION DEVICES REQUIRING 120V POWER. TOGGLE SWITCH TO BE WITHIN SIGHT OF INSTRUMENT FOR DISCONNECTING MEANS. SWITCHES NOT SHOWN FOR CLARITY.

KEY NOTES: (#)

1. SPACE FOR FUTURE IMLR PUMP CONTROL PANEL.
2. SPACE FOR FUTURE MCC SECTION.
3. SPACE FOR FUTURE SWITCHBOARD.
4. PROVIDE TEN SETS OF 3" CONDUIT FROM FUTURE SWITCHBOARD LOCATION TO FUTURE TRANSFORMER T-12. RUN UNDER FLOOR SLAB.
5. AIR HANDLING UNIT DISCONNECT SWITCH TO BE PROVIDED BY AHU MANUFACTURER. SEE MECHANICAL SCHEDULES.
6. CONDUIT STUB-UP FROM BLOWERS B-3101 TO B-3104. SEE SHEET 31E103 FOR BLOWER LOCATIONS.
7. PROVIDE 1"C FOR FUTURE PUMP.

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	O. JONGUITUD
DRAWN BY	B. LOREDO
CHECKED BY	G. JAGLOWSKI
APPROVED BY	O. JONGUITUD
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342603

STATE OF TEXAS
OSCAR JONGUITUD
133057
LICENSED
PROFESSIONAL ENGINEER
6-13-25

LEWISVILLE
Deep Roots. Broad Wings. Bright Future

CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

PLANT II BLOWER BUILDING (PROPOSED)
ELECTRICAL
ENLARGED ELECTRICAL ROOM POWER PLAN

N
0 1" 2"

FILENAME 31E102.dwg
SCALE 1/4" = 1'-0"

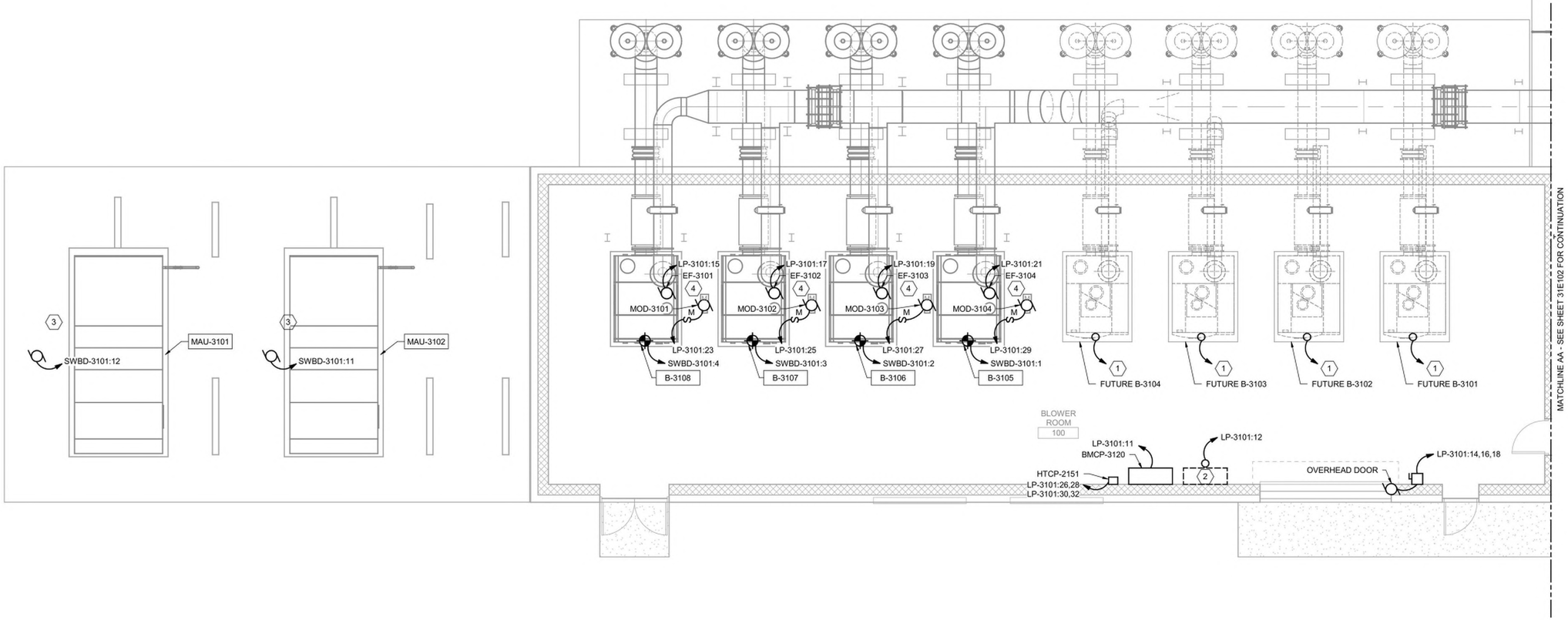
SHEET 31E102

GENERAL NOTES:

1. RUN CONDUIT BETWEEN BLOWERS AND SWITCHBOARD CONCEALED UNDER FLOOR SLAB.

KEY NOTES: (#)

1. PROVIDE 2 SETS OF 3" CONDUIT FOR FUTURE BLOWER. ROUTE CONDUIT FROM BLOWER TO FUTURE SWITCHBOARD AREA IN ELECTRICAL ROOM SHOWN ON SHEET 31E102.
2. SPACE FOR FUTURE BLOWER MASTER CONTROL PANEL.
3. AIR HANDLING UNIT DISCONNECT SWITCH TO BE PROVIDED BY AHU MANUFACTURER. SEE MECHANICAL SCHEDULES.
4. EXHAUST FAN DISCONNECT SWITCH TO BE PROVIDED BY EF MANUFACTURER. SEE MECHANICAL SCHEDULES.



1 / - ENLARGED BLOWER ROOM POWER PLAN
3/16" = 1'-0"

TEXAS P.E. FIRM
Registration No. F-754

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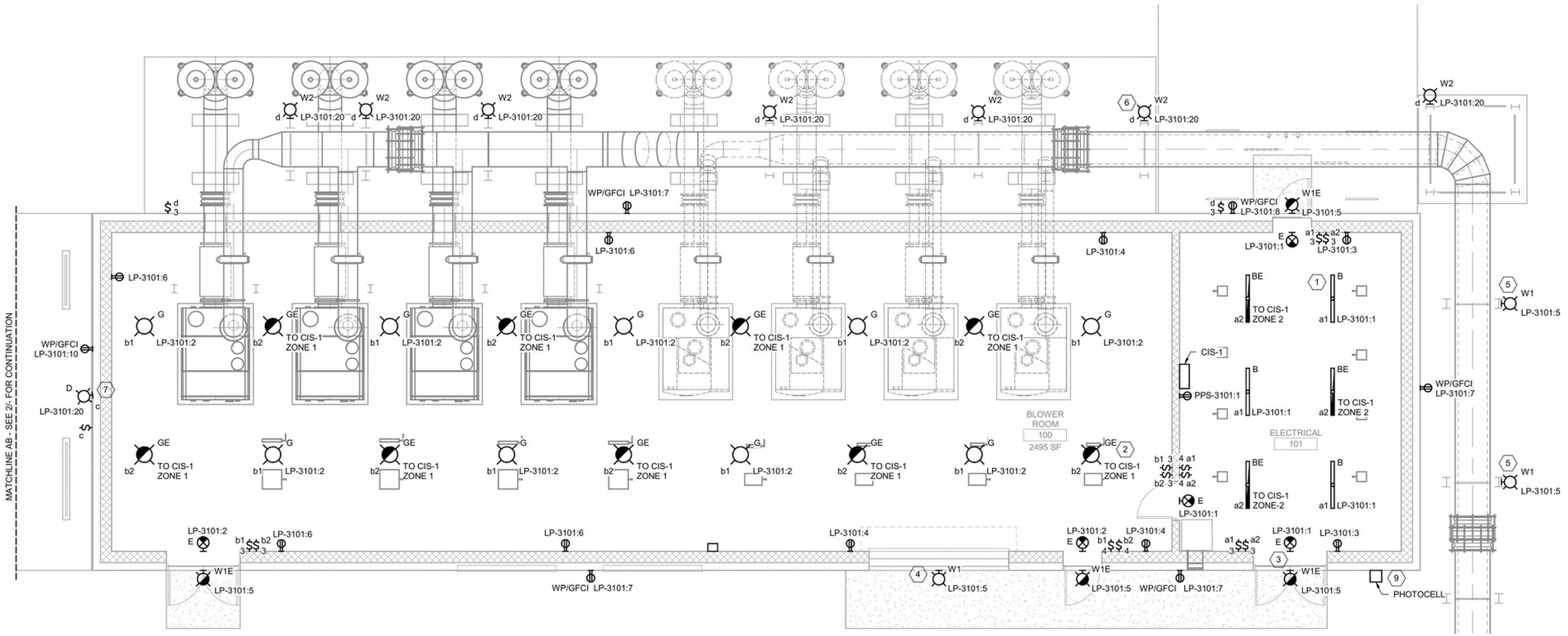
AERATION BASIN EXPANSION

PLANT II BLOWER BUILDING (PROPOSED)
ELECTRICAL
ENLARGED BLOWER ROOM POWER PLAN

N
0 1" 2"

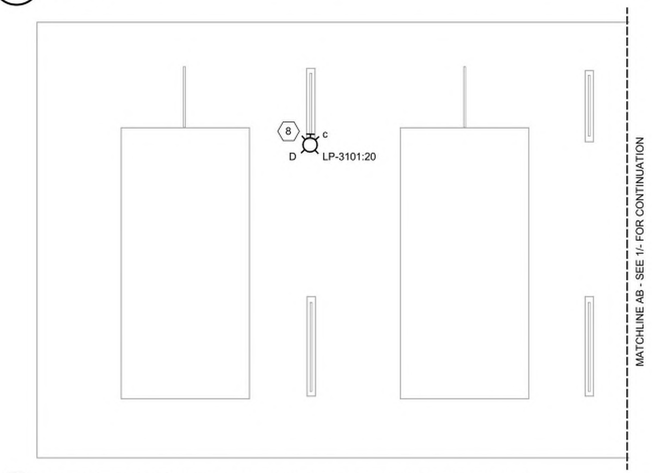
FILENAME 31E103.dwg
SCALE 3/16" = 1'-0"

SHEET
31E103



1 - BLOWER BUILDING LIGHTING AND RECEPTACLE PLAN

3/16" = 1'-0"



2 - BLOWER BUILDING AHU AREA LIGHTING PLAN

3/16" = 1'-0"

GENERAL NOTES:

1. REFER TO POWER PLAN ON SHEET 31E101 FOR AREA CLASSIFICATIONS.

KEY NOTES: (#)

1. MOUNT BOTTOM OF ELECTRICAL ROOM LIGHT FIXTURES TYPE B AND BE AT APPROXIMATELY 12'-6" A.F.F.
2. MOUNT BOTTOM OF BLOWER ROOM LIGHT FIXTURES TYPE G AND GE AT APPROXIMATELY 13'-6" A.F.F.
3. MOUNT BOTTOM OF LIGHT FIXTURE 0'-6" ABOVE TOP OF DOOR FRAME. TYPICAL FOR ALL E AND W1E TYPE FIXTURES SHOWN ON THIS DRAWING.
4. MOUNT BOTTOM OF LIGHT FIXTURE 0'-6" ABOVE TOP OF DOOR FRAME.
5. MOUNT LIGHT FIXTURE ON PIPE SUPPORT AND MOUNT BOTTOM OF LIGHT FIXTURE 10'-0" A.F.F.
6. MOUNT LIGHT FIXTURE ON PIPE SUPPORT AND MOUNT BOTTOM OF LIGHT FIXTURE 11'-6" A.F.F. TYPICAL FOR ALL W2 TYPE LIGHT FIXTURES SHOWN ON THIS DRAWING.
7. MOUNT BOTTOM OF LIGHT FIXTURE AT 13'-0" A.F.F. TILT 42.7 DEGREES.
8. MOUNT BOTTOM OF LIGHT FIXTURE AT 6'-6" A.F.F. ON HVAC SUPPORT. TILT 29.5 DEGREES.
9. PROVIDE PHOTOCELL AND WIRE TO AERATION BASIN NO. 5-8 AND SECONDARY CLARIFIER SPLITTER STRUCTURE LIGHT FIXTURES TYPE F1 AND F2 ON CIRCUIT MCC-3101:9.

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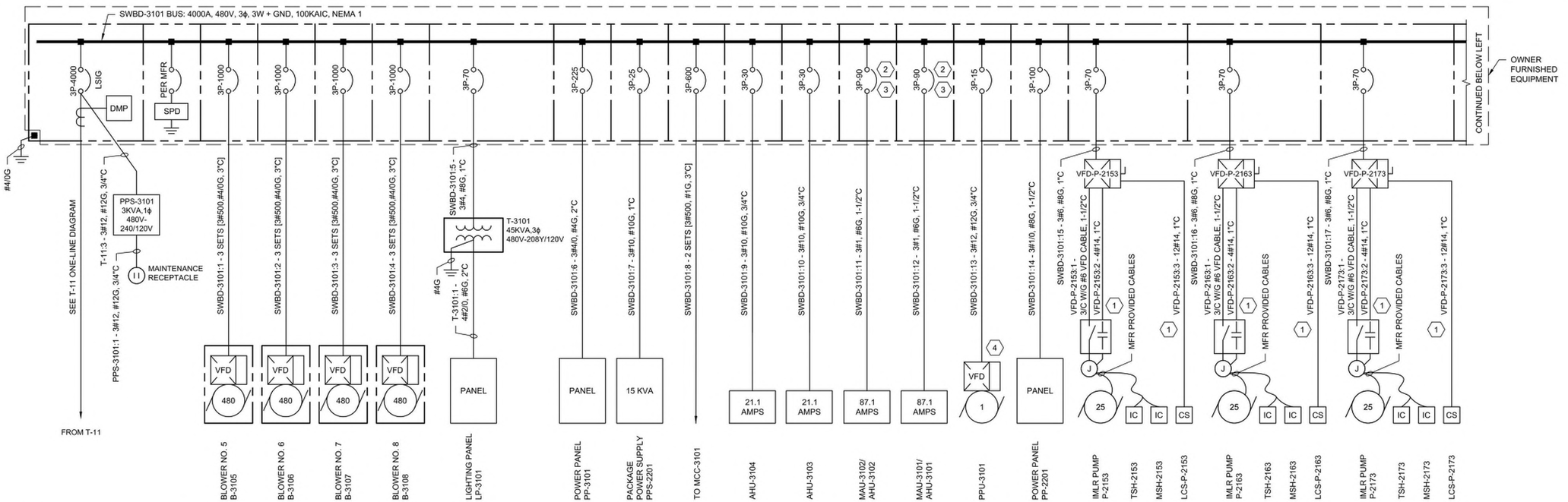
PLANT II BLOWER BUILDING (PROPOSED)
ELECTRICAL
LIGHTING AND RECEPTACLE PLAN

N
0 1" 2"

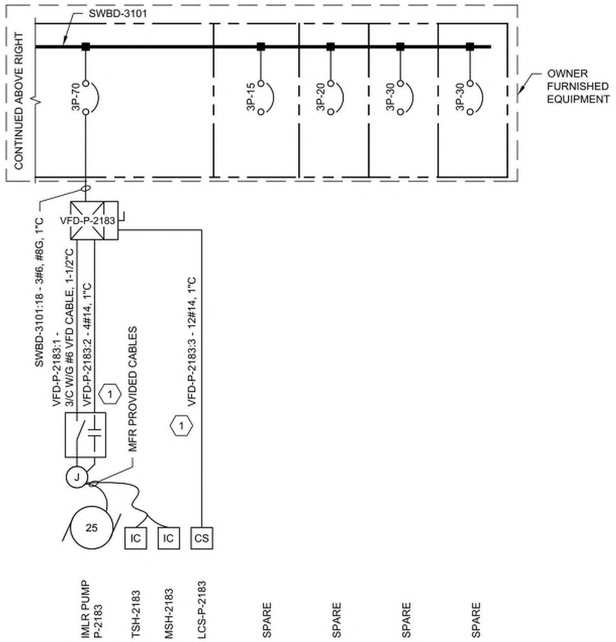
FILENAME	31E104.dwg
SCALE	3/16" = 1'-0"

SHEET
31E104



1 - SWBD-3101 ONE-LINE DIAGRAM

SCALE: NONE



SWBD- 3101

MOTOR LOAD	**HP**	**FLA @ 480V**
BLOWER NO.5 B-3105	480	541
BLOWER NO.6 B-3106	480	541
BLOWER NO.7 B-3107	480	541
BLOWER NO.8 B-3108	480	541
IMLR PUMP 5 P-2153	25	34
IMLR PUMP 6 P-2163	25	34
IMLR PUMP 7 P-2173	25	34
IMLR PUMP 8 P-2183	25	34
PPU-3101	1	2.1
SUBTOTAL MOTOR LOADS		2302.1

NON-MOTOR LOADS	**kVA**	**FLA @ 480V**
XFMR T-3101	45	54.1
POWER PANEL PP-2201	-	100
POWER PANEL PP-3101	-	225
PACKAGE POWER SUPPLY PPS-2201	15	18
MCC-3101 FEEDER	-	79.6
AIR HANDLING UNIT AHU-3101		87.2
AIR HANDLING UNIT AHU-3102		87.2
AIR HANDLING UNIT AHU-3103	-	21.1
AIR HANDLING UNIT AHU-3104	-	21.1
SUBTOTAL NON-MOTOR LOADS		693.4
SUBTOTAL CONNECTED LOAD		2995.5
25% OF LARGEST MOTOR		135.3
SUBTOTAL - MINIMUM MCC AMPACITY PER NEC		3130.7
20% SPARE CAPACITY		626.1
TOTAL, WITH +20% SPARE CAPACITY		3757
SWBD SIZE:		4000A

2 - BLOWER BUILDING LOAD ANALYSIS

SCALE: NONE

GENERAL NOTES:

1. BLOWER VARIABLE FREQUENCY DRIVES ARE INTEGRAL TO THE BLOWER PACKAGE AND PROVIDED BY THE BLOWER MFR.

KEYED NOTES: (#)

1. INSTRUMENTATION DIGITAL WIRING CIRCUIT IS COMBINED IN DUCTBANK SECTION F VIA CONDUIT TAGGED AS M. CONDUIT FILL TO NOT EXCEED 40% PER NEC.
2. PROVIDE BREAKER FOR OWNER FURNISHED SWITCHBOARD.
3. FINAL BREAKER SIZE SELECTION TO BE DETERMINED BY FINAL HVAC UNIT SELECTION. COORDINATE WITH MECHANICAL CONTRACTOR.
4. VFD PROVIDED BY THE PPU MANUFACTURER.

HDR
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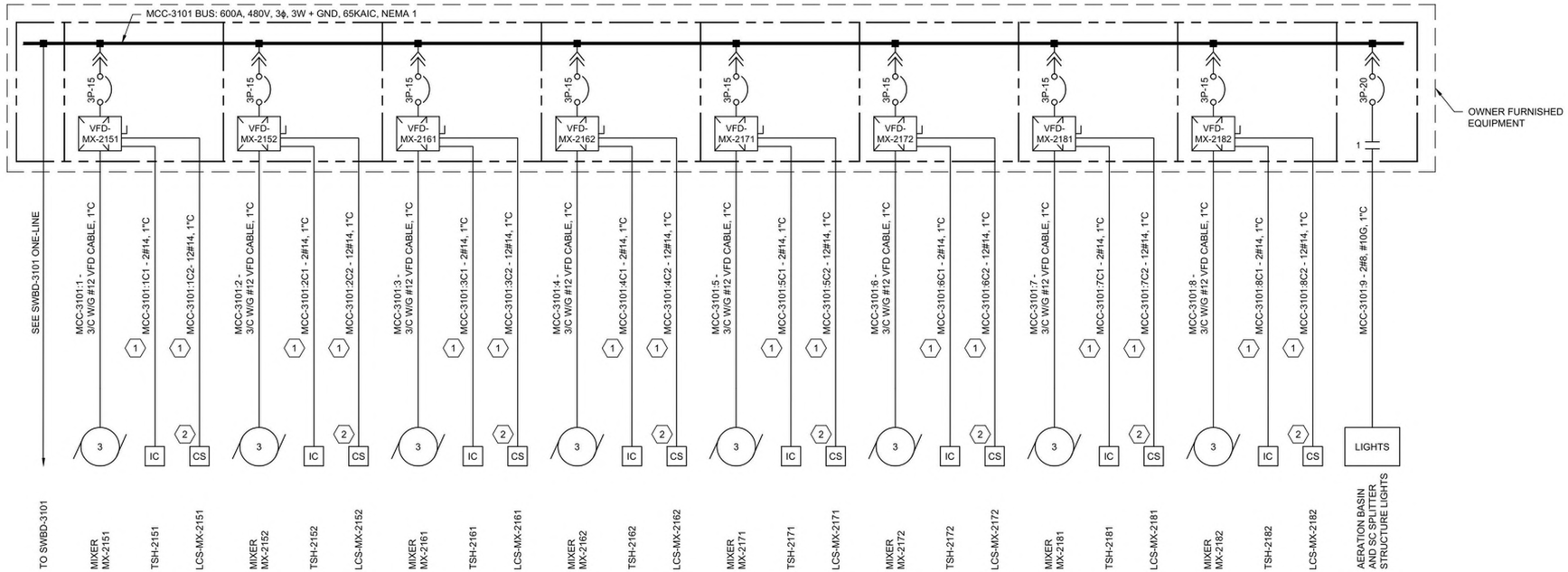
AERATION BASIN EXPANSION

PLANT II BLOWER BUILDING (PROPOSED)
ELECTRICAL
SWITCHBOARD SWBD-3101
ONE-LINE DIAGRAM

0 1" 2"

FILENAME 31E601.dwg
SCALE NONE

SHEET
31E601



1 / - MCC-3101 ONE-LINE DIAGRAM
SCALE: NONE

KEYED NOTES: (#)

1. INSTRUMENTATION DIGITAL WIRING CIRCUIT IS COMBINED IN DUCTBANK SECTION F VIA CONDUIT TAGGED AS M. CONDUIT FILL TO NOT EXCEED 40% PER NEC.
2. CONTRACTOR SHALL PROVIDE LOCAL CONTROL STATION. REFER TO MIXER CONTROL SCHEMATIC SHEET IN EARLY PROCUREMENT PACKAGE.

MCC-3101

MOTOR LOAD	**HP**	**FLA @ 480V**
BASIN 5 MIXER 1 MX-2151	3	4.8
BASIN 5 MIXER 2 MX-2152	3	4.8
BASIN 6 MIXER 1 MX-2161	3	4.8
BASIN 6 MIXER 2 MX-2162	3	4.8
BASIN 7 MIXER 1 MX-2171	3	4.8
BASIN 7 MIXER 2 MX-2172	3	4.8
BASIN 8 MIXER 1 MX-2181	3	4.8
BASIN 8 MIXER 2 MX-2182	3	4.8
FUTURE BASIN 1 MIXER 1	1.5	3
FUTURE BASIN 1 MIXER 2	1.5	3
FUTURE BASIN 2 MIXER 1	1.5	3
FUTURE BASIN 2 MIXER 2	1.5	3
FUTURE BASIN 3 MIXER 1	1.5	3
FUTURE BASIN 3 MIXER 2	1.5	3
FUTURE BASIN 4 MIXER 1	1.5	3
FUTURE BASIN 4 MIXER 2	1.5	3
SUBTOTAL MOTOR LOADS		62.4

NON-MOTOR LOADS	**kVA**	**FLA @ 480V**
AERATION BASIN & SPLITTER LIGHTS		16.0
SUBTOTAL NON-MOTOR LOADS		16.0
SUBTOTAL CONNECTED LOAD		78.4
25% OF LARGEST MOTOR		1.2
SUBTOTAL - MINIMUM MCC AMPACITY PER NEC		79.6
20% SPARE CAPACITY		15.9
TOTAL, WITH +20% SPARE CAPACITY		96
MCC SIZE:		600A

2 / - MCC-3101 LOAD ANALYSIS
SCALE: NONE

1	2	3	4	5
SPD	MIXER MX-2151 VFD	MIXER MX-2162 VFD	MIXER MX-2181 VFD	SPACE
				SPACE
INCOMING LINE AND CTS	MIXER MX-2152 VFD	MIXER MX-2171 VFD	MIXER MX-2182 VFD	SPACE
				SPACE
	MIXER MX-2161 VFD	MIXER MX-2172 VFD	LIGHTING CONTACTOR CB	SPACE
			SPACE	SPACE

3 / - MCC-3101 ELEVATIONS
SCALE: NONE

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CHECKED BY	G. JAGLOWSKI	
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CITY PROJECT NO.	U2100	
PROJECT NUMBER	10342803	

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STATE OF TEXAS
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PRAIRIE CREEK

AERATION BASIN EXPANSION

PLANT II BLOWER BUILDING (PROPOSED)
ELECTRICAL
MCC-3101 ONE-LINE DIAGRAM

0 1" 2"

FILENAME 31E602.dwg
SCALE NONE

SHEET
31E602

PANELBOARD 'PP-3101'

LOCATION: BLOWER BUILDING ELECTRICAL ROOM | VOLTAGE: 480 V | KAIC: 65 | BUSSING SHALL BE FULLY RATED
MOUNTING: SURFACE | PHASE: 3 P / 3W | CODES: 0=EQPT, 1=RCPT, 2=LTG, 3=A/C, 4=HEAT
ENCLOSURE: NEMA 1 STYLE: PER SPEC | BUSSING: 225 A | 5=CONTINUOUS MOTORS, 6=LRGST MOTOR, 7=PANEL
BRKR MTG: BOLT-ON | MCB: 225 A | ACCESSORIES: GROUND BUS, 42 SPACE
BREAKERS: 60/75 DEGREE TERMINALS | MLO: A

WIRING PHASE	WIRING NEUT.	WIRING GND	WIRING CONDUIT	CODE	BRKR	CIRCUIT USE	CKT	LOAD	A	B	C	LOAD	CKT	CIRCUIT USE	BRKR	CODE	WIRING PHASE	WIRING NEUT.	WIRING GND	WIRING CONDUIT
-	-	-	-	-	15/3	SPARE	1	-	X				2	SPACE						
				-			3	-		X			4							
				-			5	-			X		6							
-	-	-	-	-	15/3	SPARE	7	-	X				8	SPACE						
				-			9	-		X			10							
				-			11	-			X		12							
-	-	-	-	-	20/3	SPARE	13	-	X				14	SPACE						
				-			15	-		X			16							
				-			17	-			X		18							
-	-	-	-	-	20/3	SPARE	19	-	X				20	SPACE						
				-			21	-		X			22							
				-			23	-			X		24							
-	-	-	-	-	20/3	SPARE	25	-	X				26	SPACE						
				-			27	-		X			28							
				-			29	-			X		30							
-	-	-	-	-	30/3	SPARE	31	-	X				32	SPACE						
				-			33	-		X			34							
				-			35	-			X		36							
-	-	-	-	-	30/3	SPARE	37	-	X			-	38	SPD	PER MFR	-	-	-	-	-
				-			39	-		X		-	40			-				
				-			41	-			X	-	42			-				

	EQPT VA	RCPT VA	LTG VA	AC/HEAT VA	MOTORS	CONN VA	FTL VA	PANEL VA	PHASE AMP
PHASE A	0	0	0	0	0	0		0	0
PHASE B	0	0	0	0	0	0		0	0
PHASE C	0	0	0	0	0	0		0	0
TOTAL	0	0	0	0	0	0		0	

PANEL DEMAND KVA: 0.00 | PANEL DEMAND AMPACITY: 0 AMPS
RESERVE KVA: 0.00 | RESERVE AMPACITY: 0 AMPS
DESIGN KVA: 0.00 | DESIGN AMPACITY: 0 AMPS

1 - PANELBOARD PP-3101 SCHEDULE
SCALE: NONE

LIGHTING PANEL 'LP-3101'

LOCATION: BLOWER BUILDING ELECTRICAL ROOM | VOLTAGE: 208/120 V | KAIC: 22 | BUSSING SHALL BE FULLY RATED
MOUNTING: SURFACE | PHASE: 3 P / 4W | CODES: 0=EQPT, 1=RCPT, 2=LTG, 3=A/C, 4=HEAT
ENCLOSURE: NEMA 1 STYLE: PER SPECS | BUSSING: 125 A | 5=CONTINUOUS MOTORS, 6=LRGST MOTOR, 7=PANEL
BRKR MTG: BOLT-ON | MCB: 125 A | ACCESSORIES: GROUND BUS, 48 SPACE
BREAKERS: 60/75 DEGREE TERMINALS | MLO: A

WIRING PHASE	WIRING NEUT.	WIRING GND	WIRING CONDUIT	CODE	BRKR	CIRCUIT USE	CKT	LOAD	A	B	C	LOAD	CKT	CIRCUIT USE	BRKR	CODE	WIRING PHASE	WIRING NEUT.	WIRING GND	WIRING CONDUIT
#12	#12	#12	3/4"	2	20/1	ELECTRICAL ROOM NON EMERGENCY LIGHTS	1	111	X			522	2	BLOWER ROOM NON EMERGENCY LIGHTS	20/1	2	#12	#12	#12	3/4"
#12	#12	#12	3/4"	1	20/1	ELECTRICAL ROOM RECEPTACLES	3	360		X		540	4	BLOWER ROOM RECEPTACLES	20/1	1	#12	#12	#12	3/4"
#12	#12	#12	3/4"	2	20/1	EXTERIOR LIGHTS	5	68			X	720	6	BLOWER ROOM RECEPTACLES	20/1	1	#12	#12	#12	3/4"
#12	#12	#12	3/4"	1	20/1	EXTERIOR RECEPTACLES	7	720	X			180	8	ELECT RM AHU SERVICE RECEPTACLE	20/1	1	#12	#12	#12	3/4"
#12	#12	#12	3/4"	0	20/1	PLC-3101	9	600		X		180	10	BLOWER RM AHU SERVICE RECEPTACLE	20/1	1	#12	#12	#12	3/4"
#10	#10	#10	3/4"	0	30/1	BLOWER MASTER CONTROL PANEL BMCP-3120	11	2,400			X	2,400	12	FUTURE BLOWER MASTER CONTROL PANEL	30/1	0	-	-	-	3/4"
#12	#12	#12	3/4"	2	20/1	CENTRAL INVERTER CIS-1	13	618	X			1,273	14	OVERHEAD DOOR 31-100C	20/3	0	#12	-	#12	3/4"
#12	#12	#12	3/4"	0	20/1	EF-3101	15	696		X		1,273	16			0				
#12	#12	#12	3/4"	0	20/1	EF-3102	17	696			X	1,273	18			0				
#12	#12	#12	3/4"	0	20/1	EF-3103	19	696	X			221	20	EXTERIOR AHU AND BLOWER FILTER LIGHTS	20/1	2	#12	#12	#12	3/4"
#12	#12	#12	3/4"	0	20/1	EF-3104	21	696		X		240	22	PIT-3120A, PIT-3120B	20/1	0	#12	#12	#12	3/4"
#12	#12	#12	3/4"	0	20/1	MOD-3101	23	348			X		24	SPARE	20/1	-	-	-	-	-
#12	#12	#12	3/4"	0	20/1	MOD-3102	25	348	X			2,912	26	HEAT TRACE CONTROLLER AND AERATION BASINS 5 & 6 HEAT TRACE (1)	50/2	0	#6	-	#10	1"
#12	#12	#12	3/4"	0	20/1	MOD-3103	27	348		X		2,912	28			0				
#12	#12	#12	3/4"	0	20/1	MOD-3104	29	348			X	2,912	30	AERATION BASINS 7 & 8 HEAT TRACE (1)	50/2	0	#6	-	#10	1"
-	-	-	-	-	20/1	SPARE	31	-	X			2,912	32			0				
-	-	-	-	-	20/1	SPARE	33	-		X			34	SPACE						
#12	#12	#12	3/4"	0	20/1	LIT-1101	35	120			X		36	SPACE						
#12	#12	#12	3/4"	0	20/1	FIT-3121, TIT-3121	37	240	X				38	SPACE						
-	-	-	-	-	20/1	SPARE	39	-		X			40	SPACE						
-	-	-	-	-	20/1	SPARE	41	-			X		42	SPACE						
-	-	-	-	-	20/1	SPARE	43	-	X				44	SPD	PER MFR	-	-	-	-	-
-	-	-	-	-	20/1	SPARE	45	-		X			46			-				
-	-	-	-	-	20/1	SPARE	47	-			X		48			-				

	EQPT VA	RCPT VA	LTG VA	AC/HEAT VA	MOTORS	CONN VA	FTL VA	PANEL VA	PHASE AMP
PHASE A	8381	900	1472	0	0	10753		11121	93
PHASE B	6765	1080	0	0	0	7845		7845	65
PHASE C	10497	720	68	0	0	11285		11302	94
TOTAL	25643	2700	1540	0	0	29883		30268	

PANEL DEMAND KVA: 30.27 | PANEL DEMAND AMPACITY: 84 AMPS
RESERVE KVA: 7.57 | RESERVE AMPACITY: 21 AMPS
DESIGN KVA: 37.84 | DESIGN AMPACITY: 105 AMPS

2 - PANELBOARD LP-3101 SCHEDULE
SCALE: NONE

KEYED NOTES: (#)

1. PROVIDE GFPE BREAKERS.
2. COORDINATE WITH MECHANICAL CONTRACTOR IF MOD'S ARE NEEDED BASED ON FINAL MECHANICAL EQUIPMENT SELECTION.

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PRAIRIE CREEK
AERATION BASIN EXPANSION

PLANT II BLOWER BUILDING (PROPOSED)
ELECTRICAL
PANEL SCHEDULES

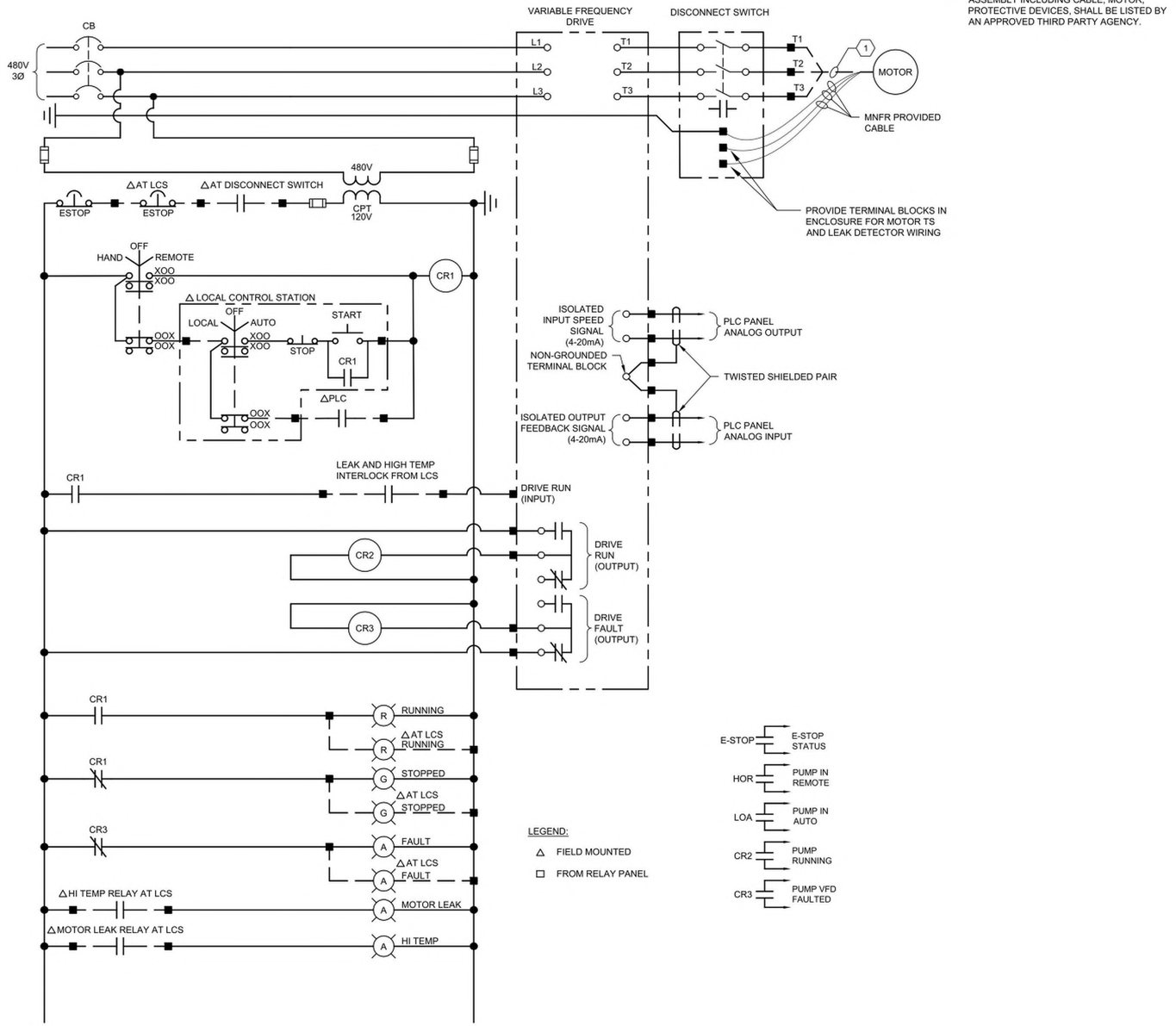
0 1" 2"

FILENAME 31E603.dwg
SCALE NONE

SHEET
31E603

KEYED NOTES:

1. SUBMERSIBLE PUMP MOTOR CABLE. ENTIRE ASSEMBLY INCLUDING CABLE, MOTOR, PROTECTIVE DEVICES, SHALL BE LISTED BY AN APPROVED THIRD PARTY AGENCY.



1 / 31E604 IMLR PUMPS CONTROL SCHEMATIC

NOT TO SCALE

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PRAIRIE CREEK

AERATION BASIN EXPANSION

PLANT II BLOWER BUILDING (PROPOSED)
ELECTRICAL
CONTROL SCHEMATIC

0 1" 2"

FILENAME 31E604.dwg
SCALE NONE

SHEET 31E604

CODE REVIEW ANALYSIS	
1.0 INTRODUCTION	
THE FOLLOWING CODE REVIEW NARRATIVE IS PROVIDED TO SERVE AS A BASIS OF UNDERSTANDING FOR THE DEVELOPMENT OF THE DESIGN, DRAWINGS AND SPECIFICATIONS FOR THE PLANNED EXPANSION OF THE PRAIRIE CREEK WASTEWATER TREATMENT PLANT IN THE CITY OF LEWISVILLE, TEXAS. THE FOLLOWING ANALYSIS REVIEWS THE APPLICABLE BUILDING AND LIFE SAFETY CODES. THE AUTHORITIES HAVING JURISDICTION (AHJ'S) FOR THIS PROJECT INCLUDE THE CITY OF LEWISVILLE TEXAS CODE ENFORCEMENT DIVISION AND THE LEWISVILLE FIRE DEPARTMENT.	
1.1 DESIGN CODES	
BUILDING CODE	2021 INTERNATIONAL BUILDING CODE (IBC)
EXISTING BUILDING CODE	2021 INTERNATIONAL EXISTING BUILDING CODE (IEBC)
PLUMBING CODE	2021 INTERNATIONAL PLUMBING CODE (IPC)
MECHANICAL CODE	2021 INTERNATIONAL MECHANICAL CODE (IMC)
ELECTRICAL CODE	2020 NATIONAL ELECTRIC CODE (NEC), NFPA 70
FIRE CODE	2021 INTERNATIONAL FIRE CODE (IFC)
ENERGY CODE	2021 INTERNATIONAL ENERGY CONSERVATION CODE (IECC)
OTHER STANDARDS AND REFERENCE GUIDES:	
NFPA 820 - STANDARD FOR FIRE PROTECTION IN WASTEWATER TERATMENT AND COLLECTION FACILITIES - 2020	

CODE DATA TABLE	
2.0 PRAIRIE CREEK WWTP - EXISTING RAS/WAS PUMP STATION	
2.1 DESCRIPTION	
THE FOLLOWING CODE REVIEW NARRATIVE IS PROVIDED TO SERVE AS A BASIS OF UNDERSTANDING FOR THE DEVELOPMENT OF THE DESIGN, DRAWINGS, AND SPECIFICATIONS FOR THE IMPROVEMENTS BEING IMPLEMENTED AT THE EXISTING RAS/WAS PUMP STATION THAT IS LOCATED AT THE PRAIRIE CREEK WASTE WATER TREATMENT PLANT (WWTP). THE FOLLOWING ANALYSIS REVIEWS THE APPLICABLE BUILDING AND LIFE SAFETY CODES. SEE SECTION 2.3 EXISTING BUILDING CODE EVALUATION FOR CODE COMPLIANCE APPROACH.	
2.2 GENERAL BUILDING DATA SUMMARY	
OCCUPANCY CLASSIFICATION(S)	GROUP F-1 MODERATE HAZARD INDUSTRIAL
BUILDING AREA	APPROXIMATELY 3,774 SF
FIRE AREA	APPROXIMATELY 3,774 SF
HEIGHT	10' 0" (1 STORY ABOVE GRADE)
TYPE OF CONSTRUCTION	II-B (NON-COMBUSTIBLE)
FIRE SEPARATION DISTANCE	10' ≤ X < 30'
FIRE PROTECTION SYSTEMS	FIRE EXTINGUISHERS (EXISTING) FIRE HYDRANTS (EXISTING)
OCCUPANT LOAD (TOTAL)	13 (BASED UPON AN OCCUPANT LOAD FACTOR OF 300 SF/OCC FOR EQUIPMENT SPACES)
2.3 EXISTING BUILDING CODE EVALUATION - EXISTING RAS/WAS PUMP BUILDING	
INTERNATIONAL EXISTING BUILDING CODE (IEBC) - CLASSIFICATION OF WORK	
SUMMARY OF SCOPE OF WORK EXISTING RAS/WAS PUMP BUILDING: - ADDITION OF AN ELECTRICAL ROOM INSIDE OF EXISTING BUILDING FOOTPRINT - REPLACEMENT OF EXISTING PUMPS IEBC COMPLIANCE: THE ABOVE SCOPE OF WORK IS CLASSIFIED BY IEBC CHAPTER 5 AS AN ALTERATION. - THE SCOPE OF WORK DOES NOT AFFECT THE MEANS OF EGRESS NOR THE STRUCTURAL INTEGRITY OF THE BUILDING. - NO CHANGES TO STRUCTURAL BEARING WALLS/MEMBERS ARE EXPECTED. - THE SCOPE OF WORK DOES NOT AFFECT THE LEVEL OF FIRE PROTECTION PROVIDED. - BASED UPON THE ABOVE EVALUATION, THIS EXISTING BUILDING IS NOT REQUIRED BY THE IEBC TO BE BROUGHT INTO COMPLIANCE WITH THE LATEST EDITION OF THE IBC. HOWEVER ALL NEW CONSTRUCTION COMPONENTS WILL BE INSTALLED ACCORDING TO THE IBC. 2024 NFPA 820 RETROACTIVITY: 2024 NFPA 820 DOES NOT REQUIRE RETROACTIVE COMPLIANCE FOR THIS STRUCTURE BECAUSE THERE IS NO CHANGE TO THE PROCESS CAPACITY, NEC CLASSIFICATION, OR USE/OCCUPANCY.	

2.4 NFPA 820 REQUIREMENTS:			NFPA 820
ROOM NAME; LOCATION AND FUNCTION	VENTILATION PROVIDED; NEC AREA HAZARD CLASSIFICATION (ALL CLASS I, GROUP D)	FIRE PROTECTION MEASURES*	CODE REFERENCE
RAS/WAS PUMP STATION; DRY SIDE OF A SLUDGE PUMPING STATION	6 AC/HR; UNCLASSIFIED	H, FE	TABLE 6.2.2(a) ROW 9, LINE B

*(FE = FIRE EXTINGUISHER, H = FIRE HYDRANT)

Autodesk Docs://10342803_COL_PCWWT_AB_Expansion_2024/40 - RAS_WAS Pump Station (Existing) - ARCH.rvt
6/11/2025 1:31:10 PM

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13/2025	ISSUED FOR BID

PROJECT MANAGER	J. R. CANTWELL
DESIGNED BY	J. BELON
DRAWN BY	J. BELON
CHECKED BY	Z. SACHSENMAIER
APPROVED BY	
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
ZACHARY J. SACHSENMAIER
112524
LICENSED
PROFESSIONAL ENGINEER
6/13/2025

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

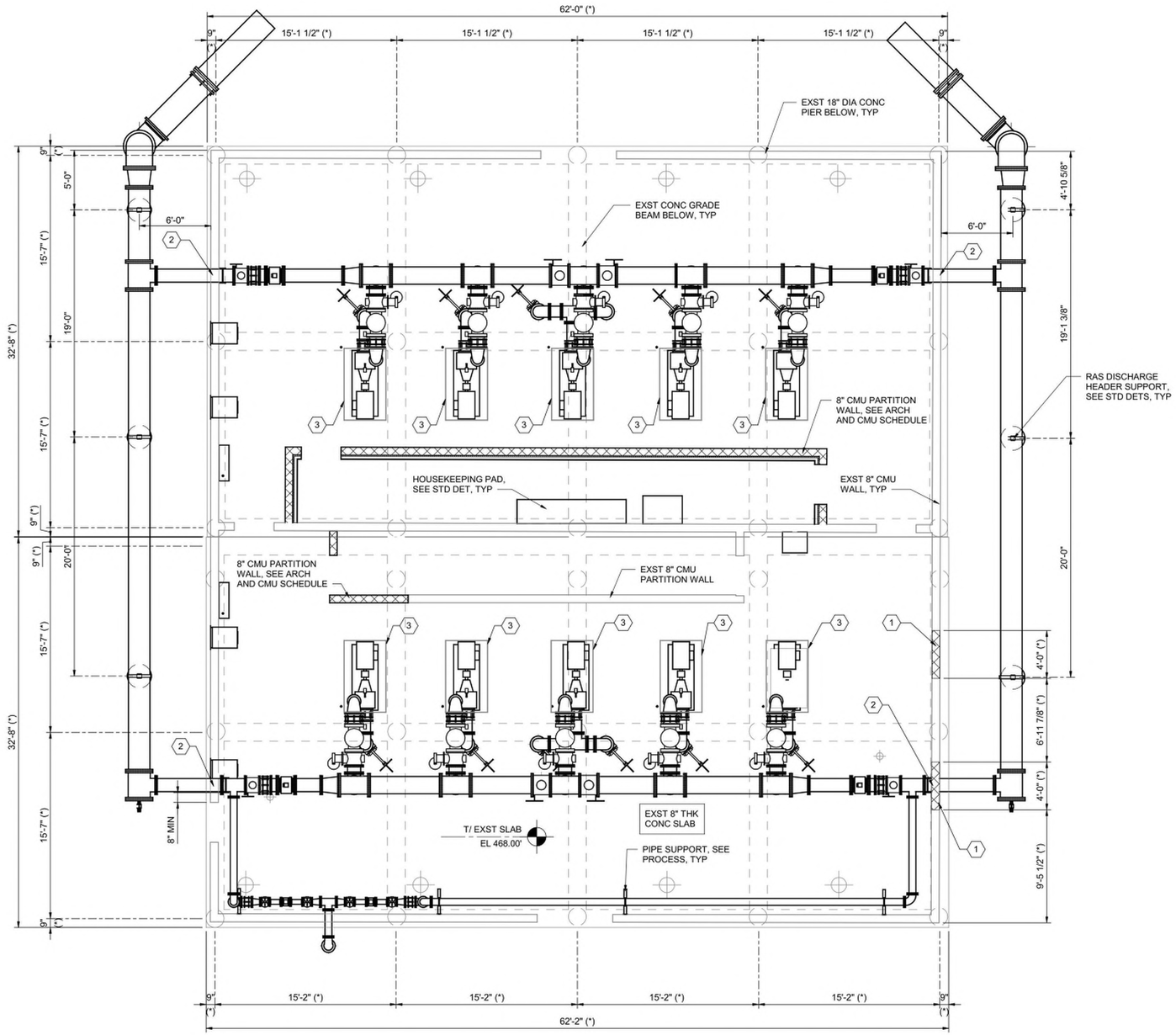
CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

RAS/WAS PUMP STATION (EXISTING)
GENERAL
LIFE SAFETY CODE ANALYSIS

0 1" 2"

FILENAME: HDRE_ALL_DISCIPLINES.rte
SCALE: NONE
SHEET: **40G001**



FOUNDATION PLAN

3/16" = 1'-0"

PLAN NOTES:

1. SEE STANDARD DRAWINGS FOR GENERAL STRUCTURAL NOTES AND STANDARD DETAILS.
2. LAYOUT SHOWN IN BASED ON TWO DIFFERENT SETS OF CONSTRUCTION PLANS FOR THE CITY OF LEWISVILLE, TEXAS. THE FIRST SET OF PLANS USED AS A REFERENCE IS THE EXPANSION OF WASTEWATER TREATMENT PLANT, DESIGNED BY SHIMEK, JACOBS & FINKLEA DATED APRIL 1987 AND THE SECOND SET OF PLANS IS THE WASTEWATER TREATMENT PLANT EXPANSION, PROJECT NO. 5395, DESIGNED BY BIRKHOFF, HENDRICKS & CONWAY, L.L.P. DATED SEPTEMBER 2004.
3. DIMENSIONS AND ELEVATIONS INDICATED WITH AN (*) ARE BASED ON EXISTING CONSTRUCTION PLANS DESCRIBED IN NOTE #2 AND ARE TO BE VERIFIED BY THE CONTRACTOR. ANY DISCREPANCIES SHALL BE SUBMITTED TO THE ENGINEER PRIOR TO CONSTRUCTION.
4. SEE PROCESS/MECHANICAL DRAWINGS FOR ALL PIPE SIZES, LOCATIONS, PENETRATIONS, AND PIPE SUPPORT DETAILS.
5. SEE PROCESS/MECHANICAL DRAWINGS FOR EQUIPMENT DETAILS, INCLUDING CONCRETE EQUIPMENT PAD LOCATIONS AND DIMENSIONS. SEE STRUCTURAL STANDARD DETAILS FOR CONCRETE EQUIPMENT PAD DETAILS.
6. SEE ELECTRICAL/MECHANICAL DRAWINGS FOR HOUSEKEEPING PAD SIZES AND LOCATIONS. SEE STRUCTURAL STANDARD DETAILS FOR PAD DETAILS.
7. SEE ARCHITECTURAL/MECHANICAL DRAWINGS FOR MASONRY OPENING DIMENSIONS AND LOCATIONS, INCLUDING LOUVERS AND OTHER MASONRY WALL PENETRATIONS. SEE 40S501 AND 40S502 FOR MASONRY LINTEL DETAILS.

KEYNOTES: (X)

1. INFILL CMU WALL AT EXISTING OPENING SEE 3/40S502.
2. NEW OPENING AT CMU WALL SEE 4/40S502. REFERENCE ARCHITECTURE AND PROCESS FOR SIZE AND LOCATION.
3. EXISTING CONCRETE EQUIPMENT PAD TO REMAIN AND SUPPORT NEW PUMPS. IF NEW PUMPS SELECTED BY CONTRACTOR DO NOT FIT ON OR MEET PUMP MANUFACTURER ANCHORAGE REQUIREMENTS, EXISTING EQUIPMENT PADS SHALL BE DEMOLISHED AND NEW TALL EQUIPMENT PADS, PER STANDARD DETAILS, SHALL BE PROVIDED. ALL ANCHORAGE SHALL BE DESIGNED AND DETAILED BY THE PUMP MANUFACTURER.

HDR
TEXAS P.E. FIRM
Registration No. F-754

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DRAWN BY	H. GARCIA
CHECKED BY	C. ZIMMERMAN
APPROVED BY	J. NAVE
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
JASON C. NAVE
130766
06/13/25

LEWISVILLE
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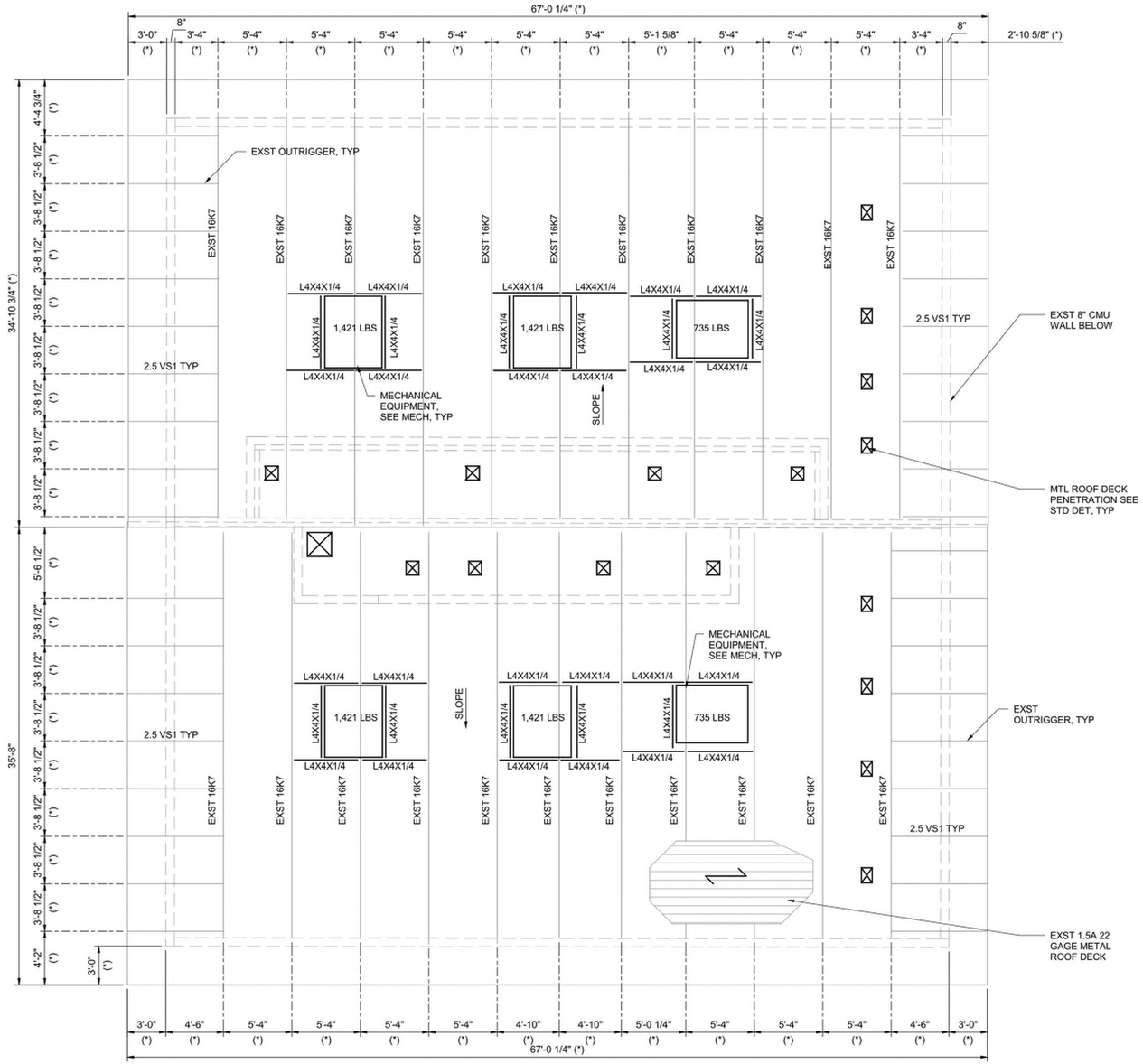
CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

N
0 1" 2"

RAS/WAS PUMP STATION (EXISTING)
STRUCTURAL
FOUNDATION PLAN

FILENAME	HDRE_ALL_DISCIPLINES.rte	SHEET	40S101
SCALE	3/16" = 1'-0"		



ROOF PLAN

3/16" = 1'-0"

PLAN NOTES:

1. SEE STANDARD DRAWINGS FOR GENERAL STRUCTURAL NOTES AND STANDARD DETAILS.
2. LAYOUT SHOWN IN BASED ON TWO DIFFERENT SETS OF CONSTRUCTION PLANS FOR THE CITY OF LEWISVILLE, TEXAS. THE FIRST SET OF PLANS USED AS A REFERENCE IS THE EXPANSION OF WASTEWATER TREATMENT PLANT, DESIGNED BY SHIMEK, JACOBS & FINKLEA DATED APRIL 1987 AND THE SECOND SET OF PLANS IS THE WASTEWATER TREATMENT PLANT EXPANSION, PROJECT NO. 5395, DESIGNED BY BIRKHOFF, HENDRICKS & CONWAY, L.L.P. DATED SEPTEMBER 2004.
3. DIMENSIONS AND ELEVATIONS INDICATED WITH AN (*) ARE BASED ON EXISTING CONSTRUCTION PLANS DESCRIBED IN NOTE #2 AND ARE TO BE VERIFIED BY THE CONTRACTOR. ANY DISCREPANCIES SHALL BE SUBMITTED TO THE ENGINEER PRIOR TO CONSTRUCTION.
4. SEE MECHANICAL DRAWINGS FOR ROOF DECK PENETRATION DIMENSIONS AND LOCATIONS.

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PRAIRIE CREEK

AERATION BASIN EXPANSION

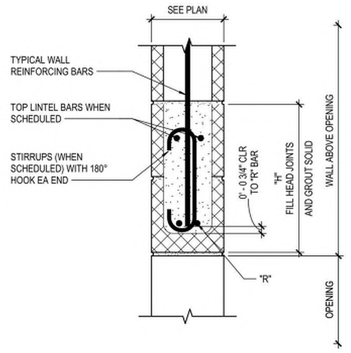
N

0 1" 2"

RAS/WAS PUMP STATION (EXISTING)
STRUCTURAL
ROOF PLAN

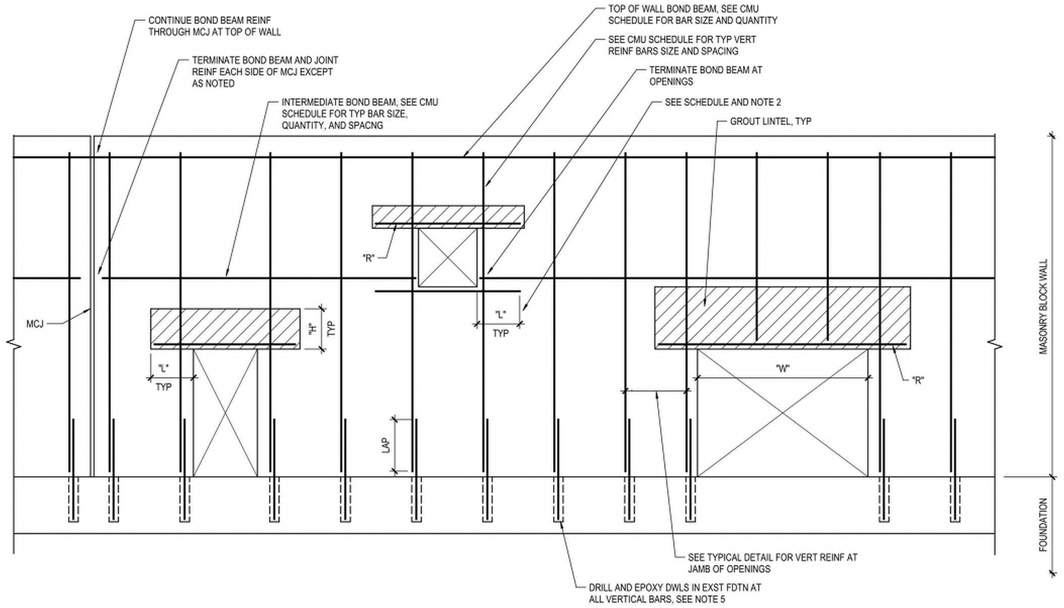
FILENAME	HDRE_ALL_DISCIPLINES.rte
SCALE	3/16" = 1'-0"
SHEET	40S102

LINTEL REINFORCEMENT SCHEDULE						
MARK	"W"	"R"	"L"	"H"	STIRRUPS	REMARKS
ML-1	1'-4" THRU 3'-4"	(1) #5	25"	8"	-	-
ML-2	1'-4" THRU 3'-4"	(2) #5	25"	16"	-	-
ML-3	3'-5" THRU 6'-8"	(2) #5	25"	24"	-	-
ML-4	6'-9" THRU 10'-0"	(2) #6	30"	32"	-	-
ML-5	10'-1" THRU 12'-0"	(2) #7	35"	32"	#3@16"	-



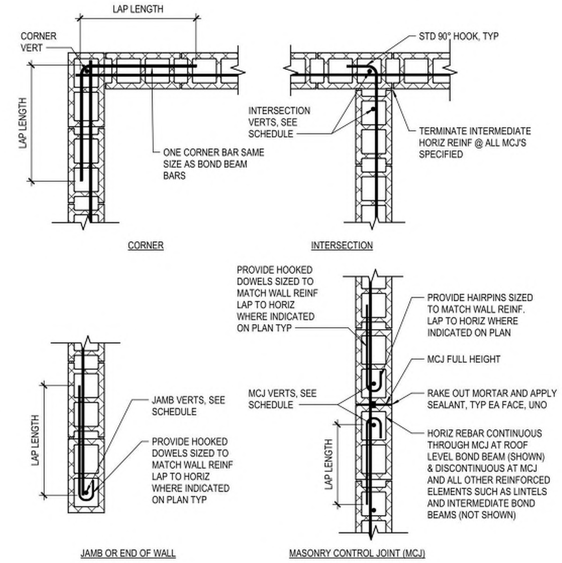
LINTEL AT OPENING

NOTES:
1. OPENINGS 8" OR LESS WIDE MAY OCCUR WITHOUT LINTEL REINFORCING AS LONG AS NO REINFORCINGS IS INTERUPTED.
2. ML-1 TO BE USED ONLY AT NON-LOAD BEARING SITUATIONS.
3. SEE DRAWINGS FOR LINTEL TYPES. WHERE LINTEL TYPES ARE NOT SHOWN, PROVIDELINTELS FROM THE ABOVE SCHEDULE BASED ON MAX CLEAR OPENING WIDTH AND VERIFY LINTEL TYPE W/ ENGINEER PRIOR TO CONSTRUCTION.



WALL ELEVATION

NOTES:
1. ONLY LINTEL GROUT IS SHOWN. GROUT SOLID ALL REINFORCED CELLS. SEE CMU WALL REINFORCING SCHEDULE.
2. WHERE OTHER DRAWING DETAILS INDICATE SOLID MASONRY SILL, PLACE BOND BEAM REINF IN FIRST COURSE BELOW SOLID CMU.
3. LINTEL REINFORCING AND BARS PASSING THROUGH "H" SHALL NOT BE SPLICED.
4. SHORE LINTEL MINIMUM 7 DAYS AFTER GROUTING OR UNTIL GROUT ATTAINS FULL DESIGN STRENGTH.
5. DOWELS SHALL BE SAME SIZE AND SPACING AS WALL VERTICAL REINFORCING. EMBED 5" MIN INTO EXISTING FOUNDATION WITH APPROVED ADHESIVE. DO NOT DAMAGE EXISTING FOUNDATION REINFORCING DURING DOWEL INSTALLATION.



NOTES:
1. FOR REINFORCING, SEE CMU WALL REINFORCING SHEDULE.
2. INDICATES LOCATION OF VERTICAL BARS AT CENTERLINE OF WALL, UNO IN SCHEDULE.
3. EXTEND MCJ FULL HEIGHT OF MASONRY BOND BEAM.
4. LIMIT DISTANCE BETWEEN MCJ TO MAX 24'-0". SEE DRAWINGS FOR LOCATIONS.
5. HORIZONTAL JOINT REINFORCING NOT SHOWN.
6. MODIFY BAR CONFIGURATION SHOWN AS REQUIRED WHERE TWO VERTICAL REINFORCING BARS ARE SHOWN ON THE SCHEDULE.
7. SEE ARCHITECTURAL DRAWINGS FOR MCJ DETAILS AND REMAINDER OF JOINT DETAILS.

1 CMU REINFORCEMENT
NOT TO SCALE

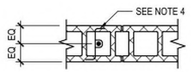
2 CMU WALL REINF
NOT TO SCALE

MASONRY LAP SPLICE LENGTHS : f'm=2000 psi, fy=60000 psi		
BAR SIZE	8" BLOCK	
	BAR @ CL	BAR @ EDGE
#3	19"	19"
#4	25"	31"
#5	31"	48"

WHEN REQD SPLICE LENGTH EXCEEDS 4'-0" USE HIGH LIFT GROUTING WITH NO SPLICES OR USE MECHANICAL TENSION SPLICES WITH LOW LIFT GROUTING.

3 CMU REINFORCEMENT LAP SCHEDULE
NOT TO SCALE

	STRUCTURE/WALL LOCATION	PARTITION WALLS (RAS/WAS PUMP STATION)
TYPE	REINFORCING LOCATION	8" WALL THK
VERTS	VERTICAL BARS	#4@48" SINGLE-CENTERED
	JAMBS/ENDS/MCJ	#4 SINGLE-CENTERED
	CORNERS / INTERSECTIONS	1 - #4 SINGLE-CENTERED
HORIZ	TOP OF WALL BOND BEAMS	1 - #4 SINGLE-CENTERED
	INTERMEDIATE BOND BEAMS	1 - #4 UNO
	HORIZ JOINT REINF	9 GAGE WIRE, TRUSS TYPE JOINT REINF @ 16" OC VERT SPACING BETWEEN BOND BEAMS
	BELOW OPENINGS	1 - #5
	LINTELS	SEE LINTEL REINFORCEMENT SCHEDULE



SINGLE CENTERED

4 CMU REINFORCEMENT SCHEDULE
NOT TO SCALE

NOTES:
1. PROVIDE THE ABOVE SCHEDULED MINIMUM WALL REINFORCING IN ALL CMU, UNO. SEE CMU WALL REINFORCEMENT DETAIL.
2. GROUT ONLY THE CELLS WITH REINFORCING.
3. MAINTAIN MINIMUM 3" X 3" CONTINUOUS VERTICAL CELL AT EACH REBAR. PLACE WALLS TO MAXIMUM 4'-0" HEIGHT BEFORE GROUTING.
4. PROVIDE WIRE REBAR POSITIONERS TO HOLD BARS IN PLACE.
5. STOP GROUT POUR 1/2" BELOW TOP OF COURSE AT EACH GROUT LIFT.

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CHECKED BY	C. ZIMMERMAN
APPROVED BY	J. NAVE
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
JASON C. NAVE
130766
06/13/25

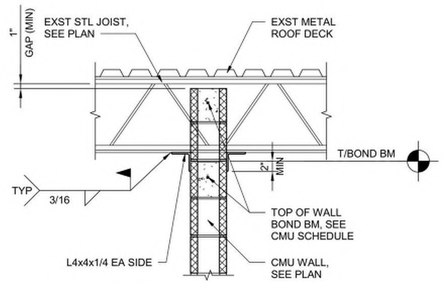
LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

RAS/WAS PUMP STATION (EXISTING) STRUCTURAL MASONRY WALL DETAILS

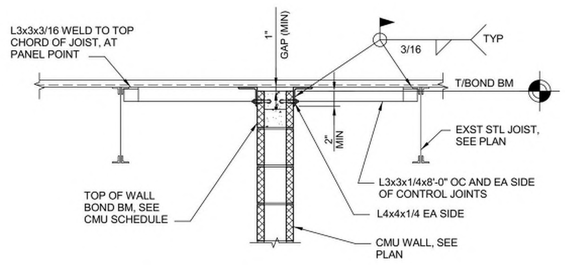
FILENAME: HDRE_ALL_DISCIPLINES.rte
SCALE: As indicated
0 1" 2"
SHEET: 40S501



NOTE:

PROVIDE MIN 1" GAP BETWEEN CMU WALLS AND ALL STRUCTURAL MEMBERS ON ALL FACES OF MEMBERS. INTERSECTING WALLS WITHIN 8'-0" OF BRACE CAN BE USED INSTEAD OF ANGLE BRACING SHOWN.

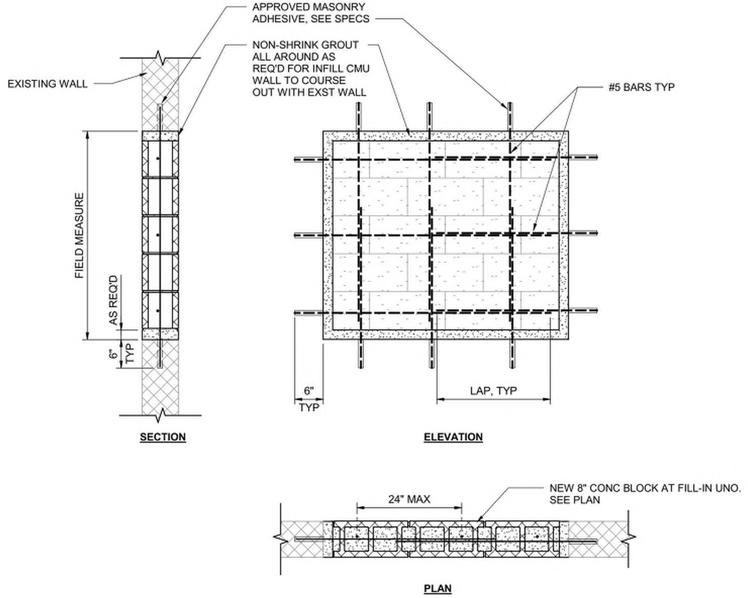
1 - CMU WALL TO DECK BRACING
NOT TO SCALE



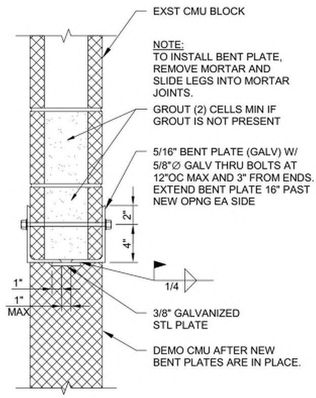
NOTE:

PROVIDE MIN 1" GAP BETWEEN CMU WALLS AND ALL STRUCTURAL MEMBERS ON ALL FACES OF MEMBERS. INTERSECTING WALLS WITHIN 8'-0" OF BRACE CAN BE USED INSTEAD OF ANGLE BRACING SHOWN.

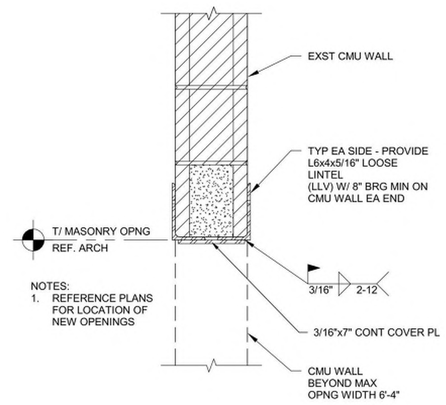
2 - CMU WALL TO DECK BRACING
NOT TO SCALE



3 / 40S101 - NEW CMU WALL INFILL
NOT TO SCALE



4 / 40S101 - SECTION AT NEW INTERIOR CMU OPENING
1 1/2" = 1'-0"



5 / - LINTEL AT OPENINGS THRU NON-LOAD BEARING CMU WALLS
NOT TO SCALE

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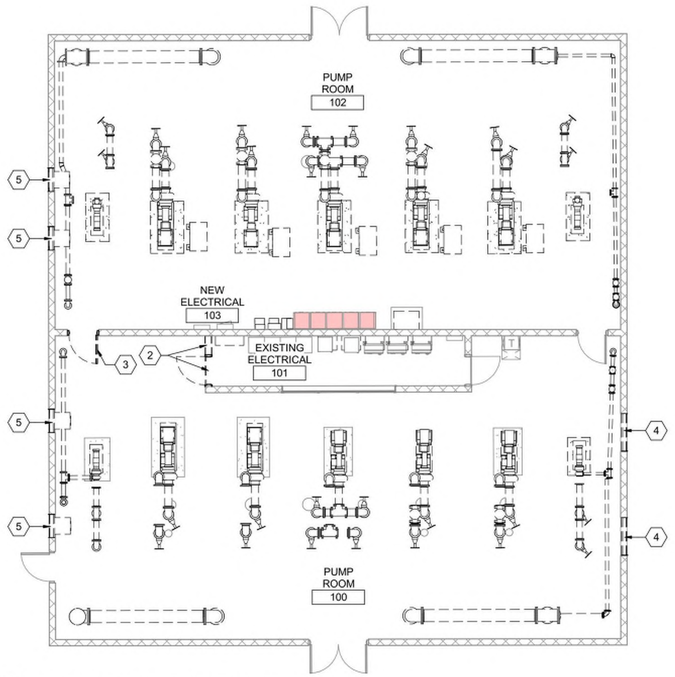
PRAIRIE CREEK

AERATION BASIN EXPANSION

RAS/WAS PUMP STATION (EXISTING) STRUCTURAL MASONRY WALL DETAILS

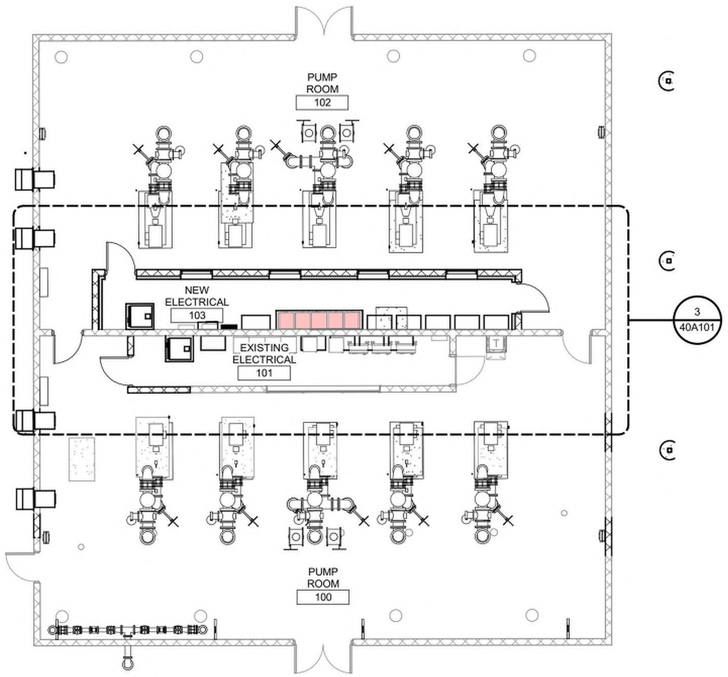
0 1" 2"

FILENAME: HDRE_ALL_DISCIPLINES.rte
SCALE: AS NOTED
SHEET: 40S502



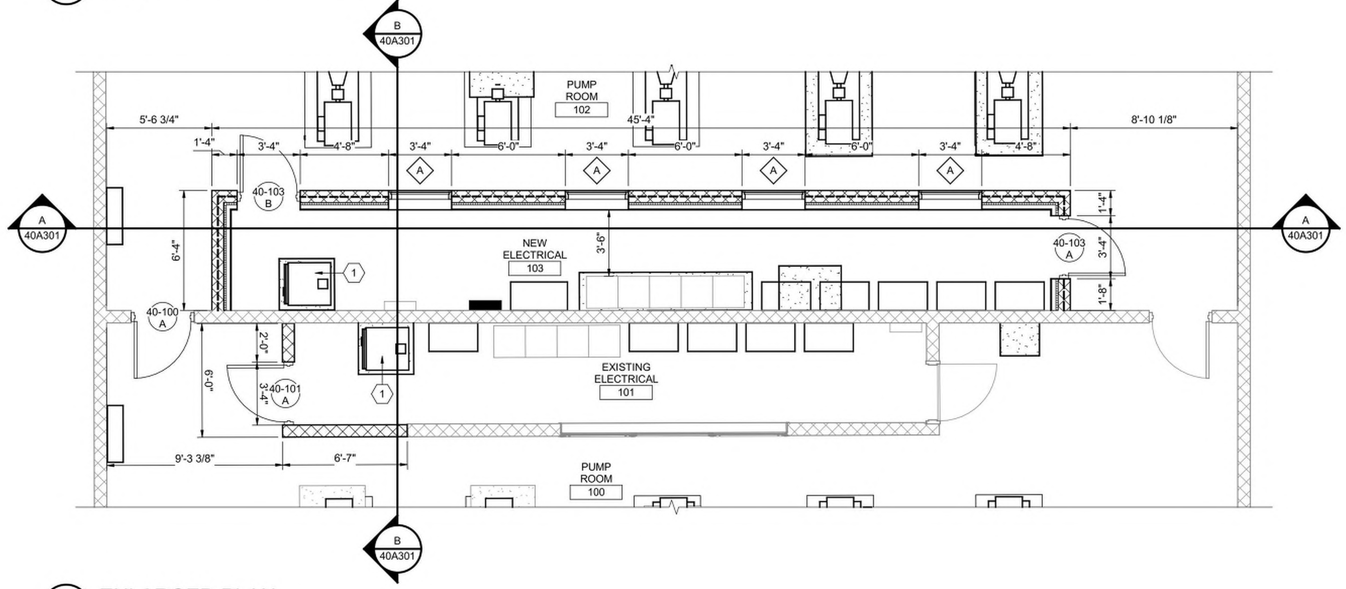
1 / 40A301 OVERALL DEMO FLOOR PLAN

1/8" = 1'-0"



2 / 40A301 OVERALL FLOOR PLAN

1/8" = 1'-0"



3 / 40A101 ENLARGED PLAN

1/4" = 1'-0"

GENERAL NOTES:

1. REFER TO PROCESS, ELECTRICAL & MECHANICAL DRAWINGS FOR EQUIPMENT NOT SHOWN ON THIS DRAWING.
2. REFER TO OTHER DISCIPLINES FOR ANY ADDITIONAL PENETRATIONS NEEDED THAT ARE NOT SHOWN ON FLOOR PLAN.
3. SEE SHEET 40A601 FOR ROOM FINISH, DOOR & WINDOW SCHEDULES.
4. REFER TO PROCESS, ELECTRICAL & MECHANICAL DRAWINGS FOR DISCIPLINE SPECIFIC DEMO ITEMS.

KEYNOTES

1 PPU, MECH. EQUIPMENT.

2 REMOVE EXISTING CMU WALL AND DOOR.

3 REMOVE EXISTING DOOR.

4 REMOVE EXISTING LOUVER AND INFILL WITH CMU, REFER TO STRUCTURAL.

5 REMOVE EXISTING FAN AND PREP FOR NEW FAN INSTALLATION. INFILL REMAINING OPENING WITH CMU, REFER TO STRUCTURAL.

PLAN LEGEND

- EXISTING WALL TO REMAIN
- 8" CONCRETE MASONRY UNIT
- 8" CONCRETE MASONRY UNIT WITH INSULATION INSERTS AND FURRING.
- EXISTING TO REMAIN
- NEW WORK

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DRAWN BY	A. VEGA
CHECKED BY	R. ANDREW
APPROVED BY	
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

REGISTERED ARCHITECT WESLEY J. WARD 15533 STATE OF TEXAS 6/13/25

LEWISVILLE Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

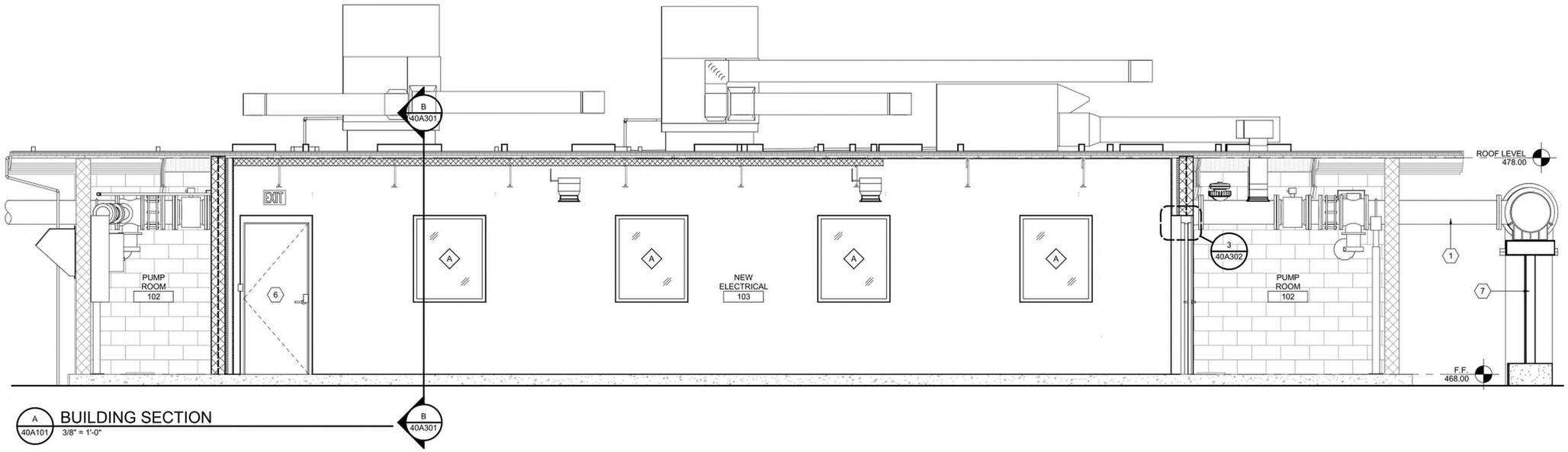
N

0 1" 2"

RAS/WAS PUMP STATION
ARCHITECTURAL
FLOOR PLAN

FILENAME HDRE_ALL_DISCIPLINES.rte
SCALE As indicated
SHEET 40A101

Autodesk Docs://10342803_COL_PCWWT_AB_Expansion_2024/40 - RAS_WAS Pump Station (Existing) - ARCH.rvt
6/12/2025 5:38:20 PM



A 40A101 BUILDING SECTION 3/8" = 1'-0"

B 40A301

KEYNOTES

1 PROCESS PIPING, TYP.

2 MECHANICAL EQUIPMENT, REFER TO MECH. DWGS.

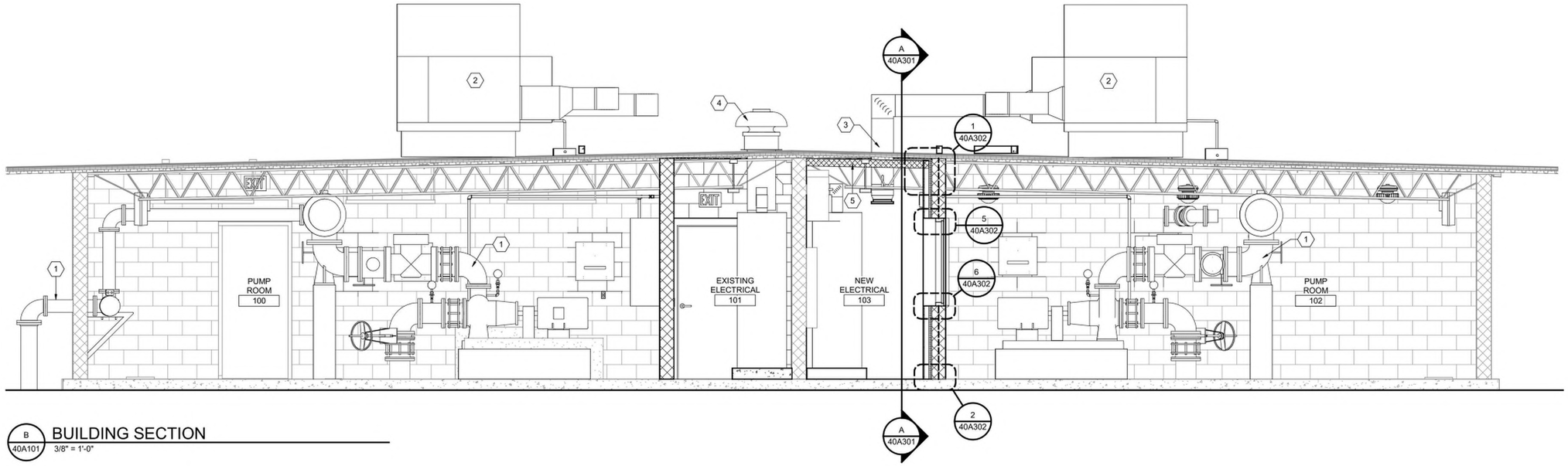
3 DUCT, VERIFY PENETRATION SIZES WITH MECH. DWGS.

4 MECHANICAL SUPPLPY FAN, REFER TO MECH. DWGS.

5 NOM. 4" OF CLOSED CELL SPRAY FOAM INSULATION. PAINTED WITH INTUMESCENT PAINT BASIS OF DESIGN: FIRESHELL F10E.

6 GALV H.M. DOOR/FRAME, AS SCHEDULED. TYP.

7 PROCESS PIPE SUPPORT, TYP.



B 40A101 BUILDING SECTION 3/8" = 1'-0"

PLAN LEGEND

- EXISTING WALL TO REMAIN
- 8" CONCRETE MASONRY UNIT
- 8" CONCRETE MASONRY UNIT WITH INSULATION INSERTS AND FURRING.
- EXISTING TO REMAIN
- NEW WORK

HDR
TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13/2025	ISSUED FOR BID

PROJECT MANAGER	J. R. CANTWELL
DESIGNED BY	W. WARD
DRAWN BY	A. VEGA
CHECKED BY	R. ANDREW
APPROVED BY	
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

REGISTERED ARCHITECT
WESLEY J. WARD
15733
STATE OF TEXAS
6/13/25

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

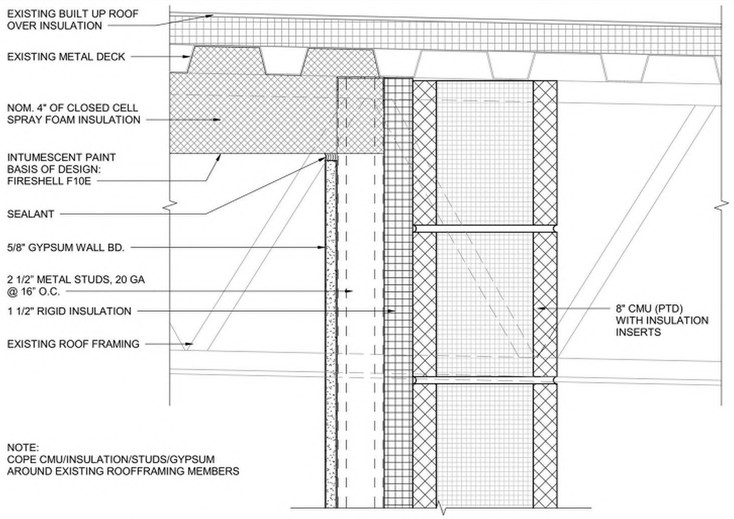
CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN
EXPANSION

RAS/WAS PUMP STATION ARCHITECTURAL SECTIONS

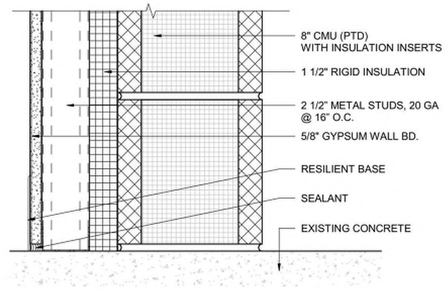
0 1" 2"

FILENAME	HDRE_ALL_DISCIPLINES.rte
SCALE	As indicated
SHEET	40A301

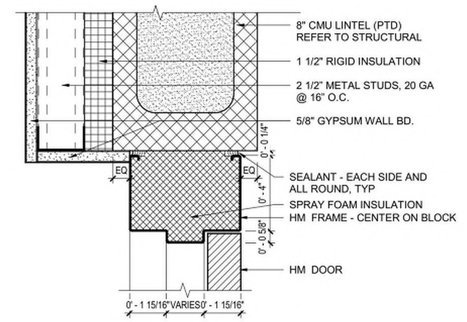
Autodesk Docs://10342803_COL_PCWWT_AB_Expansion_2024/40 - RAS_WAS Pump Station (Existing) - ARCH.rvt
6/12/2025 5:38:22 PM



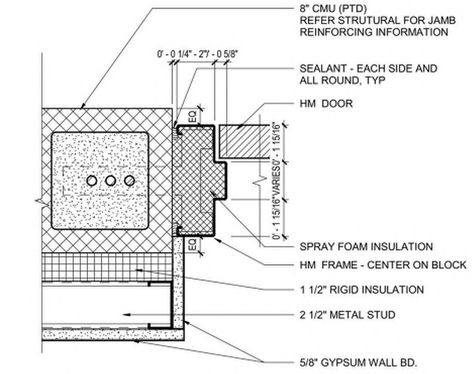
1 40A301 **WALL TO EXISTING ROOF CONNECTION**
3" = 1'-0"



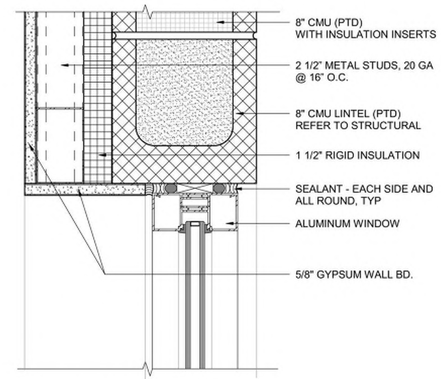
2 40A301 **BASE DETAIL**
3" = 1'-0"



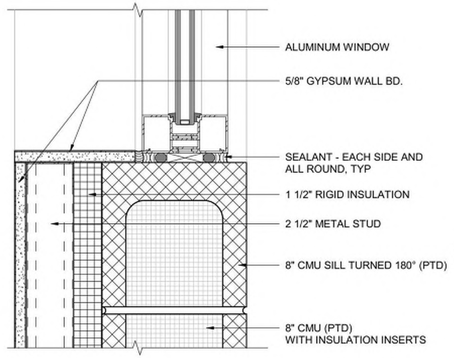
3 40A301 **HEAD - HM INTERIOR DOOR - CMU**
3" = 1'-0"



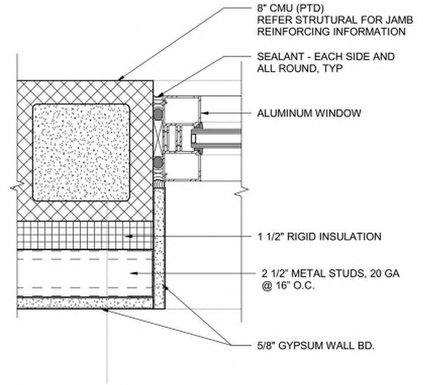
4 **JAMB - HM INTERIOR DOOR - CMU**
3" = 1'-0"



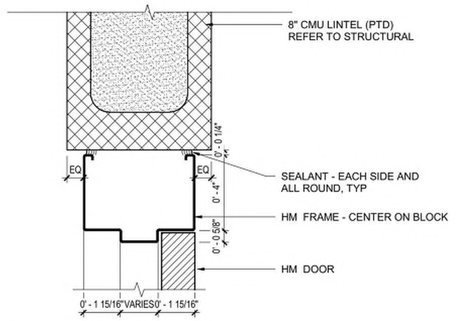
5 40A301 **WINDOW HEAD**
3" = 1'-0"



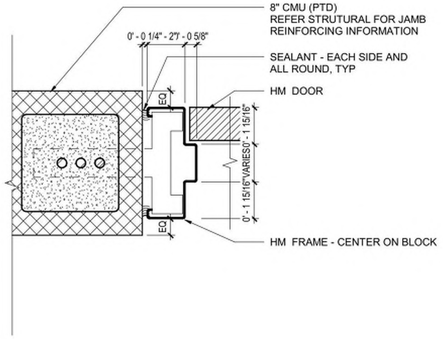
6 40A301 **WINDOW SILL**
3" = 1'-0"



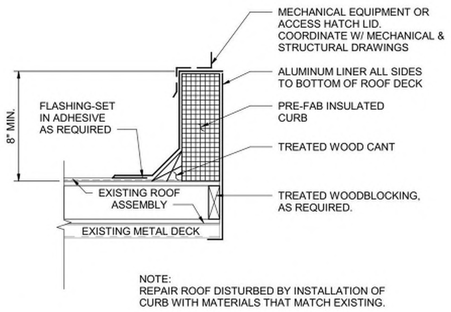
7 **WINDOW JAMB**
3" = 1'-0"



8 **HEAD - HM INTERIOR DOOR - CMU**
3" = 1'-0"



9 **JAMB - HM INTERIOR DOOR - CMU**
3" = 1'-0"



10 **TYP. CURB DETAIL**
1 1/2" = 1'-0"

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6/12/2025 5:38:23 PM

HDR
TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13/2025	ISSUED FOR BID

PROJECT MANAGER	J. R. CANTWELL
DESIGNED BY	W. WARD
DRAWN BY	A. VEGA
CHECKED BY	R. ANDREW
APPROVED BY	
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

REGISTERED ARCHITECT
BRADLEY J. WARD
15203
STATE OF TEXAS
6/13/25

LEWISVILLE
Deep Roots. Broad Wings. Bright Future

CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

RAS/WAS PUMP STATION ARCHITECTURAL DETAILS

0 1" 2"

FILENAME	HDRE_ALL_DISCIPLINES.rte
SCALE	As indicated
SHEET	40A302

ROOM FINISH SCHEDULE

ROOM NUMBER	ROOM NAME	FLOOR	BASE	WALLS				CEILING		*REMARKS
				NORTH	EAST	SOUTH	WEST	HEIGHT	FINISH	
100	PUMP ROOM	EXIST / CONC	N	EXIST	EXIST	EXIST	EXIST		ES	
101	EXISTING ELECTRICAL	EXIST / CONC	N	EXIST	EXIST	EXIST / CMU / PTD	EXIST / CMU / PTD		ES	
102	PUMP ROOM	EXIST / CONC	N	EXIST / CMU / PTD	EXIST	EXIST	EXIST		ES	
103	NEW ELECTRICAL	EXIST / CONC	RB	GYP / PTD	GYP / PTD	EXIST CMU / PTD	GYP / PTD		ES / FM	

MATERIAL AND FINISH LEGEND

FLOOR		BASE	
EXIST	EXISTING	N	NONE
CONC	CONCRETE	RB	RESILIENT BASE - BASIS OF DESIGN: ROPPE, 4". MEET ASTM F1861. GROUP 1, SOLID THRU COLOR. STYLE B, COVED.
WALLS		CEILING	
EXIST	EXISTING	ES	EXPOSED STRUCTURE (PTD)
PTD	PAINTED	FM	NOM. 4" OF CLOSED CELL SPRAY FOAM INSULATION. PAINTED WITH INTUMESCENT PAINT BASIS OF DESIGN: FIRESHELL F10E
CMU	CONCRETE MASONRY UNITS		
GYP	GYPSUM WALL BOARD		

DOOR SCHEDULE

DOOR NUMBER		WIDTH	HEIGHT	DOOR			FRAME			HARDWARE SET	DETAILS			*REMARKS
				TYPE	MATERIAL	FINISH	TYPE	MATERIAL	FINISH		HEAD	JAMB	SILL	
40-100 A		3' - 0"	7' - 0"	F	HM	PTD	1	HM	PTD		-	-	-	1
40-101 A		3' - 0"	7' - 0"	F	HM	PTD	1	HM	PTD		8/40A302	9/40A302	-	
40-103 A		3' - 0"	7' - 0"	F	HM	PTD	1	HM	PTD		3/40A302	4/40A302	-	
40-103 B		3' - 0"	7' - 0"	F	HM	PTD	1	HM	PTD		3/40A302	4/40A302	-	

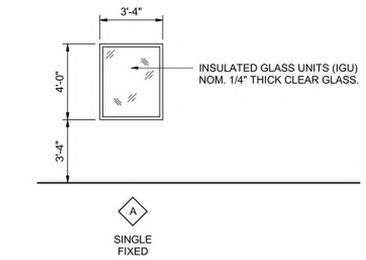
MATERIAL AND FINISH LEGEND

MATERIAL		FINISH	
HM	HOLLOW METAL	PTD	ARCHITECTURAL PAINT

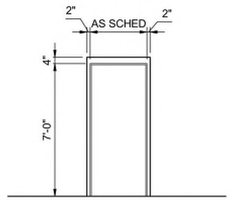
REMARKS:
1. NEW DOOR OPENING ON EXISTING CMU WALL. REFER STRUCTURAL.

WINDOW SCHEDULE

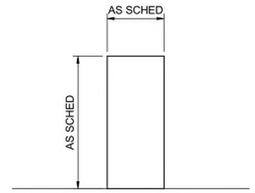
TYPE	WIDTH	HEIGHT	FRAME MATERIAL	FRAME FINISH	COMMENTS
A	3' - 4"	4' - 0"	ALUMINUM		



WINDOW TYPES
1/4" = 1'-0"



FRAME TYPES
1/4" = 1'-0"



DOOR TYPES
1/4" = 1'-0"

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6/12/2025 5:38:23 PM

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13/2025	ISSUED FOR BID

PROJECT MANAGER	J. R. CANTWELL
DESIGNED BY	W. WARD
DRAWN BY	A. VEGA
CHECKED BY	R. ANDREW
APPROVED BY	
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

REGISTERED ARCHITECT
WESLEY J. WARD
15233
STATE OF TEXAS
6/13/25

LEWISVILLE
Deep Roots. Broad Wings. Bright Future

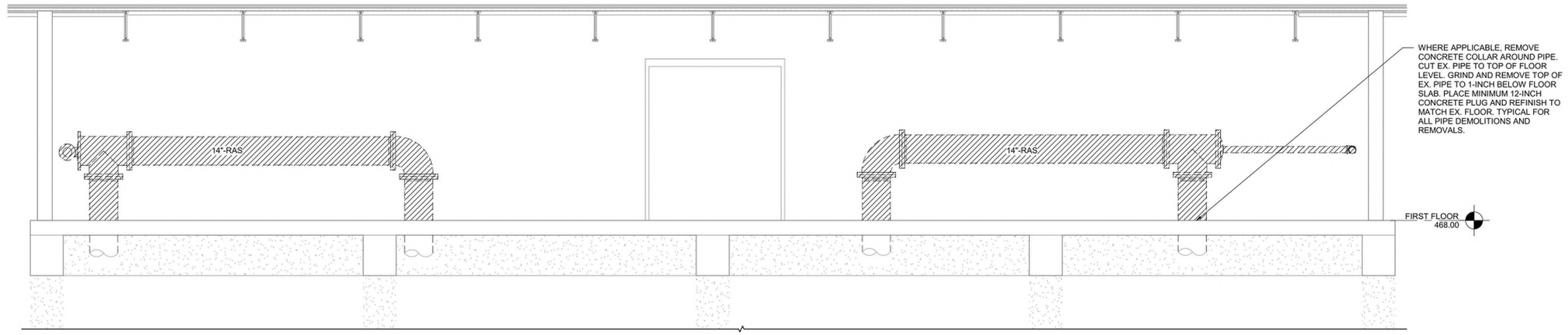
CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

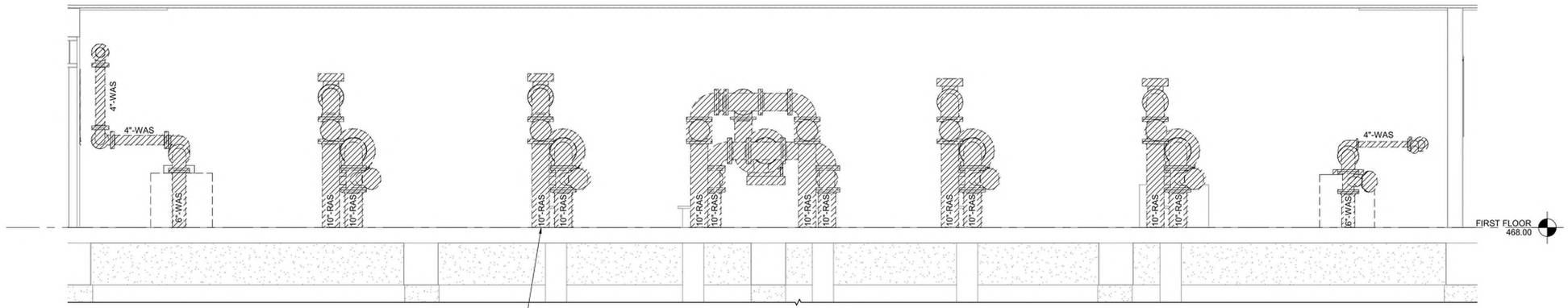
RAS/WAS PUMP STATION
ARCHITECTURAL
ROOM FINISH, DOOR & WINDOW SCHEDULES

FILENAME: HDRE_ALL_DISCIPLINES.rte
SCALE: As indicated
0 1" 2"

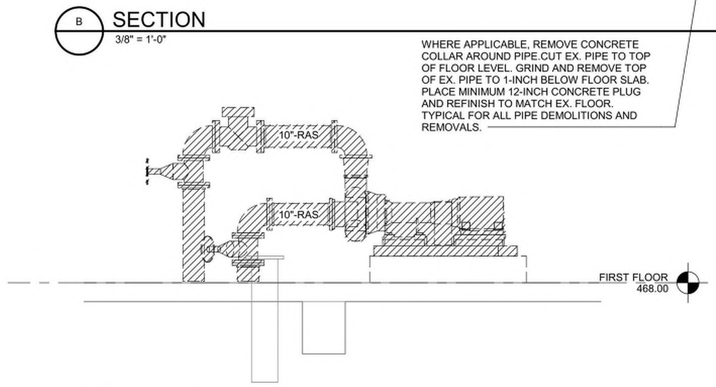
SHEET
40A601



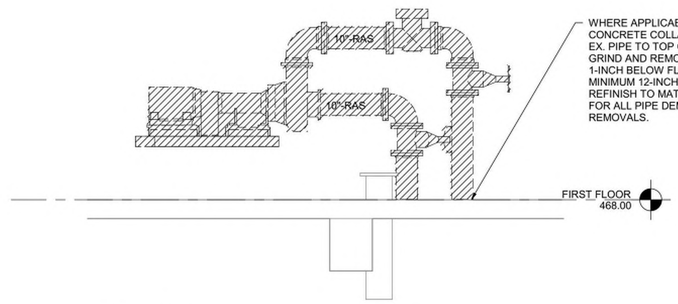
A SECTION
3/8" = 1'-0"



B SECTION
3/8" = 1'-0"



C SECTION
3/8" = 1'-0"



D SECTION
3/8" = 1'-0"

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13/2025	ISSUED FOR BID

PROJECT MANAGER	J. R. CANTWELL
DESIGNED BY	J. HIMANEN
DRAWN BY	J. COOPER
CHECKED BY	M. BOND
APPROVED BY	J. HIMANEN
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
JUHA A. HIMANEN
149760
LICENSED
PROFESSIONAL ENGINEER
June 13/2025

LEWISVILLE
Deep Roots. Broad Wings. Bright Future

CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

RAS/WAS PUMP STATION DEMOLITION SECTIONS

0 1" 2"

FILENAME: 40 - RAS_WAS Pump Station
SCALE: 3/8" = 1'-0"

SHEET
40DX301

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GENERAL NOTES:

1. WHERE APPLICABLE, REMOVE CONCRETE COLLAR AROUND PIPE BASE. CUT EX. PIPE TO TOP OF FLOOR LEVEL. GRIND AND REMOVE TOP OF EX. PIPE TO 1-INCH BELOW FLOOR SLAB. PLACE MINIMUM 12-INCH CONCRETE PLUG AND REFINISH TO MATCH EX. FLOOR. TYPICAL FOR ALL PIPE DEMOLITIONS AND REMOVALS.

1 SOUTH SIDE PUMP ROOM EX. RAS PUMPS AND PIPING
NOT TO SCALE

2 - SOUTH SIDE PUMP ROOM EX. WAS PUMPS AND PIPING
NOT TO SCALE

3 - NORTH SIDE PUMP ROOM EX. WAS PUMPS AND PIPING
NOT TO SCALE

4 SOUTH SIDE PUMP ROOM EX. RAS PUMPS AND PIPING
NOT TO SCALE

5 SOUTH SIDE PUMP ROOM EX. RAS PUMPS AND PIPING
NOT TO SCALE

6 SOUTH SIDE PUMP ROOM EX. WAS PUMPS AND PIPING
NOT TO SCALE

TEXAS P.E. FIRM
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CHECKED BY	M. BOND
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CITY PROJECT NO.	U2100
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STATE OF TEXAS
JUHA A. HIMANEN
149760
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June 13/2025

LEWISVILLE
Deep Roots. Broad Wings. Bright Future

CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

RAS/WAS PUMP STATION DEMOLITION PHOTOS

FILENAME: 40 - RAS_WAS Pump Station
SCALE: 1/4" = 1'-0"
0 1" 2"

SHEET: **40DX401**

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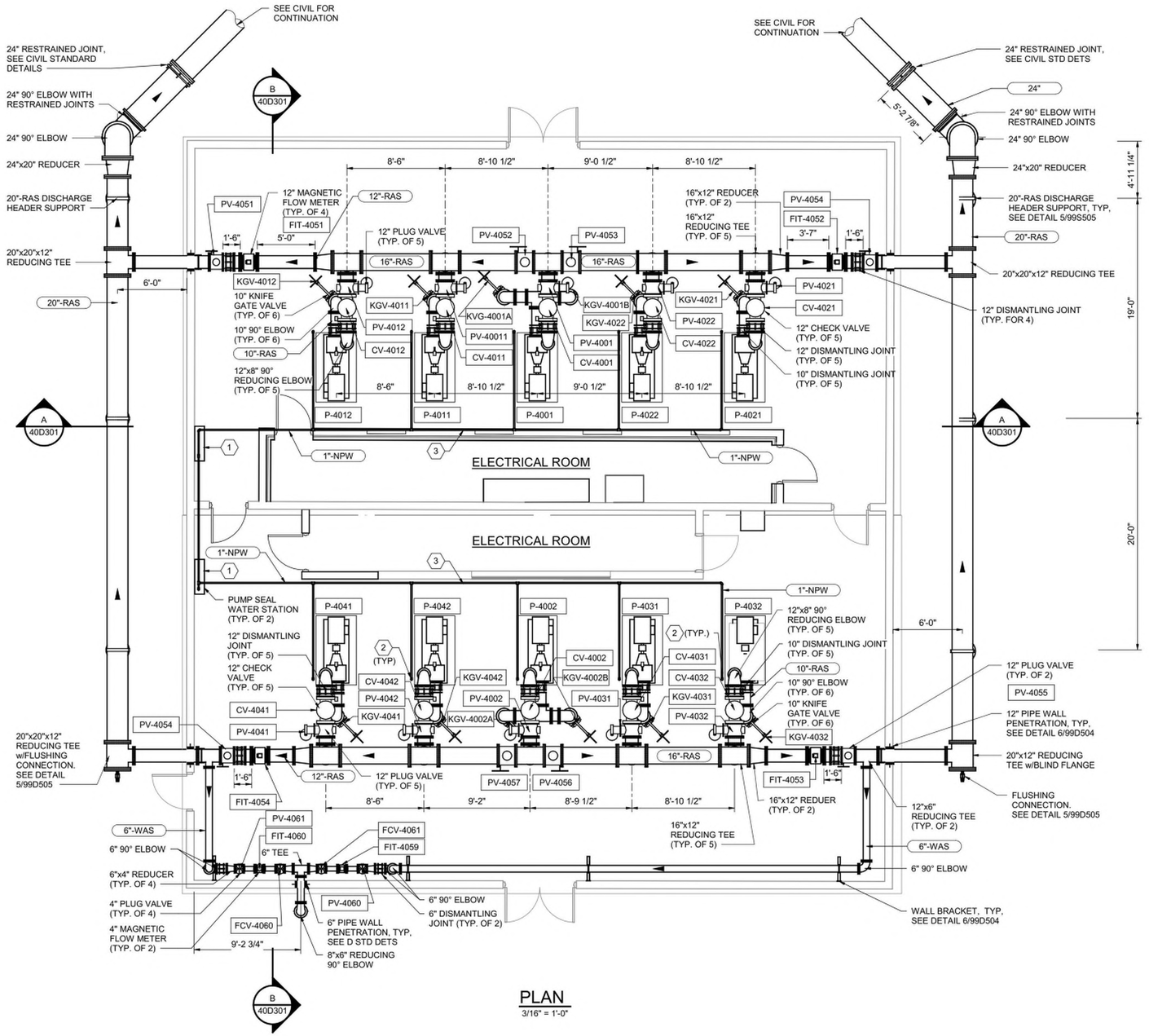
6/12/2025 3:03:01 PM



PLAN
3/16" = 1'-0"

NOTES

1. CONTRACTOR TO REALIGN CONDUITS MOUNTED TO UNDERSIDE OF OPEN WEB STEEL ROOF JOISTS IN LOCATIONS WHERE CONDUITS INTERFERE WITH ALIGNMENT OF PROCESS PIPING.

KEYNOTES (#)

1. CONNECT SEAL WATER STATION TO EXISTING 2-INCH PLANT WATER PIPE ALONG WEST INTERIOR WALL.
2. DROP 3/4-INCH NPW DOWN TO PUMP. PROVIDE SHUTOFF VALVE IN VERTICAL. REFER TO SPECIFICATION 43 21 00.
3. MOUNT 1-INCH NPW SEAL WATER PIPING ALONG OPEN WEB STEEL JOISTS ON CEILING.
4. CONTRACTOR IS TO VERIFY ALIGNMENT OF 6" AND 4" PIPING ALONG SOUTHSIDE INTERIOR WALL AND CONFIGURE PIPING AS REQUIRED TO AVOID INTERFERENCE WITH EXISTING BUILDING FEATURES.

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6/12/2025 3:03:02 PM

HDR
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CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
JUHA A. HIMANEN
149760
LICENSED PROFESSIONAL ENGINEER
June 13/2025

LEWISVILLE
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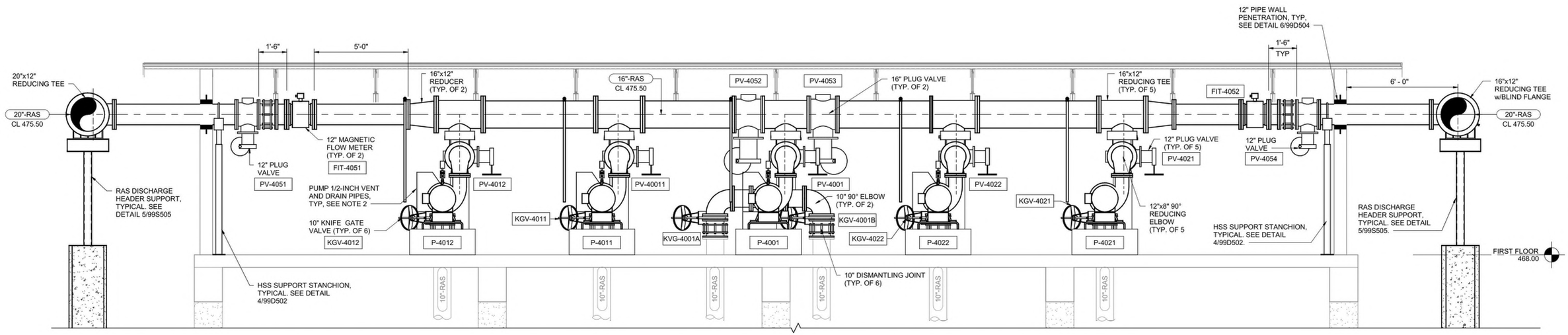
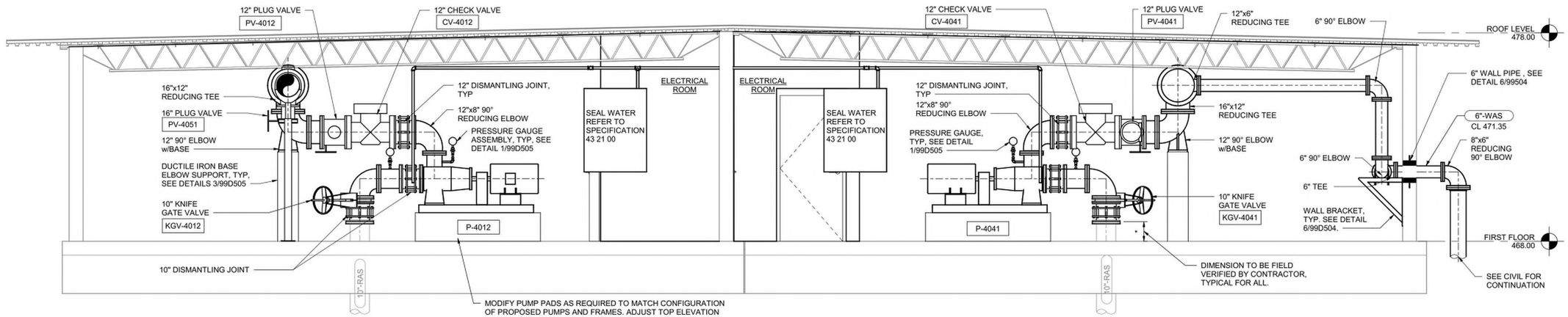
CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

RAS/WAS PUMP STATION PROCESS PLAN

FILENAME	40 - RAS_WAS Pump Station
SCALE	3/16" = 1'-0"
SHEET	40D101



A 40D101 SECTION
3/8" = 1'-0"



B 40D101 SECTION
3/8" = 1'-0"

NOTES:

1. CONTRACTOR TO REALIGN CONDUITS MOUNTED TO UNDERSIDE OF OPEN WEB STEEL ROOF JOISTS IN LOCATIONS WHERE CONDUITS INTERFERE WITH ALIGNMENT OF PROCESS PIPING.
2. CONTRACTOR TO INSTALL 1/2-INCH VENT PIPE C/W SHUT-OFF VALVE AND 1/2-INCH DRAIN PIPE C/W SHUT-OFF VALVE FROM PUMP CASING TO DISCHARGE INTO EX. DRAINS. TYPICAL FOR ALL 10 PUMPS.

Autodesk Docs://10342803_COL_PCWWT_AB_Expansion_2024/40 - RAS_WAS Pump Station (Existing) - PROCESS.rvt
6/12/2025 3:03:03 PM

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STATE OF TEXAS
JUHA A. HIMANEN
149760
LICENSED PROFESSIONAL ENGINEER
June 13/2025

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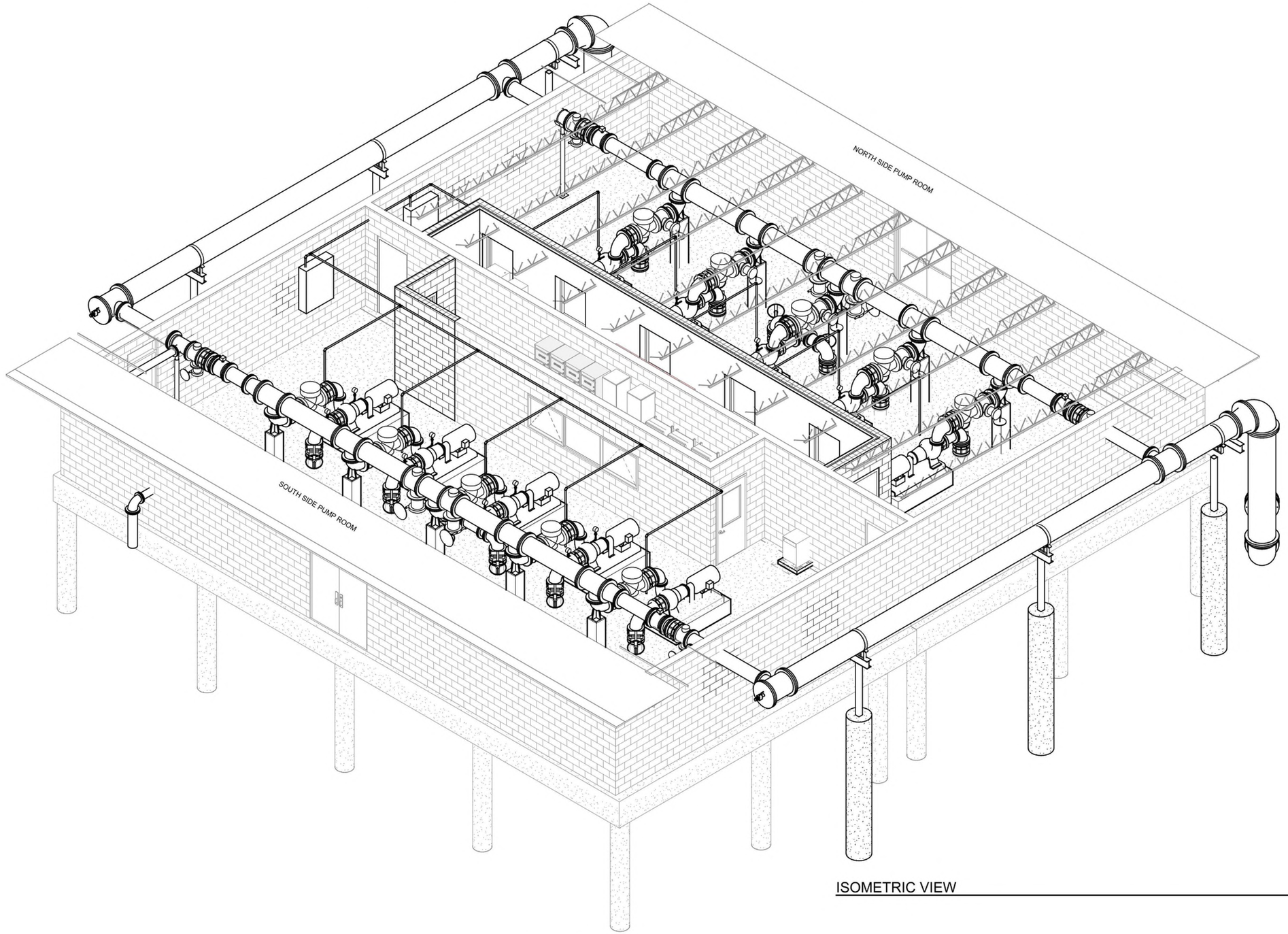
CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

RAS/WAS PUMP STATION PROCESS SECTIONS

FILENAME: 40 - RAS_WAS Pump Station
SCALE: 3/8" = 1'-0"
0 1" 2"

SHEET: 40D301



ISOMETRIC VIEW

Autodesk Docs://10342803_COL_PCWWT_AB_Expansion_2024/40 - RAS_WAS Pump Station (Existing) - PROCESS.rvt
6/12/2025 3:03:11 PM

TEXAS P.E. FIRM
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CITY PROJECT NO.	U2100
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STATE OF TEXAS
JUHA A. HIMANEN
149760
LICENSED
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June 13/2025

LEWISVILLE
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CITY OF LEWISVILLE
PRAIRIE CREEK

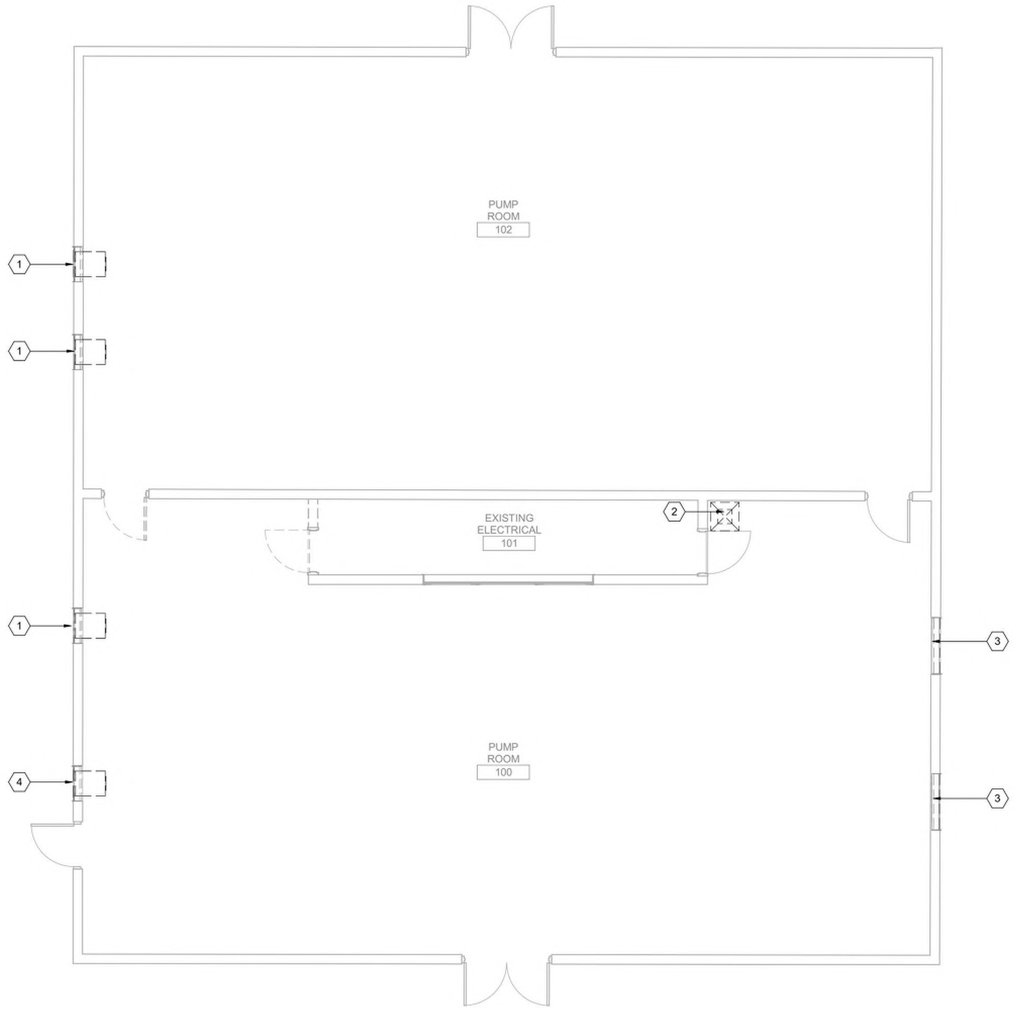
AERATION BASIN EXPANSION

RAS/WAS PUMP STATION PROCESS ISOMETRIC

0 1" 2"

FILENAME	40 - RAS_WAS Pump Station
SCALE	12" = 1'-0"

SHEET
40D601



1 / 40MX101 RAS/WAS PUMP STATION MECHANICAL LOWER LEVEL DEMOLITION PLAN

3/16" = 1'-0"

KEYNOTES

1 DEMOLISH EXISTING FAN AND ASSOCIATED ACCESSORIES, CONTROLS, AND SUPPORTS. PREPARE FOR INSTALLATION OF NEW FAN, WEATHER HOOD, CONTROLS, SUPPORTS, ETC. REFER TO 40M101 FOR NEW WORK. MODIFY EXISTING OPENING TO ACCOMMODATE INSTALLATION OF NEW FAN, WEATHER HOOD, CONTROLS, SUPPORTS, ETC. WHERE EXISTING OPENING IS LARGER THAN NEEDED FOR NEW FAN, INFILL PORTION OF WALL NOT FILLED WITH NEW FAN TO MATCH ADJACENT WALL CONSTRUCTION AND FIRE/SMOKE RATING. REFER TO ARCHITECTURAL AND STRUCTURAL PLANS FOR ADDITIONAL REQUIREMENTS.

2 REMOVE EXISTING AIR DEVICE AND DUCT. REFER TO 40MX102 FOR CONTINUATION.

3 DEMOLISH EXISTING LOUVER AND ASSOCIATED ACCESSORIES. INFILL EXISTING OPENING TO MATCH ADJACENT WALL CONSTRUCTION AND FIRE/SMOKE RATING. REFER TO ARCHITECTURAL AND STRUCTURAL PLANS FOR ADDITIONAL REQUIREMENTS.

4 DEMOLISH EXISTING FAN AND ASSOCIATED ACCESSORIES, CONTROL, AND SUPPORTS. INFILL EXISTING OPENING TO MATCH ADJACENT WALL CONSTRUCTION AND FIRE/SMOKE RATING. REFER TO ARCHITECTURAL AND STRUCTURAL PLANS FOR ADDITIONAL REQUIREMENTS.

Autodesk Docs://10342803_COL_PCWWT_AB_Expansion_2024/40 - RAS_WAS Pump Station (Existing) - Mech.rvt
6/12/2025 10:59:07 PM

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13/2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	B. PERLBERG
DRAWN BY	J. VALLES
CHECKED BY	K. CHAUDHARI
APPROVED BY	B. PERLBERG
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
BRIAN R. PERLBERG
115197
LICENSED
PROFESSIONAL ENGINEER
06/13/2025

LEWISVILLE
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CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

N

0 1" 2"

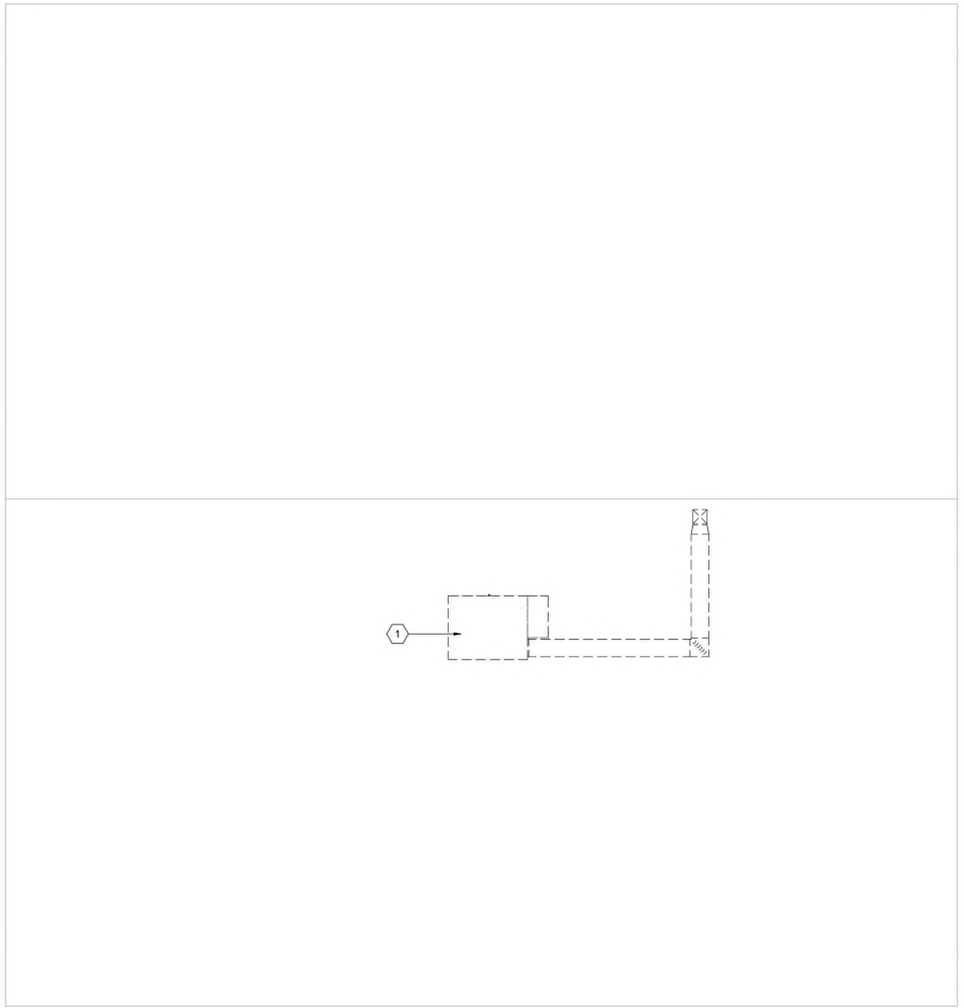
RAS/WAS PUMP STATION
MECHANICAL
LOWER LEVEL DEMOLITION PLAN

FILENAME: 40 - RAS_WAS Pump Station (Existing) - Mech.RVT
SCALE: 3/16" = 1'-0"

SHEET
40MX101

KEYNOTES

1 REMOVE EXISTING ROOFTOP UNIT, CURB, DUCTWORK, THERMOSTAT, CONTROLS, SUPPORTS, ETC.. CUT AND PATCH EXISTING ROOF OPENINGS TO MATCH ADJACENT ROOF CONSTRUCTION.



1 / 40MX102 RAS/WAS PUMP STATION MECHANICAL UPPER LEVEL DEMOLITION PLAN

3/16" = 1'-0"

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AERATION BASIN EXPANSION

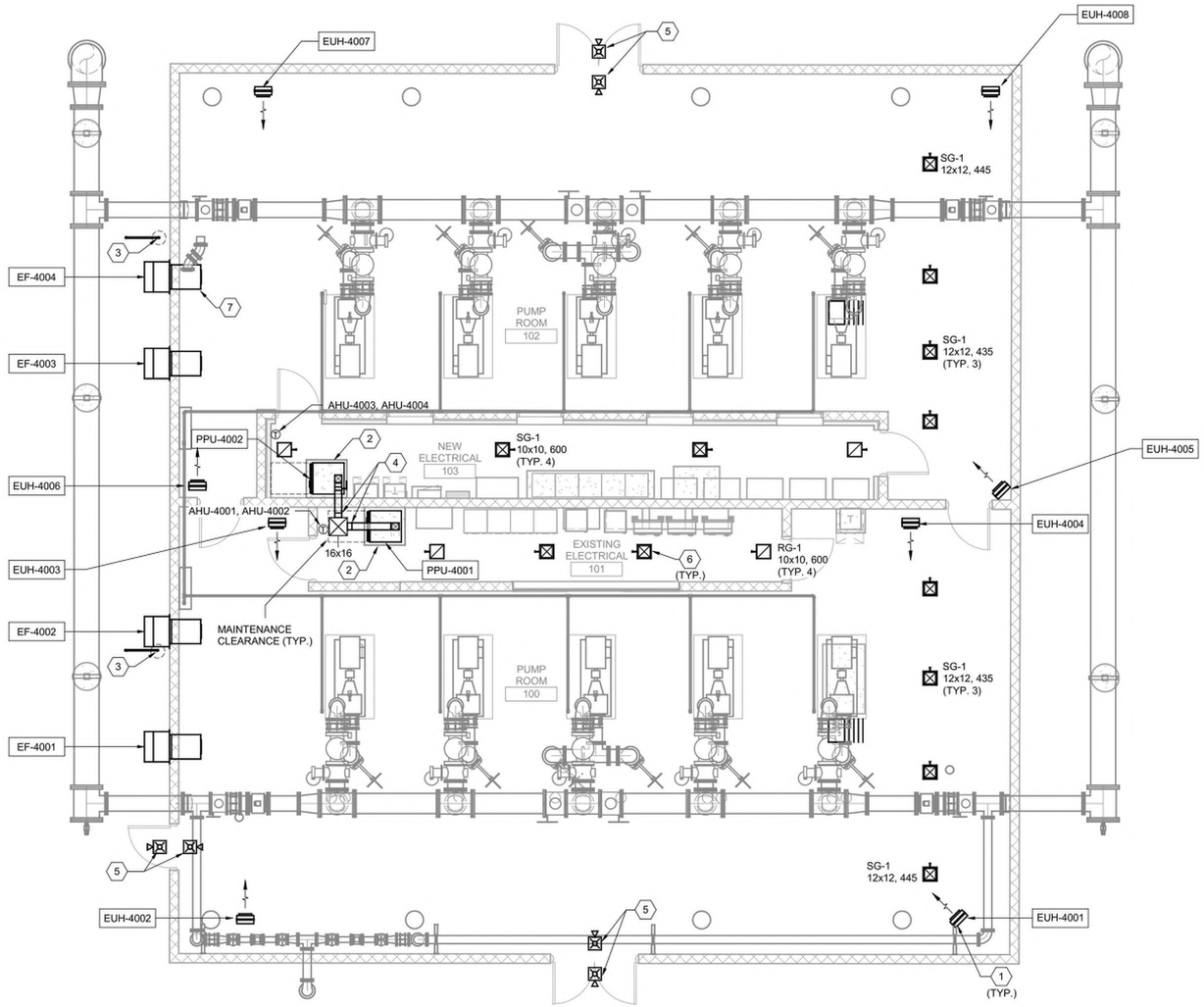
N

0 1" 2"

RAS/WAS PUMP STATION
MECHANICAL
UPPER LEVEL DEMOLITION PLAN

FILENAME: 40 - RAS_WAS Pump Station (Existing) - Mech.RVT
SCALE: 3/16" = 1'-0"

SHEET
40MX102



1 / 40M101 RAS/WAS PUMP STATION MECHANICAL LOWER LEVEL PLAN

3/16" = 1'-0"

KEYNOTES

1 MOUNT BOTTOM OF ELECTRIC UNIT HEATER 7 FT. AFF. PROVIDE WALL OR CEILING MOUNTED SUPPORT.

2 PROVIDE CONCRETE HOUSEKEEPING PAD UNDER MECHANICAL EQUIPMENT. REF: STRUCTURAL DRAWINGS FOR DETAIL.

3 ROUTE 2" CONDENSATE DRAIN AROUND ROOF OVERHANG AND DOWN WALL. TERMINATE AT CONDENSATE DRYWELL. REF: 00502 FOR CONDENSATE DRYWELL DETAIL.

4 TAP 8x8 DUCT OFF 16x16 DUCT UP AND ROUTE TO PPU INLET. PROVIDE BALANCING DAMPER AND FLEXIBLE DUCT CONNECTION BEFORE CONNECTION TO PPU. REF: 00M501 FOR FLEXIBLE DUCT CONNECTION DETAIL.

5 PROVIDE VISIBLE AND AUDIBLE ALARM SYSTEM FOR VENTILATION FAILURE ABOVE DOORWAY. PROVIDE SWITCH AT EACH LOCATION TO SILENCE ALARM. PROVIDE 12 IN. X 12 IN. LAMINATED THREE-LAYER PHENOLIC PLAQUE WITH BLACK ENGRAVED 1/4 IN. MINIMUM LETTERS ON WHITE BACKGROUND BESIDE THE ALARM SYSTEM. THE SIGN SHALL READ "IF ALARM IS VISIBLE/AUDIBLE, PROCEED INTO SPACE WITH CAUTION. EXHAUST AND SUPPLY FANS ARE NOT OPERATING". COORDINATE EXACT WORDING, LOCATION, SIZE, AND COLORS OF SIGN WITH OWNER. REFER TO ELECTRICAL PLANS AND SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS.

6 PROVIDE BALANCING DAMPER IN DUCT BEFORE GRILLE. REF: 00M502 FOR DUCT PENETRATION THRU NON-RATED ROOF/WALL/FLOOR DETAIL.

7 REF: 00M502 FOR EXHAUST FAN THRU WALL DETAIL.

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APPROVED BY	B. PERLBERG
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
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06/13/2025

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PRAIRIE CREEK

AERATION BASIN EXPANSION

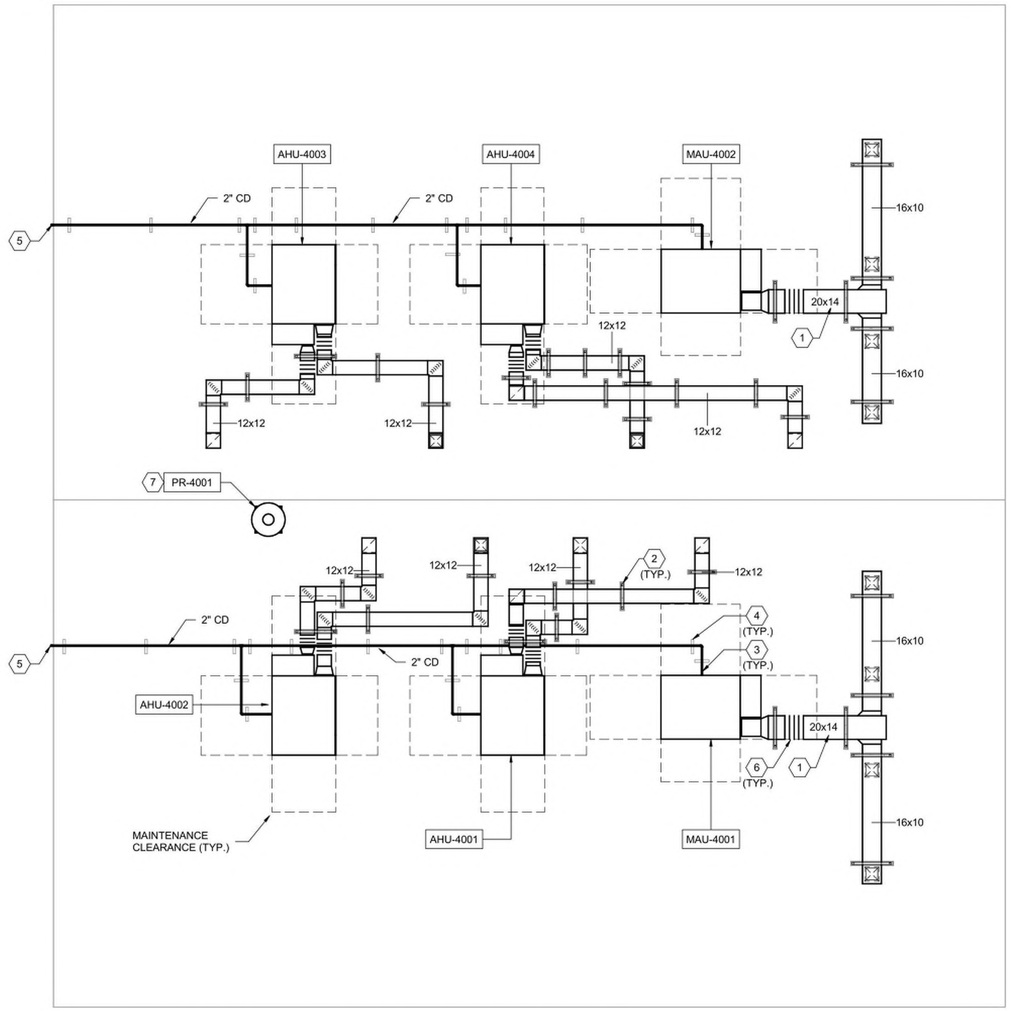
N

0 1" 2"

RAS/WAS PUMP STATION MECHANICAL LOWER LEVEL PLAN

FILENAME: 40 - RAS_WAS Pump Station (Existing) - Mech.RVT
SCALE: 3/16" = 1'-0"

SHEET: **40M101**



1 / 40M102 RAS/WAS PUMP STATION MECHANICAL UPPER LEVEL PLAN

3/16" = 1'-0"

KEYNOTES

1 APPROXIMATE LOCATION OF FLOW SWITCH FOR ASSOCIATED EQUIPMENT. COORDINATE EXACT LOCATION WITH OWNER.

2 REF: 00M502 FOR RECTANGULAR DUCT ROOF SUPPORT DETAIL.

3 REF: 00M501 FOR CONDENSATE DRAIN TRAP DETAIL.

4 REF: 00M501 FOR PIPE SUPPORT DETAIL.

5 ROUTE CONDENSATE AROUND ROOF OVERHANG AND DOWN SIDE OF WALL. REFER TO 40M101 FOR CONTINUATION.

6 REF: 00M501 FOR FLEXIBLE DUCT CONNECTION DETAIL.

7 REF: 00M501 FOR INTAKE HOOD WITH SUPPLY FAN DETAIL.

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HDR
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PRAIRIE CREEK
AERATION BASIN
EXPANSION

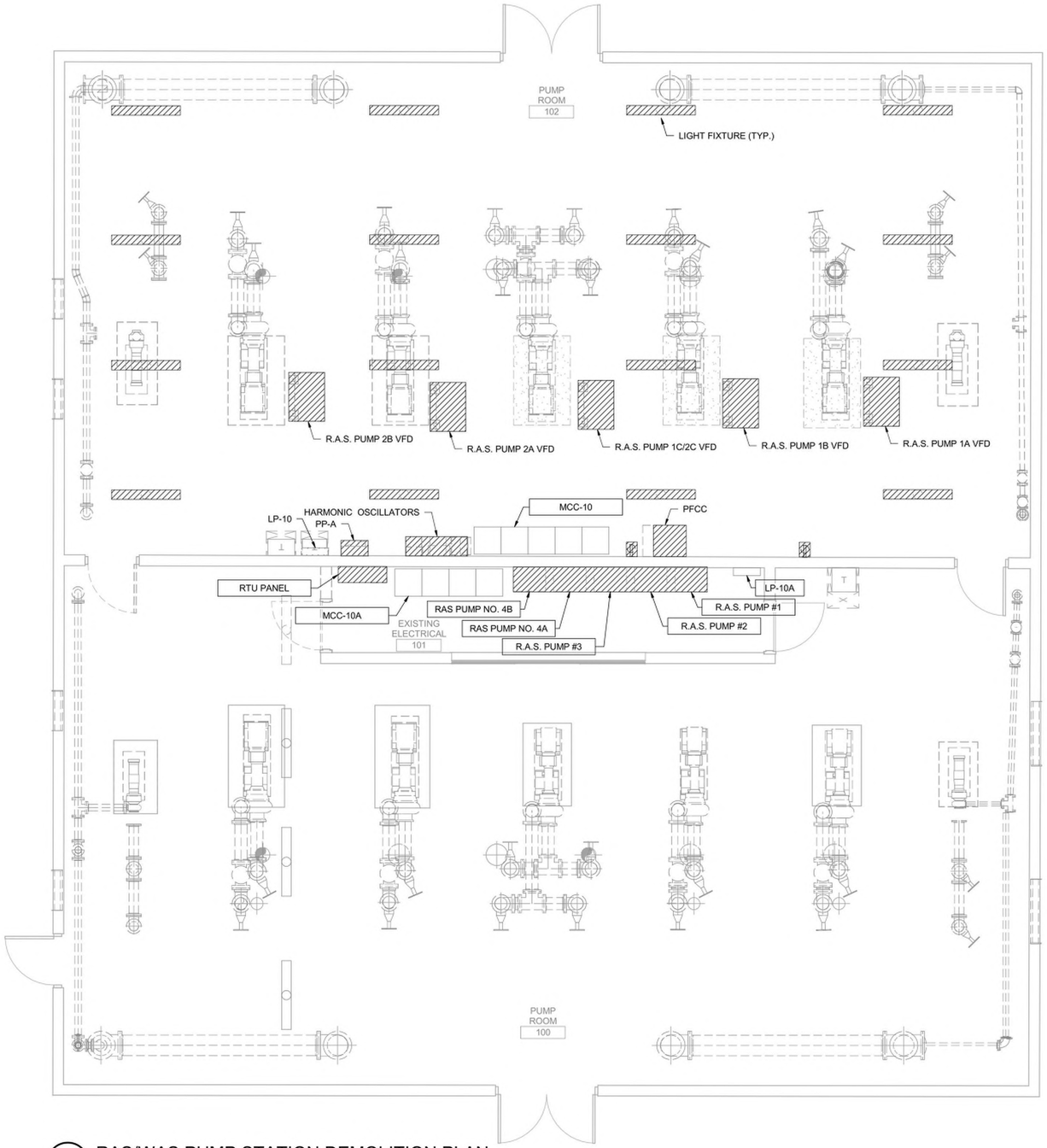
N

0 1" 2"

RAS/WAS PUMP STATION
MECHANICAL
UPPER LEVEL PLAN

FILENAME 40 - RAS_WAS Pump Station (Existing) - Mech.RVT
SCALE 3/16" = 1'-0"

SHEET
40M102



1 / - RAS/WAS PUMP STATION DEMOLITION PLAN
1/4" = 1'-0"

GENERAL NOTES:

1. DISCONNECT AND REMOVE ALL HATCHED ELECTRICAL EQUIPMENT AND THEIR CORRESPONDING CABLES, CONDUIT, DISCONNECTS, LIGHT FIXTURES, TOGGLE SWITCHES, AND RECEPTACLES FROM POWER SOURCE TO EQUIPMENT.
2. COORDINATE DISPOSAL OF DEMOLISHED EQUIPMENT WITH OWNER.

TEXAS P.E. FIRM
Registration No. F-754

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PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	O. JONGUITUD
DRAWN BY	B. LOREDO
CHECKED BY	G. JAGLOWSKI
APPROVED BY	O. JONGUITUD
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

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PRAIRIE CREEK

AERATION BASIN EXPANSION

N
0 1" 2"

RAS/WAS PUMP STATION ELECTRICAL DEMOLITION PLAN

FILENAME 40EX101.dwg
SCALE 1/4" = 1'-0"

SHEET
40EX101

1 - EXISTING MCC-10 RAS PUMP 2A AND 2B DEMOLITION
SCALE: NONE

2 - EXISTING MCC-10 RAS PUMP 1C/2C DEMOLITION
SCALE: NONE

3 - EXISTING MCC-10 RAS PUMP 1A AND 1B DEMOLITION
SCALE: NONE

4 - EXISTING MCC-10 WAS PUMPS 1 AND 2 DEMOLITION
SCALE: NONE

5 - EXISTING MCC-10A RAS PUMP 3A, 3B, 3C/4C DEMOLITION
SCALE: NONE

6 - EXISTING MCC-10A RAS PUMP 4A AND 4B DEMOLITION
SCALE: NONE

7 - EXISTING MCC-10A WAS PUMP NO. 3 DEMOLITION
SCALE: NONE

8 - EXISTING MCC-10A WAS PUMP NO. 4 DEMOLITION
SCALE: NONE

GENERAL NOTES:

1. COORDINATE DISPOSAL OF DEMOLISHED EQUIPMENT WITH OWNER.

KEYED NOTES: (#)

1. DEMOLISH INTERIOR OF BUCKET AND REUSE FOR NEW RAS PUMP. RELABEL NAME PLATE TO MATCH ONE-LINE DIAGRAM EQUIPMENT NAMES.
2. DEMOLISH INTERIOR OF BUCKET AND REUSE FOR NEW EXHAUST FAN. RELABEL NAME PLATE TO MATCH ONE-LINE DIAGRAM EQUIPMENT NAMES.
3. DEMOLISH INTERIOR OF BUCKET AND RELABEL NAME PLATE AS SPACE.

HDR
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DRAWN BY	B. LOREDO
CHECKED BY	G. JAGLOWSKI
APPROVED BY	O. JONGUITUD
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

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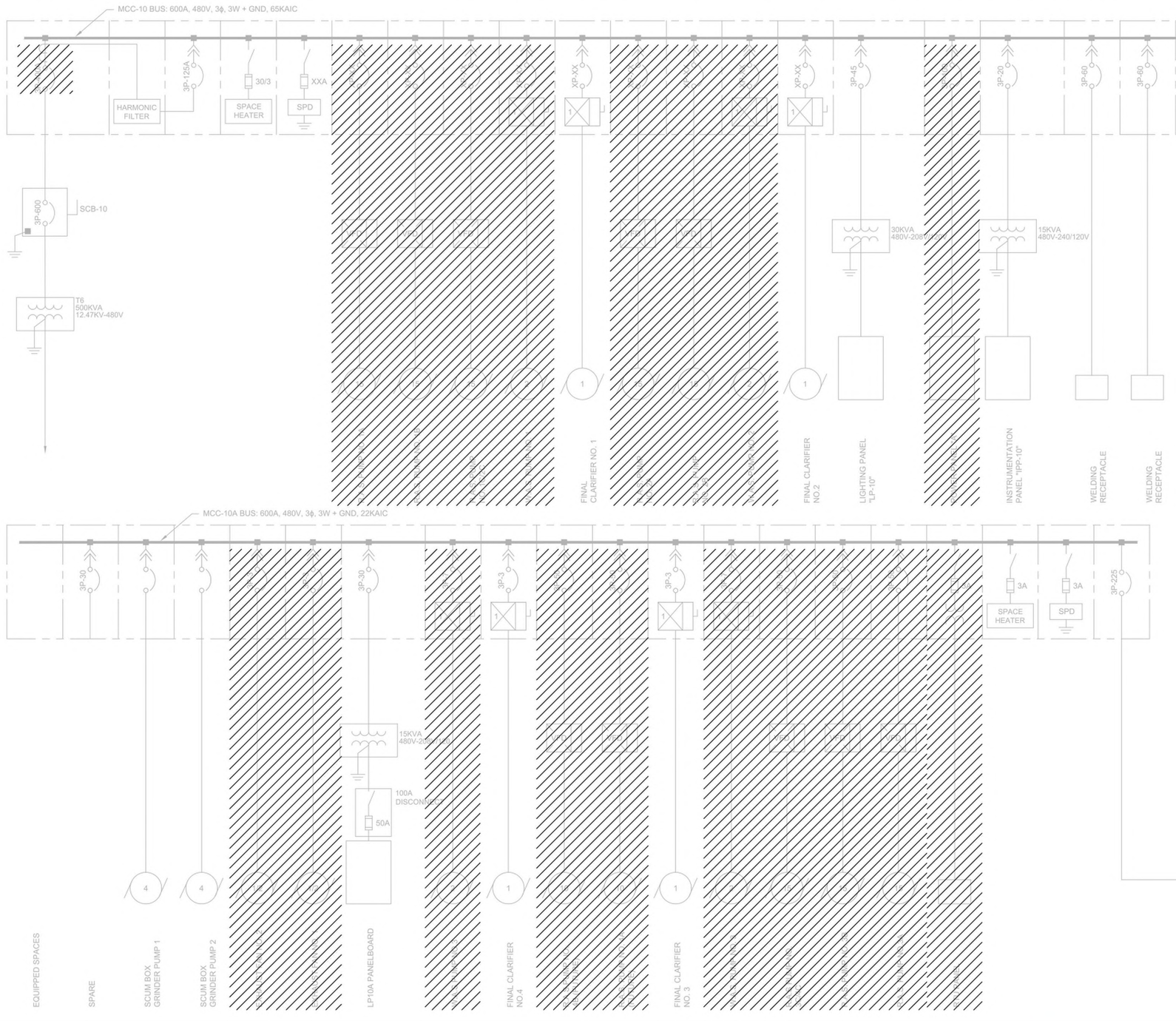
AERATION BASIN EXPANSION

RAS/WAS PUMP STATION
ELECTRICAL
MCC-10 AND MCC-10A
BUCKET DEMOLITION

0 1" 2"

FILENAME 40EX401.dwg
SCALE NONE

SHEET
40EX401



GENERAL NOTES:

1. HATCHED AREAS DENOTE AREAS TO BE DEMOLISHED, MCC SECTIONS TO REMAIN. DISCONNECT AND REMOVE CONDUCTORS AND ASSOCIATED EXPOSED CONDUITS.

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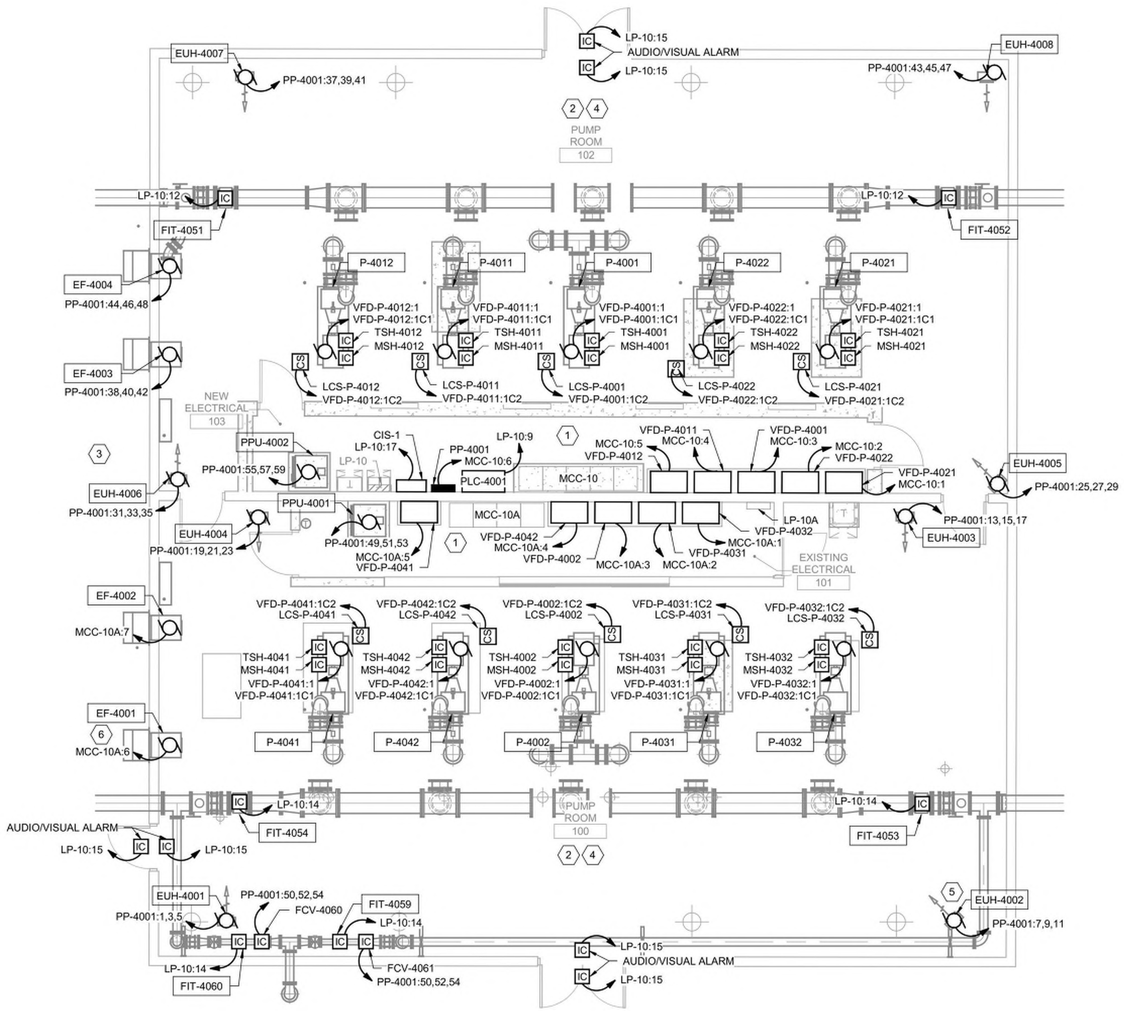
AERATION BASIN EXPANSION

RAS/WAS PUMP STATION ELECTRICAL MCC-10 AND MCC-10A ONE-LINE DIAGRAM DEMOLITION

0 1" 2"

FILENAME 40EX601.dwg
SCALE NONE

SHEET
40EX601



1 - RAS/WAS PUMP STATION POWER PLAN

3/16" = 1'-0"

GENERAL NOTES:

1. PROVIDE TOGGLE SWITCH FOR ALL INSTRUMENTATION DEVICES REQUIRING 120V POWER. TOGGLE SWITCH TO BE WITHIN SIGHT OF INSTRUMENT FOR DISCONNECTING MEANS.
2. CONTRACTOR SHALL REALIGN CONDUITS MOUNTED TO UNDERSIDE OF OPEN WEB STEEL ROOF JOIST IN LOCATIONS WHERE CONDUITS INTERFERE WITH ALIGNMENT OF PROCESS PIPING.
3. PROVIDE HOUSEPEEKING CONCRETE PADS FOR ALL VFDS. SEE STRUCTURAL SHEETS FOR PAD DETAILS.

KEY NOTES: (#)

1. AREA CLASSIFICATION IS INDOOR-DRY.
2. AREA CLASSIFICATION IS INDOOR-WET/CORROSIVE.
3. AREA CLASSIFICATION IS OUTDOOR-WET/CORROSIVE.
4. HAZARDOUS CLASSIFICATION IN RAS/WAS PUMP STATION BUILDING IS UNCLASSIFIED. SEE NFPA 820 2020 TABLE 6.2.2.A, ROW 9, LINE B.
5. DISCONNECT SWITCHES FOR ELECTRIC UNIT HEATERS SHOWN ON THIS DRAWING TO BE PROVIDED BY EUH MANUFACTURER. SEE MECHANICAL SCHEDULES.
6. DISCONNECT SWITCHES FOR EXHAUST FANS SHOWN ON THIS DRAWING TO BE PROVIDED BY EF MANUFACTURER. SEE MECHANICAL SCHEDULES.

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PRAIRIE CREEK

AERATION BASIN EXPANSION

RAS/WAS PUMP STATION ELECTRICAL POWER PLAN

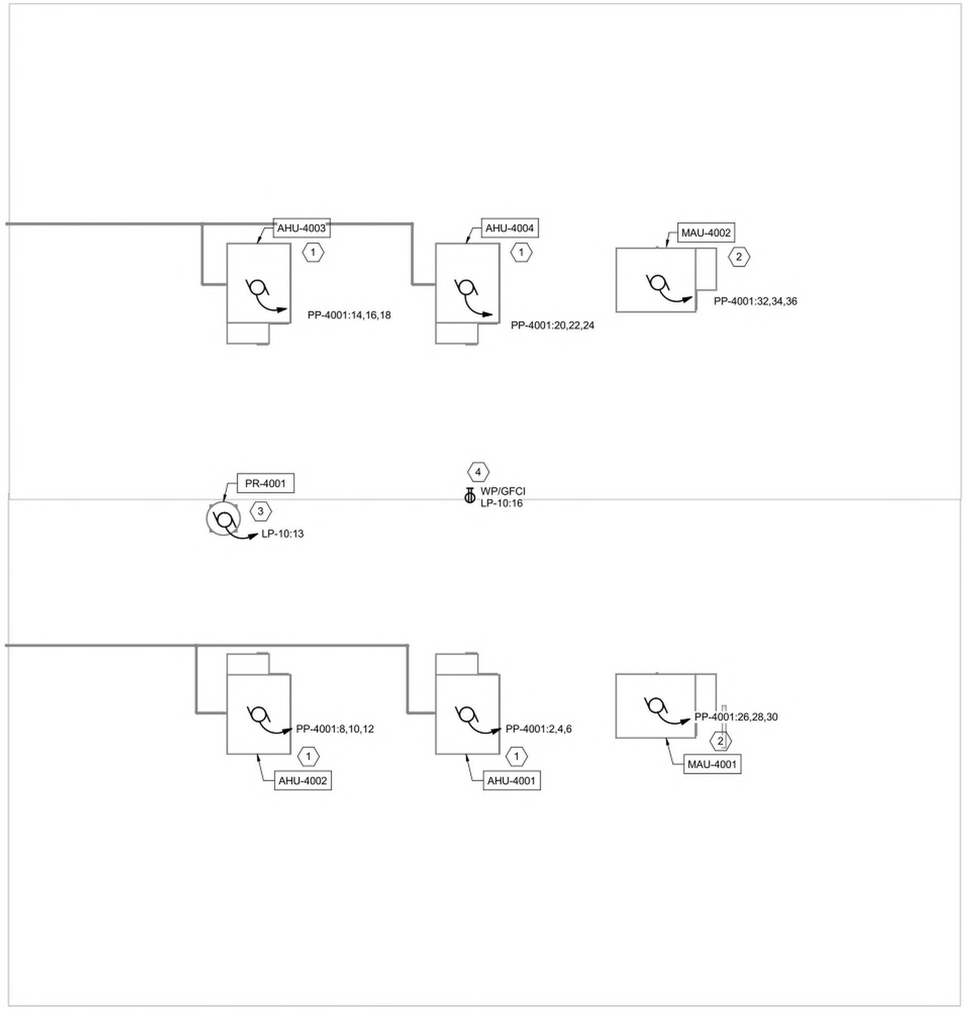
0 1" 2"

FILENAME 40E101.dwg
SCALE 3/16" = 1'-0"

SHEET
40E101

KEY NOTES: (#)

1. AIR HANDLING UNIT DISCONNECT SWITCH TO BE PROVIDED BY AHU MANUFACTURER. SEE MECHANICAL SCHEDULES.
2. MAKE-UP AIR UNIT DISCONNECT SWITCH TO BE PROVIDED BY MAU MANUFACTURER. SEE MECHANICAL SCHEDULES.
3. PROPELLER SUPPLY FAN DISCONNECT SWITCH TO BE PROVIDED BY MANUFACTURER. SEE MECHANICAL SCHEDULES.
4. MOUNT RECEPTACLE ON ROOF. SEE 3/99E502 FOR WEATHERPROOF RECEPTACLE ROOF MOUNTING DETAIL.



1 - RAS/WAS PUMP STATION ROOF POWER PLAN

3/16" = 1'-0"

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PRAIRIE CREEK

AERATION BASIN EXPANSION

N

0 1" 2"

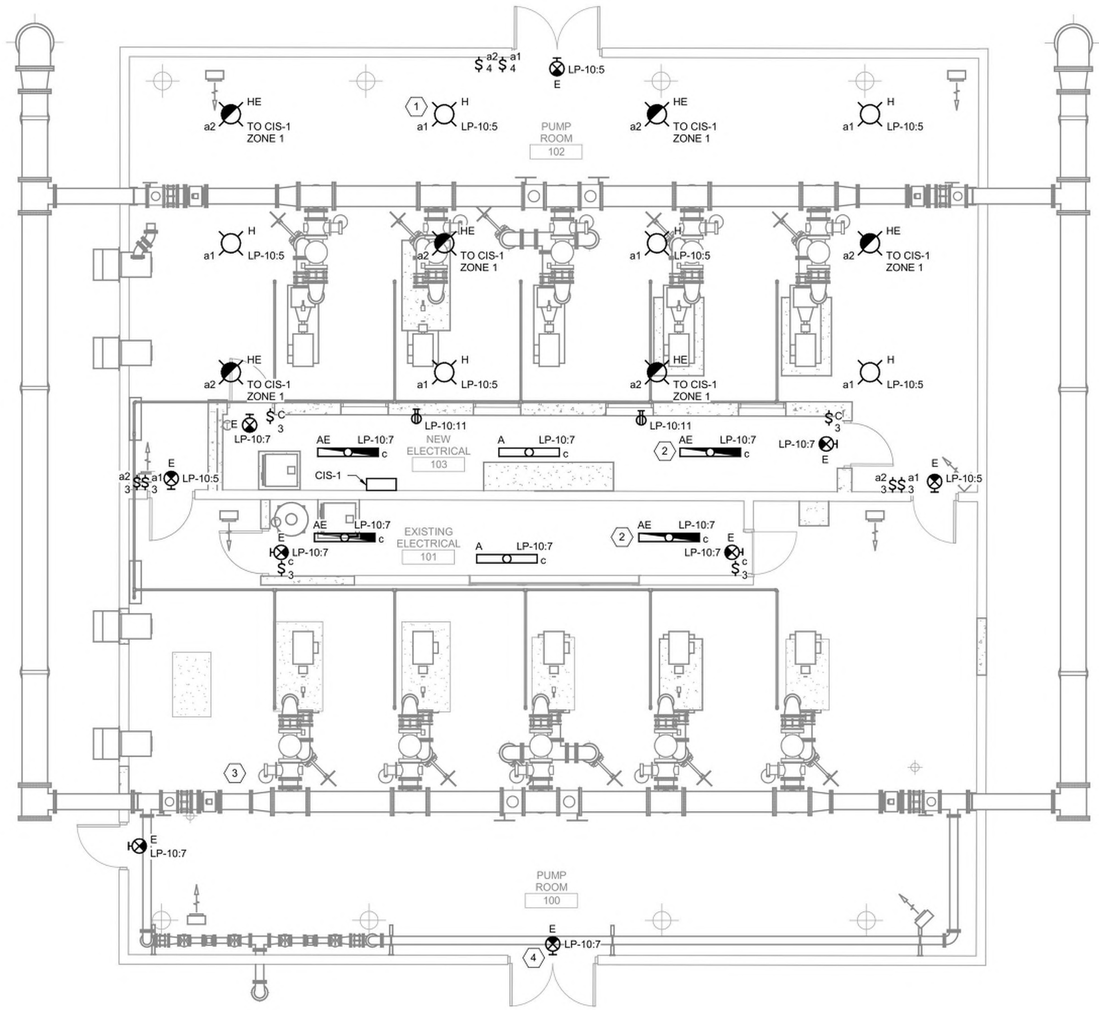
RAS/WAS PUMP STATION ELECTRICAL ROOF POWER PLAN

FILENAME 40E102.dwg
SCALE 3/16" = 1'-0"

SHEET **40E102**

KEY NOTES: (#)

1. MOUNT BOTTOM OF PUMP ROOM LIGHT FIXTURES TYPE H AND HE ON THIS SHEET AT APPROXIMATELY 8'-0" A.F.F.
2. MOUNT BOTTOM OF ELECTRICAL ROOM LIGHT FIXTURES TYPE A AND AE ON THIS SHEET AT APPROXIMATELY 8'-6" A.F.F.
3. CONTRACTOR SHALL FIELD VERIFY EXISTING LIGHTS DO NOT COLLIDE WITH PIPING. RELOCATE EXISTING LIGHTING 6" AWAY FROM PIPE IF COLLIDING.
4. MOUNT BOTTOM OF LIGHT FIXTURES TYPE E ON THIS DRAWING AT APPROXIMATELY 0'-6" ABOVE DOOR FRAME.



1 / - RAS/WAS PUMP STATION LIGHTING AND RECEPTACLE PLAN
3/16" = 1'-0"

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STATE OF TEXAS — OSCAR JONGUITUD — 133057 — LICENSED PROFESSIONAL ENGINEER — 6-13-25

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PRAIRIE CREEK
AERATION BASIN EXPANSION

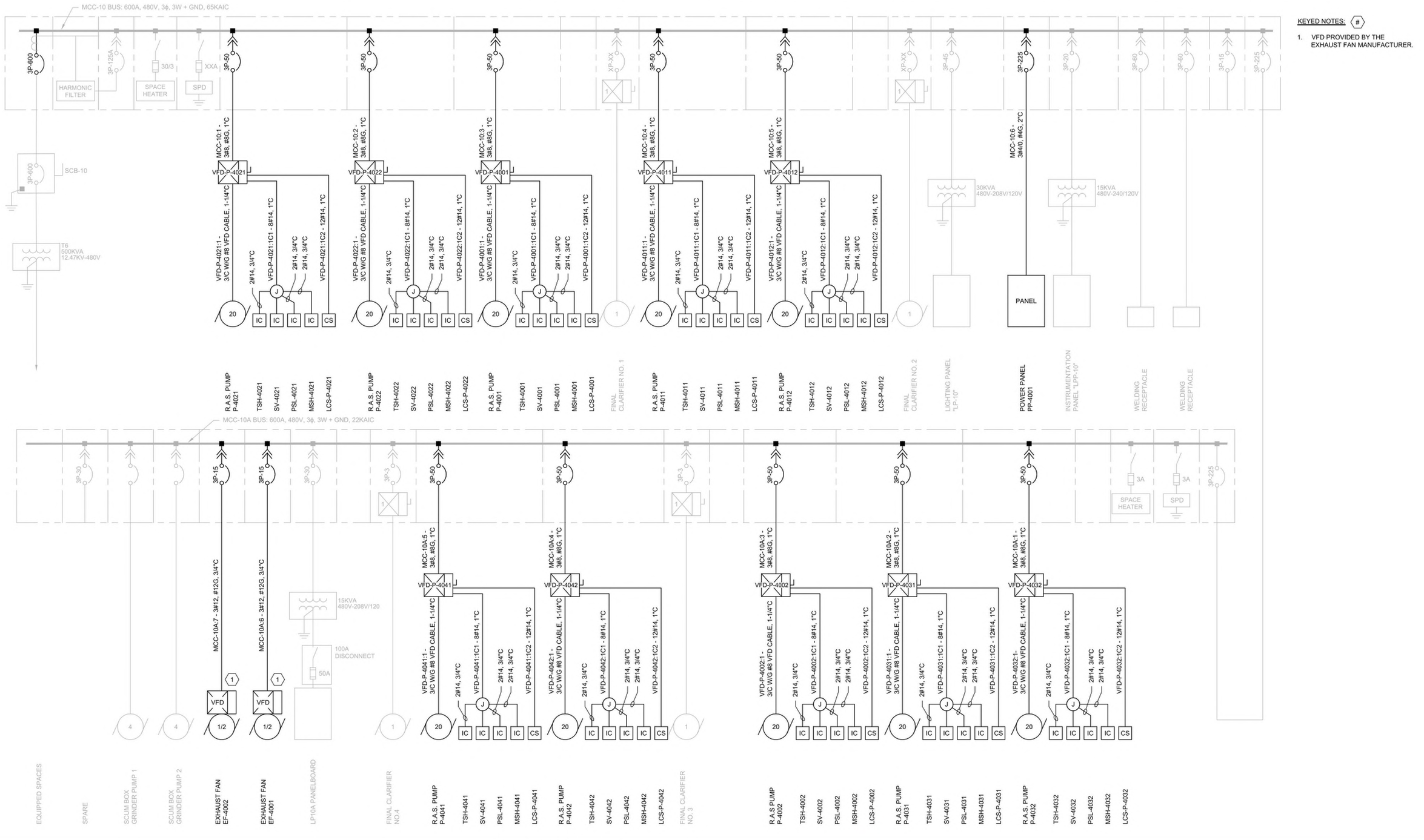
N

0 1" 2"

RAS/WAS PUMP STATION ELECTRICAL LIGHTING AND RECEPTACLE PLAN

FILENAME 40E103.dwg
SCALE 3/16" = 1'-0"

SHEET **40E103**



KEYED NOTES: (#)

1. VFD PROVIDED BY THE EXHAUST FAN MANUFACTURER.

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AERATION BASIN EXPANSION

RAS/WAS PUMP STATION ELECTRICAL MCC-10 AND MCC-10A ONE-LINE DIAGRAM

0 1" 2"

FILENAME 40E601.dwg
SCALE NONE

SHEET **40E601**

RAS/WAS PUMP STATION LOAD ANALYSIS

MCC-10

MOTOR LOAD	**HP**	**FLA @ 480V**
RAS PUMP NO. 1A	20	27
RAS PUMP NO. 1B	20	27
RAS PUMP NO. 1C/2C (STANDBY)	20	-
FINAL CLARIFIER NO.1	1	2.1
RAS PUMP NO. 2A	20	27
RAS PUMP NO. 2B	20	27
PPU-4001	1	2.1
PPU-4002	1	2.1
EXHAUST FAN EF-4003	1/2	1.1
EXHAUST FAN EF-4004	1/2	1.1
MOTORIZED VALVE FCV-4060	1	2.1
MOTORIZED VALVE FCV-4061	1	2.1
FINAL CLARIFIER NO.2	1	2.1
SUBTOTAL NON-VFD MOTOR LOADS		122.8

NON-MOTOR LOADS	**kVA**	**FLA @ 480V**
TRANSFORMER FOR LP-10	30	36.1
TRANSFORMER FOR IPP-10	15	31.3
RTU PANEL		
ELECTRIC UNIT HEATER EUH-4001	3	3.6
ELECTRIC UNIT HEATER EUH-4002	3	3.6
ELECTRIC UNIT HEATER EUH-4003	3	3.6
ELECTRIC UNIT HEATER EUH-4004	3	3.6
ELECTRIC UNIT HEATER EUH-4005	3	3.6
ELECTRIC UNIT HEATER EUH-4006	3	3.6
ELECTRIC UNIT HEATER EUH-4007	3	3.6
ELECTRIC UNIT HEATER EUH-4008	3	3.6
AIR HANDLING UNIT AHU-4001	-	15.8
AIR HANDLING UNIT AHU-4002	-	15.8
AIR HANDLING UNIT AHU-4003	-	15.8
AIR HANDLING UNIT AHU-4004	-	15.8
MAKE-UP AIR UNIT MAU-4001	-	28.9
MAKE-UP AIR UNIT MAU-4002	-	28.9
WELDING RECEPTACLE 1		
WELDING RECEPTACLE 2		
SPACE HEATER	0.5	0.6
MCC-10A FEEDER		152.1
SUBTOTAL NON-MOTOR LOADS		370.0
SUBTOTAL CONNECTED LOAD		492.8
25% OF LARGEST MOTOR		6.8
SUBTOTAL - MINIMUM MCC AMPACITY PER NEC		499.5
MCC-10 CB SIZE:		600A

1 / - MCC-10 LOAD ANALYSIS
SCALE: NONE

MCC-10A

MOTOR LOAD	**HP**	**FLA @ 480V**
RAS PUMP NO. 3A	20	27
RAS PUMP NO. 3B	20	27
RAS PUMP NO. 3C/4C (STANDBY)	20	-
FINAL CLARIFIER NO.3	1	2.1
RAS PUMP NO. 4A	20	27
RAS PUMP NO. 4B	20	27
FINAL CLARIFIER NO.4	1	2.1
EXHAUST FAN EF-4001	1/2	1.1
EXHAUST FAN EF-4002	1/2	1.1
PPU-4001	1	2.1
SCUM BOX GRINDER PUMP 1	5	7.6
SCUM BOX GRINDER PUMP 2	5	7.6
SUBTOTAL NON-VFD MOTOR LOADS		131.7

NON-MOTOR LOADS	**kVA**	**FLA @ 480V**
TRANSFORMER FOR LP-10A	15	18.0
SPACE HEATER	2	2.4
SUBTOTAL NON-MOTOR LOADS		20.4
SUBTOTAL CONNECTED LOAD		152.1
25% OF LARGEST MOTOR		6.8
SUBTOTAL - MINIMUM MCC AMPACITY PER NEC		158.9
MCC-10A CB SIZE:		225A

2 / - MCC-10A LOAD ANALYSIS
SCALE: NONE

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	O. JONGUITUD
DRAWN BY	B. LOREDO
CHECKED BY	G. JAGLOWSKI
APPROVED BY	O. JONGUITUD
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
OSCAR JONGUITUD
133057
LICENSED
PROFESSIONAL ENGINEER
6-13-25

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

RAS/WAS PUMP STATION ELECTRICAL MCC-10 AND MCC-10A LOAD ANALYSIS

0 1" 2"

FILENAME 40E602.dwg
SCALE NONE

SHEET
40E602

PANELBOARD 'PP-4001'

LOCATION: RAS/WAS PS NEW ELECTRICAL ROOM | VOLTAGE: 480 V | KAIC: 65 | BUSSING SHALL BE FULLY RATED
MOUNTING: SURFACE | PHASE: 3 P / 3W | CODES: 0=EQPT, 1=RCPT, 2=LTG, 3=A/C, 4=HEAT
ENCLOSURE: NEMA 1 STYLE: PER SPEC | BUSSING: 225 A | 5=CONTINUOUS MOTORS, 6=LRGST MOTOR, 7=PANEL
BRKR MTG: BOLT-ON | MCB: 225 A | ACCESSORIES: GROUND BUS, 60 SPACE
BREAKERS: 60/75 DEGREE TERMINALS | MLO: A

WIRING				CODE	BRKR	CIRCUIT USE	CKT	LOAD	A	B	C	LOAD	CKT	CIRCUIT USE	BRKR	CODE	WIRING			
PHASE	NEUT.	GND	CONDUIT														PHASE	NEUT.	GND	CONDUIT
#12	-	#12	3/4"	4			1	1,000	X			3,660	2			3				
				4	15/3	ELECTRIC UNIT HEATER EUH-4001	3	1,000		X		3,660	4	AHU-4001	25/3	3	#12	-	#12	3/4"
				4			5	1,000			X	3,660	6			3				
#12	-	#12	3/4"	4			7	1,000	X			3,660	8			3				
				4	15/3	ELECTRIC UNIT HEATER EUH-4002	9	1,000		X		3,660	10	AHU-4002	25/3	3	#12	-	#12	3/4"
				4			11	1,000			X	3,660	12			3				
#12	-	#12	3/4"	4			13	1,000	X			3,660	14			3				
				4	15/3	ELECTRIC UNIT HEATER EUH-4003	15	1,000		X		3,660	16	AHU-4003	25/3	3	#12	-	#12	3/4"
				4			17	1,000			X	3,660	18			3				
#12	-	#12	3/4"	4			19	1,000	X			3,660	20			3				
				4	15/3	ELECTRIC UNIT HEATER EUH-4004	21	1,000		X		3,660	22	AHU-4004	25/3	3	#12	-	#12	3/4"
				4			23	1,000			X	3,660	24			3				
#12	-	#12	3/4"	4			25	1,000	X			6,402	26			3				
				4	15/3	ELECTRIC UNIT HEATER EUH-4005	27	1,000		X		6,402	28	MAU-4001	30/3	3	#10	-	#10	3/4"
				4			29	1,000			X	6,402	30			3				
#12	-	#12	3/4"	4			31	1,000	X			6,402	32			3				
				4	15/3	ELECTRIC UNIT HEATER EUH-4006	33	1,000		X		6,402	34	MAU-4002	30/3	3	#10	-	#10	3/4"
				4			35	1,000			X	6,402	36			3				
#12	-	#12	3/4"	4			37	1,000	X			305	38			5				
				4	15/3	ELECTRIC UNIT HEATER EUH-4007	39	1,000		X		305	40	EXHAUST FANS EF-4003	15/3	5	#12	-	#12	3/4"
				4			41	1,000			X	305	42			5				
#12	-	#12	3/4"	0			43	1,000	X			305	44			5				
				0	15/3	ELECTRIC UNIT HEATER EUH-4008	45	1,000		X		305	46	EXHAUST FANS EF-4004	15/3	5	#12	-	#12	3/4"
				0			47	1,000			X	305	48			5				
#12	-	#12	3/4"	0			49	582	X			1,275	50			0				
				0	15/3	(1) PPU-4001	51	582		X		1,275	52	MOTORIZED VALVES FCV-4060 AND FCV-4061	20/3	0	#12	-	#12	3/4"
				0			53	582			X	1,275	54			0				
#12	-	#12	3/4"	0			55	582	X			-	56			-				
				0	15/3	(1) PPU-4002	57	582		X		-	58	SPD	PER MFR	-	-	-	-	-
				0			59	582			X	-	60			-				

	EQPT VA	RCPT VA	LTG VA	A/C/HEAT VA		MOTORS			CONN VA		FTL VA	PANEL VA	PHASE AMP		
PHASE A	3439	0	0	27444		610			31493			31646	114		
PHASE B	3439	0	0	27444		610			31493			31646	114		
PHASE C	3439	0	0	27444		610			31493			31646	114		
TOTAL	10317	0	0	82332		1830			94479			94937			

PANEL DEMAND KVA: 94.94 | PANEL DEMAND AMPACITY: 114 AMPS
RESERVE KVA: 23.73 | RESERVE AMPACITY: 29 AMPS
DESIGN KVA: 118.67 | DESIGN AMPACITY: 143 AMPS

(1) - PANELBOARD PP-4001 SCHEDULE
SCALE: NONE

KEYED NOTES: (#)

1. CIRCUIT BREAKER SHALL BE PROVIDED WITH LOCKABLE MEANS IN ACCORDANCE WITH NEC ARTICLE 110.25.

LIGHTING PANEL 'LP-10'

LOCATION: NEW ELECTRICAL ROOM | VOLTAGE: 208/120 V | KAIC: 22 | BUSSING SHALL BE FULLY RATED
MOUNTING: SURFACE | PHASE: 3 P / 4W | CODES: 0=EQPT, 1=RCPT, 2=LTG, 3=A/C, 4=HEAT
ENCLOSURE: STYLE: | BUSSING: 225 A | 5=CONTINUOUS MOTORS, 6=LRGST MOTOR, 7=PANEL
BRKR MTG: BOLT-ON | MCB: 100 A | ACCESSORIES: GROUND BUS, 36 SPACE
BREAKERS: 60/75 DEGREE TERMINALS | MLO: A

WIRING				CODE	BRKR	CIRCUIT USE	CKT	LOAD	A	B	C	LOAD	CKT	CIRCUIT USE	BRKR	CODE	WIRING			
PHASE	NEUT.	GND	CONDUIT														PHASE	NEUT.	GND	CONDUIT
									X				2	RECEPTACLE CLARIFIER AREA	20/1					
					100/3	MAIN CIRCUIT BREAKER				X			4	RECEPTACLE CLARIFIER AREA	20/1					
											X		6	RECEPTACLE PUMP STA.	20/1					
					20/1	LIGHTING CLARIFIER AREA WEST RECPT	1		X				8	RECEPTACLE PUMP STA.	20/1					
					20/1	LIGHTING CLARIFIER AREA EAST RECPT	3			X			10	XFMR-LTG	20/1					
#12	#12	#12	3/4"	2	20/1	PUMP ROOM LIGHTS	5	348			X	240	12	FIT-4051, FIT-4052	20/1	0	#12	#12	#12	3/4"
#12	#12	#12	3/4"	2	20/1	ELECTRICAL ROOM LIGHTS	7	310	X			480	14	FIT-4053, FIT-4054, FIT-4059, FIT-4060	20/1	0	#12	#12	#12	3/4"
#12	#12	#12	3/4"	0	20/1	PLC PANEL PLC-4001	9	600		X		180	16	HVAC RECEPTACLE	20/1	1	#12	#12	#12	3/4"
#12	#12	#12	3/4"	1	20/1	ELECTRICAL ROOM 103 RECEPTACLES	11	360			X		18	SPACE						
#12	#12	#12	3/4"	0	20/1	PR-4001	13	528	X				20	SPACE						
#12	#12	#12	3/4"	0	20/1	AUDIO/VISUAL ALARMS	15	300		X			22	SPACE						
#12	#12	#12	3/4"	0	20/1	CIS-1 PUMP ROOM EMERGENCY LIGHTS	17	348			X		24	SPACE						
						SPACE	19		X				26	SPACE						
						SPACE	21			X			28	SPACE						
						SPACE	23				X		30	SPACE						
-	-	-	-	-	PER MFR	SPD	25	-	X				32	SPACE						
				-			27	-		X			34	SPACE						
				-			29	-			X		36	SPACE						

	EQPT VA	RCPT VA	LTG VA	A/C/HEAT VA		MOTORS			CONN VA		FTL VA	PANEL VA	PHASE AMP		
PHASE A	1008	0	310	0		0			1318			1396	12		
PHASE B	900	180	0	0		0			1080			1080	9		
PHASE C	588	360	348	0		0			1296			1383	12		
TOTAL	2496	540	658	0		0			3694			3859			

PANEL DEMAND KVA: 3.86 | PANEL DEMAND AMPACITY: 11 AMPS
RESERVE KVA: 0.96 | RESERVE AMPACITY: 3 AMPS
DESIGN KVA: 4.82 | DESIGN AMPACITY: 13 AMPS

(2) - EXISTING PANELBOARD LP-10 SCHEDULE
SCALE: NONE

TEXAS P.E. FIRM Registration No. F-754

ISSUE	DATE	DESCRIPTION
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DESIGNED BY	O. JONGUITUD
DRAWN BY	B. LOREDO
CHECKED BY	G. JAGLOWSKI
APPROVED BY	O. JONGUITUD
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS — OSCAR JONGUITUD — 133057 — LICENSED PROFESSIONAL ENGINEER — 6-13-25

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CITY OF LEWISVILLE
PRAIRIE CREEK

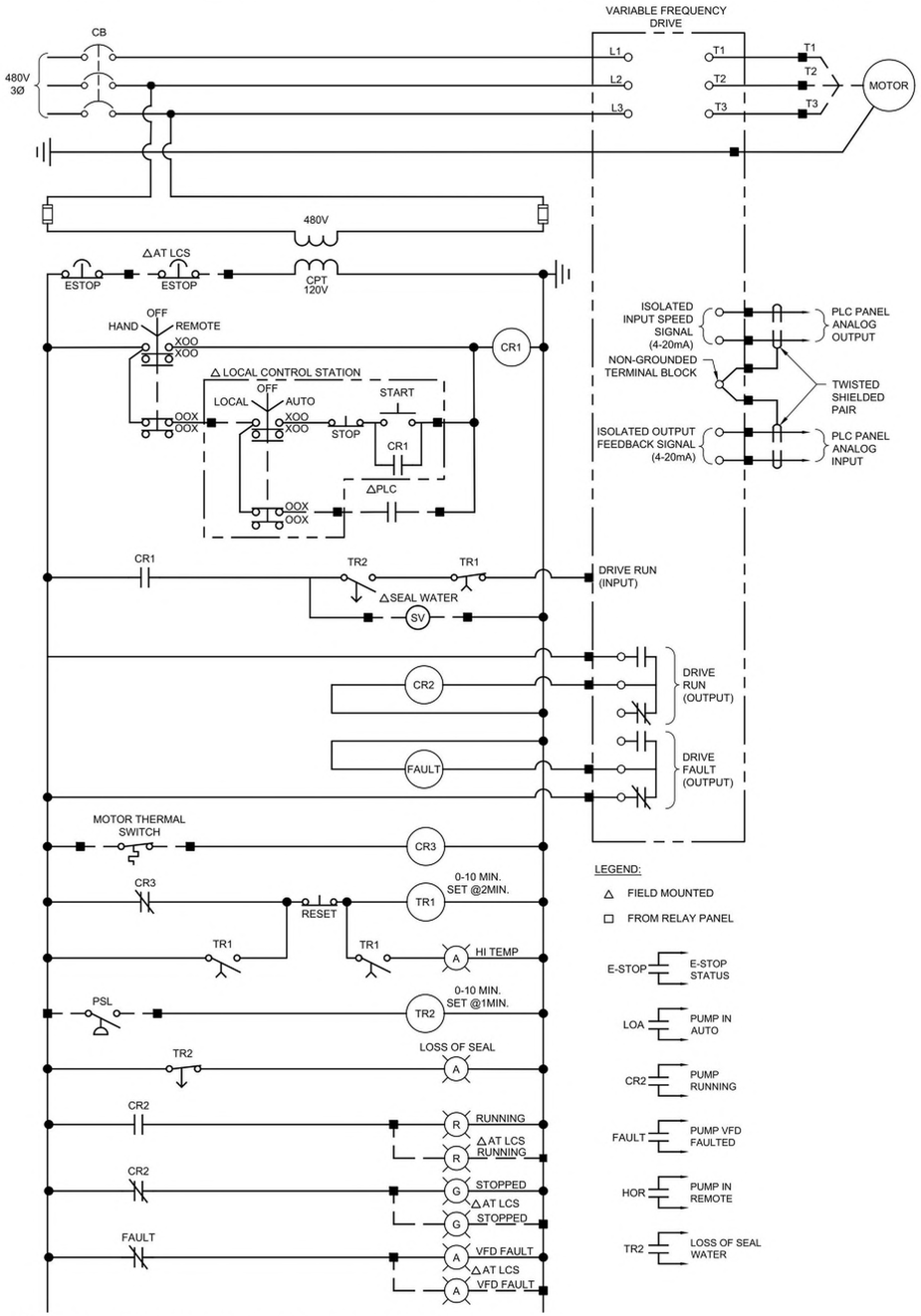
AERATION BASIN EXPANSION

RAS/WAS PUMP STATION ELECTRICAL PANEL SCHEDULES

0 1" 2"

FILENAME 40E603.dwg
SCALE NONE

SHEET 40E603



1 / 40E604 RAS PUMPS CONTROL SCHEMATIC

SCALE: NONE

HDR
TEXAS P.E. FIRM
Registration No. F-754

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CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
OSCAR JONGUITUD
13057
LICENSED
PROFESSIONAL ENGINEER
6-13-25

LEWISVILLE
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CITY OF LEWISVILLE
PRAIRIE CREEK

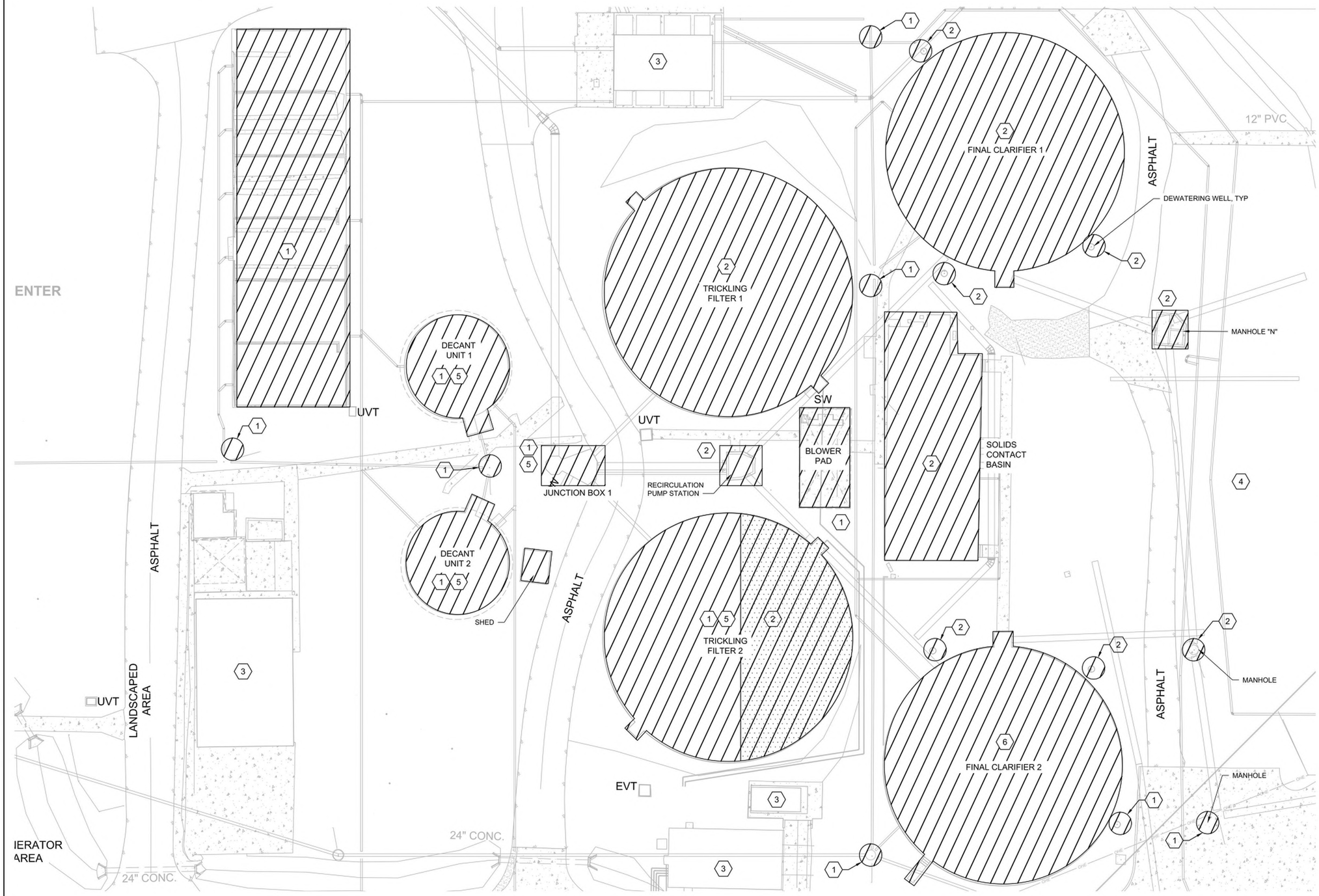
AERATION BASIN EXPANSION

RAS/WAS PUMP STATION ELECTRICAL CONTROL SCHEMATICS

0 1" 2"

FILENAME 40E604.dwg
SCALE NONE

SHEET **40E604**



N

1" = 20'

GENERAL NOTES:

1. SEE CIVIL DRAWINGS FOR YARD PIPING TO BE DEMOLISHED AND ABANDONED.
2. SEE SECTION 01 14 16 - COORDINATION WITH OWNER'S OPERATIONS FOR CONSTRUCTION SEQUENCING REQUIREMENTS AND CONSTRAINTS.
3. WHEREVER EXCAVATION AND DEMOLITION MAY UNDERMINE EXISTING STRUCTURES, ROADS, UTILITIES, DUCTBANKS, EQUIPMENT, ETC., CONTRACTOR SHALL FURNISH EXCAVATION SUPPORT PER SECTION 31 23 16.43 - TEMPORARY SUPPORT OF EXCAVATIONS AT NO ADDITIONAL COST TO THE OWNER.
4. NOT ALL EXISTING UTILITIES, DUCTBANKS, ETC. TO REMAIN ARE SHOWN ON THE CONTRACT DRAWINGS. SEE THE HISTORICAL DESIGN DRAWINGS IN THE APPENDICES FOR ADDITIONAL UTILITIES AND DUCTBANKS IN THE DEMOLITION AREA TO BE PROTECTED PER NOTE 3 ABOVE.

(X) KEYNOTES:

1. DEMOLISH STRUCTURE TO 5-FT BELOW EXISTING GRADE NOTED ON CIVIL DRAWINGS. REMOVE MISCELLANEOUS METALS, EQUIPMENT, VALVES, GATES, AND SIMILAR EQUIPMENT BEFORE BURYING REMAINING CONCRETE STRUCTURE. BACKFILL AND COMPACT REMAINING CONCRETE STRUCTURE TO FINISHED GRADE PER PROPOSED GRADING PLANS.
2. DEMOLISH STRUCTURE COMPLETELY, INCLUDING BASE SLAB, REMOVE UNDERDRAIN SYSTEM, MISCELLANEOUS METALS, EQUIPMENT, VALVES, GATES, AND SIMILAR EQUIPMENT.
3. FACILITY TO REMAIN IN SERVICE DURING CONSTRUCTION.
4. DEMOLISH ALL ROADS, PAVING, SIDEWALKS, AND SIMILAR SURFACE STRUCTURES WITHIN PLANT III AREA. SEE CIVIL DRAWINGS FOR EXTENTS.
5. FURNISH ABANDONED STRUCTURE DRAINAGE PORT AT LOW POINT OF EACH INDICATED STRUCTURE PER DETAIL ON DWG 60X107.
6. DEMOLISH ENTIRE STRUCTURE TO 3-FT BELOW EXISTING GRADE NOTED ON CIVIL DRAWINGS. AFTER EXISTING STRUCTURE IS DEMOLISHED 3-FT BELOW EXISTING GRADE, DEMOLISH THE NORTH HALF OF THE STRUCTURE COMPLETELY, INCLUDING BASE SLAB AND UNDERDRAIN SYSTEM. THICKENED FOUNDATION AT CENTER OF CLARIFIER CAN REMAIN AT CONTRACTOR'S OPTION. REMOVE MISCELLANEOUS METALS, EQUIPMENT, VALVES, GATES, AND SIMILAR EQUIPMENT BEFORE BURYING REMAINING CONCRETE STRUCTURE. BACKFILL AND COMPACT REMAINING CONCRETE STRUCTURE TO FINISHED GRADE PER PROPOSED GRADING PLANS. DO NOT SURCHARGE AT LEAST 10 FEET BEHIND EXISTING STRUCTURE TO REMAIN UNTIL BACKFILL AND COMPACTION INSIDE OF STRUCTURE TO TOP OF EXISTING WALL IS COMPLETE.
7. DEMOLISH TRICKLING FILTER 2 TO EXTENTS INDICATED ON 60X102 AND 60X103.

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Date 6/13/2025 11:05:26 AM

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	T. PAULMANN
DRAWN BY	A. FREEMON
CHECKED BY	L. PORTILLO
APPROVED BY	T. PAULMANN
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
THOMAS A. PAULMANN
128794
LICENSED PROFESSIONAL ENGINEER
6/13/25

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK

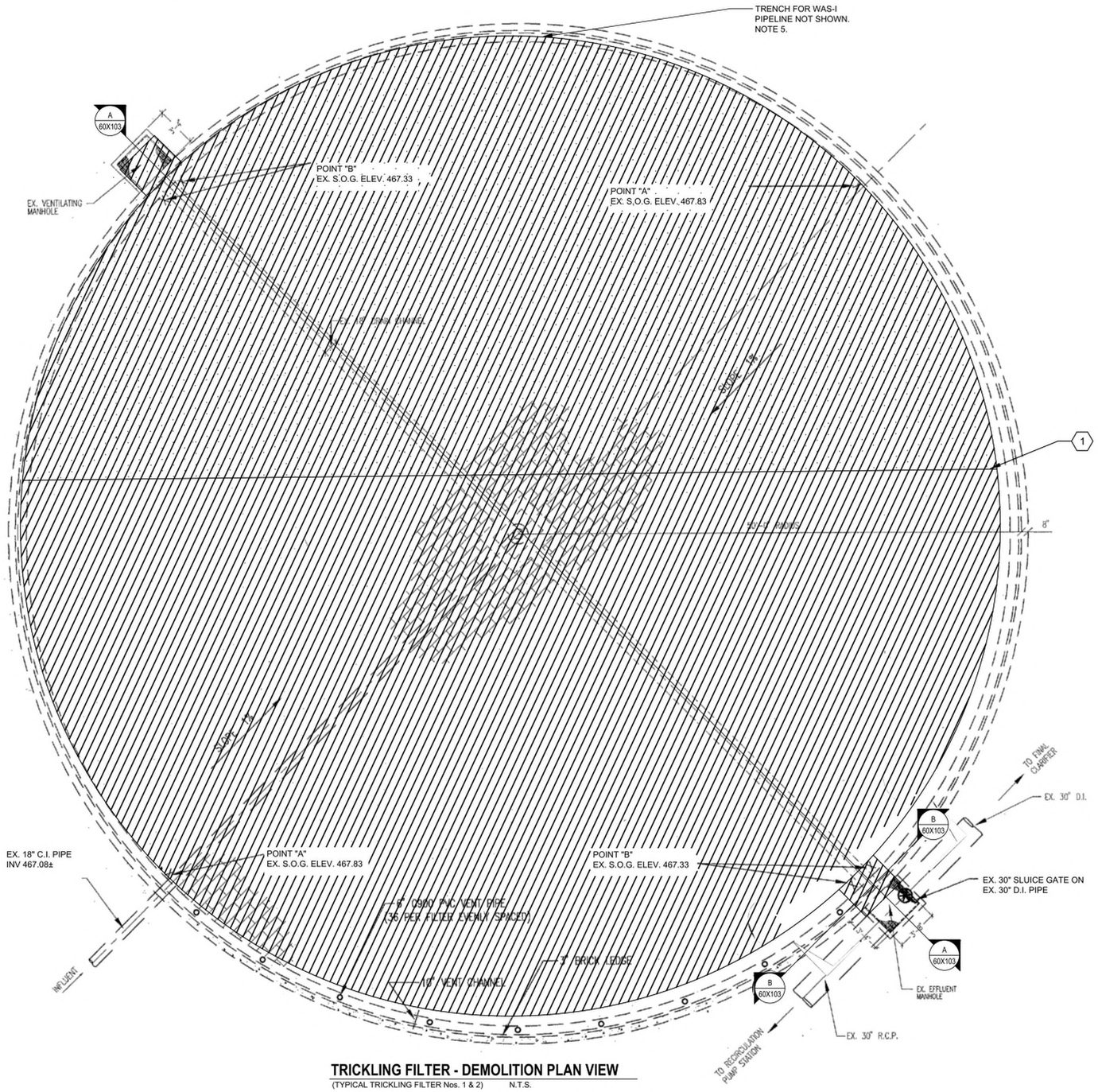
AERATION BASIN EXPANSION

PLANT III DEMOLITION
GENERAL
DEMOLITION EXISTING SITE PLAN

0 1" 2"

FILENAME 60X101.dwg
SCALE 1" = 20'

SHEET
60X101



TRICKLING FILTER - DEMOLITION PLAN VIEW

(TYPICAL TRICKLING FILTER Nos. 1 & 2) N.T.S.

NOTES:

1. TRICKLING FILTER 1 TO BE COMPLETELY DEMOLISHED.
2. HISTORICAL DRAWINGS ARE PROVIDED AS REFERENCES. CONTRACTOR TO IGNORE ALL CALLOUTS.
3. DIMENSIONS SHOWN ARE APPROXIMATE, BASED ON RECORD INFORMATION.
4. REMOVE AND DISPOSE ALL MEDIA, (FULL DEPTH), CLAY COVER BLOCKS, AND CLAY UNDERDRAIN BLOCKS FROM BOTH TRICKLING FILTERS PRIOR TO CONCRETE DEMOLITION.

KEYNOTES:

1. EAST OF EASTING 2435127.87, TRICKLING FILTER 2 TO IS TO BE FULLY DEMOLISHED. WEST OF EASTING 2435127.87, TRICKLING FILTER 2 IS TO BE DEMOLISHED TO 5' BELOW FINAL GRADE.

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TEXAS P.E. FIRM
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ISSUE	DATE	DESCRIPTION
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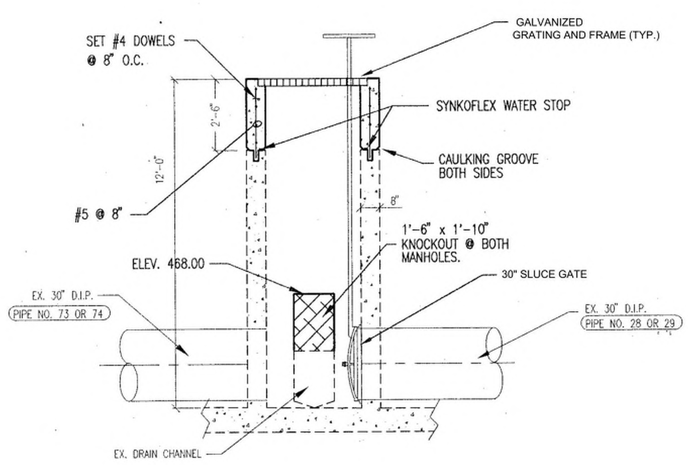
CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

PLANT III DEMOLITION
GENERAL
DEMOLITION TRICKLING FILTERS PLAN

0 1" 2"

FILENAME 60X102.dwg
SCALE NONE

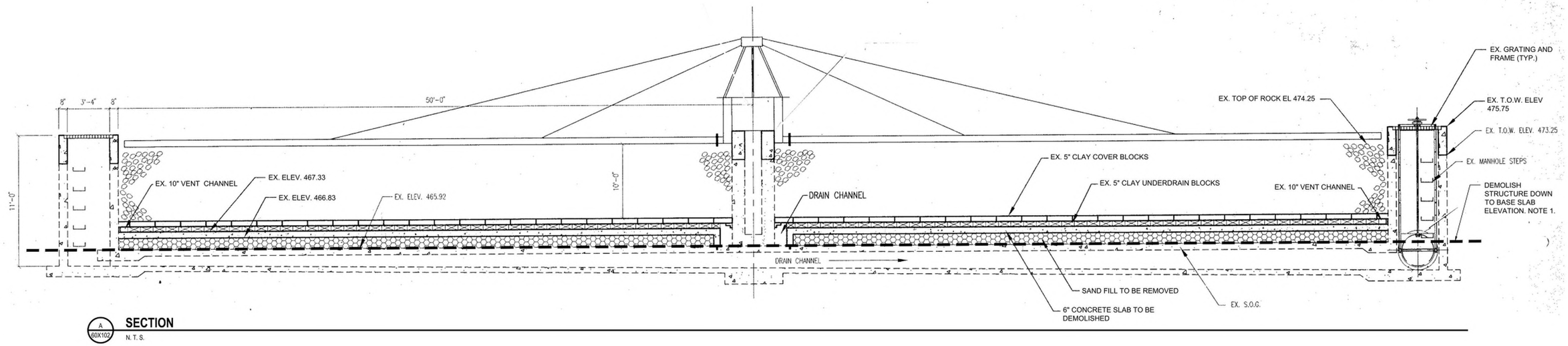
SHEET
60X102



B
60X102

SECTION

N. T. S.



A
60X102

SECTION

N. T. S.

NOTES:

1. SEE SHEET 60X102 FOR EXTENTS OF DEMOLITION.
2. HISTORICAL DRAWINGS ARE PROVIDED AS REFERENCES. CONTRACTOR TO IGNORE ALL CALLOUTS.
3. DIMENSIONS SHOWN ARE APPROXIMATE, BASED ON RECORD INFORMATION.

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6/13/25

LEWISVILLE
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CITY OF LEWISVILLE
PRAIRIE CREEK

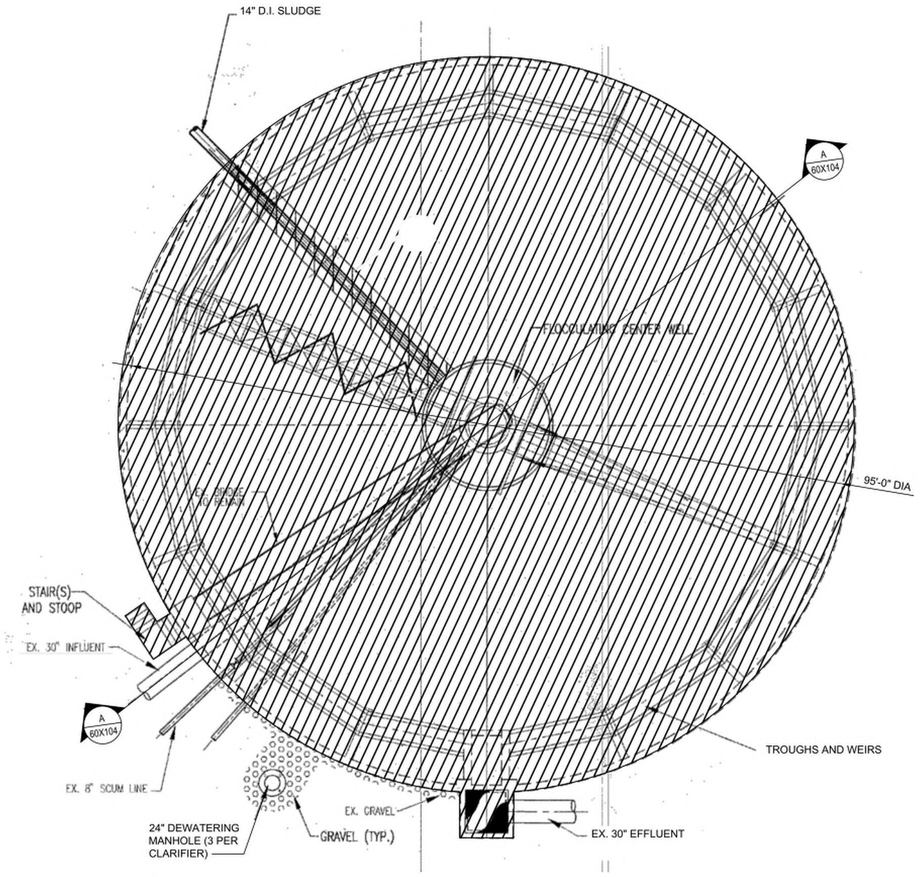
AERATION BASIN EXPANSION

PLANT III DEMOLITION
GENERAL
DEMOLITION TRICKLING FILTERS SECTION

0 1" 2"

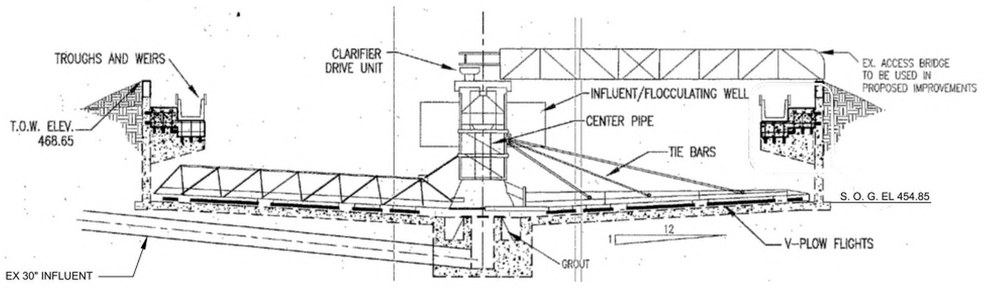
FILENAME 60X103.dwg
SCALE NONE

SHEET
60X103



FINAL CLARIFIER - DEMOLITION PLAN

N. T. S.



A 60X104 **SECTION**

N. T. S.

NOTES:

1. FINAL CLARIFIER 1 TO BE COMPLETELY DEMOLISHED.
2. DEMOLISH FINAL CLARIFIER 2 TO EXTENTS INDICATED ON DWGS 00C104A AND 60X101.
3. HISTORICAL DRAWINGS ARE PROVIDED AS REFERENCES. CONTRACTOR TO IGNORE ALL CALLOUTS.
4. DIMENSIONS SHOWN ARE APPROXIMATE, BASED ON RECORD INFORMATION.

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TEXAS P.E. FIRM
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CITY PROJECT NO.	U2100
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LICENSED
PROFESSIONAL ENGINEER
6/13/25

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

PLANT III DEMOLITION
GENERAL
DEMOLITION FINAL CLARIFIERS

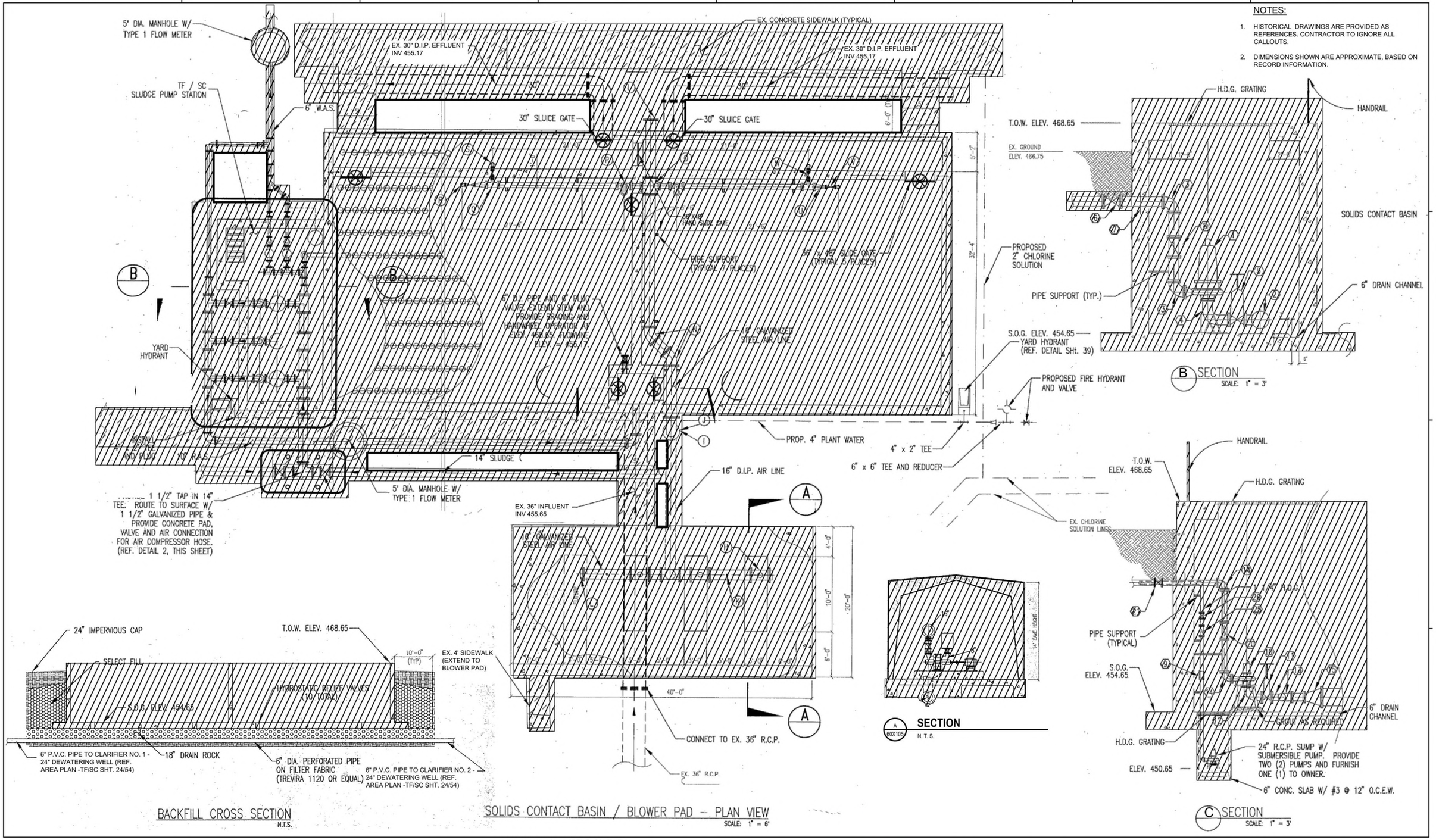
0 1" 2"

FILENAME 60X104.dwg
SCALE NONE

SHEET
60X104

NOTES:

1. HISTORICAL DRAWINGS ARE PROVIDED AS REFERENCES. CONTRACTOR TO IGNORE ALL CALLOUTS.
2. DIMENSIONS SHOWN ARE APPROXIMATE, BASED ON RECORD INFORMATION.



B SECTION
SCALE: 1" = 3'

A 60X105 SECTION
N. T. S.

C SECTION
SCALE: 1" = 3'

BACKFILL CROSS SECTION
N.T.S.

SOLIDS CONTACT BASIN / BLOWER PAD – PLAN VIEW
SCALE: 1" = 6'

File Path C:\Users\afreemon\DC\ACCDocs\HDR\10342803_COL_PCWWT_AB_Expansion_2022\Project Files\01_HDR\01_Demolition_X01.03_Sheet Files\60X105.dwg
Date 6/13/2025 11:07:23 AM

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	T. PAULMANN
DRAWN BY	A. FREEMON
CHECKED BY	L. PORTILLO
APPROVED BY	T. PAULMANN
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
THOMAS A. PAULMANN
128794
LICENSED
PROFESSIONAL ENGINEER
6/13/25

LEWISVILLE
Deep Roots. Broad Wings. Bright Future

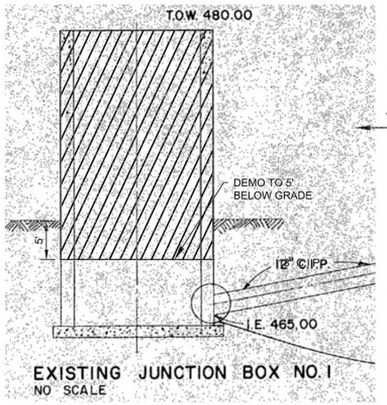
CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

PLANT III DEMOLITION
GENERAL
DEMOLITION SOLIDS CONTACT BASIN

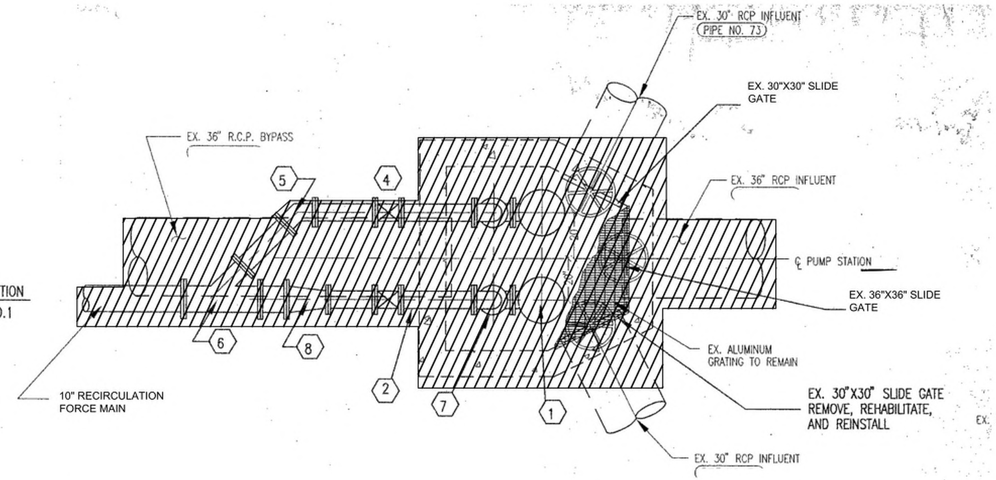
0 1" 2"

FILENAME 60X105.dwg
SCALE NONE

SHEET
60X105



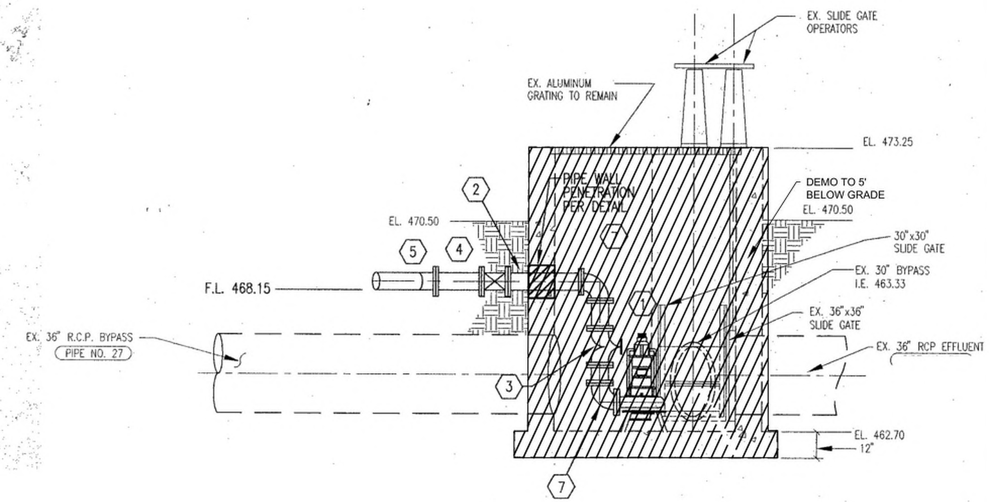
EXISTING JUNCTION BOX NO. 1
NO SCALE



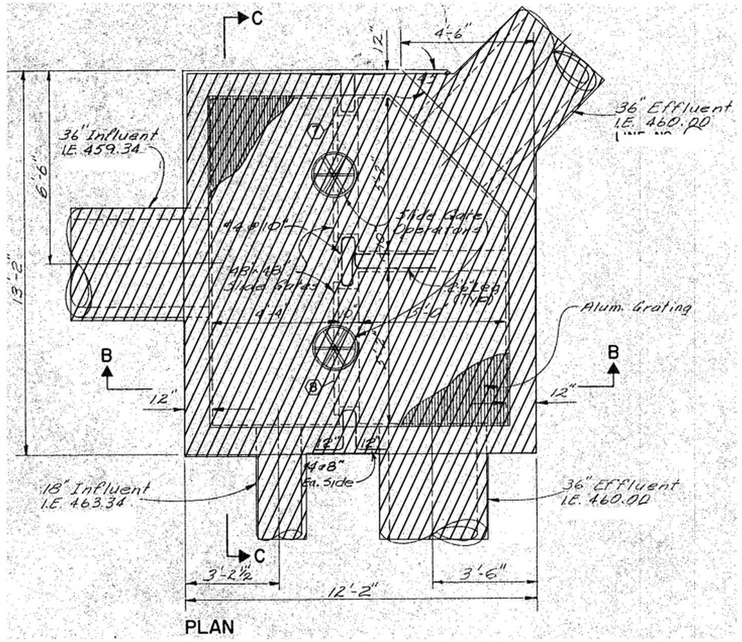
RECIRCULATION PUMP STATION PLAN

NOTES:

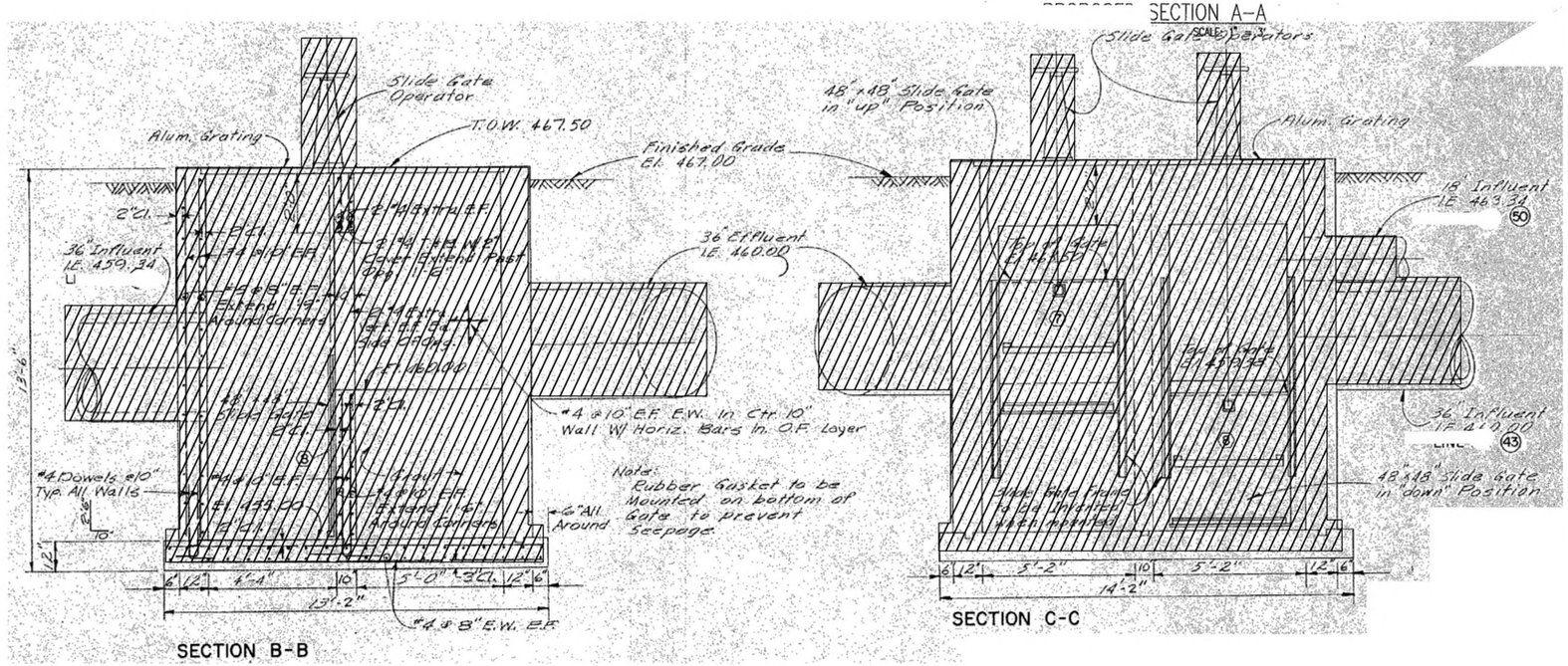
1. HISTORICAL DRAWINGS ARE PROVIDED AS REFERENCES. CONTRACTOR TO IGNORE ALL CALLOUTS.
2. DIMENSIONS SHOWN ARE APPROXIMATE, BASED ON RECORD INFORMATION.



SECTION A-A



PLAN



SECTION B-B

SECTION C-C

PLANT III MANHOLE "N"
NO SCALE

File Path C:\Users\afreemon\DC\ACCDocs\HDR\10342803_COL_PCWWT_AB_Expansion_2022\Project Files\01_HDR\01_Demolition_X\01.03_Sheet Files\60X106.dwg
Date 6/13/2025 11:08:04 AM

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	T. PAULMANN
DRAWN BY	A. FREEMON
CHECKED BY	L. PORTILLO
APPROVED BY	T. PAULMANN
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
THOMAS A. PAULMANN
128794
LICENSED PROFESSIONAL ENGINEER
6/13/25

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK

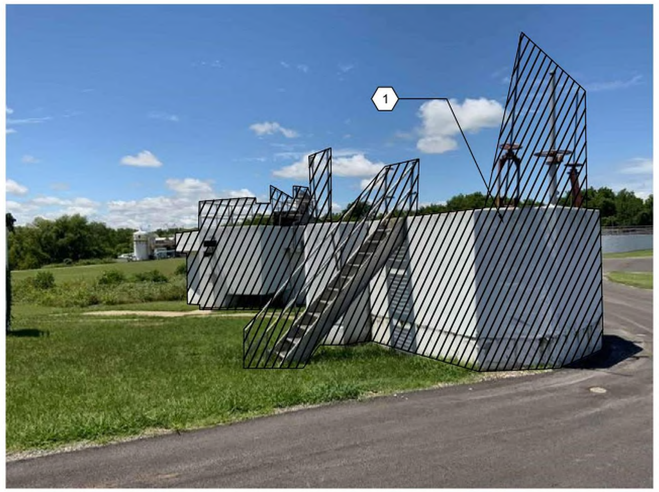
AERATION BASIN EXPANSION

PLANT III DEMOLITION
GENERAL
DEMOLITION MISCELLANEOUS STRUCTURES

0 1" 2"

FILENAME 60X106.dwg
SCALE NONE

SHEET
60X106



DECANT UNIT 1 AND JUNCTION BOX 1

N. T. S.

TRICKLING FILTER 2 AND BLOWER PAD

N. T. S.

DECANT UNIT 2, SHED, JUNCTION BOX 1, AND TRICKLING FILTER 2

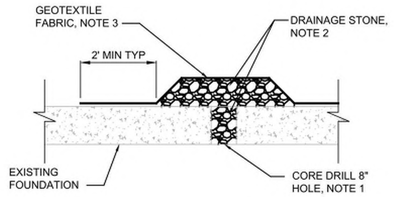
N. T. S.

GENERAL NOTES:

1. SEE SECTION 01 14 16 - COORDINATION WITH OWNER'S OPERATIONS FOR CONSTRUCTION SEQUENCING REQUIREMENTS.

KEYNOTES: (X)

1. DEMOLISH STRUCTURES TO THE EXTENT INDICATED ON SHEET 60X101.



NOTES:

1. CORE DRILL 8" HOLE THROUGH ALL FOUNDATION LAYERS TO SUBGRADE.
2. FILL AND COVER HOLE WITH 1/2 CUBIC YARD OF ASTM C33 #67 DRAINAGE STONE.
3. COVER DRAINAGE STONE WITH GEOTEXTILE FILTER FABRIC EXTENDED FLUSH WITH EXISTING FOUNDATION. SECURE IN PLACE WITH SPECIFIED BACKFILL MATERIAL.

1 / 60X102 **ABANDONED STRUCTURE DRAINAGE PORT DETAIL**

N.T.S

File Path C:\Users\afreemon\DC\ACCDocs\HDR\10342803_COL_PCWWT_AB_Expansion_2022\Project Files\01_HDR\01_Demolition_X01.03_Sheet Files\60X107.dwg
Date 6/13/2025 11:08:31 AM

HDR
TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	T. PAULMANN
DRAWN BY	A. FREEMON
CHECKED BY	L. PORTILLO
APPROVED BY	T. PAULMANN
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
THOMAS A. PAULMANN
128794
LICENSED PROFESSIONAL ENGINEER
6/13/25

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK

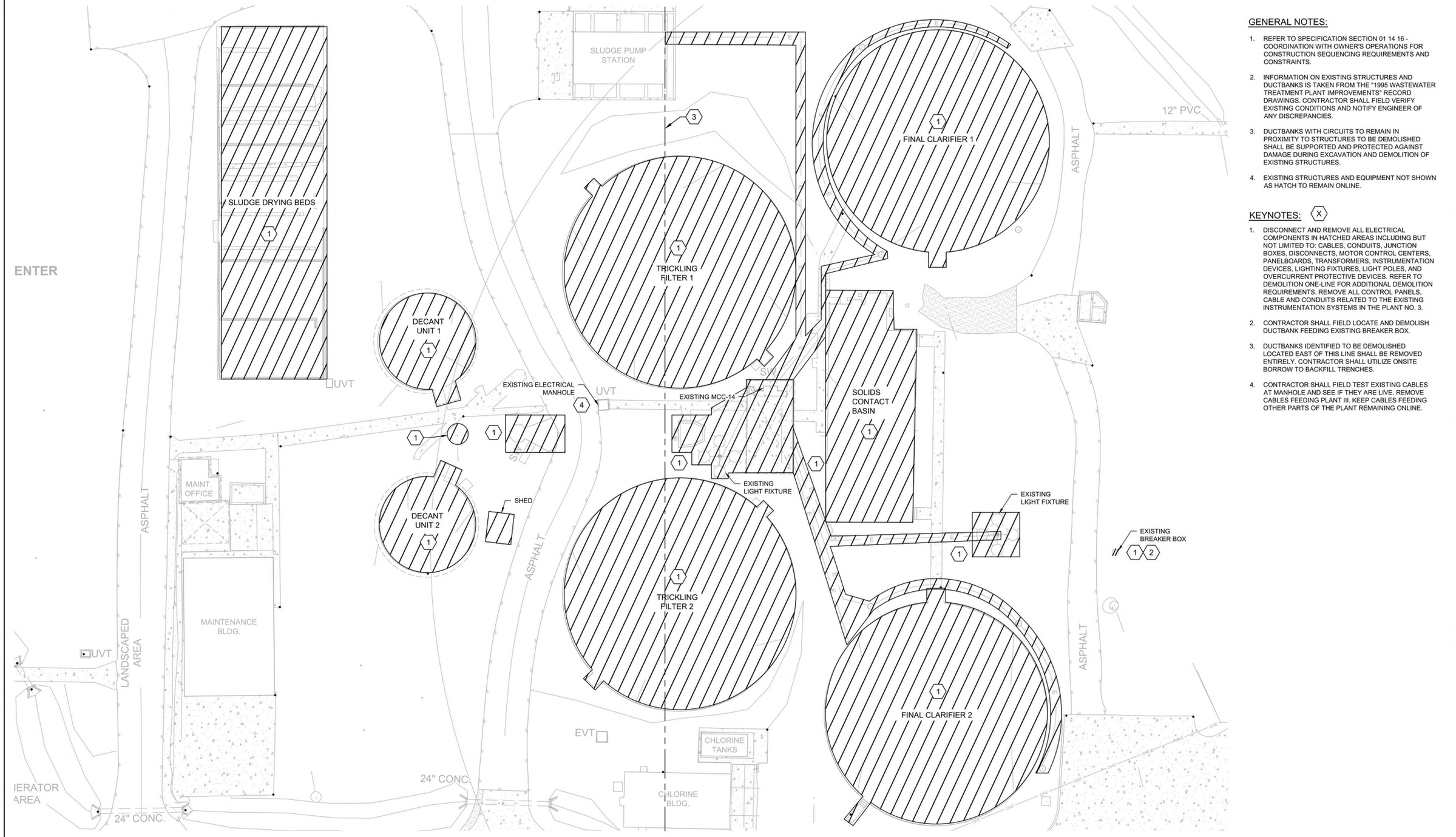
AERATION BASIN EXPANSION

PLANT III DEMOLITION
GENERAL
DEMOLITION PHOTOGRAPHS AND DETAIL

0 1" 2"

FILENAME 60X107.dwg
SCALE NONE

SHEET **60X107**



GENERAL NOTES:

1. REFER TO SPECIFICATION SECTION 01 14 16 - COORDINATION WITH OWNER'S OPERATIONS FOR CONSTRUCTION SEQUENCING REQUIREMENTS AND CONSTRAINTS.
2. INFORMATION ON EXISTING STRUCTURES AND DUCTBANKS IS TAKEN FROM THE "1995 WASTEWATER TREATMENT PLANT IMPROVEMENTS" RECORD DRAWINGS. CONTRACTOR SHALL FIELD VERIFY EXISTING CONDITIONS AND NOTIFY ENGINEER OF ANY DISCREPANCIES.
3. DUCTBANKS WITH CIRCUITS TO REMAIN IN PROXIMITY TO STRUCTURES TO BE DEMOLISHED SHALL BE SUPPORTED AND PROTECTED AGAINST DAMAGE DURING EXCAVATION AND DEMOLITION OF EXISTING STRUCTURES.
4. EXISTING STRUCTURES AND EQUIPMENT NOT SHOWN AS HATCH TO REMAIN ONLINE.

KEYNOTES: (X)

1. DISCONNECT AND REMOVE ALL ELECTRICAL COMPONENTS IN HATCHED AREAS INCLUDING BUT NOT LIMITED TO: CABLES, CONDUITS, JUNCTION BOXES, DISCONNECTS, MOTOR CONTROL CENTERS, PANELBOARDS, TRANSFORMERS, INSTRUMENTATION DEVICES, LIGHTING FIXTURES, LIGHT POLES, AND OVERCURRENT PROTECTIVE DEVICES. REFER TO DEMOLITION ONE-LINE FOR ADDITIONAL DEMOLITION REQUIREMENTS. REMOVE ALL CONTROL PANELS, CABLE AND CONDUITS RELATED TO THE EXISTING INSTRUMENTATION SYSTEMS IN THE PLANT NO. 3.
2. CONTRACTOR SHALL FIELD LOCATE AND DEMOLISH DUCTBANK FEEDING EXISTING BREAKER BOX.
3. DUCTBANKS IDENTIFIED TO BE DEMOLISHED LOCATED EAST OF THIS LINE SHALL BE REMOVED ENTIRELY. CONTRACTOR SHALL UTILIZE ONSITE BORROW TO BACKFILL TRENCHES.
4. CONTRACTOR SHALL FIELD TEST EXISTING CABLES AT MANHOLE AND SEE IF THEY ARE LIVE. REMOVE CABLES FEEDING PLANT III. KEEP CABLES FEEDING OTHER PARTS OF THE PLANT REMAINING ONLINE.

HDR
TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	O. JONGUITUD
DRAWN BY	B. LOREDO
CHECKED BY	G. JAGLOWSKI
APPROVED BY	O. JONGUITUD
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
OSCAR JONGUITUD
133057
LICENSED
PROFESSIONAL ENGINEER
6-13-25

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

N
0 1" 2"

PLANT III DEMOLITION ELECTRICAL DEMOLITION EXISTING SITE PLAN

FILENAME 60EX101.dwg
SCALE 1" = 20'

SHEET
60EX101

MCC-14 - 600A, 480V, 3Ø, 3W, 42 KAIC, WITH 50% GRD. BUS.

TWO RUNS OF 3" CONDUIT W/ (3)-350 MCM & (1)- 3/0 EGC IN EACH

TO EXISTING MCC-3

TO VFD AIR COND. UNIT

TO AREA LIGHTS

TO RECIRC. P. STA.

RAS PUMP #1 (M-1401)

RAS PUMP #2 (M-1402)

RAS PUMP #3 (M-1403)

WAS PUMP #1 (M-1404)

WAS PUMP #2 (M-1405)

FLOAT SWITCHES

SUMP PUMP (M-1406)

BLOWER #1

BLOWER #2

BLOWER #3

MCC-14 CONT'D

SPARE

SPARE

FINAL CLARIFIER #1 (M-1410) (NOTE 3)

FINAL CLARIFIER #2 (M-1411) (NOTE 3)

TO R/U-JB-1400

TO MCC-14

PUMP CONTROL PANEL

CONDUIT SEAL (TYP.) 3 PLACES

RECIRC P. # 1 (M-1418)

RECIRC P. # 2 (M-1419)

RECIRCULATION PUMP STATION

PANEL L15 SCHEDULE

N.T.S.

120/208V, 3Ø, 4W, S/N, 100A, 10KAIC, 42 SPACE WITH PLUG-IN C/B'S LOCATED IN MCC-14 W/ GFCI

30 KVA T2MR 114 (NOTE 1)

MBMS METERING SECTION

LIGHTING PANEL L15

600A MAIN C/B & INCOMING LINE SECTION

(NOTE 2)

MCC-14 ELEVATION

N.T.S.

(NEMA-2R-NON-WALK-IN)

GENERAL NOTES:

1. INFORMATION CONTAINED IN ONE-LINE DIAGRAM AND ELECTRICAL EQUIPMENT ELEVATIONS IS TAKEN FROM THE "1995 WASTEWATER TREATMENT PLANT IMPROVEMENTS" RECORD DRAWINGS AND SHOWN TO ILLUSTRATE THE DESIGN INTENT OF THE MODIFICATIONS. CONTRACTOR SHALL FIELD VERIFY EXISTING CONDITIONS AND NOTIFY ENGINEER OF ANY DISCREPANCIES.
2. DISCONNECT AND REMOVE ALL HATCHED ELECTRICAL COMPONENTS ON ONE-LINE DIAGRAM INCLUDING BUT NOT LIMITED TO: CABLES, CONDUITS, JUNCTION BOXES, DISCONNECTS, MOTOR CONTROL CENTERS, PANELBOARDS, TRANSFORMERS, INSTRUMENTATION DEVICES, AND OVERCURRENT PROTECTIVE DEVICES.

TEXAS P.E. FIRM
Registration No. F-754

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DESIGNED BY	O. JONGUITUD
DRAWN BY	B. LOREDO
CHECKED BY	G. JAGLOWSKI
APPROVED BY	O. JONGUITUD
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
OSCAR JONGUITUD
133057
LICENSED
PROFESSIONAL ENGINEER
6-13-25

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

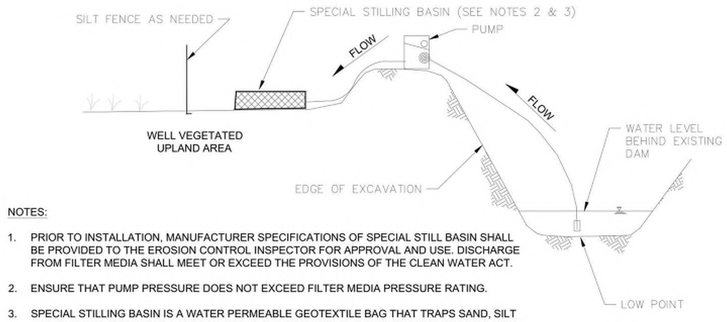
CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

PLANT III DEMOLITION
ELECTRICAL
DEMOLITION
ONE-LINE DIAGRAM

0 1" 2"

FILENAME	60EX102.dwg
SCALE	NONE
SHEET	60EX102



NOTES:

1. PRIOR TO INSTALLATION, MANUFACTURER SPECIFICATIONS OF SPECIAL STILL BASIN SHALL BE PROVIDED TO THE EROSION CONTROL INSPECTOR FOR APPROVAL AND USE. DISCHARGE FROM FILTER MEDIA SHALL MEET OR EXCEED THE PROVISIONS OF THE CLEAN WATER ACT.
2. ENSURE THAT PUMP PRESSURE DOES NOT EXCEED FILTER MEDIA PRESSURE RATING.
3. SPECIAL STILLING BASIN IS A WATER PERMEABLE GEOTEXTILE BAG THAT TRAPS SAND, SILT AND FINES AS SEDIMENT-LADEN WATER IS PUMPED INTO. THE BAG CONSTRUCTED TO BE A MIN. SIZE OF 10'x15' MADE FROM A NON-WOVEN GEOTEXTILE.
4. PUMP STRAINER SHALL NOT BE IN CONTACT WITH BOTTOM OF PIT.

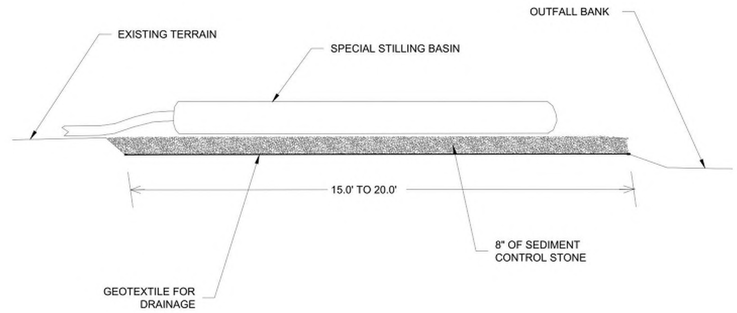
CONTRACTOR CAN USE THIS FLOW TO HELP SIZE PUMP:

EXCAVATION PIT Q100 - 11.38 CFS

EXCAVATION PIT DEWATERING

1

NOT TO SCALE



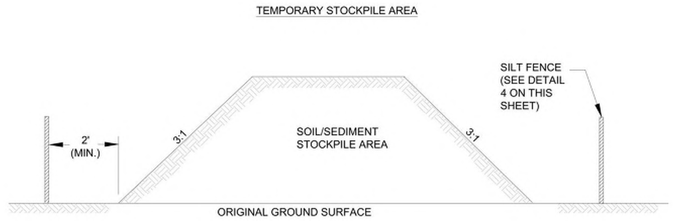
NOTES:

1. USE NO. 5 OR NO. 57 STONE FOR SEDIMENT CONTROL STONE.

SPECIAL STILLING BASIN

2

NOT TO SCALE



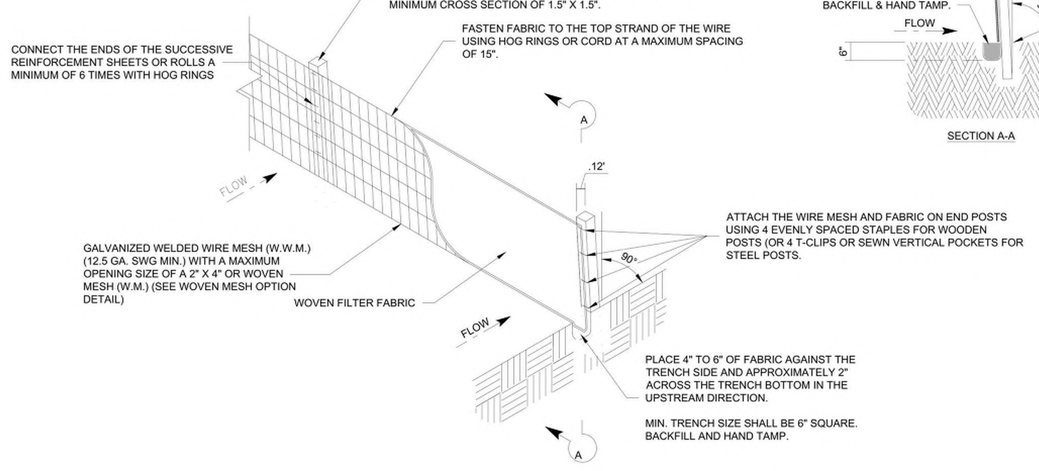
NOTES:

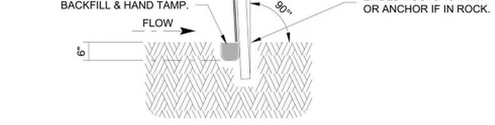
1. SILT FENCE TO EXTEND AROUND ENTIRE PERIMETER OF STOCKPILE, OR IF STOCKPILE AREA IS LOCATED ON/NEAR A SLOPE THE SILT FENCE IS TO EXTEND ALONG CONTOURS OF THE DOWN-GRADIENT AREA.
2. IF STOCKPILE IS TO REMAIN FOR MORE THAN 14 DAYS, TEMPORARY STABILIZATION MEASURES MUST BE IMPLEMENTED.
3. SILT FENCE SHALL BE MAINTAINED UNTIL STOCKPILE AREA HAS EITHER BEEN REMOVED OR PERMANENTLY STABILIZED.
4. THE KEY TO FUNCTIONAL TEMPORARY STOCKPILE AREAS IS WEEKLY INSPECTIONS, ROUTINE MAINTENANCE, AND REGULAR SEDIMENT REMOVAL.

TEMPORARY STOCKPILE DETAIL

3

NOT TO SCALE

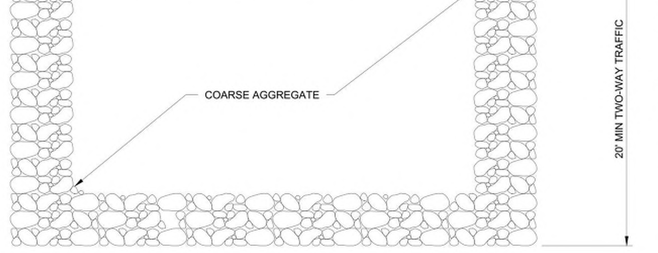




SILT FENCE

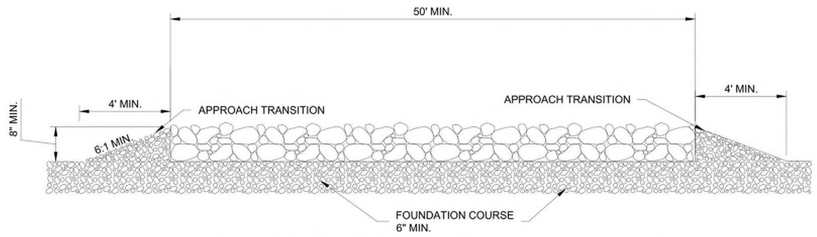
4

NOT TO SCALE



GENERAL NOTES (TYPE 1)

1. THE LENGTH OF THE TYPE 1 CONSTRUCTION SHALL BE AS INDICATED ON THE PLANS, BUT NOT LESS THAN 50'.
2. THE COARSE AGGREGATE SHOULD BE OPEN GRADED WITH A SIZE OF 4" TO 8".
3. THE APPROACH TRANSITIONS SHOULD BE NO STEEPER THAN 6:1 AND CONSTRUCTED AS DIRECTED BY THE ENGINEER.
4. THE CONSTRUCTION EXIT FOUNDATION COURSE SHALL BE FLEXIBLE BASE, BITUMINOUS CONCRETE, PORTLAND CEMENT CONCRETE OR OTHER MATERIALS APPROVED BY THE ENGINEER.
5. THE CONSTRUCTION EXIT SHALL BE GRADED TO ALLOW DRAINAGE TO A SEDIMENT TRAPPING DEVICE.
6. THE GUIDELINES SHOWN HEREON ARE SUGGESTIONS ONLY AND MAY BE MODIFIED BY THE ENGINEER.
7. CONSTRUCT EXITS WITH A WIDTH OF AT LEAST 14FT FOR ONE-WAY AND 20FT FOR TWO-WAY TRAFFIC FOR THE FULL WIDTH OF THE EXIT, OR AS DIRECTED BY THE ENGINEER.



STABILIZED CONSTRUCTION EXIT

5

NOT TO SCALE

File Path C:\Users\gmcclinton\a\DC\ACCDocs\HDR\10342803_COL_PCWWT_AB_Expansion_2024\Project Files\01_HDR\05_Civil_C\05.03_Sheet Files\99C501.dwg
Date 6/12/2025 4:23:39 PM

HDR
TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	B. SMITH
DRAWN BY	G. MCCLINTON
CHECKED BY	K. LEISSING
APPROVED BY	K. LEISSING
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

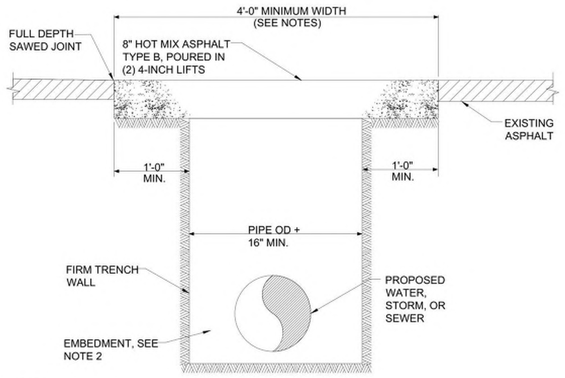
STATE OF TEXAS · KARIN S. LEISSING · 143328 · LICENSED PROFESSIONAL ENGINEER

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

STANDARD DETAILS
CIVIL
DETAILS I

FILENAME	99C501.dwg
SCALE	NO SCALE
SHEET	99C501



NOTES:

1. COMPACT SUBGRADE TO 95% STANDARD PROCTOR DENSITY
2. FOR PIPE EMBEDMENT DETAILS, SEE DETAIL 2 ON SHEET 99C504 AND DETAILS 1,2,3 & 4 ON SHEET 99C561.

ASPHALT PAVEMENT REPLACEMENT

1 -

NOT TO SCALE

A COMPACTION BY FLOODING OR JETTING IS NOT PERMITTED

B 95% STANDARD PROCTOR DENSITY, HAND OPERATED MECHANICAL TAMPERS MAY BE USED

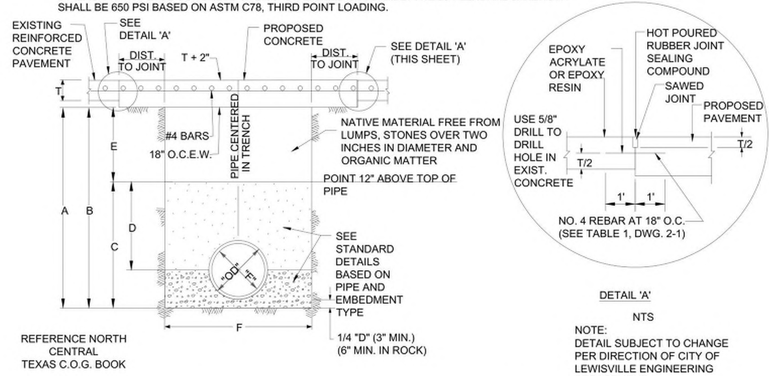
C FOR PIPE EMBEDMENT, SEE DETAIL 1 ON SHEET 99C504 AND DETAILS 1,2,3 & 4 ON SHEET 99C561.

D EMBEDMENT BACKFILL

E TRENCH BACKFILL

F OD + 16" MINIMUM
MAX TRENCH WIDTH = OD + 24" (D=42" OR LESS)
= OD + 48" (D OVER 42")

T THICKNESS OF EXISTING CONCRETE PAVEMENT. PER 1999 SLUDGE DEWATERING AND LIFT STATION IMPROVEMENTS, EXISTING PAVEMENT IS 8" CONCRETE PAVEMENT WITH NO. 4 BARS AT 24" EACH WAY. PLACE CONCRETE OVER 6" STABILIZED SUBGRADE. THE 28-FLEXURAL STRENGTH SHALL BE 650 PSI BASED ON ASTM C78, THIRD POINT LOADING.



REFERENCE NORTH CENTRAL TEXAS C.O.G. BOOK

DETAIL 'A'

NTS

NOTE:
DETAIL SUBJECT TO CHANGE PER DIRECTION OF CITY OF LEWISVILLE ENGINEERING DEPARTMENT

TYPICAL CONCRETE PAVEMENT REPLACEMENT DETAIL

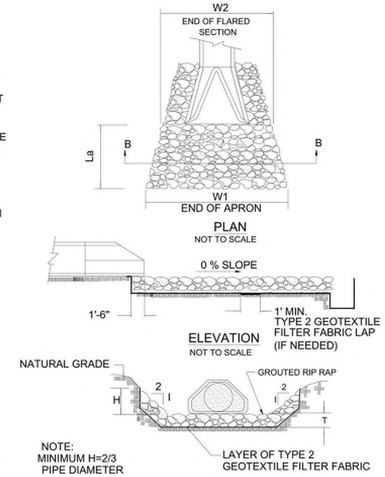
2 -

NOT TO SCALE

NOTES:

1. CLASS OR MEDIAN SIZE OF RIP RAP AND LENGTH, WIDTH AND DEPTH OF APRON TO BE SHOWN ON PLANS.
2. RIP RAP SHOULD EXTEND UP BOTH SIDES OF THE APRON AND AROUND THE END OF THE PIPE OR CULVERT AT THE DISCHARGE OUTLET AT A MAXIMUM SLOPE OF 2:1 AND A HEIGHT NOT LESS THAN TWO THIRDS THE PIPE DIAMETER OR CULVERT HEIGHT.
3. THERE SHALL BE NO OVERFLOW FROM THE END OF THE APRON TO THE SURFACE OF THE RECEIVING CHANNEL. THE AREA TO BE PAVED OR RIP RAPPED SHALL BE UNDERCUT SO THAT THE INVERT OF THE APRON SHALL BE THE SAME GRADE (FLUSH) WITH THE SURFACE OF THE RECEIVING CHANNEL. THE APRON SHALL HAVE A CUTOFF OR TOE WALL AT THE DOWNSTREAM END.
4. THE WIDTH OF THE END OF THE APRON SHALL BE EQUAL TO THE BOTTOM WIDTH OF THE RECEIVING CHANNEL. MAXIMUM TAPER TO RECEIVING CHANNEL 5:1.
5. ALL SUBGRADE FOR STRUCTURE TO BE COMPACTED TO 95% OR GREATER.
6. THE PLACING OF FILL, EITHER LOOSE OR COMPACTED IN THE RECEVIGING CHANNEL SHALL NOT BE ALLOWED.
7. NO BENDS OR CURVES IN THE HORIZONTAL ALIGNMENT OF THE APRON UNLESS OTHERWISE SHOWN.
8. TYPE 2 GEOTEXTILE FILTER FABRIC SHALL BE INSTALLED ON COMPACTED SUBGRADE PRIOR TO PLACEMENT OF RIP RAP.
9. ANY DISTURBED AREA FROM END OF APRON TO RECEIVING CHANNEL MUST BE STABILIZED.
10. RIP RAP APRON TO BE GROUTED PER TXDOT ITEM 432.

LOCATION	W1	W2	La	TYPE	T
INTERIM PUMP	16'	3'	9'	COMMON	6"
FES-A100	16'	3'	9'	COMMON	6"

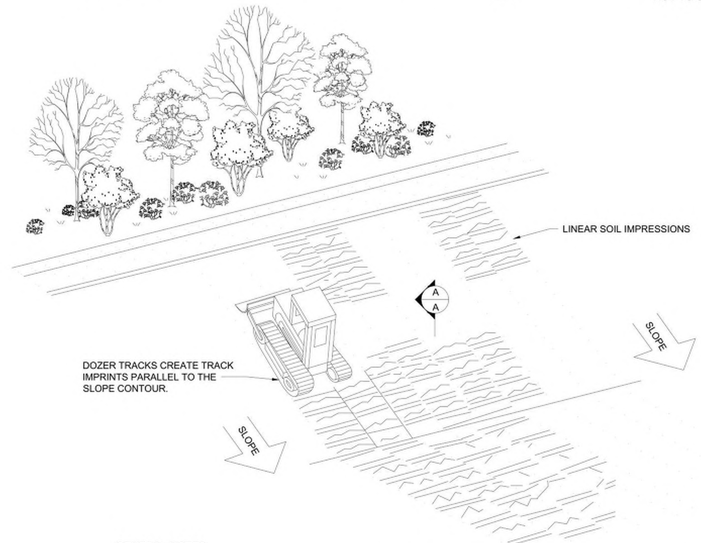


1. EW = ENDWALL
2. TYPE = PER TXDOT ITEM 432

RIPRAP APRON AT PIPE OUTFALLS

3 -

NOT TO SCALE



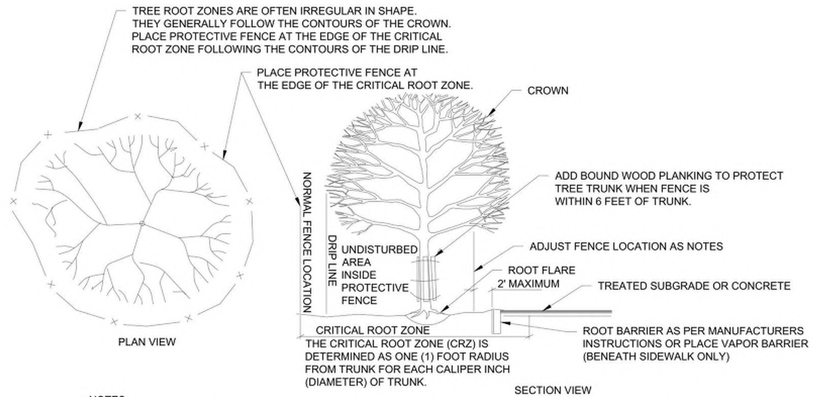
GENERAL NOTES

1. VERTICAL TRACKING IS REQUIRED ON PROJECTS WHERE SOIL DISTURBING ACTIVITIES HAVE OCCURRED UNLESS OTHERWISE APPROVED.
2. PERFORM VERTICAL TRACKING ON SLOPES TO TEMPORARILY STABILIZE SOIL.
3. PROVIDE EQUIPMENT WITH A TRACK UNDERCARRIAGE CAPABLE OF PRODUCING LINEAR SOIL IMPRESSIONS MEASURING A MINIMUM OF 12" IN LENGTH BY 2" TO 4" IN WIDTH BY 1/2" TO 2" IN DEPTH.
4. DO NOT EXCEED 12" BETWEEN TRACK IMPRESSIONS.
5. INSTALL CONTINUOUS LINEAR TRACK IMPRESSIONS WHERE THE MINIMUM 12" LENGTH IMPRESSION ARE PERPENDICULAR TO THE SLOPE OR DIRECTION OF WATER FLOW.

VERTICAL TRACKING DETAIL

4 -

NOT TO SCALE



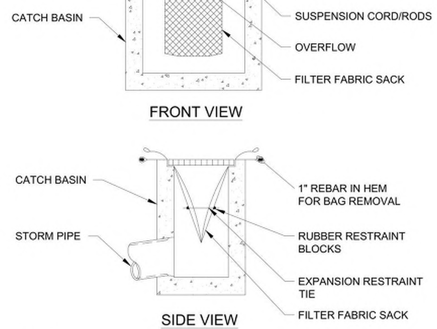
NOTES:

1. CRITICAL ROOT ZONE IS 1 FT. AWAY FORM TREE TRUNK FOR EVERY 1 INCH OF TREE DIAMETER MEASURED AT 4 FT HEIGHT.
2. WATER TREES EVERY 2 WEEKS WITH A MINIMUM OF 100 GALLONS PER TREE.
3. SPRAY TREE WITH WATER TO REMOVE CONSTRUCTION DUST WHEN DIRECTED.
4. CONSTRUCTION FENCE SHALL BE 4 FT TALL.
5. DO NOT PERFORM WORK OR STORE EQUIPMENT WITHIN PROTECTED AREA.
6. COVER THE CRITICAL ROOT ZONE BETWEEN THE PROTECTED AREA AND THE CONSTRUCTION ZONE WITH 4 INCHES OF MULCH.
7. PERFORM TREE TRIMMING AND WOUND REPAIR PER STANDARD TEXAS DOT SPECIFICATIONS.
8. DAMAGED AND EXPOSED ROOTS SHALL BE TRIMMED AND TREATED PER STANDARD TEXAS DOT SPECIFICATIONS. BACKFILL EXPOSED ROOTS WITH TOPSOIL WITHIN 24 HOURS.
9. PLACE PLASTIC UNDER CONCRETE PLACED IN THE CRITICAL ROOT ZONE.
10. PLACE A ROOT BARRIER IN THE CRITICAL ROOT ZONE AT THE EDGE OF THE TREATED SUBGRADE TO THE DEPTH OF THE SUBGRADE.

TREE PROTECTION DETAIL

5 -

NOT TO SCALE



NOTES:

1. CURB INLETS AND COMBINATION CURB AND GRATE INLETS WILL REQUIRE THE USE OF A CURB INLET FILTER. CURB INLET FILTER SHALL BE THE "GUTTER EEL" AS MANUFACTURED BY ACF ENVIRONMENTAL, INC., OR EQUAL. CURB INLET FILTER, WHEN REQUIRED, WILL BE INSTALLED AT NO ADDITIONAL COST TO THE OWNER.
2. SIZE OF SACK TO BE DETERMINED BY MANUFACTURER TO SUIT INLET.
3. INSTALL BAGS WITHOUT GAPS AT INLET GRATE.
4. FILTER FABRIC SACK SHALL BE "SILTSACK" MANUFACTURED BY ACF ENVIRONMENTAL, INC.

INLET SEDIMENT PROTECTION DETAIL

6 -

NOT TO SCALE

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TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	B. SMITH
DRAWN BY	G. MCCLINTON
CHECKED BY	K. LEISSING
APPROVED BY	K. LEISSING
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
KARIN S. LEISSING
143328
LICENSED
PROFESSIONAL ENGINEER
13th June

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN
EXPANSION

STANDARD DETAILS
CIVIL
DETAILS II

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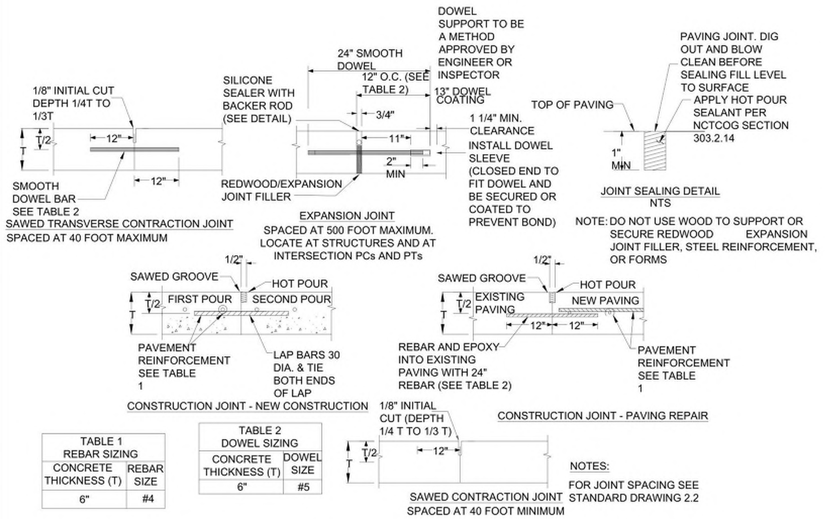


TABLE 1 REBAR SIZING	
CONCRETE THICKNESS (T)	REBAR SIZE
6"	#4

TABLE 2 DOWEL SIZING	
CONCRETE THICKNESS (T)	DOWEL SIZE
6"	#5

REINFORCED CONCRETE JOINTS

NOT TO SCALE

1

CONCRETE PAVING GENERAL NOTES

1. REINFORCED CONCRETE PLACEMENT:
   A. PLACE ALL CURBS INTEGRAL WITH PAVEMENT UNLESS OTHERWISE APPROVED BY THE CITY.
   B. CURBS TO MEET SAME COMPRESSIVE STRENGTH AS SPECIFIED FOR PAVEMENT.
   C. BAR LAPS TO BE 30 BAR DIAMETERS.
   D. REINFORCING BARS TO BE SUPPORTED BY CHAIRS OR OTHER DEVICES APPROVED BY THE CITY.
   E. DO NOT USE FLY ASH IN CONCRETE PAVEMENT.

2. SUBGRADE (MINIMUM REQUIREMENTS UNLESS APPROVED BY CITY ENGINEER). SUBGRADE UNDER ALL PAVEMENT TO BE INITIALLY MIXED WITH 8-INCH THICK AND REMIXED WITH 6-INC THICK AND STABILIZED WITH 6% MINIMUM BY WEIGHT OF HYDRATED LIME (GENERALLY +/- 40 POUNDS PER SQUARE YARD), AND COMPACTED TO A DENSITY NOT LESS THAN 95% STANDARD PROCTOR DENSITY. ALTERNATIVE SUBGRADES SUPPORTED BY LABORATORY TESTS MAY BE SUBMITTED TO THE CITY ENGINEER FOR APPROVAL.

3. HAND POURED CONCRETE TO BE 3,750 PSI AT 28 DAYS.

TYPE OF CONCRETE[1]	MINIMUM CEMENTOUS (LB/CY)	7 DAY COMPRESSIVE STRENGTH (PSI)	28 DAY COMPRESSIVE STRENGTH (PSI)[2]	MINIMUM WATER/ CEMENTITIOUS RATIO	COURSE AGGREGATE MAXIMUM SIZE[3]
SIDEWALK[4]	470	1,950	3,000	0.58	1 1/2"
STREET	517	2,350	3,500	0.53	1 1/2"
(MACHINE POUR)	564	2,600	3,750	0.49	1 1/2"
STREET (HAND POUR)	AS DIRECTED BY THE OWNER OR AS SHOWN ON THE PLANS				
HES[5]	752	4,200[6]	6,500	0.40	1 1/2"

1. ALL EXPOSED HORIZONTAL CONCRETE TO HAVE ENTRAINED AIR.
2. MINIMUM STRENGTH REQUIRED BY OWNER.
3. SMALLER NOMINAL MAXIMUM SIZE AGGREGATE MAY BE USED IF STRENGTH REQUIREMENT IS SATISFIED.
4. SIDEWALKS, SEPARATE CURB AND GUTTER, AND 1 INCH MEDIAN PAVEMENT.
5. HIGH EARLY STRENGTH CONCRETE, COMPRESSIVE STRENGTH AT 3 DAYS.

CONCRETE USE	AVG. SLUMP (IN)	MAX. SLUMP (IN)
SLIP FORM PAVING	3	4
SIDEWALK, SEPARATE CURB AND GUTTER, AND OTHER MISCELLANEOUS CONCRETE	AS SPECIFIED	

SOLUBLE SULFATE	SUBGRADE TREATMENT
<3,000 PPM	SUBGRADE COMPATIBLE WITH LIME OR CEMENT TREATMENT (SEE NOTE 4 & 5)
<3,000 PPM TO 8,000 PPM	SUBGRADE IDENTIFIED AS COMPATIBLE WITH LIME OR CEMENT TREATMENT. DESIGN ENGINEER TO CONSULT WITH CITY FOR APPROVAL TO USE LIME TREATED SUBGRADE. REFER TO TxDOT "GUIDELINES FOR MODIFICATION AND STABILIZATION OF SOILS AND BASE FOR USE IN PAVEMENT STRUCTURES" AND "GUIDELINES FOR TREATMENT OF SULFATE RICH SOILS AND BASES IN PAVEMENT STRUCTURES" FOR MORE INFORMATION.
> 8,000 PPM	SUBGRADE IS INCOMPATIBLE WITH LIME OR CEMENT TREATMENT. USE 4-INCH TYPE B HMAC OR 8-INCH FLEXIBLE BASE CRUSHED STONE (TxDOT ITEM 247 GRADE 1). CRUSHED CONCRETE IS NOT ACCEPTABLE.

4. SOILS WITH A P.I. OF 20 OR LESS TO BE STABILIZED WITH A CEMENT SLURRY. THE APPLICATION RATE TO BE DETERMINED BY ENGINEER AND APPROVED BY THE CITY ENGINEER.

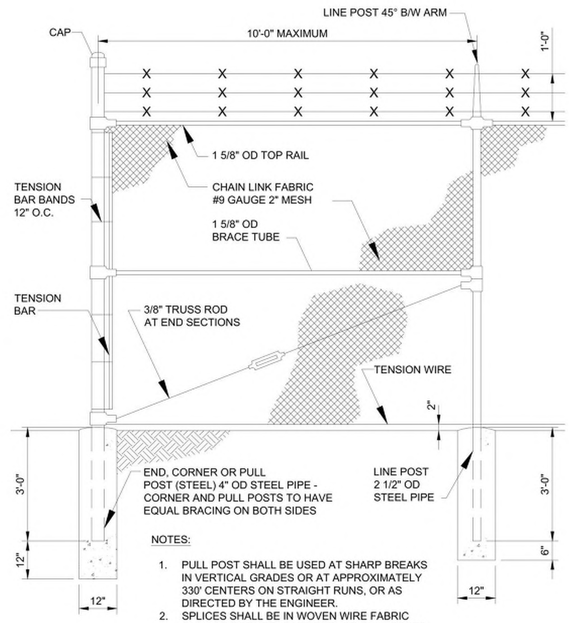
5. SOILS WITH A P.I. GREATER THAN 20 TO BE STABILIZED WITH LIME SLURRY. THE APPLICATION RATE TO BE DETERMINED BY THE ENGINEER AND APPROVED BY THE CITY ENGINEER.

6. ALL SOILS MUST BE TESTED BY A QUALIFIED TESTING LABORATORY TO DETERMINE THE SOLUBLE SULFATE LEVELS IN THE SOIL BEFORE APPLYING LIME OR CEMENT STABILIZATION. SOILS WITH ELEVATED SOLUBLE SULFATE CONTENT ARE NOT SUITABLE FOR LIME OR CEMENT TREATMENT BECAUSE OF INCREASED RISK OF SULFATE-INDUCED HEAVE.

REINFORCED CONCRETE GENERAL NOTES

NOT TO SCALE

3

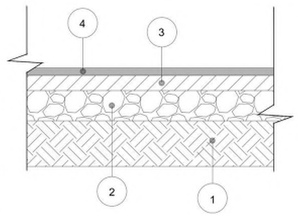


NOTES:

1. PULL POST SHALL BE USED AT SHARP BREAKS IN VERTICAL GRADES OR AT APPROXIMATELY 330' CENTERS ON STRAIGHT RUNS, OR AS DIRECTED BY THE ENGINEER.
2. SPLICES SHALL BE IN WOVEN WIRE FABRIC ONLY AT CORNER, GATE END, OR PULL POSTS.

ALL MATERIALS AND CONSTRUCTION TECHNIQUES SHALL BE IN ACCORDANCE WITH THE TxDOT PAVEMENT DESIGN PROCEDURES AND STANDARD SPECIFICATIONS.

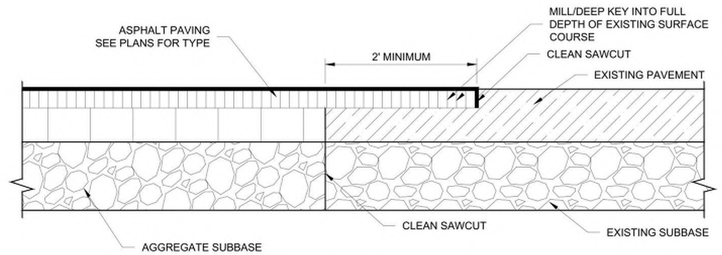
1. PREPARED SUBGRADE
2. 8" CRUSHED ROCK BASE TYPE A OR D, GRADE 1 OR 2 . UNDERLAIN BY HEAVY DUTY GEOTEXTILE.
3. 5" TYPE B BINDER COURSE ASPHALT.
4. 2" TYPE D WEARING COURSE ASPHALT.



HEAVY DUTY ASPHALT

NOT TO SCALE

2



ASPHALT PAVEMENT KEY

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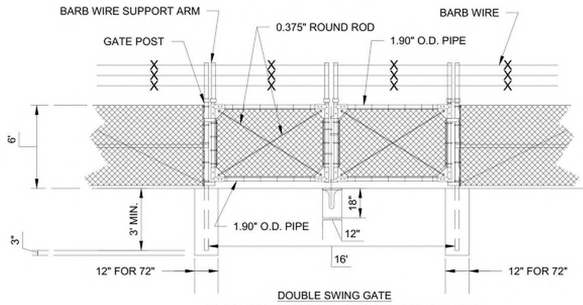
4



NOTES:
1. MAXIMUM WIRE SPACING TO BE 6".
2. MAXIMUM CLEARANCE BETWEEN LOWEST STRANGE AND GROUND TO BE 6".
3. BRACE POSTS SHALL BE ERECTED BETWEEN END, CORNER OR GATE POSTS AT INTERVALS NOT EXCEEDING 700' ON TANGENTS OR 350' ON SHORT RADIUS CURVES.
4. ADDITIONAL BRACE POSTS SHALL BE ERECTED IF SO DIRECTED BY THE ENGINEER.
5. BRACE POSTS SHALL BE BRACED FROM BOTH SIDES OF POST.

SECURITY FENCE AND SWING GATE

NOT TO SCALE

5

HDR
TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	B. SMITH
DRAWN BY	G. MCCLINTON
CHECKED BY	K. LEISSING
APPROVED BY	K. LEISSING
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

LEWISVILLE
Deep Roots. Broad Wings. Bright Future

CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

STANDARD DETAILS
CIVIL
DETAILS III

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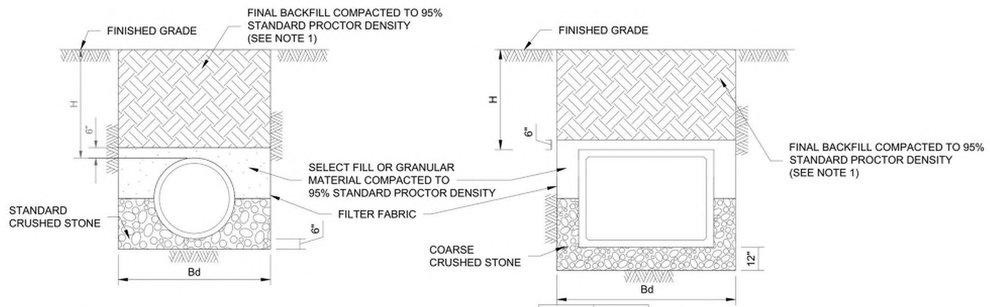


PIPE DIAMETER (IN)	TRENCH WIDTH (FT)
18	3.5
21	3.8
24	4.1
27	4.5
33	5.2
36	5.6
42	6.3
48	7.0
54	7.8
60	8.5
66	9.2
72	10.0

NOTES

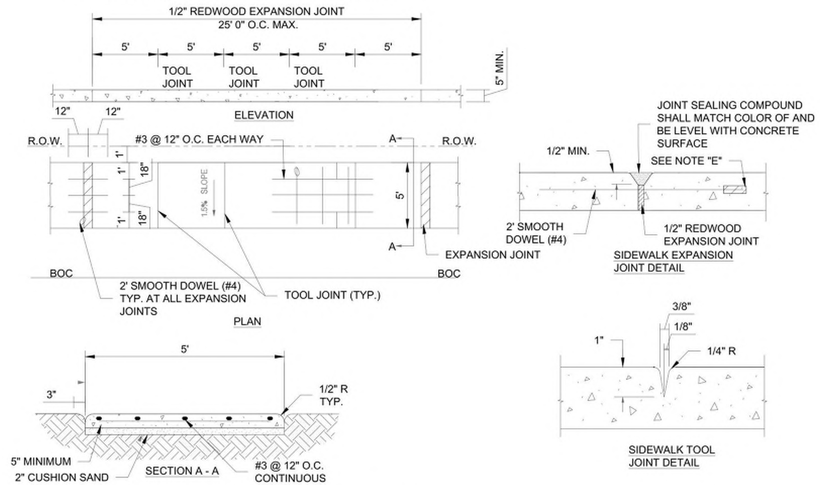
1. SELECT BACKFILL SALVAGED FROM TRENCH EXCAVATION MUST BE CLEAN AND FREE OF LARGE ROCKS (LARGER THAN 4 INCHES IN ANY DIMENSION). BACKFILL MUST BE APPROVED BY INSPECTOR AND STOCKPILED FOR USE WHEN NEEDED.
2. FOR DEPTHS (H) GREATER THAN 10 FEET, CHECK DESIGN. UNLIMITED TRENCH WIDTH IS NOT PERMITTED FOR CLASS III PIPE (HIGHER TYPE PIPE EMBEDMENT MAY BE REQUIRED).
3. TRENCH WIDTHS SHOWN ARE MINIMUM FOR PROPER PLACEMENT AND COMPACTION OF EMBEDMENT AND BACKFILL.
4. TRENCH WIDTH (Bd) IS BASED ON 1.25 (Bc+1.0) WHERE Bc IS THE OUTSIDE DIAMETER OF THE PIPE, IN FEET.

STORM DRAIN EMBEDMENT

NOT TO SCALE

1

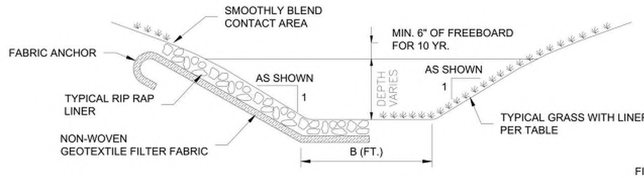
SIDEWALK:
A. REQUIRED MIN. COMPRESSIVE STRENGTH OF CONCRETE IS 4,000 PSI @ 28 DAYS.
B. CONCRETE SIDEWALK TO BE PLACED ON 2" MIN. CUSHION SAND ON SUBGRADE COMPACTED TO 95% STD. PROCTOR DENSITY.
C. SET FORMS TRUE TO LINE AND GRADE AND USE A 2" X 6" FORM BOARD OR APPROVED EQUAL.
D. SET FORMS SO CONCRETE DOES NOT FLOW UNDERNEATH THEM.
E. ASPHALT COAT OR DOWEL SLEEVE THROUGH SECOND POUR.
F. CONTRACTOR TO SAWCUT EXISTING SIDEWALK AT EXISTING TOOL JOINT.
G. CONCRETE TO HAVE A LIGHT HORSEHAIR BROOM FINISH



5.0' SIDEWALK DETAILS

NOT TO SCALE

2



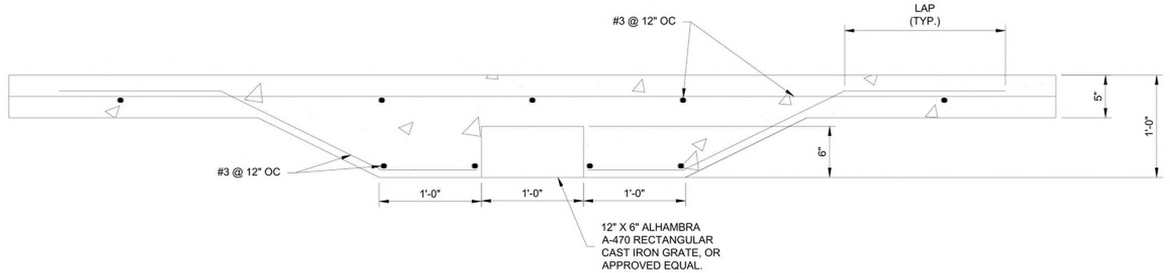
FINAL - ALL UPSTREAM AREA STABILIZED

SWALE #	BOTTOM WIDTH (FT)	MINIMUM DEPTH (D) (FT)	SIDE SLOPE X:1	SIDE SLOPE X:1	DRAINAGE AREA (AC)	100 YR FLOW (CFS)	100 YR DEPTH (FT)	TEMPORARY LINER	VELOCITY (FT/S)	PERMANENT LINER	D50 (IN)	T (IN)
1	5	2	4	4	0.69	3.95	0.27	SC-150BN	2.41	VEGETATED	-	-
2	4	1	3	3	0.09	0.48	0.08	SC-150BN	1.42	VEGETATED	-	-
3	2	1	3	22	0.11	0.93	0.14	SC-150BN	1.56	VEGETATED	-	-
4	2	1	3	4	0.11	0.77	0.22	SC-150BN	1.26	VEGETATED	-	-
5	2	3	3	3	0.34	2.48	0.42	SC-150BN	1.81	VEGETATED	-	-
6	2	3	3	3	0.45	2.90	0.45	SC-150BN	1.92	VEGETATED	-	-
7	1	1	3	3	0.18	0.99	0.28	SC-150BN	1.92	VEGETATED	-	-

DITCH CROSS SECTION

NOT TO SCALE

3



SIDEWALK DRAINAGE GRATE

NOT TO SCALE

4

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	B. SMITH
DRAWN BY	G. MCCLINTON
CHECKED BY	K. LEISSING
APPROVED BY	K. LEISSING
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

TEXAS P.E. FIRM Registration No. F-754

STATE OF TEXAS · KARIN S. LEISSING · 143328 · LICENSED PROFESSIONAL ENGINEER

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

N

0 1" 2"

STANDARD DETAILS
CIVIL
DETAILS IV

FILENAME 99C504.dwg
SCALE NO SCALE

SHEET **99C504**

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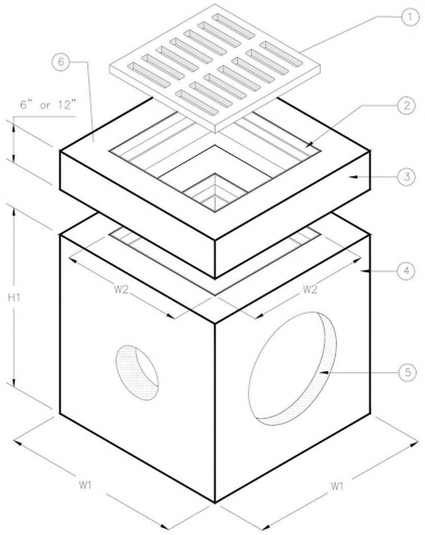

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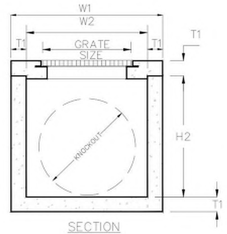
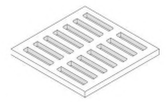


SECTION

TRAFFIC DUTY CAST IRON GRATE



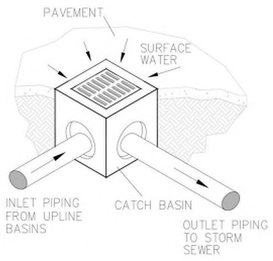
D.I. CASTINGS: MANHOLE FRAMES, COVERS OR GRATES ARE MANUFACTURED OF DUCTILE IRON CONFORMING TO ASTM A536, AASHTO M306, & AASHTO M105 STANDARDS.

KEYED NOTES		
MARK	QTY	DESCRIPTION
1	1	GRATE OR COVER AS REQUESTED, SEE OPTIONS
2	1	CAST-IN STEEL FRAME
3	1	OPTIONAL TOP/EXTENSION 6" TO 18"
4	1	PRECAST CONCRETE BASIN SECTION
5	4	KNOCKOUTS (STD) AND PENETRATIONS (OPT) AS REQUIRED, SEE KO DIMENSION FOR MAXIMUM PIPE O.D.*
6	1	NAMEPLATE INDICATING: MFG: PARKUSA 888-611-PARK WWW.PARKUSA.COM MODEL: CB-01 DATE MANUFACTURED

NOTE: KNOCKOUT-STD, PENETRATIONS-OPTIONAL

MODEL	W1	W2	H1	H2	T1	T2	KO	GRATE SIZE	OPEN AREA	WEIGHT LBS
CB-12	15"	10"	21"	18"	3"	2½"	10"	12"x12"x1"	90	180
CB-14	20"	12"	28"	24"	4"	4"	12"	14"x14"x1½"	120	600
CB-18	24"	16"	34"	30"	4"	4"	15"	18"x18"x1½"	168	1,000
CB-20	26"	18"	34"	30"	4"	4"	17"	20"x20"x1½"	170	1,335
CB-24	32"	22"	41"	36"	5"	5"	22"	24"x24"x2"	268	2,245
CB-27	37"	25"	42"	36"	6"	6"	24"	27"x27"x2"	350	2,875
CB-30	42"	30"	42"	36"	6"	6"	30"	32"x32"x2"	490	3,675
CB-36	48"	36"	42"	36"	6"	6"	32"	38"x38"x2"	693	4,585
CB-48	60"	48"	54"	48"	6"	6"	48"	38"x38"x2"	693	7,250
*CB-60	72"	60"	66"	60"	6"	6"	60"	38"x38"x2"	693	10,500
*CB-72	84"	72"	78"	72"	6"	6"	72"	38"x38"x2"	693	15,350
*CB-84	96"	84"	78"	72"	6"	6"	72"	38"x38"x2"	693	19,500

*KNOCKOUTS NOT AVAILABLE



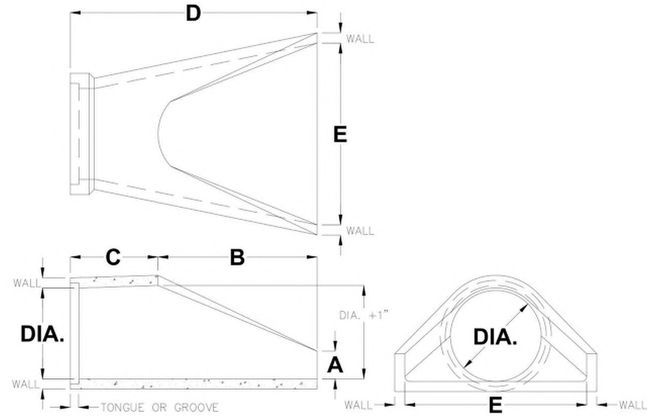
SPECIFICATIONS

CONCRETE : CLASS I/II CONCRETE WITH OF DESIGN STRENGTH OF 4500 PSI AT 28 DAYS. UNIT IS OF MONOLITHIC CONSTRUCTION AT FLOOR AND FIRST STAGE OF WALL WITH SECTIONAL RISER TO REQUIRED DEPTH.

REINFORCEMENT: GRADE 60 REINFORCED. STEEL REBAR CONFORMING TO ASTM A615 ON REQUIRED CENTERS OR EQUAL.

C.I. CASTINGS: CAST IRON FRAMES AND GRATES ARE MANUFACTURED OF GREY CAST IRON CONFORMING TO ASTM A48-76 CLASS 30.

CATCH BASIN
NOT TO SCALE
1



DIA.	WALL	TONGUE OR GROOVE	WEIGHT	A	B	C	D	E
15"	2-1/4"	1-3/4"	970	6"	27"	46"	73"	30"
18"	2-1/2"	1-3/4"	1340	9"	27"	46"	73"	36"
24"	3"	1-3/4"	1820	9-1/2"	43-1/2"	30"	73-1/2"	48"
30"	4-1/4"	3-7/8"	2400	12"	54"	19-3/4"	73-3/4"	60"
36"	4-3/4"	3-7/8"	5500	15"	63"	34-3/4"	97-3/4"	72"

REINFORCED CONCRETE PIPE CONFORMS TO ASTM C-76, ASTM-C-443, AASHTO M-170, AND AASHTO M-198.

FOR COMPLETE DESIGN AND PRODUCT INFORMATION CONTACT JENSEN PRECAST.

FLARED END SECTION
NOT TO SCALE
2

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TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER JOEL R. CANTWELL

DESIGNED BY	B. SMITH
DRAWN BY	G. MCCLINTON
CHECKED BY	K. LEISSING
APPROVED BY	K. LEISSING
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS · KARIN S. LEISSING · 143328 · LICENSED PROFESSIONAL ENGINEER
13 JUNE 2025

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN
EXPANSION

N
0 1" 2"

STANDARD DETAILS
CIVIL
DETAILS V

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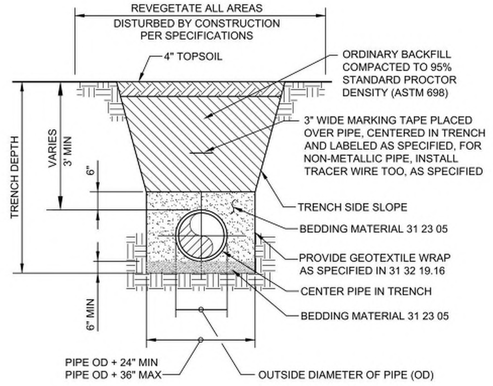
SCALE NO SCALE

SHEET
99C505

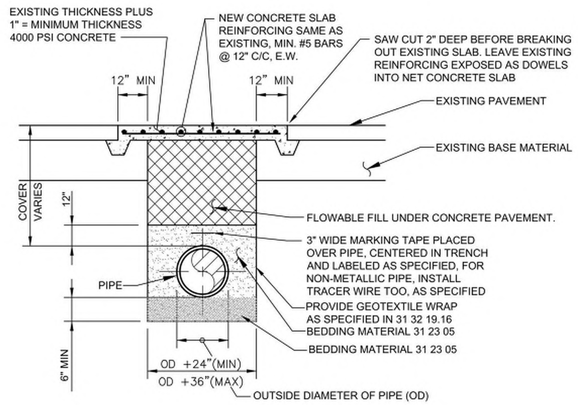


NOTE:

1. MATERIAL PLACED WITHIN 12" ABOVE TOP OF PIPE SHALL BE SCREENED TO ROCK LESS THAN 2" IN SIZE WHEN BACKFILLING WITH ROCK FROM EXCAVATED MATERIAL.
2. FOR TRENCHES WITH MULTIPLE PIPE, PROVIDE SINGLE GEOTEXTILE WRAP IN ONE CONTINUOUS WRAP AROUND THE PIPES.

1 - TYPICAL TRENCH SECTION FOR DEPTH OF COVER 3 TO 15 FEET

NO SCALE

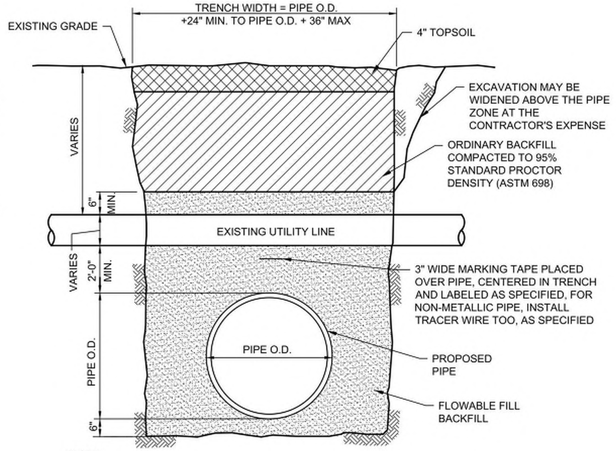


NOTE:

FOR TRENCHES WITH MULTIPLE PIPE, PROVIDE SINGLE GEOTEXTILE WRAP IN ONE CONTINUOUS WRAP AROUND THE PIPES.

2 - TYPICAL TRENCH SECTION FOR OPEN CUT CONCRETE PAVEMENT

NO SCALE

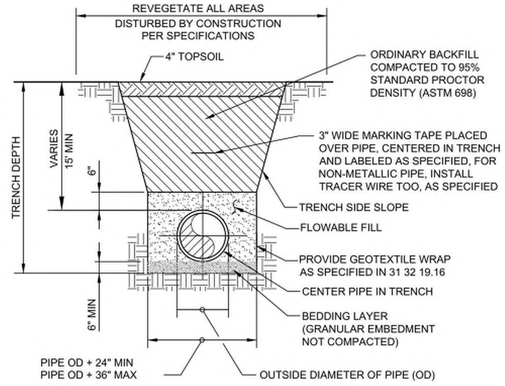


NOTES:

1. MINIMUM 2' CLEARANCE BETWEEN UTILITY LINES AND PROPOSED PIPELINE.
2. THE CONTRACTOR SHALL BE REQUIRED TO USE WOOD MATS FOR CONSTRUCTION TRAFFIC OVER EXISTING GAS PIPELINES AND 12" AND LARGER WATERLINES.
3. THE CONTRACTOR SHALL CONTACT UTILITY OWNER AT LEAST (3) DAYS PRIOR TO CROSSING THE UTILITY.
4. EXTEND A MINIMUM OF 12" ON BOTH SIDES OF THE EXISTING UTILITY.
5. PROVIDE PIPE CRADLE FOR CROSSINGS INVOLVING PIPES THAT ARE 18" OR LARGER IN DIAMETER WHERE VERTICAL SEPARATION IS LESS THAN 12 INCHES. SEE DETAIL 6 THIS SHEET.

3 - UTILITY LINE CROSSING DETAIL BY OPEN CUT

NO SCALE

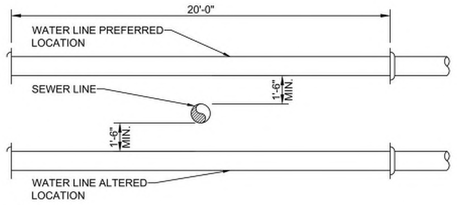


NOTE:

FOR TRENCHES WITH MULTIPLE PIPE, PROVIDE SINGLE GEOTEXTILE WRAP IN ONE CONTINUOUS WRAP AROUND THE PIPES.

4 - TYPICAL TRENCH SECTION FOR DEPTH OF COVER > 15 FEET

NO SCALE

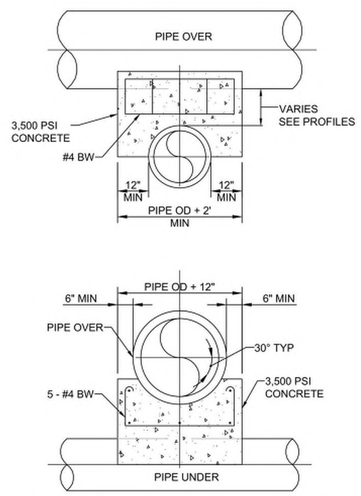


NOTES:

1. CONSTRUCT THRUST BLOCKS AND/OR INSTALL RESTRAINED JOINT FITTINGS FOR VERTICAL OR HORIZONTAL CHANGES IN ALIGNMENT REQUIRED TO AVOID UTILITY CONFLICTS. SEE SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS.
2. CENTER WATER PIPE OVER SEWER PIPE CROSSING TO MAXIMIZE SPACING OF JOINTS FROM THE PIPE CROSSING.

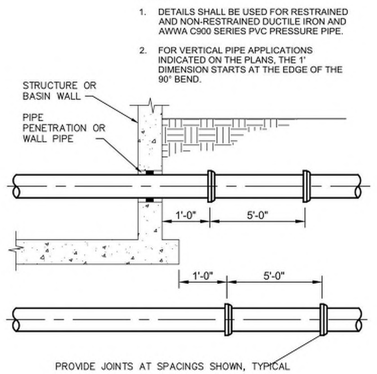
5 - UTILITY CROSSING

1/4" = 1'-0"



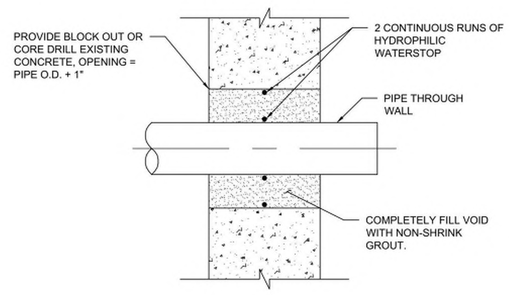
6 - PIPE CROSSING CRADLE

NO SCALE



7 - LOCATION OF PIPE JOINTS AT STRUCTURES

NO SCALE



NOTE:

1. CONTRACTOR TO LOCATE EXISTING REINFORCEMENT PRIOR TO CORING AND NOT DAMAGE EXISTING REINFORCEMENT DURING CORING OPERATIONS.

8 - CORED PIPE WALL PENETRATION GROUT IN PLACE (EXISTING WALL)

NO SCALE

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUN 13/2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	J. THOMPSON
DRAWN BY	T. SCHLOTTMAN
CHECKED BY	S. BEROSET
APPROVED BY	J. THOMPSON
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
JONATHAN D. THOMPSON
147189
LICENSED
PROFESSIONAL ENGINEER
06/13/2025

LEWISVILLE
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CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

N

STANDARD DETAILS
YARD PIPING
SHEET I

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SCALE

SHEET 99C561

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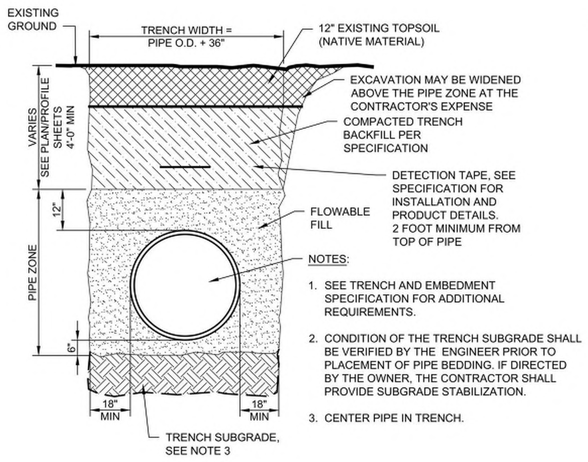
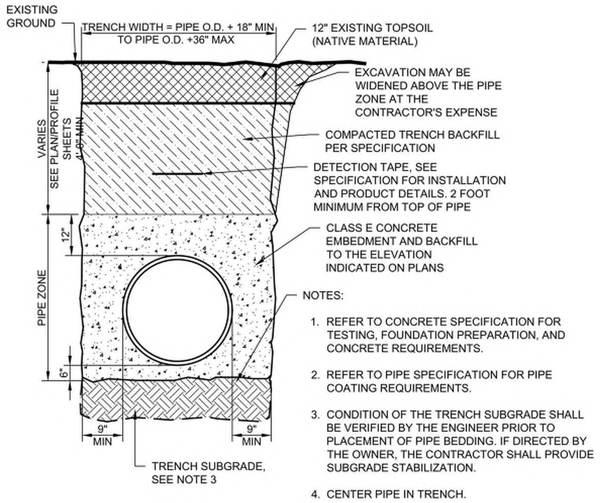


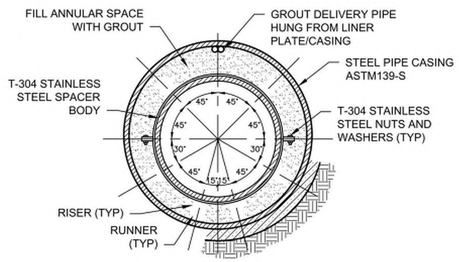
1 - FLOWABLE FILL ENCASEMENT
NOT TO SCALE



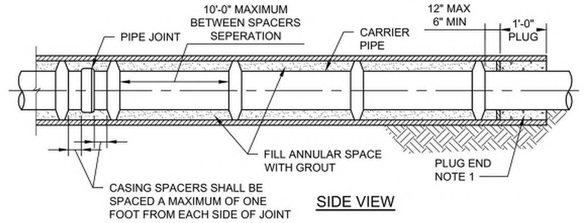
2 - CONCRETE ENCASEMENT
NOT TO SCALE

NOTES:

1. CASING SHALL BE PLUGGED ON BOTH ENDS BEFORE BACKFILLING. PLUGS SHALL CONSIST OF MINIMUM OF 1' LF OF BRICK AND LOW STRENGTH GROUT (1,500 PSI MIN).
2. SPACER HEIGHT SHALL BE SIZED TO PREVENT THE CARRIER PIPE BELL AND PIPE RESTRAINT FROM COMING INTO CONTACT WITH THE CASING PIPE.
3. CASING SIZE MAY BE INCREASED FOR EASE OF CONSTRUCTION AT CONTRACTOR'S EXPENSE.
4. CASING PIPE SHALL BE COATED AS PER SPECIFICATION 09 96 00.
5. CASING SPACERS & INSULATORS BY ADVANCE PRODUCTS & SYSTEMS, INC, OR EQUAL.

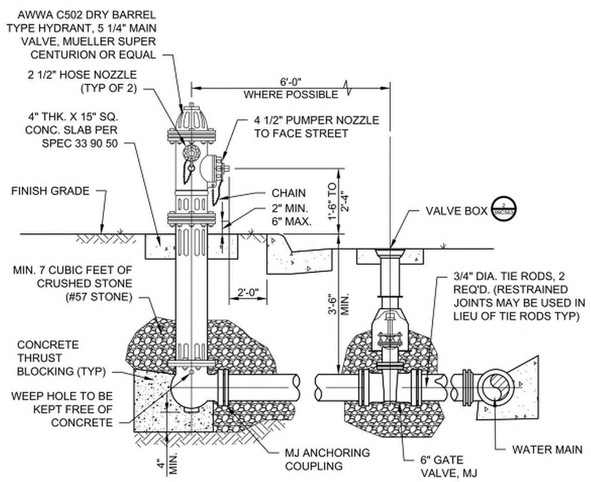


END VIEW



SIDE VIEW

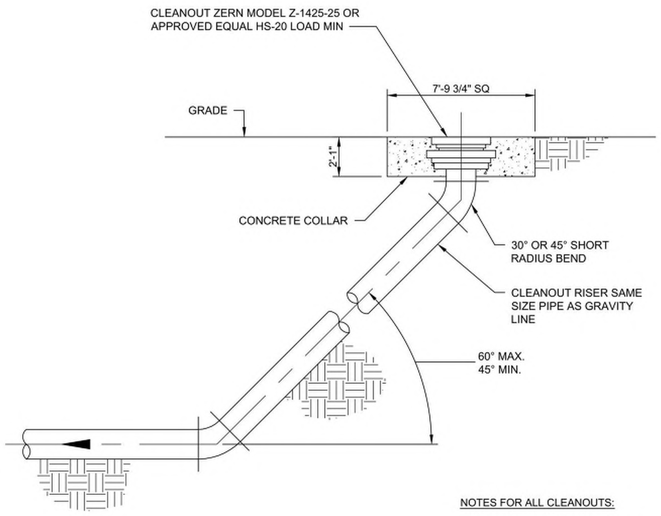
3 - TYPICAL PIPELINE IN CASING
NOT TO SCALE



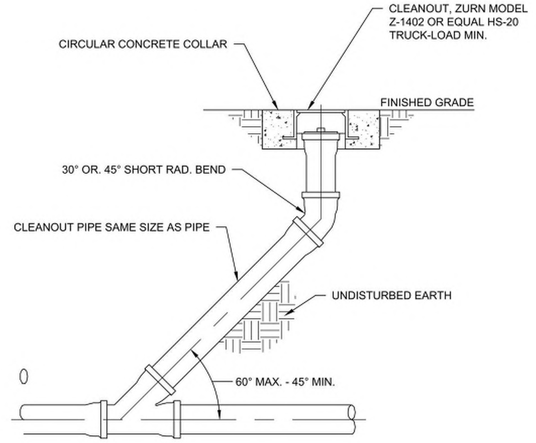
NOTES:

1. TIE RODS AND CLAMPS; RESTRAINED JOINTS; OR DUCTILE IRON PIPE WITH THRUST BLOCKS AS SPECIFIED, COMBINATIONS OF THESE MAY BE USED WHERE ADDITIONAL RESTRAINING/ANCHORAGE IS REQUIRED.
2. IN GENERAL, ALL FIRE HYDRANTS SHALL CONFORM TO AWWA STANDARD SPECIFICATIONS FOR FIRE HYDRANTS FOR ORDINARY WATER WORKS SERVICE, C-502. FIRE HYDRANTS SHALL HAVE A 5-1/4" MIN. VALVE OPENING AND A BARREL APPROXIMATELY 7" INSIDE DIAMETER. ALL HYDRANTS SHALL EQUIPPED WITH A BREAKAWAY FLANGE.
3. ALL JOINTS SHALL BE MECHANICAL JOINTS.
4. ACTUAL VALVE LOCATION WILL DEPEND ON LOCATION OF WATER MAIN.
5. F.H. NO CLOSER THAN 18" TO EXISTING OR PROPOSED SIDEWALKS. (USUAL)
6. STANDARD BURY DEPTH 4 FEET.
7. 1-1/4" OPERATING NUT AND CAPS NUTS.
8. 4-1/2" PUMPER NOZZLE.
9. 2-1/2" STREAMER NOZZLES.
10. AWWA STANDARD THREAD.
11. EACH FIRE HYDRANT TO BE MARKED WITH SIGNAGE STATING, "NON-POTABLE WATER SOURCE".

4 - FIRE HYDRANT
NOT TO SCALE



5 - CLEANOUT
NOT TO SCALE



NOTES FOR ALL CLEANOUTS:

1. PIPE MATERIAL (PVC OR DUCTILE IRON) AS SCHEDULED.
2. RESTRAIN ALL JOINTS AS SPECIFIED.

6 - WYE CLEANOUT
NOT TO SCALE

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HDR
TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUN 13/2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	J. THOMPSON
DRAWN BY	T. SCHLOTTMAN
CHECKED BY	S. BEROSET
APPROVED BY	J. THOMPSON
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
JONATHAN D. THOMPSON
147189
LICENSED PROFESSIONAL ENGINEER
06/13/2025

LEWISVILLE
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CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

N

STANDARD DETAILS
YARD PIPING
SHEET II

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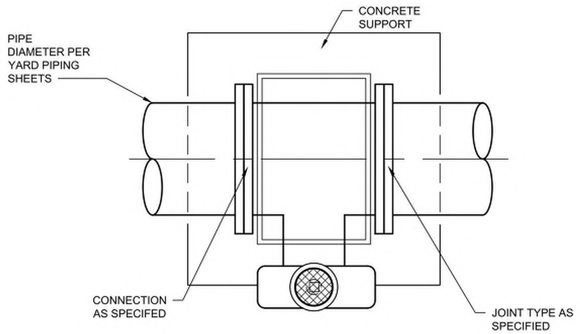

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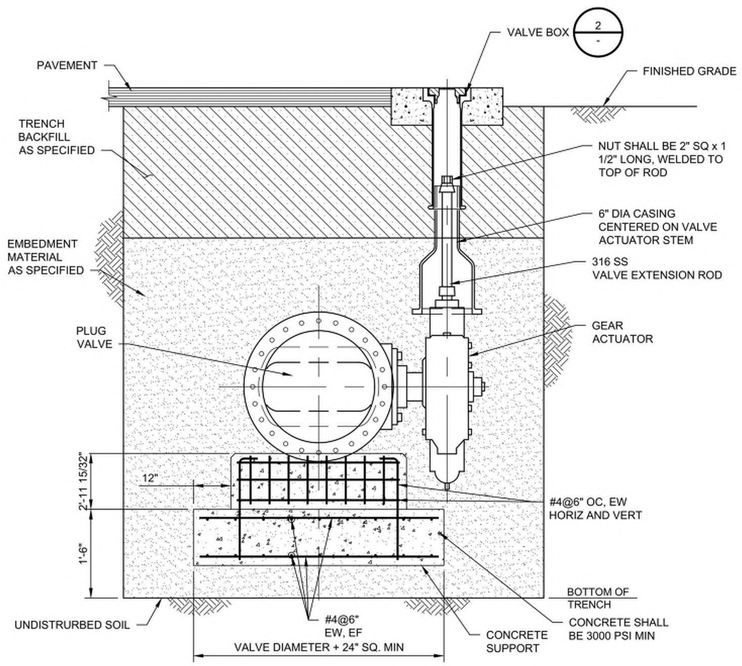
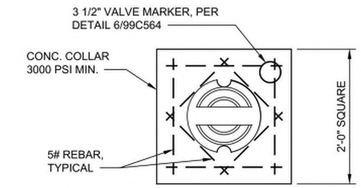


SECTION

NOTES:

1. DETAIL FOR PLUG VALVES 24" AND LARGER



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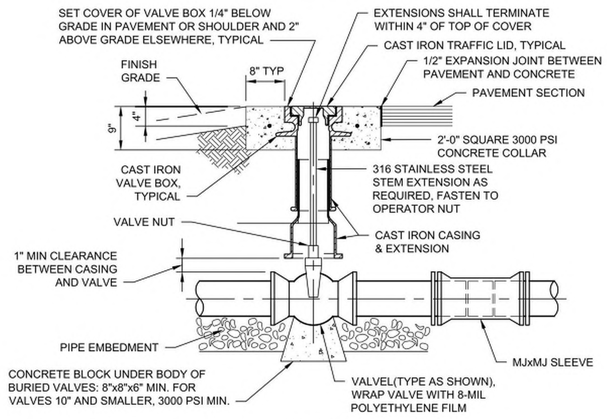
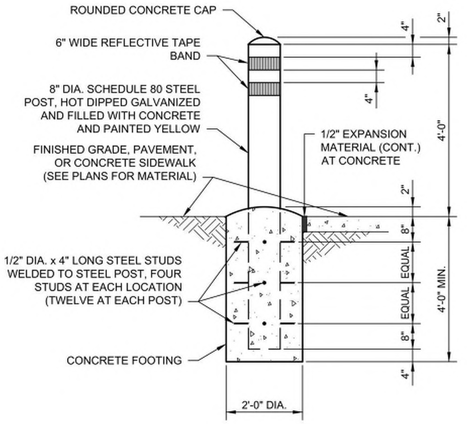
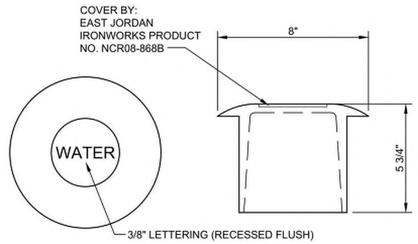


SECTION

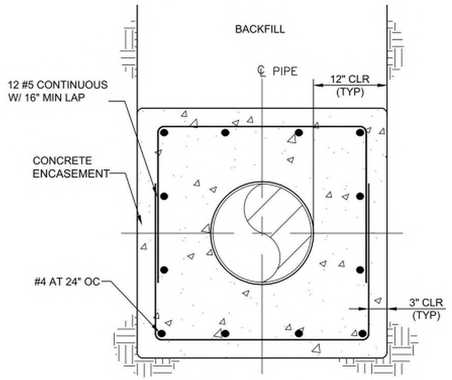
2 - BURIED VALVE
NOT TO SCALE



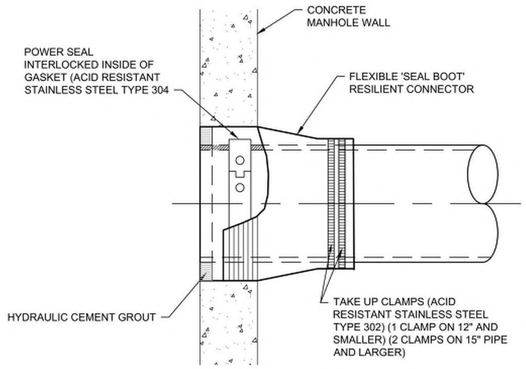
3 - BOLLARD
NOT TO SCALE



TOP SIDE VIEW



NOTE:
PIPE SHALL NOT HAVE DIRECT CONTACT WITH ANY REINFORCING STEEL.



1 - BURIED PLUG VALVE
NOT TO SCALE

4 - ACTUATOR STEM COVER
NOT TO SCALE

5 - PIPE CONCRETE ENCASEMENT
1/4" = 1'-0"

6 - FLEXIBLE 'SEAL BOOT' RESILIENT CONNECTOR
NOT TO SCALE

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TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUN 13/2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	J. THOMPSON
DRAWN BY	T. SCHLOTTMAN
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APPROVED BY	J. THOMPSON
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
JONATHAN D. THOMPSON
147189
LICENSED PROFESSIONAL ENGINEER
06/13/2025

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

N

STANDARD DETAILS
YARD PIPING
SHEET III

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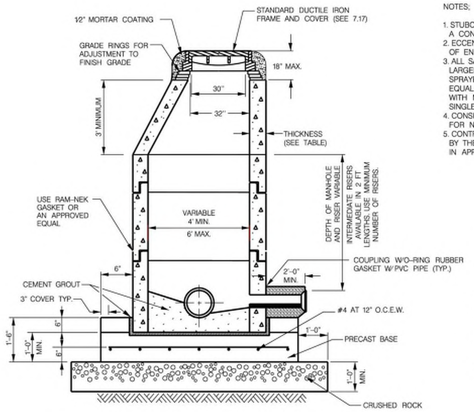


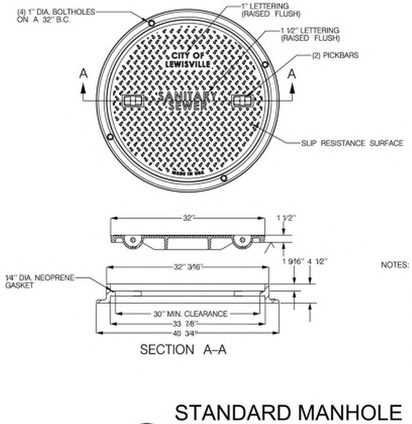
NOTES;

1. STUBOUTS TO BE A MINIMUM OF 2' LONG WITH A CONCRETE CRADLE UNDER THE ENTIRE LENGTH.
2. ECCENTRIC MANHOLES TO BE USED AT DISCRETION OF ENGINEER.
3. ALL SANITARY SEWERS MANHOLES FOR SEWERS LARGER THAN 12-INCHES IN DIAMETER MUST BE SPRAYED WITH WARREN EPOXY 301-14 OR APPROVED EQUAL 100% SOLIDS EPOXY CONTAINING NO VOC's WITH MINIMUM THICKNESS OF 150 MILS IN A SINGLE APPLICATION.
4. CONSHIELD CONCRETE ADMIXTURE MAY BE USED FOR NEW CAST–IN–PLACE OR PRECAST MANHOLES.
5. CONTRACTOR AND EQUIPMENT SHALL BE CERTIFIED BY THE MANUFACTURER TO ENSURE PROFICIENCY IN APPLYING THE EPOXY OR ADDITIVE PRODUCTS.

MIN. MANHOLE THICKNESS	
48"MH	5" WALL
60"MH	6" WALL
72"MH	7" WALL
PER ASTM C478 NCTCOG 502.1.1.1	

NOTE:
DETAIL SUBJECT TO CHANGE PER DIRECTION OF CITY OF LEWISVILLE ENGINEERING DIVISION.

1 PRECAST MANHOLE ECCENTRIC
NOT TO SCALE

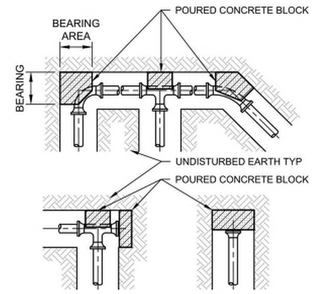


SECTION A–A

NOTES:

1. COVER SHALL BE DUCTILE IRON ASTM A536 FRAME SHALL BE CAST IRON ASTM A48 CL35B.
2. MANHOLE COVER AND FRAME SHALL HAVE A MINIMUM TOTAL WEIGHT OF 300 POUNDS.
3. MANHOLE FRAME SHALL HAVE A MINIMUM CLEAR OPENING OF 30".
4. MANHOLE COVER AND FRAME SHALL HAVE MACHINED SURFACES WHERE SHOWN.
5. WHERE PRIVATE SANITARY SYSTEMS UTILIZE MANHOLES, 'CITY OF LEWISVILLE' SHALL BE REMOVED.

3 STANDARD MANHOLE FRAME AND COVER
NOT TO SCALE



NOTES:

1. PLACE 4 MIL POLYETHYLENE BETWEEN CONCRETE AND FITTING.
2. CONSTRUCT BLOCK SUCH THAT CONCRETE DOES NOT INTERFERE WITH THE ADJACENT PIPE JOINT.
3. THE HORIZONTAL DIMENSION OF THE BEARING AREA SHALL BE BETWEEN 0.8 AND 1.25 TIMES THE VERTICAL DIMENSION.
4. THRUST BLOCK ORIENTATION SHALL BE SUCH THE CENTER OF THE FITTING CORRESPONDS WITH THE CENTER OF THE THRUST BLOCK.
5. CONCRETE SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 4000 PSI AT 28 DAYS.

FITTING SIZES	TOTAL BEARING AREA OF BLOCK IN SQUARE FEET				
	TEE & END	90 DEG BEND	45 DEG BEND	22 1/2 DEG BEND	11 1/4 DEG BEND
4"	1.0	1.9	1.4	0.8	0.4
6"	2.2	4.3	3.0	1.7	0.9
8"	3.8	7.6	5.4	2.9	1.5
10"	5.9	11.8	8.4	4.6	2.3
12"	8.5	17.0	12.0	6.5	3.4
14"	11.6	23.1	16.4	8.9	4.6
16"	15.1	30.2	21.4	11.6	5.9
18"	19.1	38.2	27.0	14.6	7.5
20"	23.6	47.1	33.3	18.1	9.2
24"	34.0	67.9	48.0	26.0	13.3
30"	53.0	106.0	75.0	40.6	20.7
36"	76.4	152.7	107.9	58.4	29.8

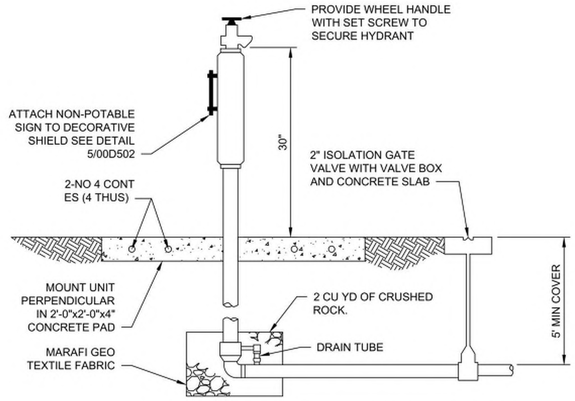
BEARING AREAS ARE BASED UPON AN ALLOWABLE SOIL BEARING PRESSURE OF 2000 PSF AND A PIPE TEST PRESSURE OF 150 PSI.

5 THRUST BLOCK DETAILS
NOTICE TO CONTRACTOR

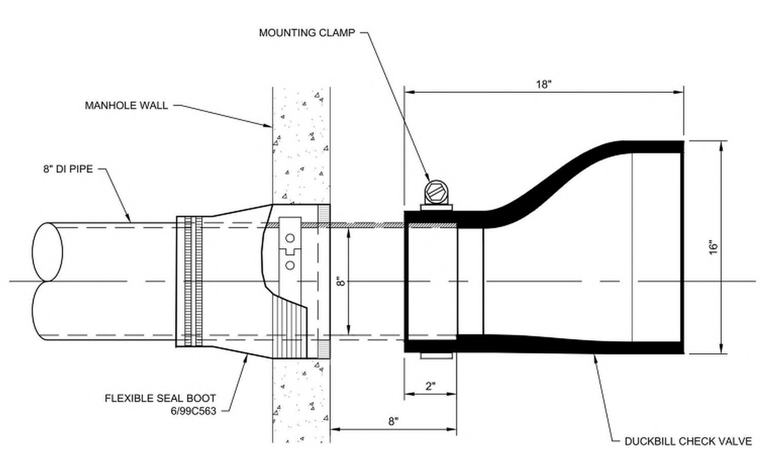
NOTES:

1. VALVE MARKER SHALL BE 3 1/2" DIAMETER, MANUFACTURED BY BERNTSEN FOUNDRY MODEL C350B OR APPRV'D EQUAL.
2. MARKERS SHALL BE STAMPED WITH 3/16" HIGH CHARACTERS.
3. VALVE SIZE SHALL BE STAMPED IN PLACE OF XX.

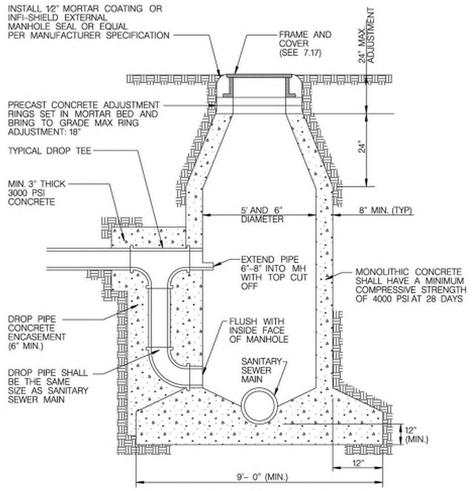
6 VALVE MARKER
NOT TO SCALE



7 NON-FREEZE NPW YARD HYDRANT
NOT TO SCALE



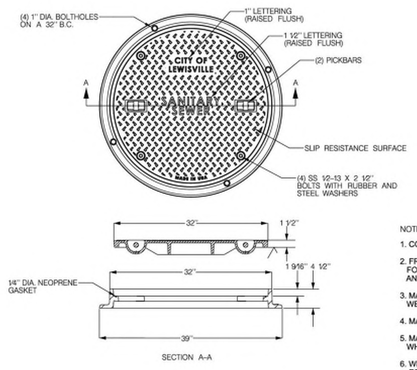
8 DUCKBILL CHECK VALVE IN MANHOLE
NOT TO SCALE



* NOTES:
1. CONCRETE SHALL BE A MONOLITHIC POUR.
2. PIPE CONNECTIONS SHALL BE CORE DRILLED WITH SEALS.
3. EXTERNAL DROP TO BE INSTALLED IN THE FOLLOWING CONDITIONS:
   A. ON SANITARY SEWER MAINS 24–INCHES IN DIAMETER AND LARGER,
   B. WHEN 4–FOOT CLEARANCE BETWEEN THE INTERNAL DROP BOWL AND THE OPPOSITE MANHOLE WALL CANNOT BE MET,
   C. WHEN THERE ARE MORE THAN TWO PIPES ENTERING THE DROP MANHOLE.
   D. UPON WRITTEN APPROVAL OF THE CITY ENGINEER.

NOTE:
DETAIL SUBJECT TO CHANGE PER DIRECTION OF CITY OF LEWISVILLE ENGINEERING DIVISION

2 EXTERNAL DROP CONNECTION MANHOLE
NOT TO SCALE



SECTION A–A

NOTES:

1. COVER SHALL BE DUCTILE IRON, ASTM A536.
2. FRAME SHALL BE CAST IRON ASTM A48 CL35B WITH PROVISIONS FOR 4 BOLTS AT 1/2" DIAMETER BY 2 1/2" LONG EACH WITH RUBBER AND STEEL WASHERS
3. MANHOLE COVER AND FRAME SHALL HAVE A MINIMUM TOTAL WEIGHT OF 300 POUNDS.
4. MANHOLE FRAME SHALL HAVE A MINIMUM CLEAR OPENING OF 30-INCHES.
5. MANHOLE COVER AND FRAME SHALL HAVE MACHINED SURFACES WHERE SHOWN.
6. WHERE PRIVATE SANITARY SEWER SYSTEMS USE MANHOLE COVERS, REMOVE "CITY OF LEWISVILLE"
7. BOLT DOWN COVERS REQUIRED IN FLOOD PLAINS, HIGH VEHICLE TRAFFIC AREAS, AND MANHOLES THAT EXPERIENCE HIGH ODOR LEVELS.

4 BOLT DOWN MANHOLE & COVER
NOT TO SCALE

File Path C:\Users\rgentry\DC\ACCDocs\HDR\10342803_COL_PCWWT_AB_Expansion_2024\Project Files\01_HDR\05_Civil_C\05.03_Sheet Files\99C564.dwg
Date 6/13/2025 7:18:33 AM

HDR
TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUN 13/2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	J. THOMPSON
DRAWN BY	T. SCHLOTTMAN
CHECKED BY	S. BEROSET
APPROVED BY	J. THOMPSON
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
JONATHAN D. THOMPSON
147189
LICENSED
PROFESSIONAL ENGINEER
06/13/2025

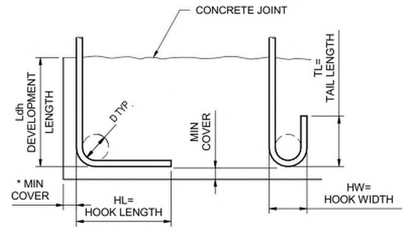
LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

N

STANDARD DETAILS
YARD PIPING
SHEET IV

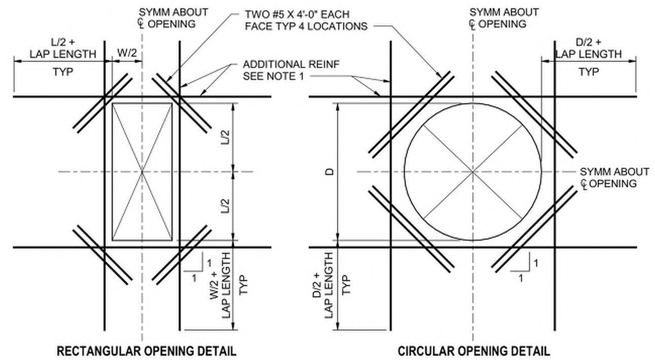
FILENAME 99C564.dwg
SCALE
SHEET 99C564



90 DEG STD HOOK 180 DEG STD HOOK

BAR SIZE GRADE 60	HL	HW	TL	D	f'c = 4.5 KSI
					Ldh
#3	6"	3"	3"	2 1/4"	6"
#4	8"	4"	4 1/2"	3"	6 1/2"
#5	10"	5"	5"	3 3/4"	9"
#6	1'-0"	6"	6"	4 1/2"	12"
#7	1'-2"	7"	7"	5 1/4"	15"
#8	1'-4"	8"	8"	6"	18 1/2"
#9	1'-7"	11 1/2"	10 1/2"	9"	22"
#10	1'-10"	1'-1 1/4"	11 1/2"	10 3/4"	26"
#11	2'-0"	1'-2 3/4"	1'-1"	12"	31"

1 REINFORCING HOOK SCHEDULE
NOT TO SCALE



RECTANGULAR OPENING DETAIL CIRCULAR OPENING DETAIL

NOTES:

1. PROVIDE ADDITIONAL REINFORCING THE SAME SIZE AS DISCONTINUOUS REINFORCEMENT AT OPENING. QUANTITY OF REINFORCING IN EACH DIRECTION SHALL BE EQUAL TO OR ONE GREATER THAN THE NUMBER OF DISCONTINUOUS BARS. PLACE 1/2 OF ADDITIONAL REINFORCING BARS EACH SIDE OF OPENING, PLACE ADDITIONAL REINFORCEMENT AT 3" OC (TYPICAL BOTH DIRECTIONS AND ALL LAYERS OF REINFORCEMENT). START FIRST BAR 2" CLEAR TO OPENING.
2. EXTEND ADDITIONAL REINFORCING BEYOND EDGE OF OPENING AS SHOWN. ADDITIONAL BARS MAY TERMINATE AT THE END OF THE WALL/SLAB WITH A STANDARD HOOK WHERE THE LENGTH OF THE WALL/SLAB WILL NOT PERMIT BARS TO EXTEND AS SHOWN.
3. TYPICAL WALL OR SLAB REINFORCING NOT SHOWN FOR CLARITY. TERMINATE TYPICAL REINFORCING 2" CLEAR TO OPENING.
4. UNLESS SHOWN OTHERWISE ON DRAWINGS, PROVIDE EXTRA REINFORCING AROUND OPENINGS AS SHOWN AND INDICATED.
5. PROVIDE ADDITIONAL DOWELS PER NOTE 1 FOR ALL OPENINGS NEAR THE FLOOR SLAB, BASE SLAB, OR CORNERS.

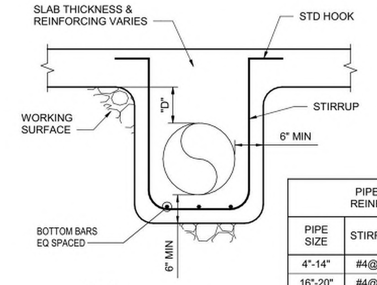
2 EXTRA REINFORCEMENT AROUND OPENINGS
NOT TO SCALE

MINIMUM LAP SPLICE LENGTHS f'c = 4000 - 5000 psi					
BAR	* MIN BAR SPACING	LAPS FOR BARS SPACED GREATER THAN MIN BAR SPACING		LAPS FOR BARS SPACED CLOSER THAN MIN BAR SPACING	
		OTHER	TOP	OTHER	TOP
#3	3"	1'-4"	1'-6"	1'-4"	1'-6"
#4	3"	1'-7"	2'-0"	2'-2"	2'-9"
#5	3"	1'-11"	2'-6"	3'-0"	4'-0"
#6	4"	2'-4"	3'-0"	4'-0"	5'-2"
#7	4"	3'-6"	4'-6"	6'-4"	8'-3"
#8	4"	4'-7"	5'-11"	7'-9"	10'-0"
#9	4 1/2"	5'-9"	7'-6"	9'-3"	12'-0"
#10	5"	7'-4"	9'-6"	11'-0"	14'-3"
#11	5 5/8"	9'-0"	11'-8"	12'-9"	16'-8"

NOTES:

1. REBAR SPLICE LENGTHS SHOWN UNDER HEADING "TOP" ARE HORIZONTAL BARS WITH 12" OR MORE CONCRETE BELOW. ALL SPLICE LENGTHS FOR VERTICAL BARS AND HORIZONTAL BARS WITH LESS THAN 12" OF CONCRETE BELOW SHALL BE AS SHOWN UNDER HEADING "OTHER".
2. *AT SPLICES THE BAR SPACING IS THE CENTER TO CENTER DISTANCE BETWEEN ADJACENT REBAR.
3. ALL SPLICES SHALL BE CONTACT SPLICES AND WIRED TOGETHER.
4. NO WELDED OR MECH SPLICES ARE PERMITTED UNLESS INDICATED OTHERWISE.
5. UNLESS OTHERWISE SHOWN, SPLICES FOR BOTTOM REINF BARS IN BEAM AND SLABS SHALL BE CENTERED OVER THE SUPPORTS. SPLICES FOR TOP REINFORCING BARS SHALL BE LOCATED ON THE CENTERLINE OF SPAN.

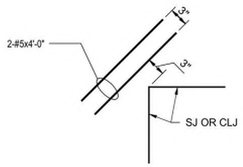
3 CONCRETE REINFORCEMENT LAP SPLICE SCHEDULE
NOT TO SCALE



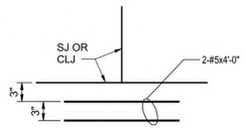
PIPE ENCASEMENT REINFORCING TABLE			
PIPE SIZE	STIRRUP	BOT/TOP BARS	SIDE BARS
4"-14"	#4@12	3-#4	#4@12
16"-20"	#4@12	4-#4	#4@12
22"-30"	#5@12	4-#5	#5@12
32"-48"	#5@12	5-#5	#5@12

NOTE:

FOR ALL UNDERSLAB PIPE ENCASEMENT WHEN "D" < 4'-0".



RE-ENTRANT CORNER

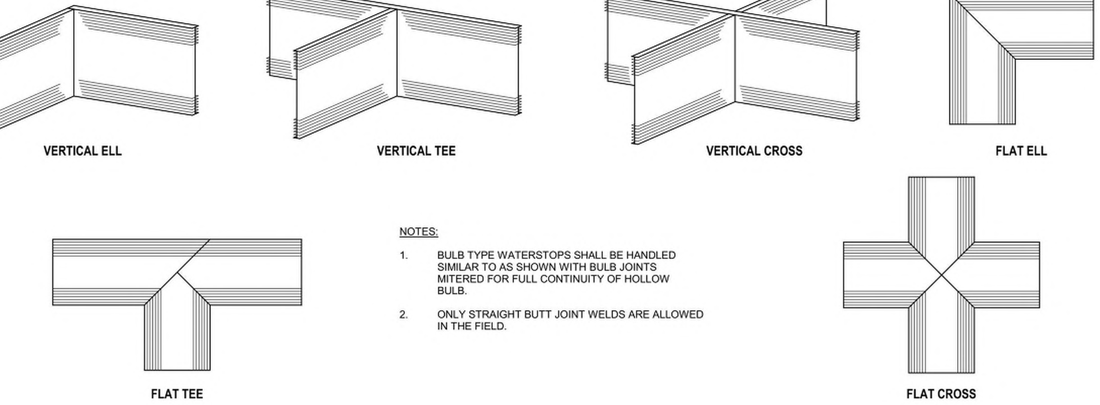


DISCONTINUOUS JOINT INTERSECTION

NOTE:

1. LOCATE ALL ADDITIONAL REINFORCING BELOW MAIN REINFORCEMENT.

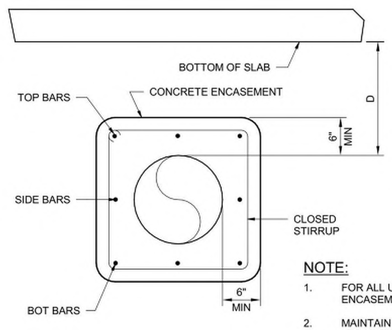
5 ADDITIONAL SLAB REINFORCING
NOT TO SCALE



NOTES:

1. BULB TYPE WATERSTOPS SHALL BE HANDLED SIMILAR TO AS SHOWN WITH BULB JOINTS MITERED FOR FULL CONTINUITY OF HOLLOW BULB.
2. ONLY STRAIGHT BUTT JOINT WELDS ARE ALLOWED IN THE FIELD.

4 SHOP FABRICATED WATERSTOP
NOT TO SCALE



NOTE:

1. FOR ALL UNDERSLAB PIPE ENCASEMENT WHEN D > 4'-0".
2. MAINTAIN REINFORCEMENT AT PIPE RISER ENCASEMENTS AND TERMINATE VERTICAL REINFORCEMENT WITH STANDARD HOOKS INTO SLAB.

6 UNDERSLAB PIPE ENCASEMENT
NOT TO SCALE

HDR
TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	OCT 16/2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	W. DONELAN
DRAWN BY	H. GARCIA
CHECKED BY	C. ZIMMERMAN
APPROVED BY	J. NAVE
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
JASON C. NAVE
130766
10/16/25

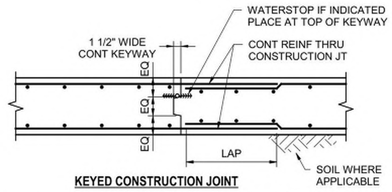
LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK

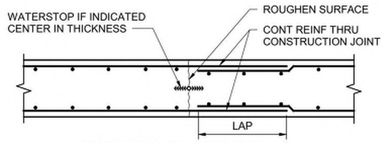
AERATION BASIN EXPANSION

STANDARD DETAILS STRUCTURAL DETAILS I

FILENAME: Structural Standard Details
SCALE: As indicated
0 1" 2"
SHEET: 99S501



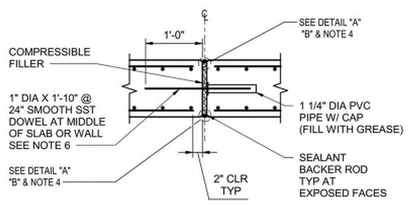
KEYED CONSTRUCTION JOINT



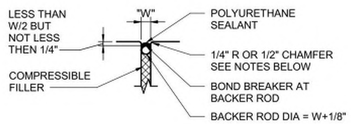
ROUGHEN CONSTRUCTION JOINT

NOTE:

1. SEE SPECIFICATION FOR REQUIREMENT TO TIE WATERSTOPS IN PLACE TO PREVENT MOVEMENT OR FOLDING OVER.



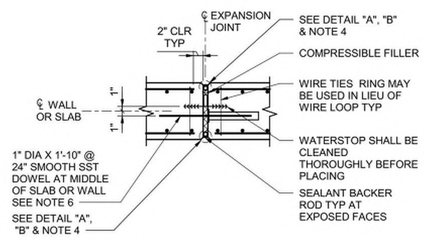
NON-WATER BEARING SLAB OR WALL



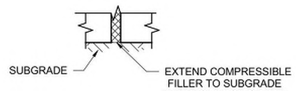
DETAIL "A" EXPOSED FACE

NOTES:

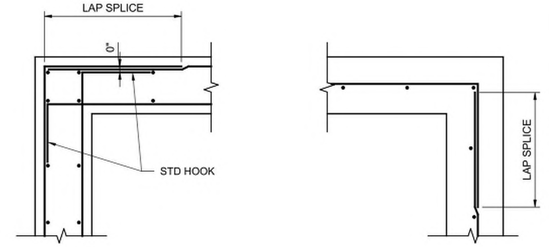
1. FOR WALLS, FORM ALL JOINT EDGES AT 1/2" CHAMFER.
2. FOR UNDER SIDE OF EXPOSED SLABS, FORM JOINT EDGES AT 1/2" CHAMFER.
3. FOR SLABS, PROVIDE 1/4" RADIUS TOOLED EDGES AT TOP SURFACE.
4. USE DETAIL "B" AT UNDERSIDE OF SLABS ON GRADE ONLY. USE DETAIL "A" AT ALL OTHER LOCATIONS.
5. "W" = 1" WIDE UNLESS OTHERWISE INDICATED ON THE DRAWINGS.
6. SMOOTH DOWEL AND PVC ASSEMBLY AT EXPANSION JOINTS SHALL USE SIKA "SPEED DOWEL"

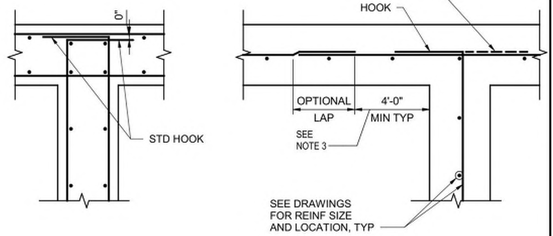


WATER BEARING SLAB OR WALL



DETAIL "B" SOIL SIDE



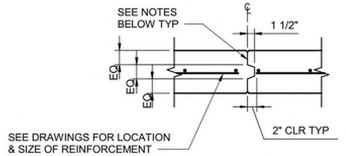


NOTES:

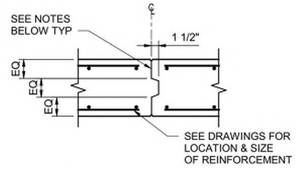
1. ALL HOOKS SHALL BE STD 90 DEGREE HOOKS.
2. SEE DRAWINGS FOR ADDITIONAL HORIZONTAL BARS. STAGGER BETWEEN TYPICAL REINF SPACING.
3. OPTIONAL LAP LOCATION. APPLIES TO BOTH DOUBLE AND SINGLE LAYER CONDITIONS TYP.

1 CONSTRUCTION JOINT (CJ)

NOT TO SCALE



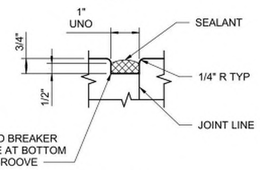
NON-WATER BEARING WALL OR SLAB LESS THAN 10" THICK



NON-WATER BEARING SLAB OR WALL 10" THICK OR GREATER

2 EXPANSION JOINTS WITH SEALANT (EJ)

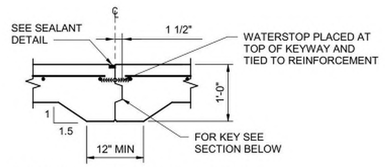
NOT TO SCALE



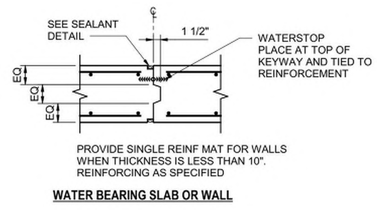
SEALANT DETAIL

NOTES:

1. COAT CONCRETE JOINT SURFACES WITH BOND BREAKER COMPOUND.
2. FOR WALLS, FORM ALL JOINT EDGES AT 1/2" CHAMFER.
3. FOR SLABS, EDGE TOP OF EXPOSED SLAB JOINT AT 1/4" RADIUS.
4. FOR UNDERSIDE OF EXPOSED SLABS, FORM JOINT EDGES AT 1/2" CHAMFER.

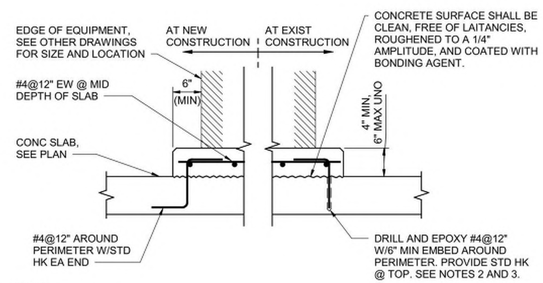


WATER BEARING SLAB LESS THAN 12" THICK



PROVIDE SINGLE REINF MAT FOR WALLS WHEN THICKNESS IS LESS THAN 10". REINFORCING AS SPECIFIED

WATER BEARING SLAB OR WALL

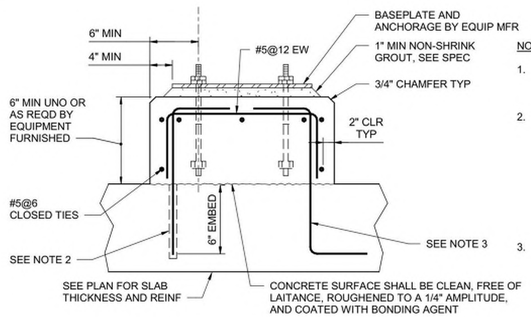


NOTES:

1. REF PROCESS, ELECTRICAL, AND MECHANICAL DRAWINGS FOR DIMENSIONS AND LOCATIONS OF PADS. FINAL PAD DIMENSIONS MUST BE ADJUSTED AS NEEDED TO FIT ACTUAL EQUIPMENT SELECTED.
2. FOR HOUSEKEEPING PAD ON EXISTING SLABS, CONTRACTOR MUST VERIFY EXISTING SLAB THICKNESS IS ADEQUATE TO PROVIDE MINIMUM SPECIFIED CONCRETE COVER UNDER DOWELS. NOTIFY ENGINEER OF RECORD PRIOR TO CONSTRUCTION IF EXISTING SLAB THICKNESS IS NOT SUFFICIENT.
3. FOR HOUSEKEEPING PADS ON EXISTING SLABS, CONTRACTOR MUST LOCATE EXISTING SLAB/GRADE BEAM REINFORCEMENT PRIOR TO DRILLING HOLES FOR POST-INSTALLED REINFORCEMENT. DO NOT DAMAGE EXISTING REINFORCEMENT.

3 CONTROL JOINT (CLJ)

NOT TO SCALE

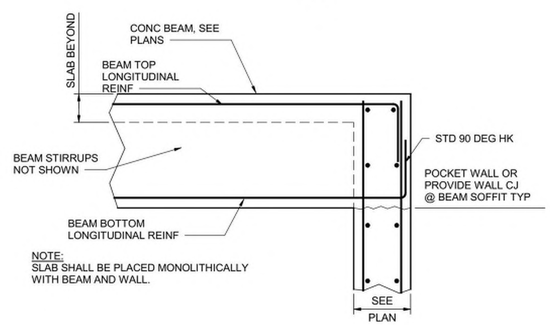


NOTES:

1. EQUIPMENT BASE DIMENSIONS SHALL BE AS REQUIRED BY THE APPROVED SHOP DRAWINGS. EQUIPMENT BASES SHALL BE INSTALLED LEVEL.
2. FOR NEW EQUIPMENT BASES ON EXISTING SLABS, DRILL INTO SLABS TO INDICATED DEPTH AT 12" ON CENTER AROUND PERIMETER OF EQUIPMENT BASE AND SET #5 DOWEL HOOKED AS SHOWN USING APPROVED ADHESIVE FOR CONCRETE ANCHORS. CONTRACTOR MUST VERIFY SLAB THICKNESS IS ADEQUATE TO PROVIDE SPECIFIED CONCRETE COVER UNDER DOWELS. NOTIFY ENGINEER OF RECORD PRIOR TO CONSTRUCTION IF EXISTING SLAB THICKNESS IS NOT SUFFICIENT.
3. FOR EQUIPMENT BASES ON NEW SLABS, PROVIDE #5 DOWELS HAVING TWO HOOKED ENDS AT12" ON CENTER AROUND PERIMETER, UNO.

4 HOUSEKEEPING PAD

NOT TO SCALE



NOTE:
SLAB SHALL BE PLACED MONOLITHICALLY WITH BEAM AND WALL.

5 WALL REINFORCEMENT AT CORNERS AND INTERSECTIONS

NOT TO SCALE

6 TALL EQUIPMENT PAD

NOT TO SCALE

7 WALL POCKET AT BEAM

NOT TO SCALE

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13/2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	W. DONELAN
DRAWN BY	H. GARCIA
CHECKED BY	C. ZIMMERMAN
APPROVED BY	J. NAVE
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
JASON C. NAVE
130766
06/13/25

LEWISVILLE
Deep Roots. Broad Wings. Bright Future

CITY OF LEWISVILLE
PRAIRIE CREEK

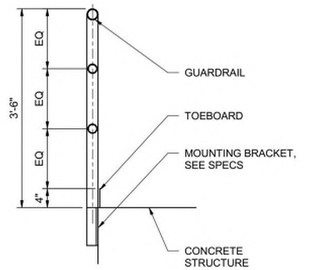
AERATION BASIN EXPANSION

STANDARD DETAILS
STRUCTURAL
DETAILS II

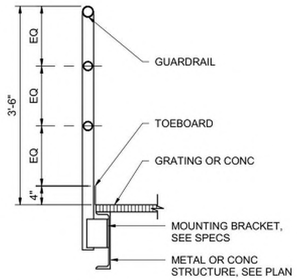
0 1" 2"

FILENAME	Structural Standard Details
SCALE	As indicated

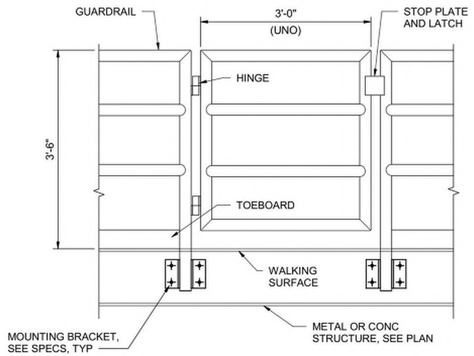
SHEET 99S502



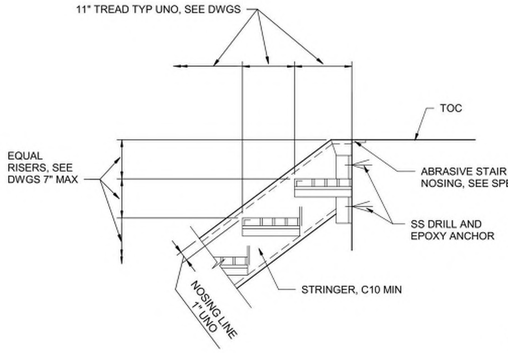
1 GUARDRAIL SIDE MOUNTED
NOT TO SCALE



2 GUARDRAIL SIDE MOUNTED
NOT TO SCALE



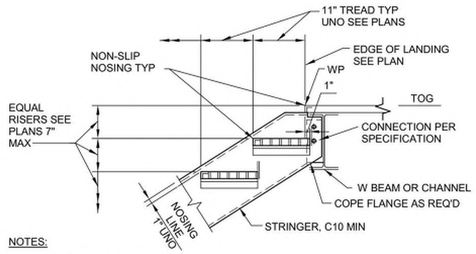
3 GUARDRAIL GATE
NOT TO SCALE



ALUMINUM STAIR NOTES:

1. ALL STAIRS AND APPURTENANT ITEMS SHOWN ON DRAWINGS SHALL BE ALUMINUM, UNLESS SHOWN AS CONCRETE STAIRS ON DRAWINGS. ALL FASTENERS SHALL BE STAINLESS STEEL TYPE 316.
2. STAIR TREADS, STRINGERS, RAILING AND CONNECTION DESIGN BY FABRICATOR. SEE SPECIFICATION SECTION 01 35 73, 05 50 00 AND 05 52 46.

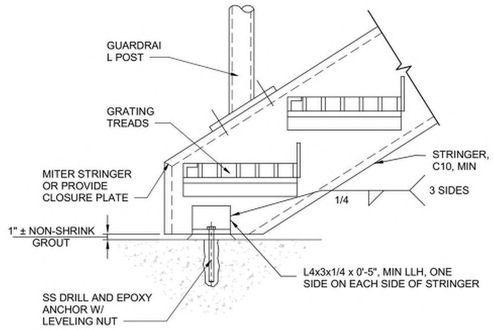
4 ALUMINUM STAIR
NOT TO SCALE



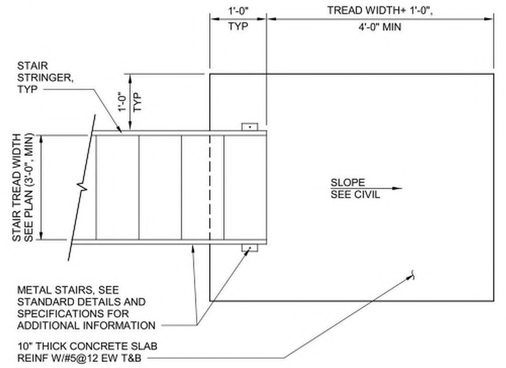
NOTES:

1. SEE SPECS AND DRAWINGS FOR MATERIAL TYPE.
2. FASTENER MATERIAL SHALL MATCH STAIR MATERIAL TYPE EXCEPT THAT ALUMINUM STAIRS SHALL USE SST TYPE 316 FASTENERS.
3. SEE SPECIFICATIONS FOR DESIGN REQUIREMENTS.

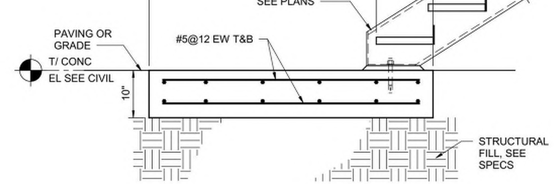
5 STAIR TOP CONNECTION AT BEAM
NOT TO SCALE



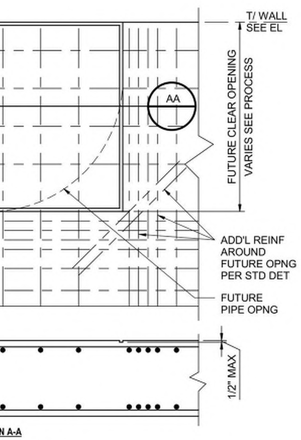
6 ALUMINUM STAIR AT BOTTOM
NOT TO SCALE



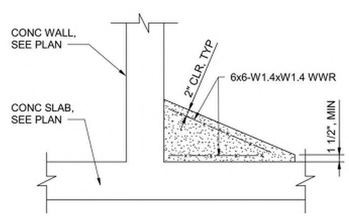
7 STAIR LANDING PAD
NOT TO SCALE



8 STAIR LANDING PAD
NOT TO SCALE

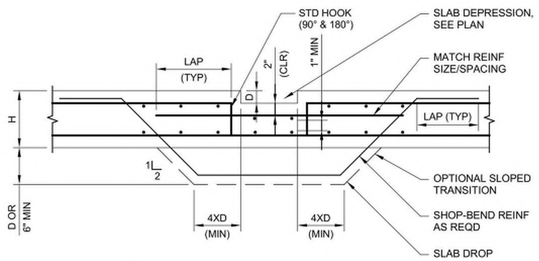


9 FUTURE WALL OPENING
NOT TO SCALE



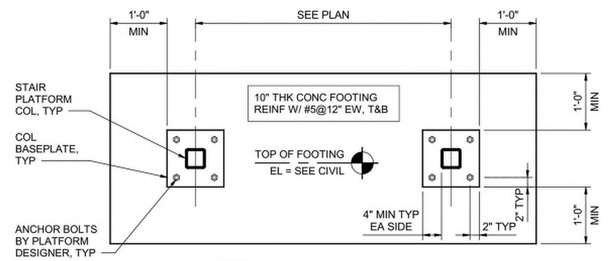
NOTE:
1. REINFORCE CONCRETE TOPPING AS SHOWN WHENEVER CONCRETE TOPPING THICKNESS EXCEEDS 4", UNLESS NOTED OTHERWISE.

10 CONCRETE FILL REINFORCING
NOT TO SCALE



NOTE:
WHERE THE DEPRESSION DEPTH, D IS GREATER THAN H/4, PROVIDE A DROP IN THE SOFFIT AND SHOP-BEND BOT REINF AS INDICATED.

11 SLAB DEPRESSION
NOT TO SCALE



NOTE:
BASE PLATES FOR ALUMINIUM COLUMNS SHALL REST ON 1" NON-SHRINK GROUT.

12 STAIR PLATFORM COLUMN FOOTING
NOT TO SCALE

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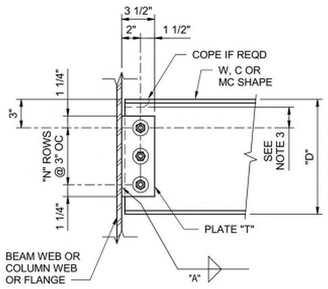
PRAIRIE CREEK

AERATION BASIN EXPANSION

STANDARD DETAILS
STRUCTURAL
DETAILS III

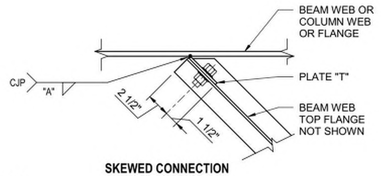
FILENAME: Structural Standard Details
SCALE: As indicated
0 1" 2"

SHEET: **99S503**



PERPENDICULAR CONNECTION

SINGLE PLATE BEAM CONNECTION SCHEDULE 3/4" DIA BOLTS			
NOMINAL BEAM DEPTH "D"	NUMBER OF BOLT ROWS "N"	PLATE THICKNESS "T"	WELD SIZE "A"
W8	2	5/16"	1/4"
W10	2	5/16"	1/4"
W12	3	5/16"	1/4"
W14	3	5/16"	1/4"
W16	4	5/16"	1/4"
W18	5	5/16"	1/4"
W21	6	5/16"	1/4"
W24	7	3/8"	5/16"
W27	7	3/8"	5/16"
W30	8	7/16"	3/8"
W33	9	7/16"	3/8"
W36	10	7/16"	3/8"

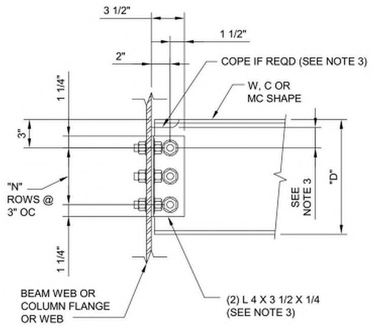


SKEWED CONNECTION
(IF APPLICABLE)

NOTES:

1. ALL BOLTS SHALL BE 3/4" DIA ASTM F3125 GRADE A325 UNLESS NOTED OTHERWISE.
2. PROVIDE MINIMUM NUMBER OF BOLT ROWS "N" SHOWN AS THE TYPICAL CONN. INCREASE NUMBER OF ROWS AND/OR BOLT DIA IF INDICATED ON PLANS.
3. MINIMUM DISTANCE FROM CENTERLINE OF TOP BOLT TO A COPE SHALL BE 1 1/2". WHERE DEEP COPES ARE REQD, INCREASE DISTANCE FROM TOP OF BEAM TO CENTERLINE OF TOP BOLT.
4. USE STANDARD OR SHORT HORIZONTAL SLOTTED HOLES AS REQUIRED.

1 SINGLE PLATE BEAM CONNECTION
NOT TO SCALE

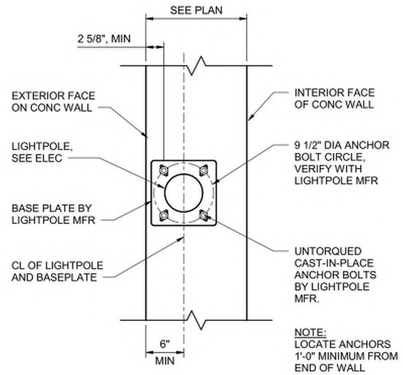


STANDARD BOLTED CONNECTION SCHEDULE	
NOMINAL BEAM SIZE "D" (IN)	NUMBER OF BOLT ROWS "N"
8	2
10	2
12	3
14	3

NOTES:

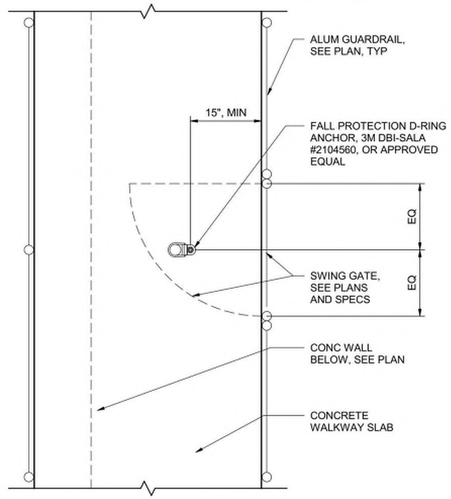
1. ALL BOLTS SHALL BE 3/4" DIA STAINLESS STEEL ASTM F593 TYPE 316 UNLESS NOTED OTHERWISE.
2. PROVIDE MINIMUM NUMBER OF BOLT ROWS "N" SHOWN AS THE TYPICAL CONN. INCREASE NUMBER OF ROWS AND / OR BOLT DIA. IF INDICATED ON PLANS.
3. MINIMUM DISTANCE FROM CL OF TOP BOLT TO A COPE SHALL BE 1 1/2". WHERE DEEP COPES ARE REQD, INCREASE DISTANCE FROM TOP OF BEAM TO CL OF TOP BOLT.
4. USE STANDARD OR SHORT HORIZONTAL SLOTTED HOLES AS REQUIRED.

3 ALUMINUM BEAM CONNECTION
NOT TO SCALE



NOTE:
LOCATE ANCHORS 1'-0" MINIMUM FROM END OF WALL

5 LIGHTPOLE TOP MOUNTED
NOT TO SCALE

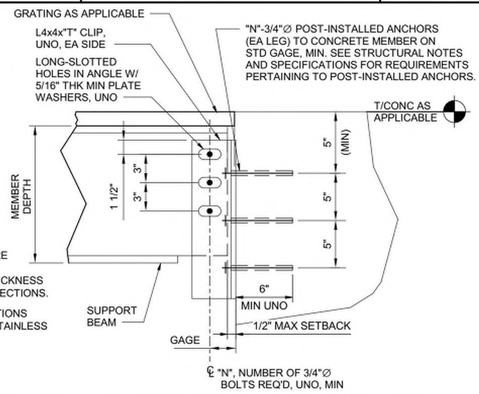


NOTES:

1. FURNISH 3/8" 316/304 SST CHAIN AND WEATHER RESISTANT PADLOCK TO SECURE GATE CLOSED. ALL PADLOCKS SHALL BE KEYED ALIKE.
2. DETAIL APPLIES AT ALL DAVIT CRANE BASE AND SWING GATE LOCATIONS. PROVIDE LEFT HAND AND RIGHT HAND, INWARD OPENING GATES AS REQUIRED TO COORDINATE WITH GATE HINGE OPPOSITE THE DAVIT CRANE BASE.
3. FURNISH SAFETY SIGN FASTENED TO SWING GATE WITH 316 SST FASTENERS. SIGN SHALL BE TYPE B2 NONMETALLIC SAFETY SIGN COMPLYING WITH LISTED OSHA STANDARDS PER SECTION 10 14 00. SIGN SHALL READ:

DANGER:
FALL HAZARD TIE OFF TO D-RING BEFORE OPENING GATE

6 FALL PROTECTION D-RING ANCHOR DETAIL
NOT TO SCALE

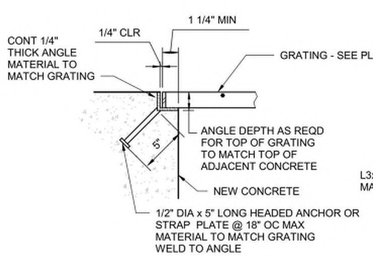


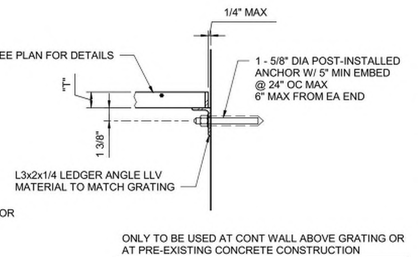
MEMBER DEPTH	"N"	"T"
4", 6"	2 **	1/4
8" THRU 10"	2	1/4
12" THRU 16"	3	5/16
18" THRU 24"	5	5/16
27" THRU 30"	8	5/16

NOTES:

1. **ONE ROW WITH 2 BOLTS EACH LEG.
2. DBL-SIDE CONNECTIONS SHALL BE REQUIRED EXCEPT WHERE SPECIFICALLY SHOWN OR PERMITTED TO BE SINGLE-SIDED. CONNECTION ANGLES SHALL BE 1/8" IN (MIN) GREATER IN THICKNESS THAN WEB OF CONNECTED MEMBER FOR SINGLE SIDE CONNECTIONS.
3. IN THE CASE OF ALUMINUM & FRP CONSTRUCTION, CONNECTIONS SHALL BE ALL-BOLTED, BOLTS AND CLIP ANGLES SHALL BE STAINLESS STEEL, UNO; SAME NUMBER AND DIAMETER AS INDICATED.

2 BEAM TO CONCRETE WALL
NOT TO SCALE



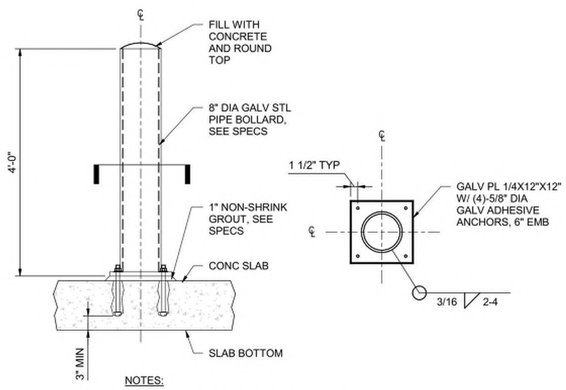


ONLY TO BE USED AT CONT WALL ABOVE GRATING OR AT PRE-EXISTING CONCRETE CONSTRUCTION

NOTES:

1. GRATING SIZE PER CONTRACT DOCUMENTS.
2. ALL ENDS AND OPENINGS SHALL BE BANDED, SEE SPECIFICATION.
3. ATTACH GRATING TO ALL SUPPORT ANGLES WITH BOLTED CLIPS, SPACED AT 2'-0" MAX CENTERS.
4. PROVIDE DISSIMILAR MATERIAL PROTECTION FOR ALUMINUM IN CONTACT WITH CONCRETE PER SPECIFICATION.

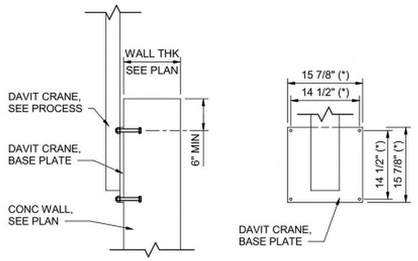
4 GRATING AND SUPPORT
NOT TO SCALE



NOTES:

1. REINFORCING FOR CONCRETE SLAB NOT SHOWN.

7 FLOOR SLAB MOUNTED BOLLARD
NOT TO SCALE



NOTES:

1. SEE PROCESS FOR ALL LOCATIONS OF DAVIT CRANES.
2. ANCHORAGE FOR WALL MOUNTED DAVIT CRANES MUST BE DESIGNED BY THE CONTRACTOR'S ENGINEER BASED ON THE FINAL EQUIPMENT SELECTED. SEE SPECIFICATIONS FOR 03 15 19 FOR ADDITIONAL REQUIREMENTS.
3. BASIS OF DESIGN: 5PT20 COMMANDER 2000 SERIES BY THERN
   A. MAX VERTICAL LOAD = 2.0 KIPS (UNFACTORED)
   B. MAX MOMENT = 7.9 KIP-FT (UNFACTORED)
4. DIMENSIONS SHOWN WITH (*) MUST BE VERIFIED BASED ON FINAL EQUIPMENT SELECTED. WALL MOUNT BASE PLATE BY DAVIT CRANE MFR.

8 DAVIT CRANE - WALL MOUNTED
3/4" = 1'-0"

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PRAIRIE CREEK

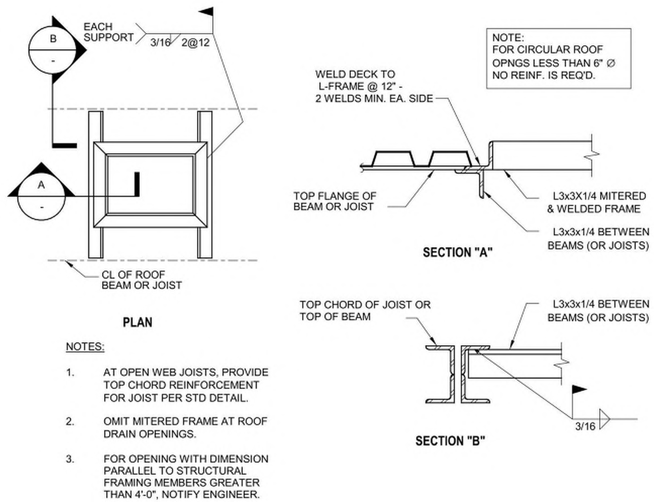
AERATION BASIN EXPANSION

STANDARD DETAILS
STRUCTURAL
DETAILS IV

0 1" 2"

FILENAME	Structural Standard Details
SCALE	As indicated

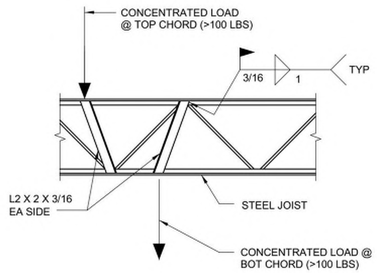
SHEET
99S504



NOTES:

1. AT OPEN WEB JOISTS, PROVIDE TOP CHORD REINFORCEMENT FOR JOIST PER STD DETAIL.
2. OMIT MITERED FRAME AT ROOF DRAIN OPENINGS.
3. FOR OPENING WITH DIMENSION PARALLEL TO STRUCTURAL FRAMING MEMBERS GREATER THAN 4'-0", NOTIFY ENGINEER.

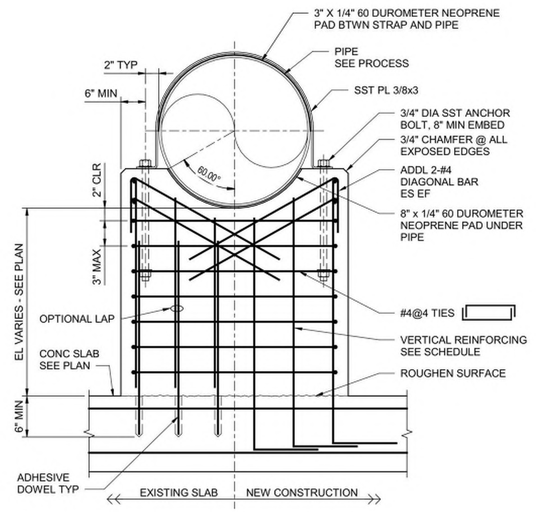
1 ROOF OPENING DETAIL
NOT TO SCALE



NOTE:

1. PROVIDE REINFORCEMENT WHEN CONCENTRATED LOAD IS MORE THAN 4" FROM PANEL JOINT.

2 JOIST AT CONCENTRATED LOAD DETAIL
NOT TO SCALE

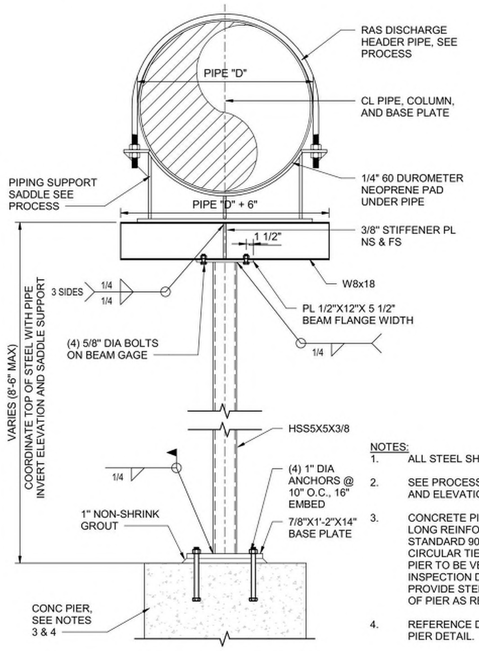


PIPE SIZE DIAMETER	PEDESTAL THICKNESS	VERTICAL REINFORCING @ EF	
		QUANTITY	BAR SIZE
6" - 12"	1'-0"	3	#7
14" - 20"	1'-2"	4	#7
24" - 36"	1'-4"	6	#7

NOTE:

CONTRACTOR SHALL TEMPORARILY SUPPORT PIPE AT SPECIFIED ELEVATION AND POUR SUPPORT AROUND PIPE. DO NOT POUR PIPE SUPPORT WITHOUT PIPE IN PLACE.

3 CONCRETE CRADLE PIPE SUPPORT DETAIL
NOT TO SCALE



NOTES:

1. ALL STEEL SHALL BE HOT-DIP GALVANIZED.
2. SEE PROCESS DRAWINGS FOR PIPE LOCATION AND ELEVATION.
3. CONCRETE PIER TO BE 24" DIAMETER X 20'-0" LONG REINFORCED WITH (8) - #7 VERTS WITH STANDARD 90° HOOK AT TOP AND #4@12" OC CIRCULAR TIES. DEPTH AND ELEVATION OF PIER TO BE VERIFIED BY GEOTECHNICAL INSPECTION DURING CONSTRUCTION. PROVIDE STEEL CASING AT UPPER SECTION OF PIER AS REQUIRED.
4. REFERENCE DETAIL 6/ 99S510 FOR TYPICAL PIER DETAIL.

4 RAS DISCHARGE HEADER SUPPORT
NOT TO SCALE

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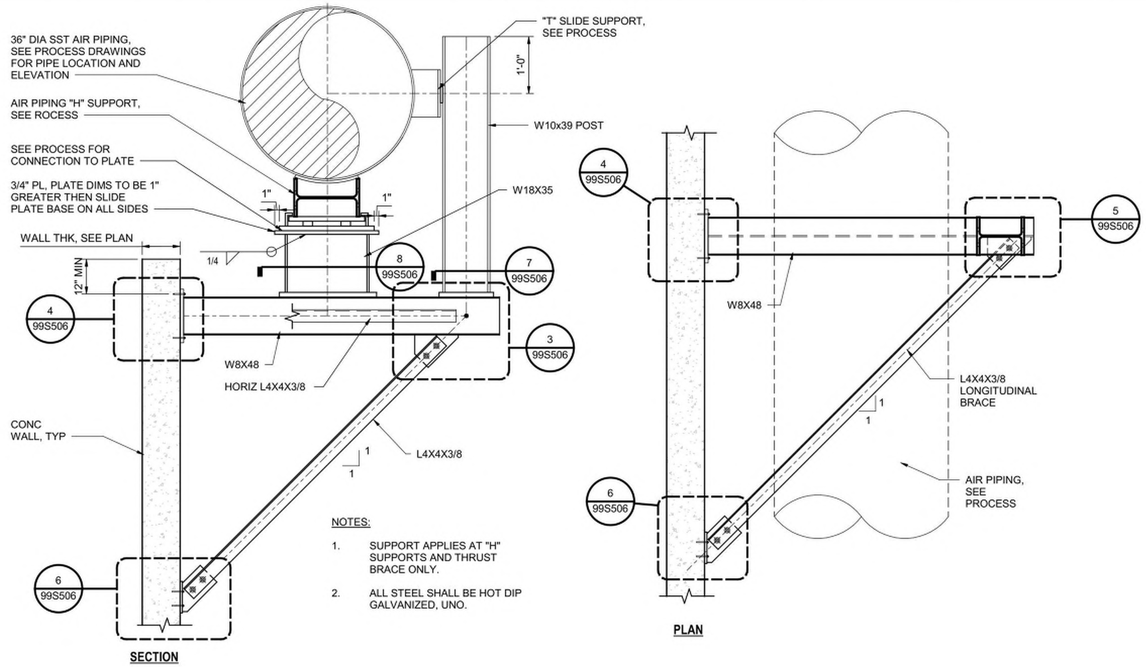
STRUCTURAL
DETAILS V

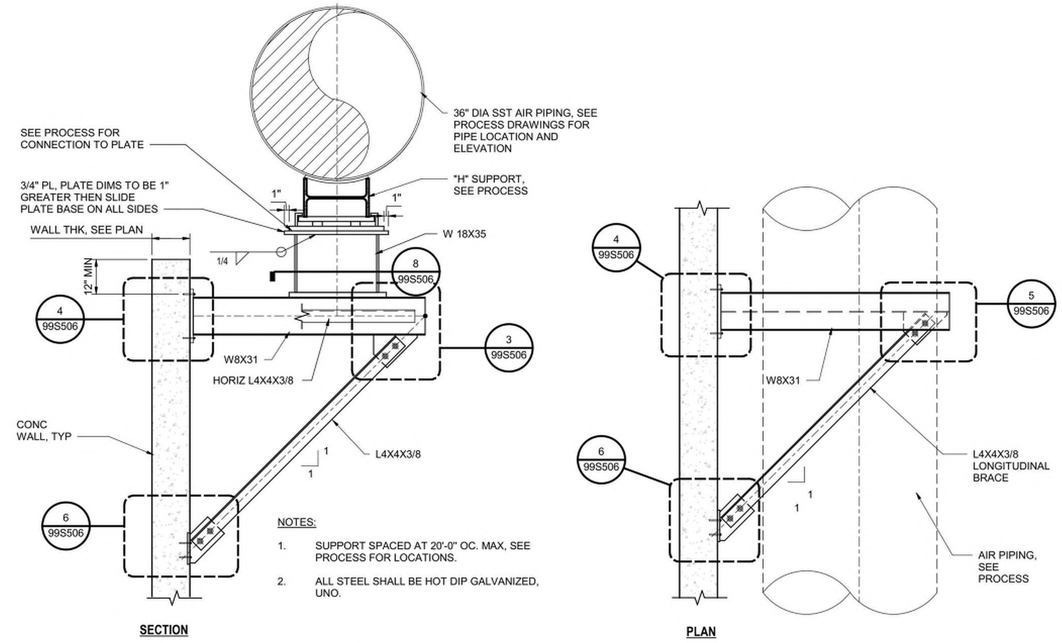
0 1" 2"

FILENAME	Structural Standard Details
SCALE	As indicated

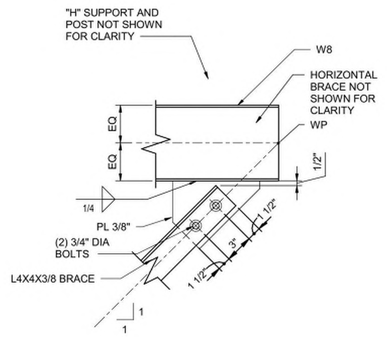
SHEET
99S505



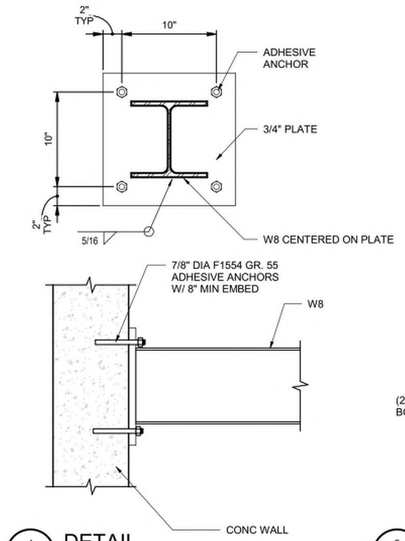
1 - AIR PIPE SUPPORT BRACKET DETAIL - "H" SUPPORT AND THRUST BRACE
NOT TO SCALE



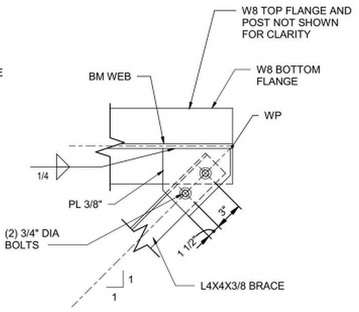
2 - AIR PIPE SUPPORT BRACKET DETAIL
NOT TO SCALE



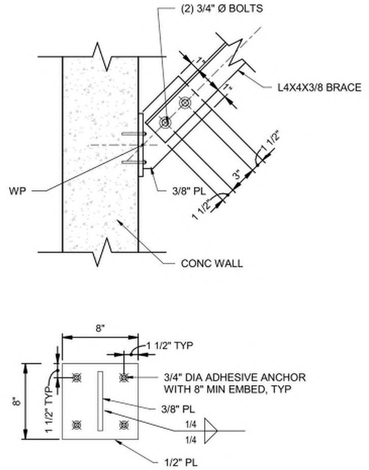
3 - DETAIL
NOT TO SCALE



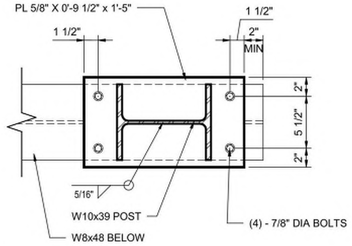
4 - DETAIL
NOT TO SCALE



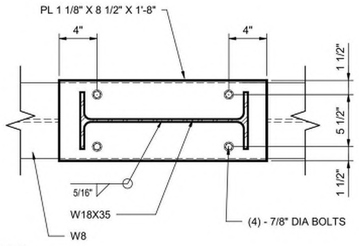
5 - DETAIL
NOT TO SCALE



6 - DETAIL
NOT TO SCALE



7 - DETAIL
NOT TO SCALE



8 - DETAIL
NOT TO SCALE

100%	OCT 16/2025	ISSUED FOR BID
ISSUE	DATE	DESCRIPTION

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	W. DONELAN
DRAWN BY	H. GARCIA
CHECKED BY	C. ZIMMERMAN
APPROVED BY	J. NAVE
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

HDR
TEXAS P.E. FIRM
Registration No. F-754

STATE OF TEXAS
JASON C. NAVE
130766
10/16/25

LEWISVILLE
Deep Roots. Broad Wings. Bright Future

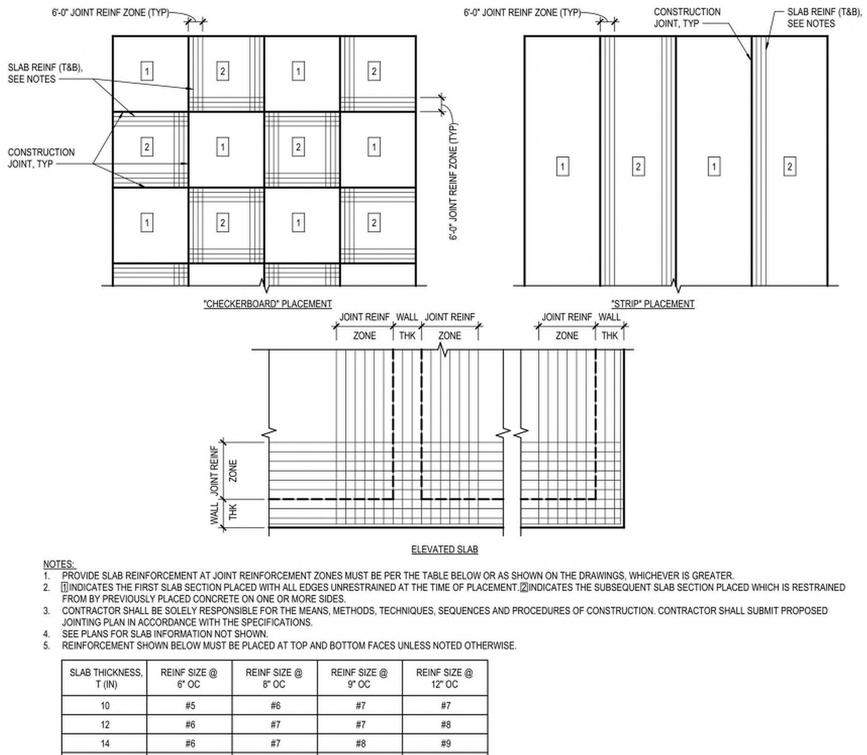
CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

STANDARD DETAILS
STRUCTURAL
DETAILS VI

0 1" 2"

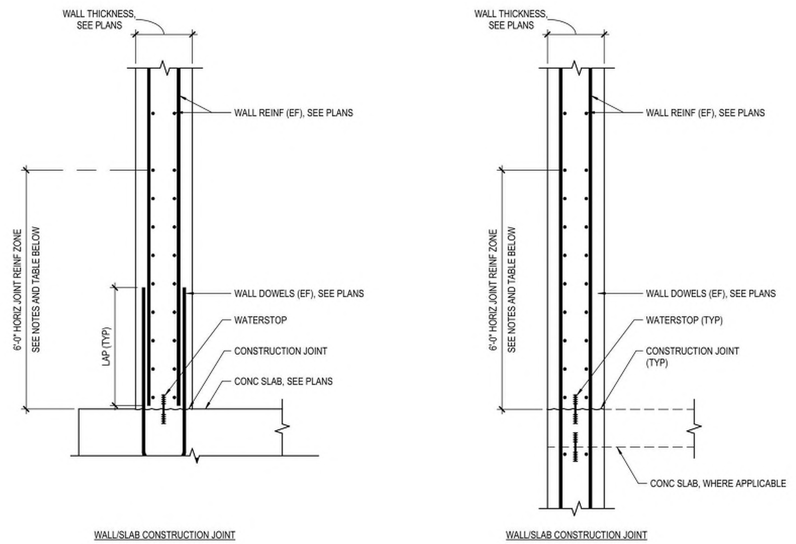
FILENAME	Structural Standard Details	SHEET	99S506
SCALE	As indicated		



NOTES:
1. PROVIDE SLAB REINFORCEMENT AT JOINT REINFORCEMENT ZONES MUST BE PER THE TABLE BELOW OR AS SHOWN ON THE DRAWINGS, WHICHEVER IS GREATER.
2. [1] INDICATES THE FIRST SLAB SECTION PLACED WITH ALL EDGES UNRESTRAINED AT THE TIME OF PLACEMENT. [2] INDICATES THE SUBSEQUENT SLAB SECTION PLACED WHICH IS RESTRAINED FROM BY PREVIOUSLY PLACED CONCRETE ON ONE OR MORE SIDES.
3. CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR THE MEANS, METHODS, TECHNIQUES, SEQUENCES AND PROCEDURES OF CONSTRUCTION. CONTRACTOR SHALL SUBMIT PROPOSED JOINTING PLAN IN ACCORDANCE WITH THE SPECIFICATIONS.
4. SEE PLANS FOR SLAB INFORMATION NOT SHOWN.
5. REINFORCEMENT SHOWN BELOW MUST BE PLACED AT TOP AND BOTTOM FACES UNLESS NOTED OTHERWISE.

SLAB THICKNESS, T (IN)	REINF SIZE @ 6" OC	REINF SIZE @ 8" OC	REINF SIZE @ 9" OC	REINF SIZE @ 12" OC
10	#5	#6	#7	#7
12	#6	#7	#7	#8
14	#6	#7	#8	#9
15	#7	#7	#8	#9
16	#7	#8	#8	#9
18	#7	#8	#9	#10
20	#7	#9	#9	#10
22	#8	#9	#9	#11
THICKNESS ≥ 24	#8	#9	#10	#11

1 - SLAB REINFORCING AT CONSTRUCTION JOINTS
NOT TO SCALE



NOTES:
1. WALL HORIZONTAL REINFORCEMENT AT JOINT REINFORCEMENT ZONES MUST BE PER THE TABLE BELOW OR AS SHOWN ON THE DRAWINGS, WHICHEVER IS GREATER. PROVIDE REINFORCEMEN AT EACH FACE OF THE WALL FOR THE FIRST 6'-0" ABOVE ALL WALL HORIZONTAL CONSTRUCTION JOINTS.
2. SEE PLANS FOR WALL REINFORCEMENT SIZE AND SPACING REQUIREMENTS NOT SHOWN.

WALL THICKNESS, T (IN)	REINF SIZE @ 6" OC	REINF SIZE @ 8" OC	REINF SIZE @ 9" OC	REINF SIZE @ 12" OC
10	#5	#6	#7	#7
12	#6	#7	#7	#8
14	#6	#7	#8	#9
15	#7	#7	#8	#9
16	#7	#8	#8	#9
18	#7	#8	#9	#10
20	#7	#9	#9	#10
22	#8	#9	#9	#11
THICKNESS ≥ 24	#8	#9	#10	#11

2 - WALL HORIZONTAL REINFORCING AT CONSTRUCTION JOINT
NOT TO SCALE

TEXAS P.E. FIRM
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APPROVED BY	J. NAVE
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
JASON C. NAVE
130766
10/16/25

LEWISVILLE
Deep Roots. Broad Wings. Bright Future

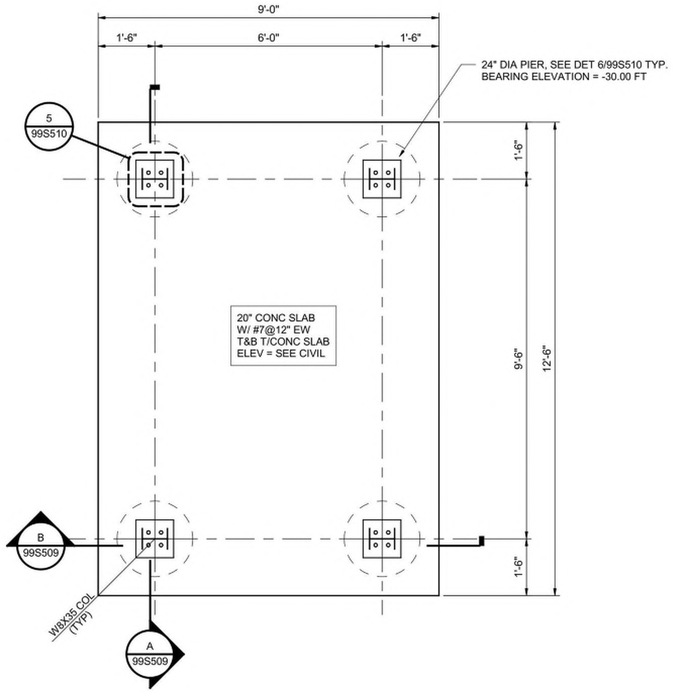
CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

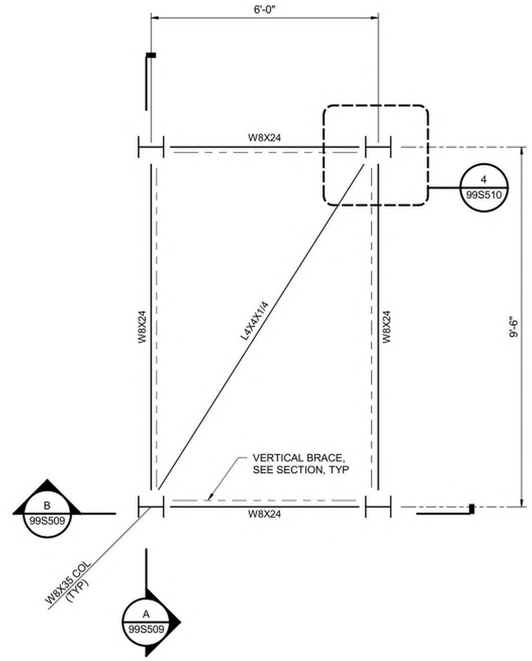
STANDARD DETAILS STRUCTURAL DETAILS VII

0 1" 2"

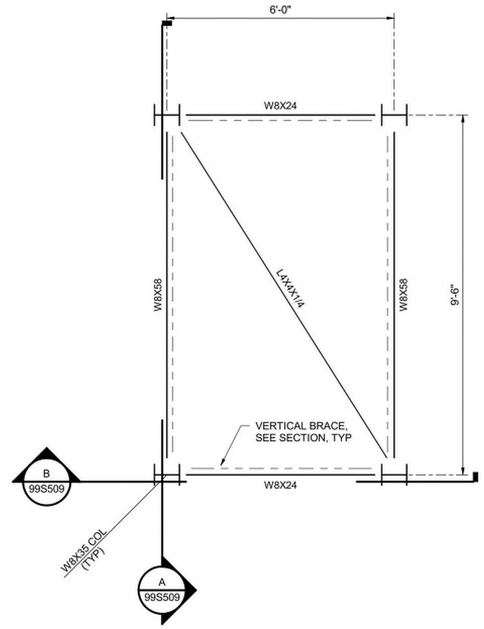
FILENAME: Structural Standard Details
SCALE: 3/4" = 1'-0"
SHEET: 99S507



1 AIR PIPE SUPPORT TOWER FOUNDATION PLAN
1/2" = 1'-0"



2 AIR PIPE SUPPORT TOWER MID-LEVEL PLAN
1/2" = 1'-0"



3 AIR PIPE SUPPORT TOWER UPPER LEVEL PLAN
1/2" = 1'-0"

PLAN NOTES:

1. SEE STANDARD DRAWINGS FOR GENERAL STRUCTURAL NOTES AND STANDARD DETAILS.
2. SEE PROCESS/ MECHANICAL DRAWINGS FOR ALL PIPE SIZES, LOCATIONS, AND PENETRATION DETAILS.
3. ALL STRUCTURAL MEMBERS, PLATES, ETC. SHALL BE HOT-DIPPED GALVANIZED.
4. ALL DRILLED PIER AND FOUNDATION CONCRETE SHALL CONTAIN CRYSTALLINE CEMENTITIOUS WATERPROOFING ADMIXTURE, REFERENCE SPECIFICATION 03 31 30.
5. ALL ELEVATIONS ARE FROM A REFERENCED TOP OF FOUNDATION ELEVATION OF 0.00'. SEE CIVIL PLANS FOR FINAL TOP OF FOUNDATION ELEVATION. SEE PROCESS FOR PIPE ELEVATIONS. FINAL STEEL ELEVATIONS MUST BE COORDINATED BASED ON FINAL PIPE SUPPORT CONDITIONS.

HDR
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STATE OF TEXAS
JASON C. NAVE
130766
10/16/25

LEWISVILLE
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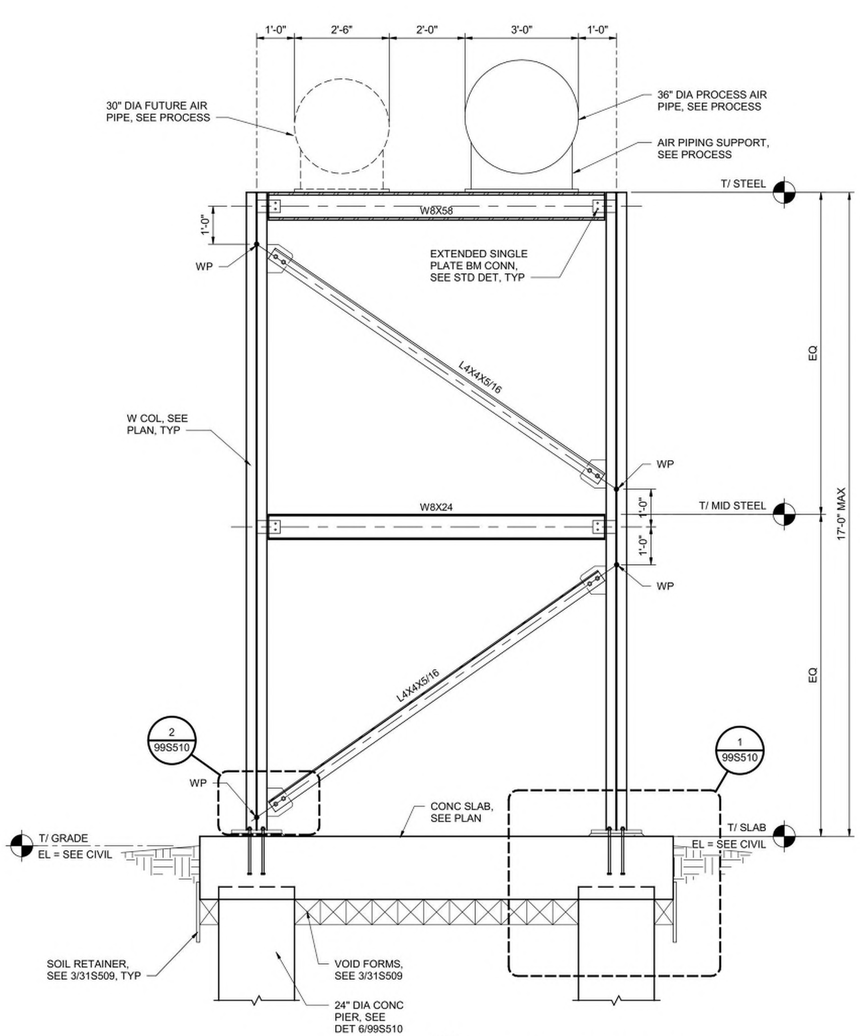
CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

STANDARD DETAILS
STRUCTURAL
AIR PIPE SUPPORT TOWER PLANS

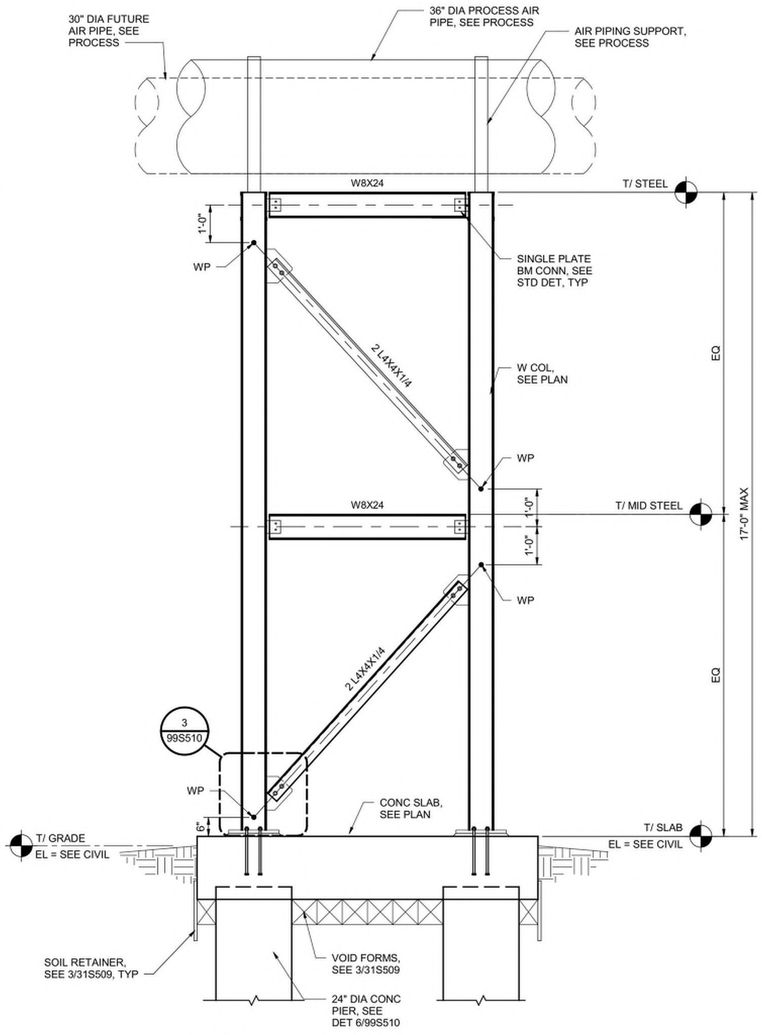
0 1" 2"

FILENAME: Structural Standard Details
SCALE: 1/2" = 1'-0"
SHEET: **99S508**



NOTE:
SEE CIVIL PLANS FOR FINAL TOP OF FOUNDATION ELEVATION. SEE PROCESS FOR PIPE ELEVATIONS. FINAL STEEL ELEVATIONS MUST BE COORDINATED BASED ON FINAL PIPE SUPPORT CONDITIONS.

A 99S508 SECTION
1/2" = 1'-0"



NOTE:
SEE CIVIL PLANS FOR FINAL TOP OF FOUNDATION ELEVATION. SEE PROCESS FOR PIPE ELEVATIONS. FINAL STEEL ELEVATIONS MUST BE COORDINATED BASED ON FINAL PIPE SUPPORT CONDITIONS.

B 99S508 SECTION
1/2" = 1'-0"

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CITY OF LEWISVILLE
PRAIRIE CREEK

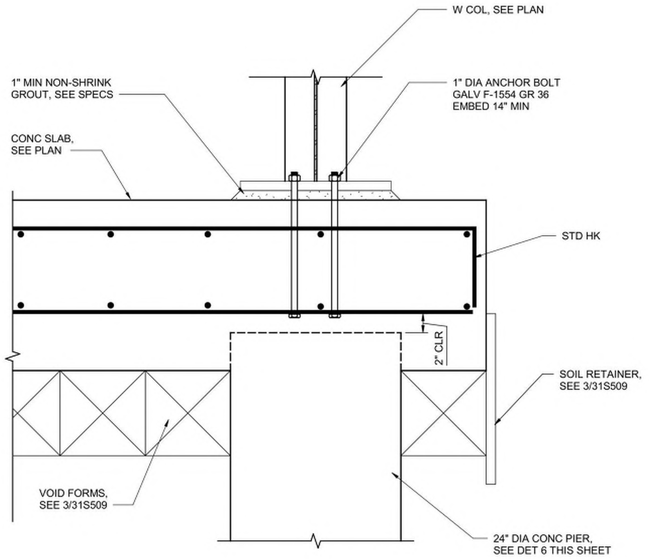
AERATION BASIN EXPANSION

STANDARD DETAILS
STRUCTURAL
AIR PIPE SUPPORT TOWER SECTIONS

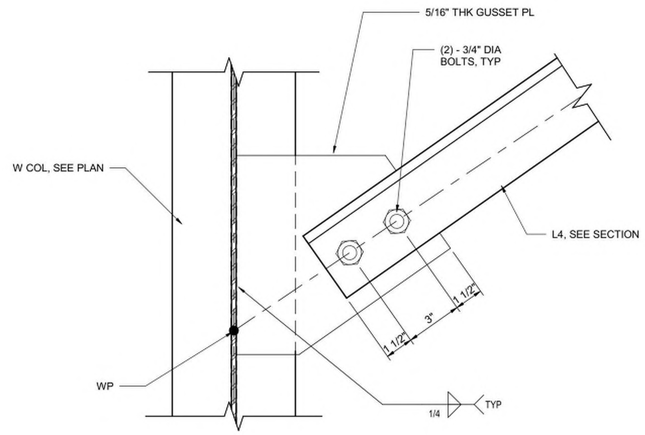
0 1" 2"

FILENAME	Structural Standard Details
SCALE	1/2" = 1'-0"

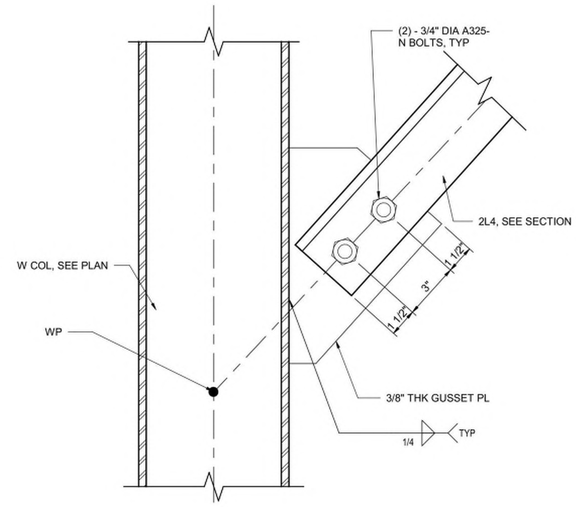
SHEET
99S509



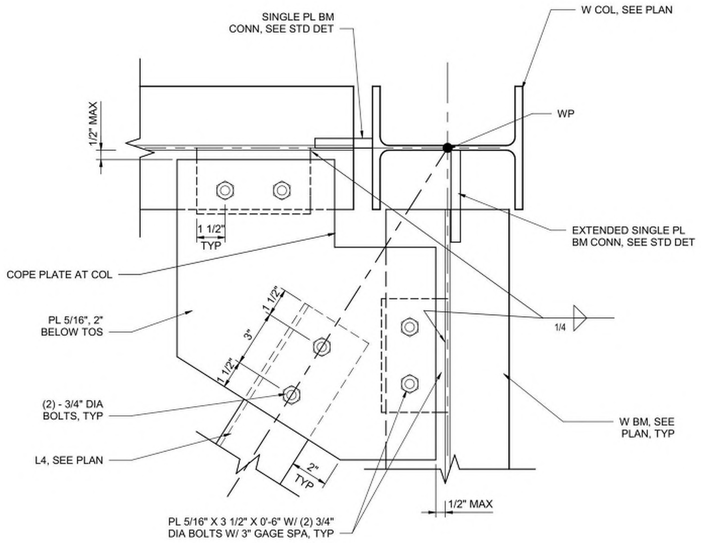
1 99S509 DETAIL
1 1/2" = 1'-0"



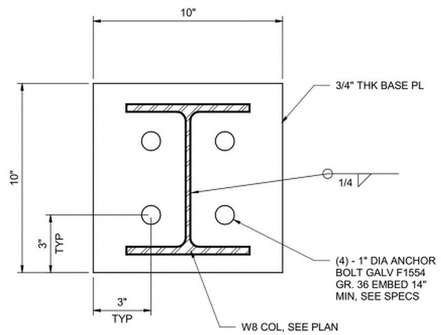
2 99S509 BRACE TO COLUMN WEB CONNECTION DETAIL
3" = 1'-0"



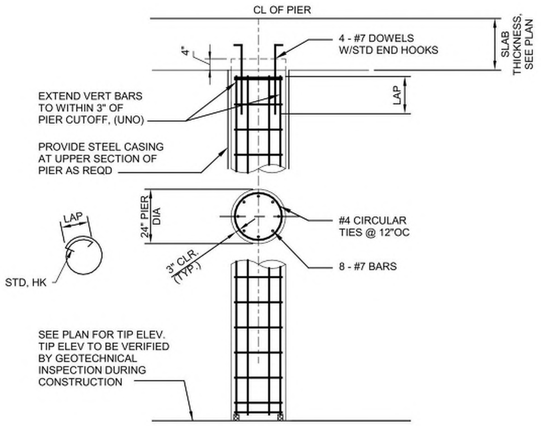
3 99S509 BRACE TO COLUMN FLANGE CONNECTION DETAIL
3" = 1'-0"



4 99S508 DETAIL
3" = 1'-0"



5 99S508 DETAIL
3" = 1'-0"



6 - TYPICAL PIER DETAIL
NOT TO SCALE

HDR
TEXAS P.E. FIRM
Registration No. F-754

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CITY PROJECT NO.	U2100
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CITY OF LEWISVILLE
PRAIRIE CREEK

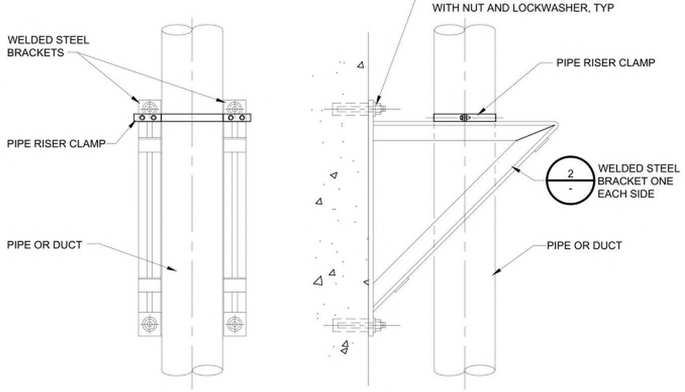
AERATION BASIN EXPANSION

STANDARD DETAILS
STRUCTURAL
AIR PIPE SUPPORT TOWER DETAILS

FILENAME	Structural Standard Details
SCALE	As indicated

0 1" 2"

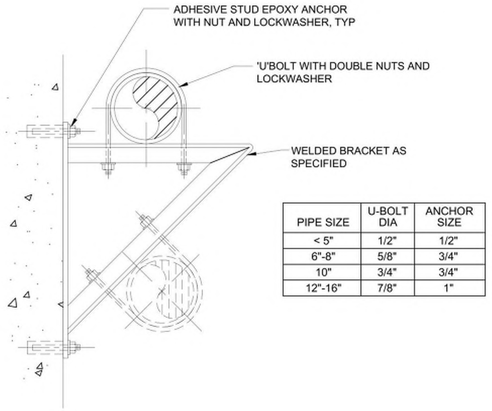
SHEET 99S510



GENERAL NOTES:

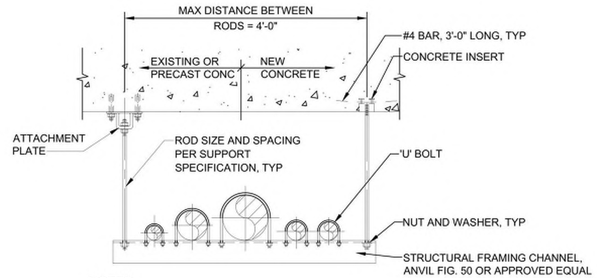
1. SEE SECTION 40 05 07 FOR SUPPORT MATERIALS.
2. PROVIDE MINIMUM ANCHOR EMBEDMENT DEPTH ACCORDING TO ADHESIVE ANCHOR MANUFACTURER.

1 - VERTICAL SUPPORT DETAIL
NO SCALE



PIPE SIZE	U-BOLT DIA	ANCHOR SIZE
< 5"	1/2"	1/2"
6"-8"	5/8"	3/4"
10"	3/4"	3/4"
12"-16"	7/8"	1"

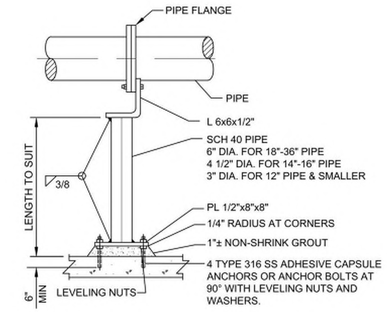
2 - WALL BRACKET DETAIL
NO SCALE



NOTES:

1. THIS DETAIL IS NOT TO BE USED WHERE PIPE MAY BE SUBJECT TO LATERAL FORCES WITHOUT SUPPLEMENTAL SWAY BRACING.

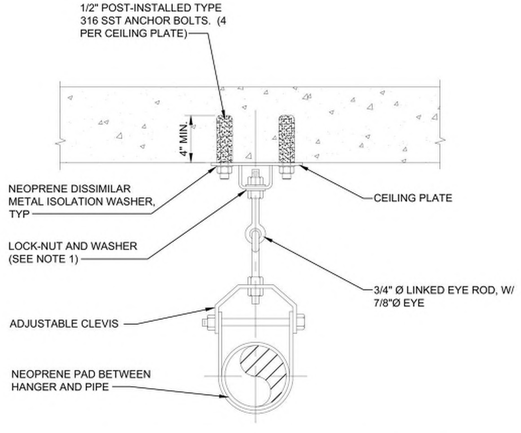
3 - TRAPEZE HANGER DETAIL
NO SCALE



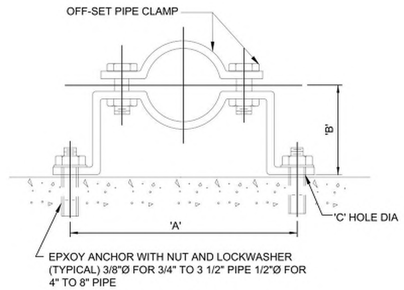
4 - PIPE FLANGE SUPPORT DETAIL
NOT TO SCALE

GENERAL NOTES:

1. SEE SECTION 40 05 07 FOR SUPPORT MATERIALS.
2. PROVIDE MINIMUM ANCHOR EMBEDMENT DEPTH ACCORDING TO ADHESIVE ANCHOR MANUFACTURER.



5 - PIPE HANGER SUPPORT DETAIL
NO SCALE



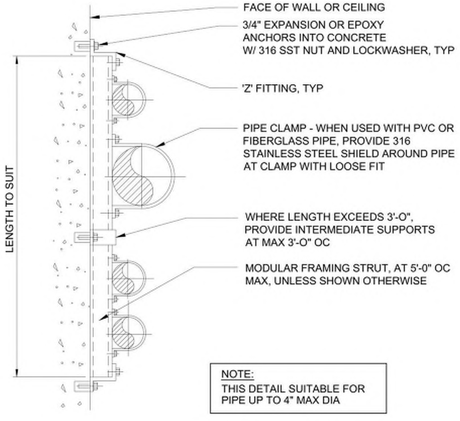
DIMENSIONS IN INCHES					
PIPE DIA.	'A'	'B'	'C' HOLE DIA	'D' FLAT BAR SIZE	LOAD RATING LBS. *
3/4	5-15/16	2-1/2	7/16	3/16 x 1-1/4	300
1	6-1/4	2-5/8	7/16	3/16 x 1-1/4	300
1-1/4	6-11/16	2-3/4	7/16	3/16 x 1-1/4	300
1-1/2	6-15/16	3	7/16	3/16 x 1-1/4	300
2	8-5/16	3-3/16	7/16	1/4 x 1-1/4	500
2-1/2	8-7/8	3-7/16	7/16	1/4 x 1-1/4	500
3	9-1/8	3-3/4	7/16	1/4 x 1-1/4	500
3-1/2	10-1/16	4	7/16	1/4 x 1-1/4	500
4	10-9/16	4-1/4	9/16	1/4 x 1-1/2	600
5	11-3/4	4-3/4	9/16	1/4 x 1-1/2	600
6	14-3/8	5-5/16	9/16	3/8 x 1-1/2	850
8	16-5/8	6-5/16	9/16	3/8 x 1-1/2	850

* SAFETY FACTOR OF 5

NOTE:

1. FOR FLANGED PIPING, INCREASE 'B' DIMENSION AS REQUIRED.

6 - PIPE CLAMP DETAIL
NO SCALE

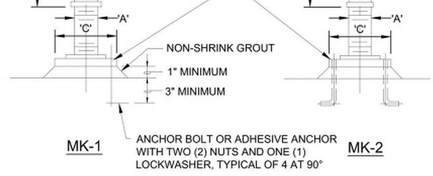


NOTE:
THIS DETAIL SUITABLE FOR PIPE UP TO 4" MAX DIA

GENERAL NOTES:

1. SEE SECTION 40 05 07 FOR SUPPORT MATERIALS.
2. PROVIDE MINIMUM ANCHOR EMBEDMENT DEPTH ACCORDING TO ADHESIVE ANCHOR MANUFACTURER.

7 - FLUSH MOUNTED SUPPORT DETAIL
NO SCALE



ADJUSTABLE PIPE SUPPORT APPROXIMATE DIMENSIONS IN INCHES					
PIPE SIZE	'A'	'B'	'C'	'D' MINIMUM	'D' MAXIMUM
4	3	2-1/2	10	10-1/4	SEE DWGS
6	3	2-1/2	10	11-5/8	SEE DWGS
8	3	2-1/2	10	13-5/8	SEE DWGS
10	3	2-1/2	10	14-5/8	SEE DWGS
12	3	2-1/2	10	15-5/8	SEE DWGS
14	4	3	10	18-7/8	SEE DWGS
16	4	3	10	19-7/8	SEE DWGS
18	6	4	12	21-1/4	SEE DWGS
20	6	4	12	23-1/4	SEE DWGS
24	6	4	12	26-1/2	SEE DWGS
30	6	4	12	29-5/8	SEE DWGS
36	6	4	12	32-5/8	SEE DWGS

NOTES:

1. DIMENSION A, B, AND C NOTED ARE MINIMUMS. COORDINATE FINAL DIMENSION WITH SUPPLIER

8 - ADJUSTABLE STANCHION DETAIL
NO SCALE

File Path C:\Users\KHENDERSON\DC\ACCDocs\HDR\10342803_COL_PCWWT_AB_Expansion_2024\Project Files\01_HDR\12_Process_D\12.03_Sheet Files\99D501.dwg
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TEXAS P.E. FIRM Registration No. F-754

ISSUE	DATE	DESCRIPTION
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PROJECT MANAGER JOEL R. CANTWELL
DESIGNED BY T. PAULMANN
DRAWN BY A. FREEMON
CHECKED BY M. BOND
APPROVED BY T. PAULMANN
CITY PROJECT NO. U2100
PROJECT NUMBER 10342803

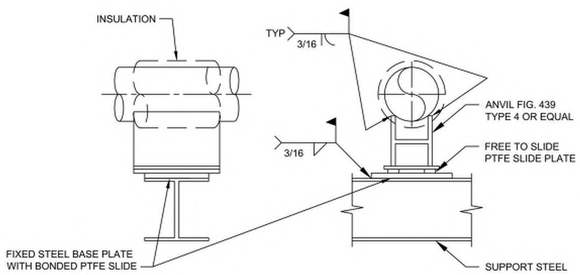
STATE OF TEXAS · THOMAS A. PAULMANN · 128794 · LICENSED PROFESSIONAL ENGINEER · 10/16/25

LEWISVILLE Deep Roots. Broad Wings. Bright Future.

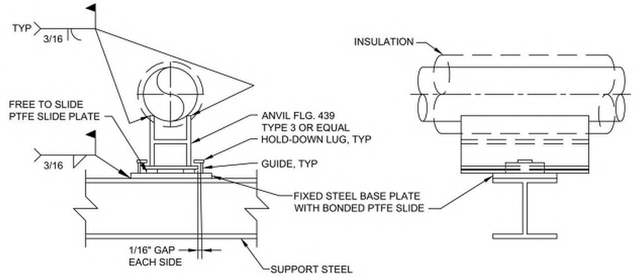
CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

GENERAL PROCESS STANDARD DETAILS I

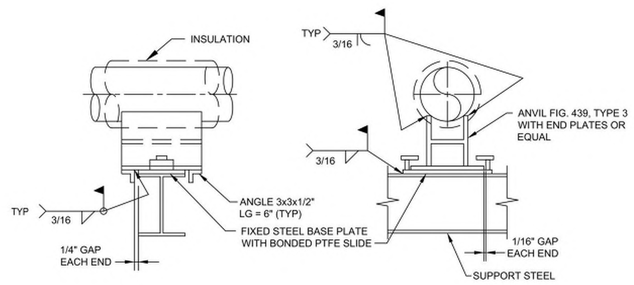
0 1" 2"
FILENAME 99D501.DWG
SCALE NO SCALE
SHEET 99D501



1 - "H" SLIDE SUPPORT DETAIL
NO SCALE



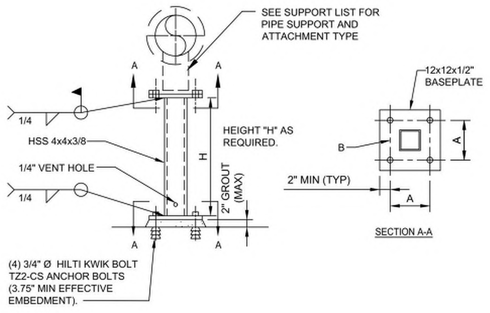
2 - "H" GUIDE SUPPORT DETAIL
NO SCALE



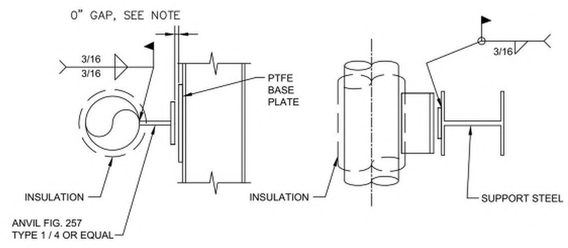
3 - "H" GUIDE SUPPORT WITH LINESTOPS DETAIL
NO SCALE

NOTES:

1. FOR ALL "H" AND "T" SLIDE AND GUIDE SUPPORTS, MATERIALS ABOVE PTFE SLIDING SURFACES SHALL MATCH PIPING MATERIAL AND MATERIALS BELOW PTFE SLIDING SURFACES SHALL BE HOT DIP GALVANIZED STEEL. ALL HARDWARE AND ANCHORS SHALL BE 316 STAINLESS STEEL.
2. FURNISH HSS SUPPORT STANCHIONS UNDER ALL "H" SLIDE AND GUIDE SUPPORTS EXCEPT WHERE ALTERNATE SUPPORT FRAMES ARE DETAILED ON STRUCTURAL DRAWINGS.



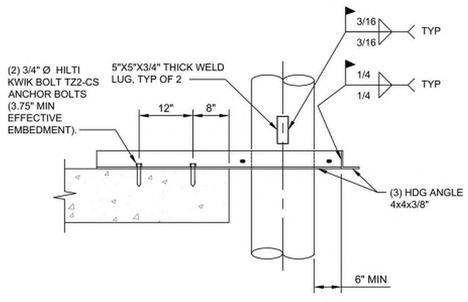
4 - HSS SUPPORT STANCHION DETAIL
NO SCALE

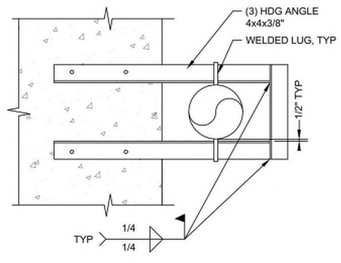


5 - "T" SLIDE HORIZONTAL THRUST BRACE DETAIL
NO SCALE

NOTE:

1. THRUST BRACES ARE ONLY USED IN CONJUNCTION WITH LINESTOPPED "H" GUIDE SUPPORTS. SET "T" SLIDE BASE PLATE GAP TO 0 INCHES WITH "H" SLIDE CENTERED BETWEEN GUIDES.





NOTES:

1. WELD LUG MATERIALS TO MATCH PIPING.

6 - LUGGED PIPE RISER SUPPORT DETAIL
NO SCALE

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	OCT 16/2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	T. PAULMANN
DRAWN BY	A. FREEMON
CHECKED BY	M. BOND
APPROVED BY	T. PAULMANN
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
THOMAS A. PAULMANN
128794
LICENSED
PROFESSIONAL ENGINEER
10/16/25

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

GENERAL PROCESS STANDARD DETAILS II

0 1" 2"

FILENAME 99D501.DWG
SCALE NO SCALE

SHEET
99D502

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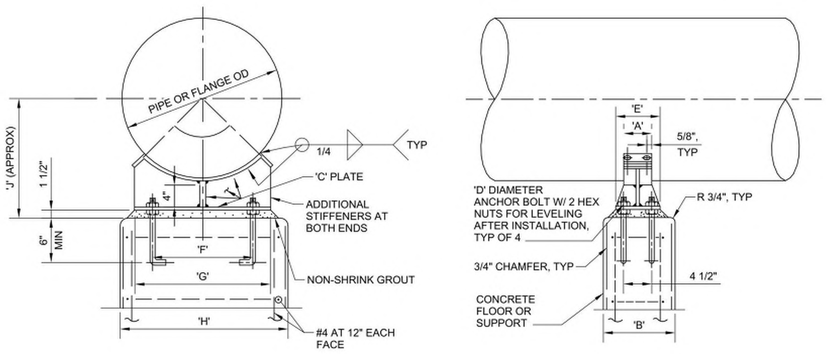

PIPE SUPPORT DIMENSIONS [1]

NOMINAL PIPE SIZE	"A" (IN)	"B" (IN)	"C" (IN)	"D" (IN)	"E" (IN)	FLAT BAR	SUPPORTING							
							PIPE				FLANGE			
							"F" (IN)	"G" (IN)	"H" (IN)	"J" (IN)	"F" (IN)	"G" (IN)	"H" (IN)	"J" (IN)
6	4	12	3/8	5/8	6	1/4	4 1/2	8	14	10	6 1/2	11	16	13
8	4	12	3/8	5/8	6	1/4	5	9 1/2	14	11	7 1/2	13	18	14
10	4	12	3/8	5/8	6	1/4	6	11	16	12	9	15	20	15
12	4	12	3/8	5/8	6	1/4	7	13	18	13	10	17	22	16
14	4	12	3/8	5/8	6	1/4	8	13	18	14	11	18	23	17
16	4	12	3/8	5/8	6	1/4	9	15	21	15	12	20	26	18
18	4	12	3/8	5/8	6	1/4	10	16	22	16	13	21	26	19
20	5	12	3/8	5/8	6	3/8	10	18	24	17	15	23	28	21
22	5	12	3/8	5/8	6	3/8	12	19	24	18	16	25	30	22
24	5	12	3/8	5/8	6	3/8	13	21	24	19	16	26	32	23

[1] ALL DIMENSIONS ARE IN INCHES, UNO
[2] PROVIDE LARGER OF MIN WELDING PER AWS OR SCHEDULED VALUE

1 FIXED PIPE SUPPORT DETAIL
NO SCALE

NOTES:

1. FOR STAINLESS STEEL PIPE APPLICATIONS, MATCH SUPPORT MATERIAL TO PIPE MATERIAL. FOR DIP AND STEEL PIPE APPLICATIONS, FURNISH HOT DIP GALVANIZED STEEL MATERIAL FOR SUPPORT..
2. ANCHORS AND HARDWARE SHALL BE TYPE 316 STAINLESS STEEL.

Autodesk Docs://10342803_COL_PCWWT_AB_Expansion_2024/99 - STANDARD DETAILS - PROCESS.rvt
10/15/2025 12:26:54 PM

HDR
TEXAS P.E. FIRM
Registration No. F-754

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10/16/25

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PRAIRIE CREEK

AERATION BASIN EXPANSION

GENERAL PROCESS STANDARD DETAILS III

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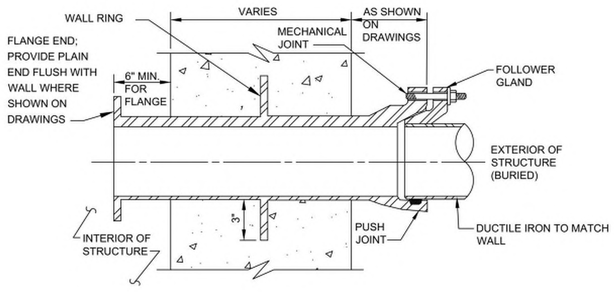
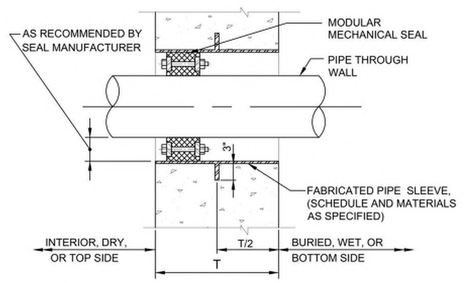
SCALE: NO SCALE
0 1" 2"
SHEET: **99D503**



NOTES:

1. MECHANICAL JOINT BELLS OR FLANGES WITH TAPPED HOLES SHALL BE INSTALLED FLUSH WITH FACE OF CONCRETE ONLY WHERE SHOWN ON THE DRAWINGS.
2. RESTRAIN JOINTS AS SPECIFIED

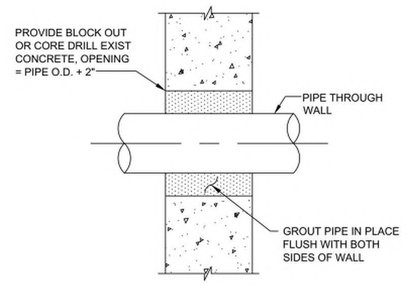
1 - DUCTILE IRON WALL PIPE DETAIL
NO SCALE



NOTES:

1. BOLT HEADS ON ACCESSIBLE SIDE OF PENETRATION.
2. WHEN USED AS FLOOR PENETRATION IN WET AREA, PROVIDE CASTING / SLEEVES WITH TOP 3 INCHES ABOVE FINISH FLOOR.
3. PROVIDE DOUBLE ROW OF SEALS FOR PIPES 16" DIAMETER AND LARGER IF CONCRETE THICKNESS PERMITS.
4. ONE SEAL FOR WALLS LESS THAN 8" THICK, TWO FOR WALLS 8" THICK AND LARGER.
5. FOR BURIED APPLICATIONS, INSTALL NON-SHRINK GROUT IN ANNUAL SPACE ON EXTERIOR SIDE.

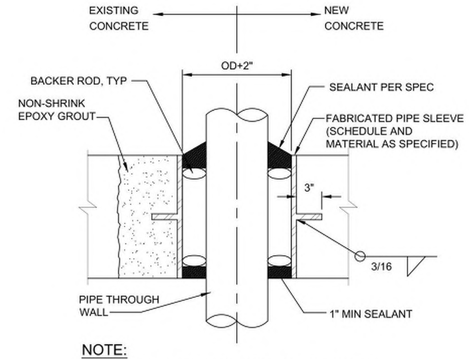
2 - SLEEVED PIPE WALL PENETRATION (NEW WALL) DETAIL
NO SCALE



NOTE:

1. ALL MATERIALS, BOLTS, AND HARDWARE SHALL BE 316 STAINLESS STEEL.

3 - CORED PIPE WALL PENETRATION GROUT IN PLACE (EXISTING) DETAIL
NO SCALE

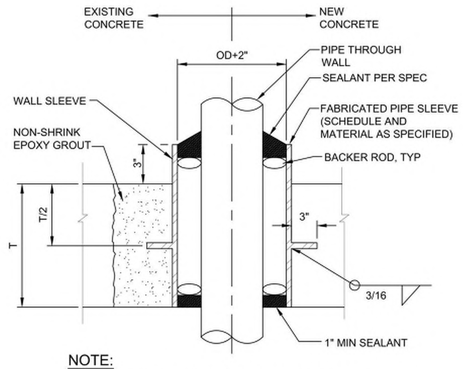


NOTE:

1. SEE STRUCTURAL DETAILS FOR WALL DEMOLITION AND REPAIR/REQUIREMENTS.

4 - SLAB PIPE PENETRATION DRY AREAS DETAIL
NO SCALE

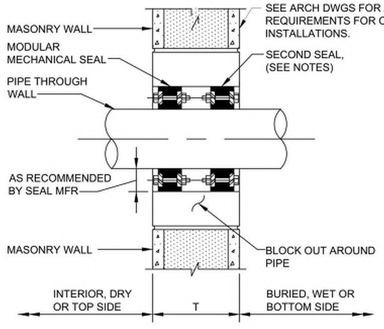
FLANGE END; PROVIDE PLAIN END FLUSH WITH WALL WHERE SHOWN ON DRAWINGS



NOTE:

1. SEE STRUCTURAL DETAILS FOR WALL DEMOLITION AND REPAIR/REQUIREMENTS.

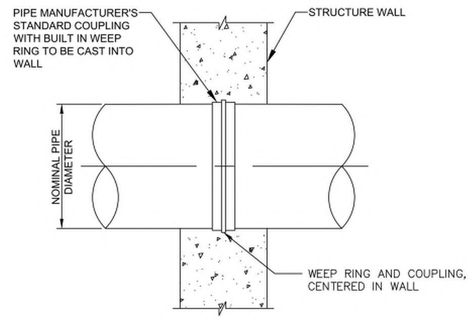
5 - SLAB PIPE PENETRATION WET AREAS DETAIL
NO SCALE



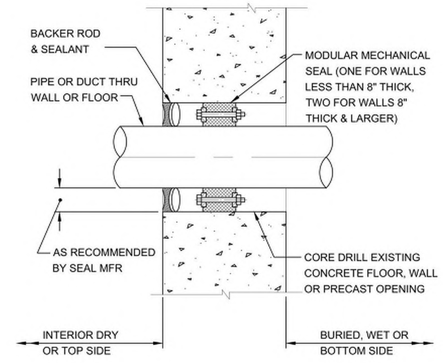
NOTES:

1. BOLT HEADS ON ACCESSIBLE SIDE OF WALL.
2. WHEN USED AS FLOOR PENETRATION IN WET AREA, PROVIDE CASTING / SLEEVES WITH TOP 3 INCHES ABOVE FINISH FLOOR.
3. PROVIDE DOUBLE ROW OF SEALS FOR PIPES 16" DIAMETER AND LARGER IF CONCRETE THICKNESS PERMITS.
4. ONE SEAL FOR WALLS LESS THAN 8" THICK, TWO FOR WALLS 8" THICK AND LARGER.

6 - PIPE WALL PENETRATION (MASONRY WALL) DETAIL
NO SCALE



7 - FRP WALL PIPE PENETRATION DETAIL
NO SCALE



NOTE:

1. BOLT HEAD ON ACCESSIBLE SIDE OF WALL OR FLOOR

8 - PIPE WALL PENETRATION (EXISTING WALL OR PRECAST OPENING) DETAIL
NO SCALE

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Date 10/15/2025 12:33:16 PM

TEXAS P.E. FIRM
Registration No. F-754

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DESIGNED BY	T. PAULMANN
DRAWN BY	A. FREEMON
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CITY PROJECT NO.	U2100
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PRAIRIE CREEK

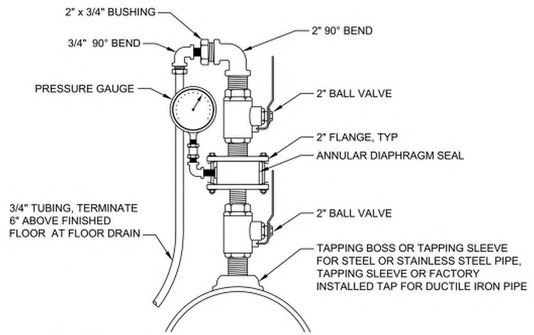
AERATION BASIN EXPANSION

GENERAL PROCESS STANDARD DETAILS IV

0 1" 2"

FILENAME 99D501.DWG
SCALE NO SCALE

SHEET
99D504

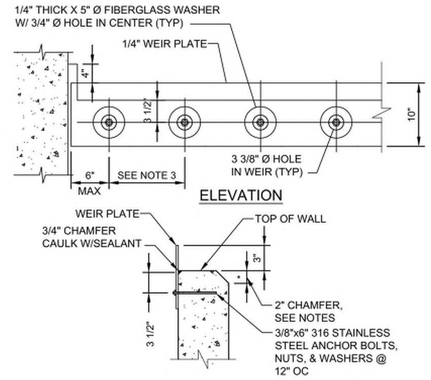


NOTES:

1. ALL PIPING AND VALVES TO BE TYPE 316 STAINLESS STEEL.
2. DETAIL SHOWN FOR USE WITH RAW SEWAGE AND SLUDGE. SEE INSTRUMENTATION DETAILS FOR CLEAN WATER GAUGE ASSEMBLIES.

1 - PRESSURE GAUGE WITH ANNULAR DIAPHRAGM ASSEMBLY DETAIL

NO SCALE



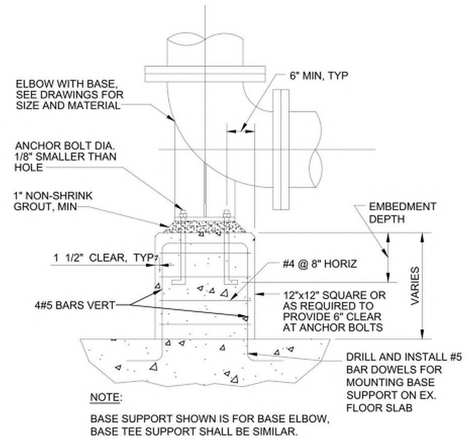
TYPICAL SECTION

NOTES:

1. SEE SPECIFICATIONS FOR MATERIAL REQUIREMENTS.
2. SEE DRAWINGS FOR WEIR LENGTHS.
3. ANCHOR BOLT SPACING = 12" OC FOR STRAIGHT WEIRS AND 2'-0" OC FOR CIRCULAR WEIRS.
4. 2" CHAMFER AT AERATION BASIN SPLITTER STRUCTURE WEIRS, 16" CHAMFER AT AERATION BASIN WEIRS.

2 - RECTANGULAR WEIR PLATE DETAIL

NO SCALE

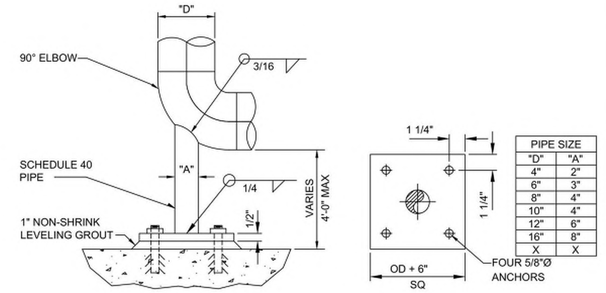


NOTE:

BASE SUPPORT SHOWN IS FOR BASE ELBOW, BASE TEE SUPPORT SHALL BE SIMILAR.

3 - DUCTILE IRON BASE ELBOW SUPPORT DETAIL

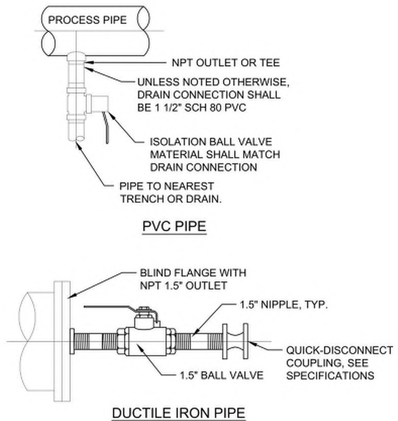
NO SCALE



PIPE SIZE	
"D"	"A"
4"	2"
6"	3"
8"	4"
10"	4"
12"	6"
16"	8"
X	X

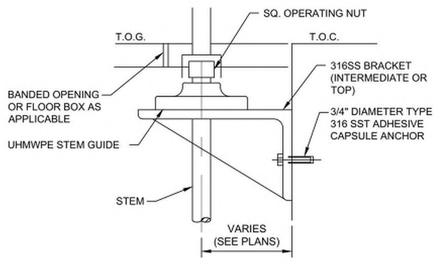
4 - STEEL OR STAINLESS STEEL BASE ELBOW SUPPORT DETAIL

NO SCALE



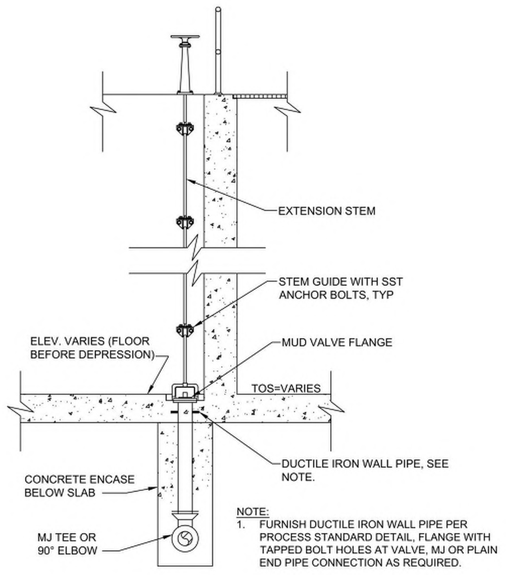
5 - FLUSHING CONNECTION DETAIL

NO SCALE



6 - VALVE OR STEM GUIDE DETAIL

NOT TO SCALE



NOTE:

1. FURNISH DUCTILE IRON WALL PIPE PER PROCESS STANDARD DETAIL, FLANGE WITH TAPPED BOLT HOLES AT VALVE, MJ OR PLAIN END PIPE CONNECTION AS REQUIRED.

7 - MUD VALVE DETAIL

NO SCALE

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Date 10/15/2025 12:33:21 PM

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PRAIRIE CREEK

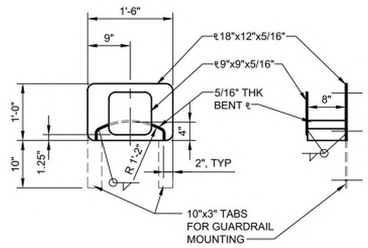
AERATION BASIN EXPANSION

GENERAL PROCESS STANDARD DETAILS V

0 1" 2"

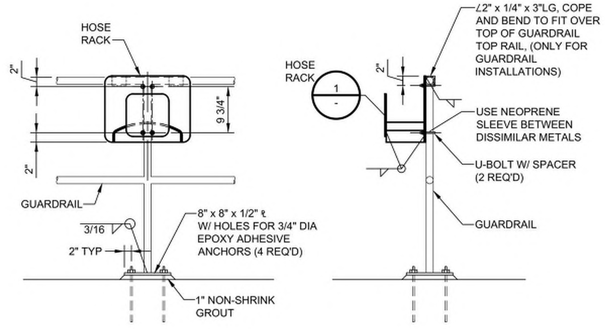
FILENAME	99D501.DWG
SCALE	NO SCALE

SHEET 99D505



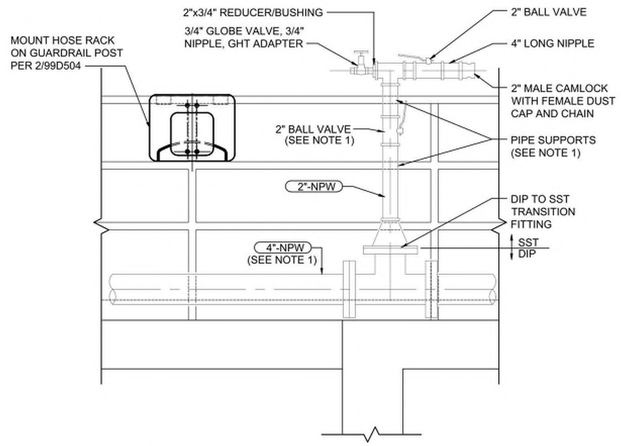
1 - FABRICATED HOSE RACK DETAIL

3/4" = 1'-0"



2 - HOSE RACK DETAIL MNT'D ON GUARDRAIL POST

3/4" = 1'-0"



NOTE:

1. SUPPORT NPW PIPE FROM HANDRAIL USING CHANNEL STRUT AND CLAMPS PER HOSE RACK DETAIL, THIS SHEET.

3 - WASHDOWN HOSE STATION DETAIL

3/4" = 1'-0"

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PRAIRIE CREEK

AERATION BASIN EXPANSION

GENERAL PROCESS STANDARD DETAILS VI

0 1" 2"

FILENAME 99D501.DWG
SCALE NO SCALE

SHEET
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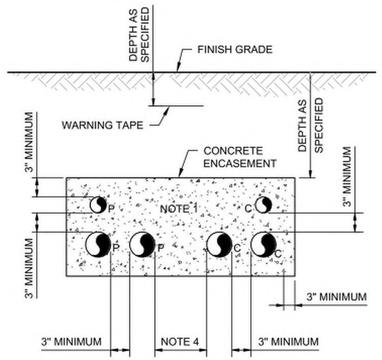
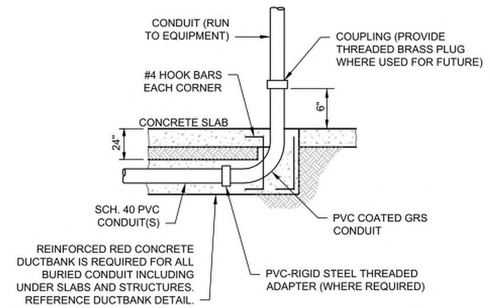


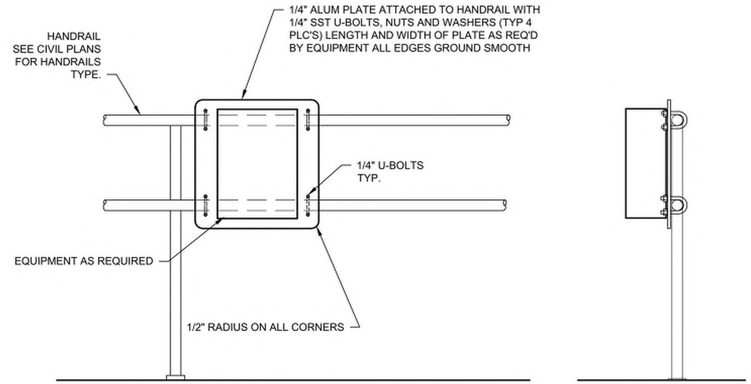
NOTES:

1. NUMBER OF CONDUITS AS REQUIRED FOR THE APPLICATION.
2. P SUBSCRIPT ELECTRICAL POWER OR CONTROL CONDUIT.
3. C SUBSCRIPT COMMUNICATION (TELEPHONE, DATA, INSTRUMENTATION) CONDUIT.
4. 6" MINIMUM WHEN POWER CONDUIT CONTAINS LESS THAN 1000V. 12" MINIMUM WHEN POWER CONDUIT CONTAINS MORE THAN 1000V.

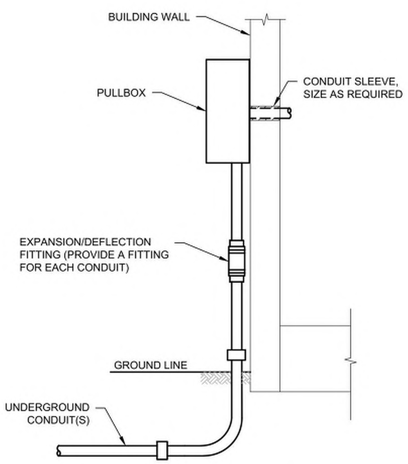
1 / 99E501 CONCRETE ENCASED DUCTBANK DETAIL
NO SCALE



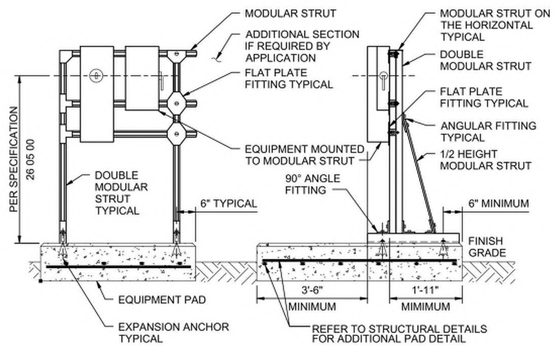
2 / 99E501 FINISHED AREA CONDUIT STUB-UP DETAIL
NOT TO SCALE



3 / 99E501 GUARDRAIL MOUNTED EQUIPMENT
NOT TO SCALE



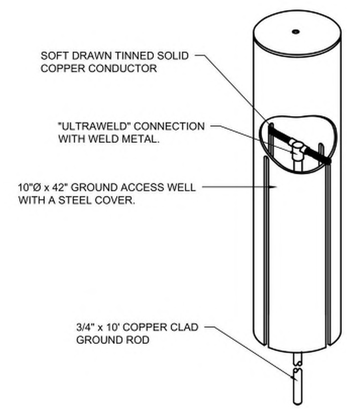
4 / 99E501 UNDERGROUND CONDUIT BUILDING ENTRY DETAIL
NOT TO SCALE



NOTES

1. COMBINED EQUIPMENT LOADS PER 36" SPAN SHALL NOT EXCEED 500LBS.
2. PROVIDE GROUNDING FOR OUTDOOR INSTALLATIONS, PER SPECIFICATION 26 05 00.
3. MODULAR STRUCT WIDTH: 1 5/8".
4. RACK ASSEMBLY MATERIAL: GALVANIZED PER SPECIFICATION 26 05 00.
5. ANCHORS: STAINLESS STEEL, 1/2" DIAMETER, 3 1/2" EMBEDMENT, PER SPECIFICATION 03 15 19.
6. PROTECT SURFACES WITH DISSIMILAR MATERIALS IN ACCORDANCE WITH SPECIFICATION 09 96 00.
7. REPAIR CUT ENDS AND DAMAGED SURFACES IN ACCORDANCE WITH SPECIFICATION 05 50 00.

5 / 99E501 MODULAR EQUIPMENT RACK ON CONCRETE PAD
NOT TO SCALE



6 / 99E501 GROUNDING TEST WELL DETAIL
NOT TO SCALE

TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	O. JONGUITUD
DRAWN BY	B. LOREDO
CHECKED BY	G. JAGLOWSKI
APPROVED BY	O. JONGUITUD
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
OSCAR JONGUITUD
133057
LICENSED
PROFESSIONAL ENGINEER
6-13-25

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK

AERATION BASIN EXPANSION

STANDARD DETAILS
ELECTRICAL
STANDARD DETAILS I

0 1" 2"

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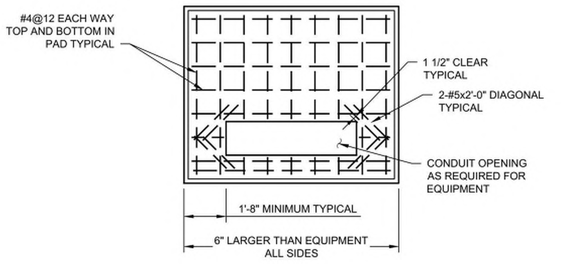
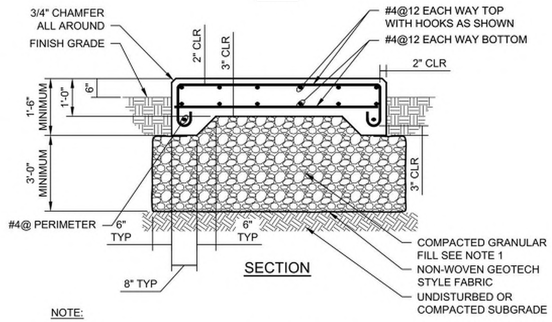
SCALE	NONE

SHEET 99E501



PLAN

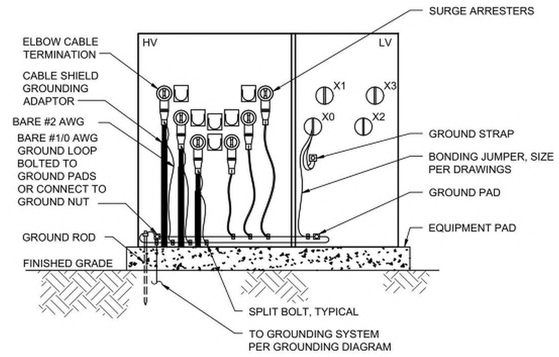


SECTION

NOTE:

1. COMPACTED GRANULAR FILL: COURSE AGGREGATE PER ASTM C33, SIZE NO. 67 OR NO. 57 WITH MINIMUM COMPACTION TO 95 PERCENT OF MAXIMUM DRY DENSITY PER ASTM D1557.
2. CONCRETE AND REINFORCING STEEL: SEE DIVISION 3.

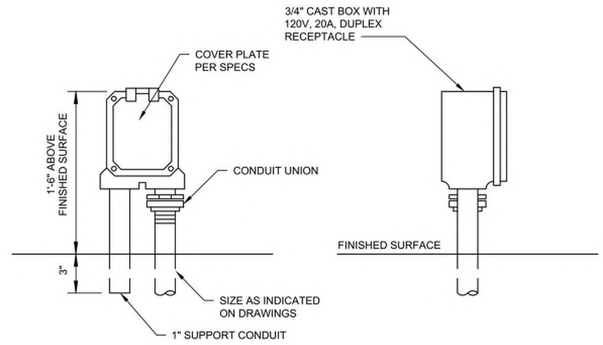
1 99E502 TYPICAL TRANSFORMER PAD DETAIL
NOT TO SCALE



NOTE:

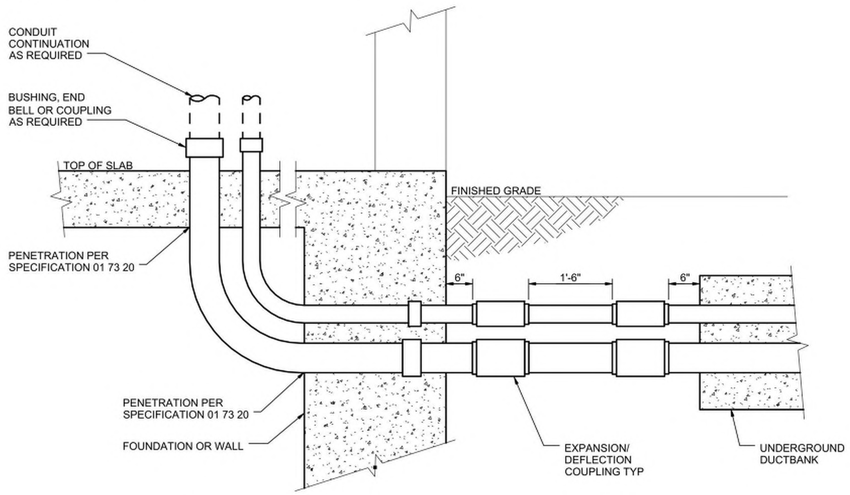
1. SEE OTHER CONTRACT DRAWINGS FOR PAD REQUIREMENTS.
2. INSTALL ADDITIONAL GROUND ROD AT A MINIMUM DISTANCE OF 6'-0". BOND GROUND RODS USING #1/0 BARE COPPER WIRE.

2 99E502 TRANSFORMER GROUNDING DETAIL
NOT TO SCALE



FRONT VIEW **SIDE VIEW**

3 99E502 WEATHERPROOF RECEPTACLE ROOF MOUNTING DETAIL
NO SCALE



NOTES

1. SEE DUCTBANK DETAIL FOR ADDITIONAL REQUIREMENTS.

4 99E502 CONDUIT TRANSITION TO ABOVE GRADE (EXTERIOR TO INTERIOR)
NOT TO SCALE

TEXAS P.E. FIRM
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PRAIRIE CREEK

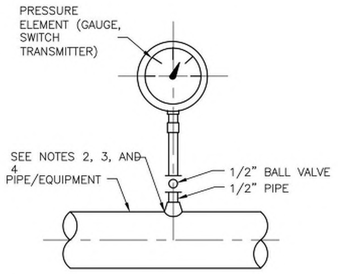
AERATION BASIN EXPANSION

STANDARD DETAILS
ELECTRICAL
STANDARD DETAILS II

0 1" 2"

FILENAME 99E502.dwg
SCALE NONE

SHEET
99E502

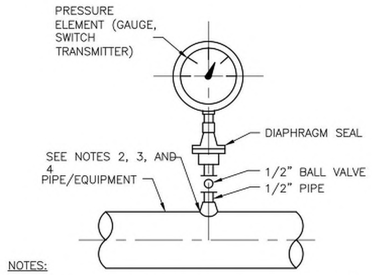


NOTES:

1. PIPE NIPPLES AND FITTINGS TO BE 316 STAINLESS STEEL FOR ALL SERVICES EXCEPT CHEMICAL SERVICES. USE PIPE MATERIAL PER THE PIPE SCHEDULE FOR CHEMICALS.
2. FOR STEEL, GALVANIZED STEEL AND PVC 2½" AND SMALLER USE A BUSHING IN A TEE.
3. FOR DUCTILE IRON, ALL SIZES, USE PIPE SADDLE WITH BUSHING.
4. FOR STEEL AND STAINLESS STEEL PIPES 3" AND LARGER, USE A THRED–O–LET AS SHOWN.
5. NOT ALL REQUIRED COMPONENTS OR CONNECTIONS SHOWN; SEE SPECIFICATION SECTION 40 73 00.
6. ISOLATION VALVE FOR CHEMICAL SERVICES SHALL MATCH VALVE TYPE USED THROUGHOUT THE CHEMICAL PIPING SYSTEM.
7. NO DIAPHRAGM SEAL IS REQUIRED FOR CW, PW, HW, HWC, TW, OR WHERE NOT SHOWN ON P&IDS.

1 99Y501 PRESSURE GAUGE/PRESSURE TRANSMITTER WITHOUT DIAPHRAGM SEAL

NOT TO SCALE



NOTES:

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2. FOR STEEL, GALVANIZED STEEL AND PVC 2½" AND SMALLER USE A BUSHING IN A TEE.
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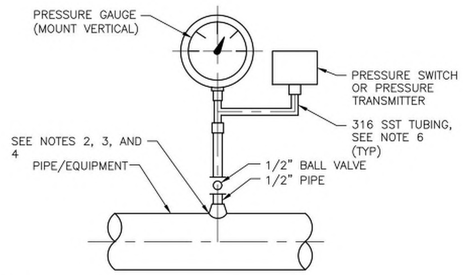
4. FOR STEEL AND STAINLESS STEEL PIPES 3" AND LARGER, USE A THRED–O–LET AS SHOWN.
5. NOT ALL REQUIRED COMPONENTS OR CONNECTIONS SHOWN; SEE SPECIFICATION SECTION 40 73 00.
6. ISOLATION VALVE FOR CHEMICAL SERVICES SHALL MATCH VALVE TYPE USED THROUGHOUT THE CHEMICAL PIPING SYSTEM.
7. NO DIAPHRAGM SEAL IS REQUIRED FOR CW, PW, HW, HWC, TW, OR WHERE NOT SHOWN ON P&IDS.

2 99Y501 PRESSURE GAUGE/PRESSURE TRANSMITTER WITH DIAPHRAGM SEAL

NOT TO SCALE

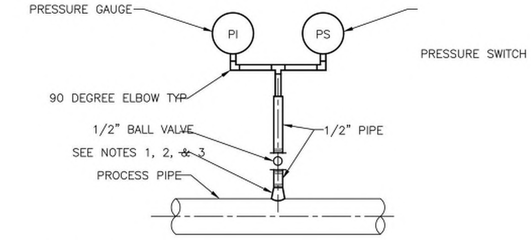


NOTES:

1. PIPE NIPPLES AND FITTINGS TO BE 316 STAINLESS STEEL FOR ALL SERVICES EXCEPT CHEMICAL SERVICES. USE PIPE MATERIAL PER THE PIPE SCHEDULE FOR CHEMICALS.
2. FOR STEEL, GALVANIZED STEEL AND PVC 2½" AND SMALLER USE A BUSHING IN A TEE.
3. FOR DUCTILE IRON, ALL SIZES, USE PIPE SADDLE WITH BUSHING.
4. FOR STEEL AND STAINLESS STEEL PIPES 3" AND LARGER, USE A THRED–O–LET AS SHOWN.
5. NOT ALL REQUIRED COMPONENTS OR CONNECTIONS SHOWN; SEE SPECIFICATION SECTION 40 73 00.
6. ALL TUBE FITTINGS SHALL BE UNION TYPE.
7. ISOLATION VALVE FOR CHEMICAL SERVICES SHALL MATCH VALVE TYPE USED THROUGHOUT THE CHEMICAL PIPING SYSTEM.
8. NO DIAPHRAGM SEAL IS REQUIRED FOR CW, PW, HW, HWC, TW, OR WHERE NOT SHOWN ON P&IDS.

9 99Y501 PRESSURE INDICATOR AND SWITCH/TRANSMITTER WITH DIAPHRAGM SEAL

NOT TO SCALE

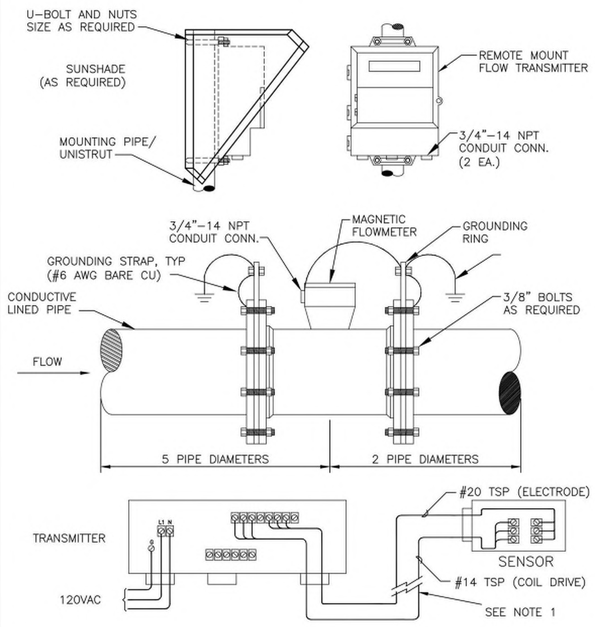


NOTES:

1. FOR STL, GSP, AND PVC 2 1/2" AND SMALLER, USE A BUSHING IN A TEE.
2. FOR DI AND FRP ALL SIZES, USE PIPE SADDLE W/ BUSHING.
3. FOR STL, AND SST PIPES 3" AND LARGER, AND PRESSURE VESSELS, USE THREAD–O–LET, OR EQUAL AS SHOWN.

4 99Y501 PRESSURE GAUGE AND SWITCH WITHOUT DIAPHRAGM SEAL

NOT TO SCALE

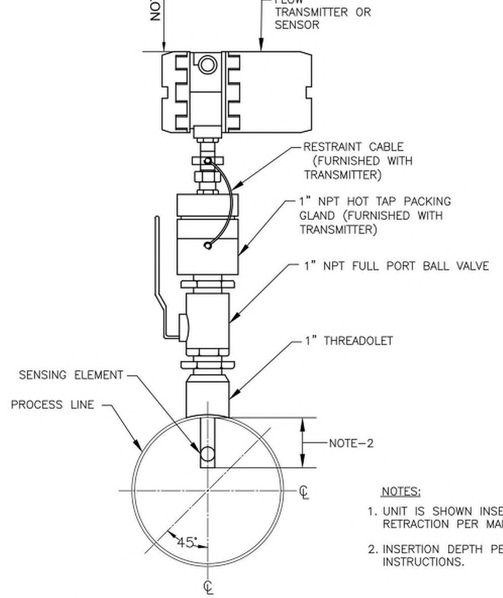


NOTES:

1. INSTALL EQUAL LENGTHS OF ELECTRODES AND COIL CABLES BETWEEN SENSOR AND TRANSMITTER.
2. MAGNETIC FLOW METERS CONFIGURED TO MEASURE BIDIRECTIONAL FLOW SHALL HAVE A MINIMUM OF 5 PIPE DIAMETERS OF STRAIGHT PIPE ON BOTH SIDES OF THE FLOW METER

5 99Y501 MAGNETIC FLOW METER

NOT TO SCALE

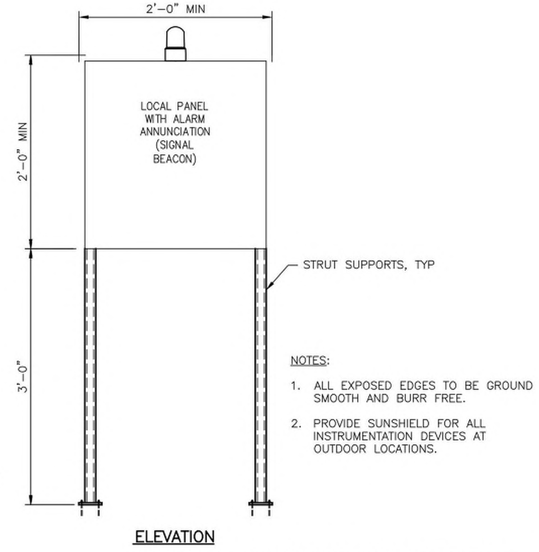


NOTES:

1. UNIT IS SHOWN INSERTED. ALLOW CLEARANCE FOR RETRACTION PER MANUFACTURER INSTRUCTIONS.
2. INSERTION DEPTH PER MANUFACTURER INSTRUCTIONS.

6 99Y501 THERMAL DISPERSION FLOWMETER

NOT TO SCALE



ELEVATION

NOTES:

1. ALL EXPOSED EDGES TO BE GROUND SMOOTH AND BURR FREE.
2. PROVIDE SUNSHIELD FOR ALL INSTRUMENTATION DEVICES AT OUTDOOR LOCATIONS.

7 99Y501 SECONDARY CLARIFIER SPLITTER HIGH LEVEL ALARM PANEL

NOT TO SCALE

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HDR
TEXAS P.E. FIRM
Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	P. KAPADIA
DRAWN BY	P. KAPADIA
CHECKED BY	S. HORRAS
APPROVED BY	
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS
PRANAVKUMAR KAPADIA
105500
LICENSED PROFESSIONAL ENGINEER
06/13/2025

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK

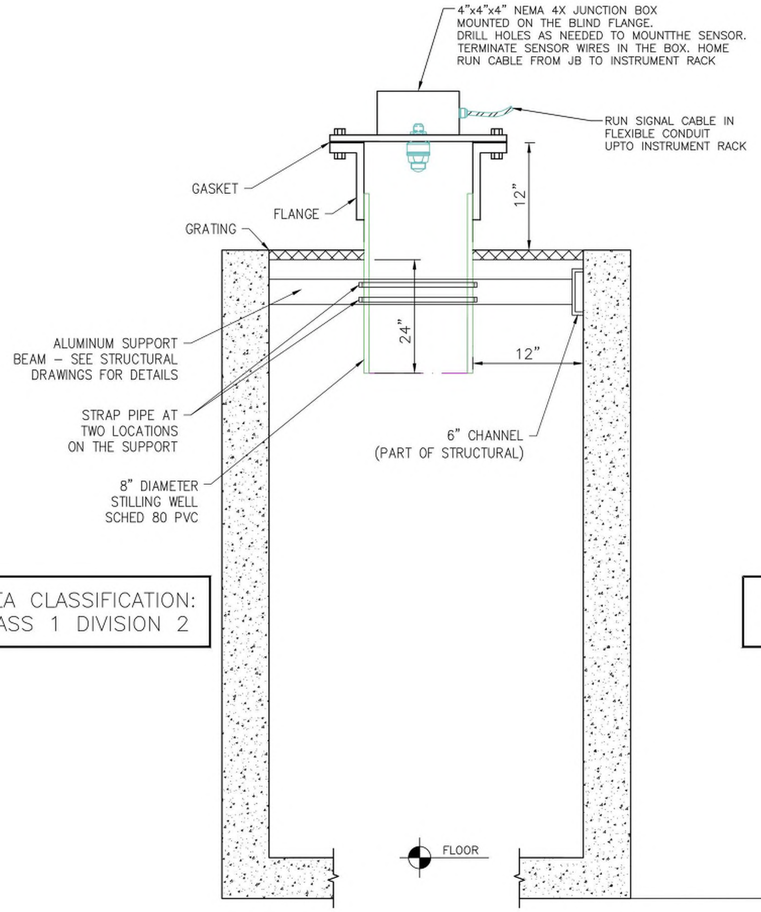
AERATION BASIN EXPANSION

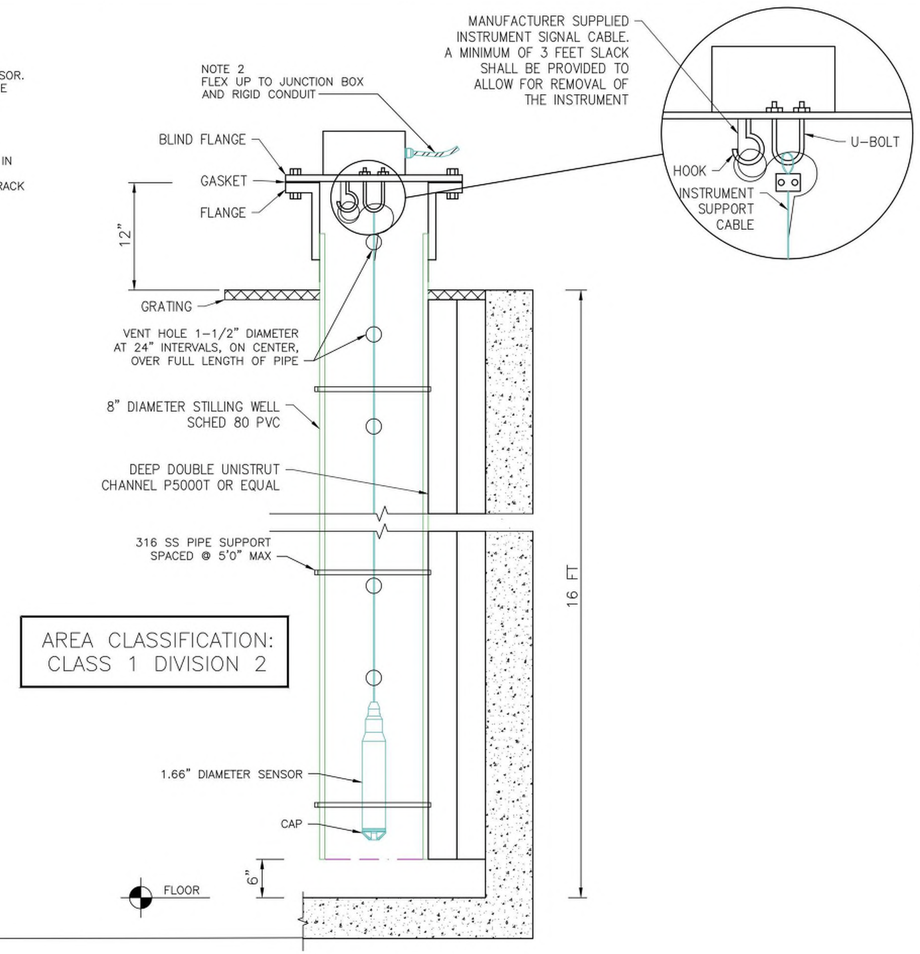
STANDARD DETAILS
INSTRUMENTATION I

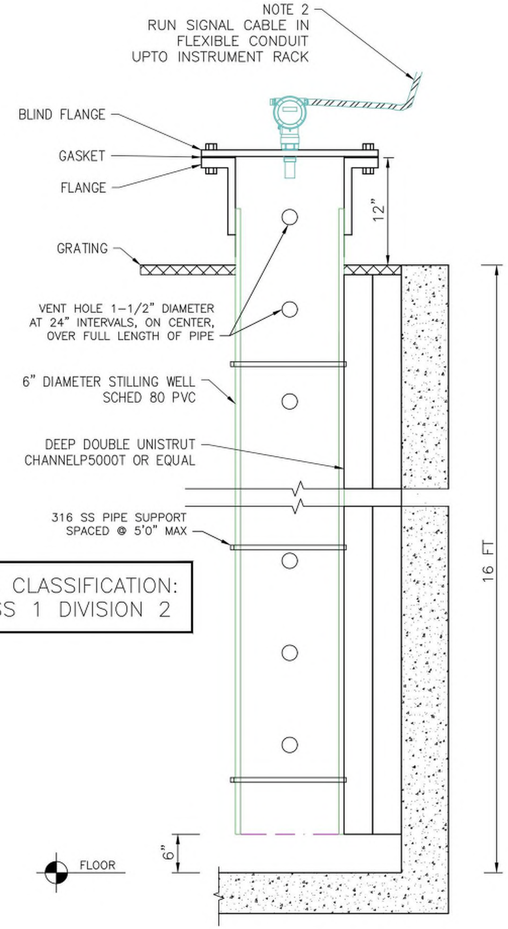
0 1" 2"

FILENAME 99Y501.dwg
SCALE NO SCALE

SHEET
99Y501







LE–2202A & LE–2202B

NOTES

1. FLANGE, GASKET AND HARDWARE TO BE COORDINATED WITH THE INSTRUMENT MANUFACTURER.
2. FURNISH SUFFICIENT LENGTH OF LIQUID TIGHT CONDUIT AND CABLE TO REMOVE THE INSTRUMENT FOR MAINTENANCE
3. 120 VAC POWER TO TRANSMITTER AND 4–20 mA OUTPUT SHALL BE ROUTED THROUGH SEPARATE JUNCTION BOXES.4
4. PROVIDE WEATHER PROTECTIVE COVER FOR THE SENSOR

8 / 99Y502 — RADAR LEVEL SENSOR (E&H: FMR) — NOT TO SCALE

LE–2201A & LE–2201B

NOTES

1. FLANGE, GASKET AND HARDWARE TO BE COORDINATED WITH THE INSTRUMENT MANUFACTURER
2. FURNISH SUFFICIENT LENGTH OF LIQUID TIGHT CONDUIT AND CABLE TO REMOVE THE INSTRUMENT FOR MAINTENANCE
3. 120 VAC POWER TO TRANSMITTER AND 4–20 mA OUTPUT SHALL BE ROUTED THROUGH SEPARATE JUNCTION BOXES.
4. USE 1.66 INCH DIAMETER SENSOR

9 / 99Y502 — HYDROSTATIC LEVEL SENSOR (E&H: FMX21) — NOT TO SCALE

LT–1101

NOTES

1. FLANGE, GASKET AND HARDWARE TO BE COORDINATED WITH THE INSTRUMENT MANUFACTURER.
2. FURNISH SUFFICIENT LENGTH OF LIQUID TIGHT CONDUIT AND CABLE TO REMOVE THE INSTRUMENT FOR MAINTENANCE
3. 120 VAC POWER TO TRANSMITTER AND 4–20 mA OUTPUT SHALL BE ROUTED THROUGH SEPARATE JUNCTION BOXES.

10 / 99Y502 — ULTRASONIC LEVEL SENSOR (E&H: PROSONIC M) — NOT TO SCALE

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TEXAS P.E. FIRM Registration No. F-754

ISSUE	DATE	DESCRIPTION
100%	JUNE 13 2025	ISSUED FOR BID

PROJECT MANAGER	JOEL R. CANTWELL
DESIGNED BY	P. KAPADIA
DRAWN BY	P. KAPADIA
CHECKED BY	S. HORRAS
APPROVED BY	
CITY PROJECT NO.	U2100
PROJECT NUMBER	10342803

STATE OF TEXAS — PRANAVKUMAR KAPADIA — 105500 — LICENSED PROFESSIONAL ENGINEER
06/13/2025

LEWISVILLE — Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

STANDARD DETAILS
INSTRUMENTATION II

0 1" 2"

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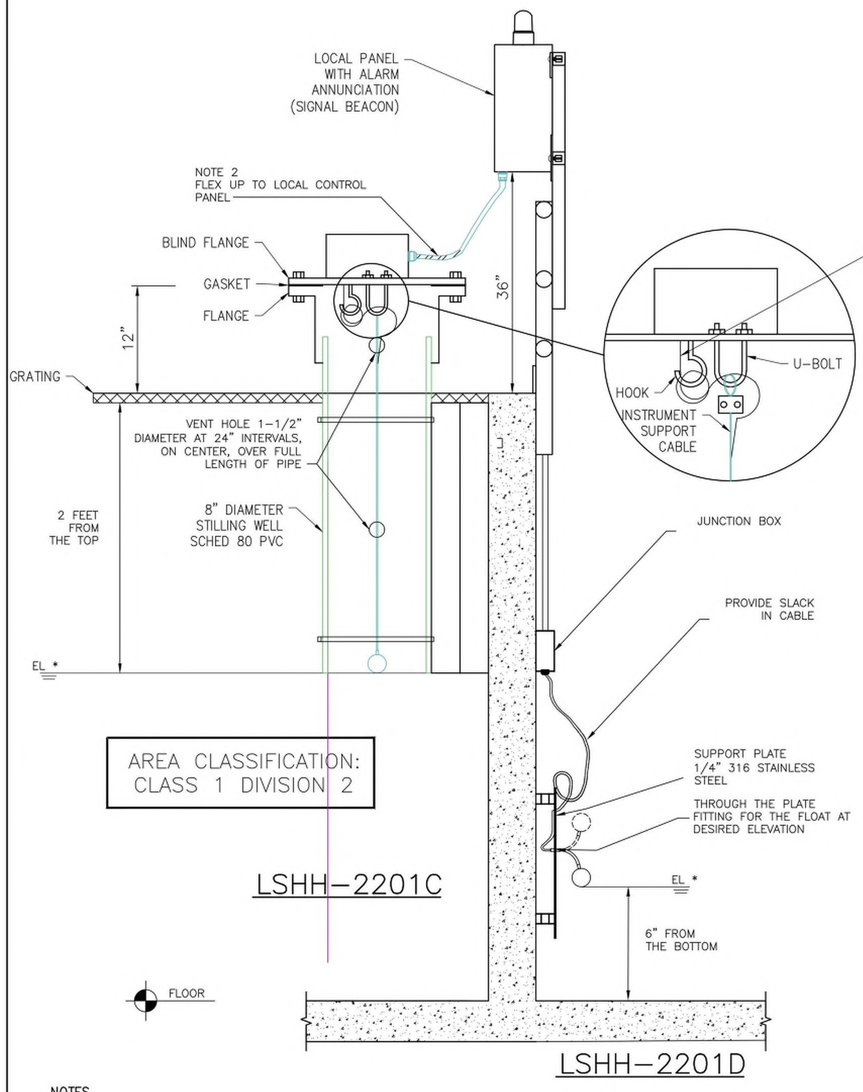
SCALE NO SCALE

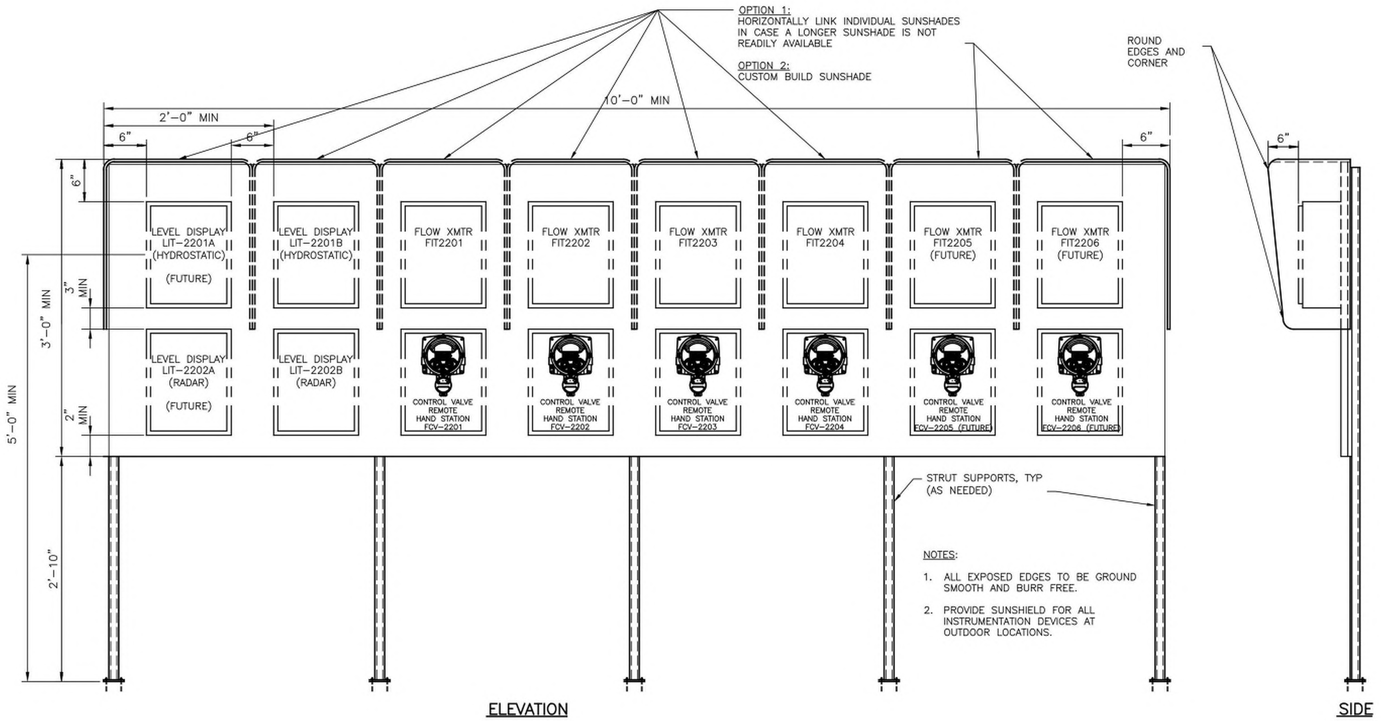
SHEET 99Y502



NOTES

1. FLANGE, GASKET AND HARDWARE TO BE COORDINATED WITH THE INSTRUMENT MANUFACTURER.
2. FURNISH SUFFICIENT LENGTH OF LIQUID TIGHT CONDUIT AND CABLE TO REMOVE THE INSTRUMENT FOR MAINTENANCE
3. 120 VAC POWER TO TRANSMITTER AND 4-20 mA OUTPUT SHALL BE ROUTED THROUGH SEPARATE JUNCTION BOXES.

11 / 99Y503 — LEVEL FLOATS (CONTEGRA: FS 90)
NOT TO SCALE



NOTES:

1. ALL EXPOSED EDGES TO BE GROUND SMOOTH AND BURR FREE.
2. PROVIDE SUNSHIELD FOR ALL INSTRUMENTATION DEVICES AT OUTDOOR LOCATIONS.

ELEVATION

SIDE

12 / 99Y503 — SECONDARY CLARIFIER SPLITTER FIELD INSTRUMENT/SUN SHIELD
NOT TO SCALE

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TEXAS P.E. FIRM Registration No. F-754

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STATE OF TEXAS — PRANAVKUMAR KAPADIA — 105500 — LICENSED PROFESSIONAL ENGINEER
06/13/2025

LEWISVILLE
Deep Roots. Broad Wings. Bright Future.

CITY OF LEWISVILLE
PRAIRIE CREEK
AERATION BASIN EXPANSION

STANDARD DETAILS
INSTRUMENTATION III

0 1" 2"

FILENAME 99Y503.dwg
SCALE NO SCALE

SHEET 99Y503