

**COMPETITIVE SEALED BID
CITY OF LYTLE, TEXAS**



**Multi-Column Elevated Water Storage Tank
(250,000/400,000 Gal)
COMPETITIVE SEALED BID - #2024-08-04**

**BID OPENING DATE:
Tuesday, September 10, 2024 – 2:00 PM**

**City of Lytle
Elevated Water Storage Tank**

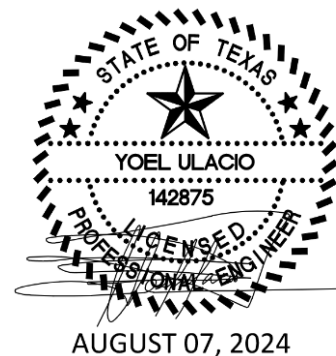
SPECIFICATION CERTIFICATIONS

Division 0 (All Sections)
Division 1 (All Sections)
Division 2 (All Sections)
Division 3 (All Sections)
Division 5 (All Sections)
Division 9 (All Sections)
Division 10 (All Sections)
Division 11 (All Sections)
Division 31 (All Sections)
Division 32 (All Sections)
Division 33 (All Sections)



Division 26 (Sections Listed Below)

Section 26 00 00
Section 26 05 04
Section 26 05 26
Section 26 05 33
Section 26 05 53
Section 26 05 70
Section 26 24 16
Section 26 56 29



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**CONTRACT DOCUMENTS AND TECHNICAL SPECIFICATIONS
FOR
CITY OF LYTLE
MULTI-COLUMN ELEVATED WATER STORAGE TANK (250,000/400,000 GAL)
COMPETITIVE SEALED BID – #2024-08-04**

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**PROPOSAL OPENING DATE:
TUESDAY, SEPTEMBER 10, 2024 – 2:00 PM**

**COMPETITIVE SEALED BID – #2024-08-04
SCHEDULE SUMMARY**

Wednesday	August 14, 2024 The Devine News and www.CivCastUSA.com	Bid Documents Released and 1 st Legal Advertising for Bid
Wednesday	August 21, 2024 The Devine News and www.CivCastUSA.com	2 nd Legal Advertising for Bid
Wednesday	August 28, 2024 at 10:00 AM Zoom Meeting with Link to be Provided Through www.CivCastUSA.com	Pre-Bid Conference
Tuesday	September 3, 2024	Last day for inquiries and clarifications. (Please submit all questions via www.CivCastUSA.com)
Tuesday	September 10, 2024 2:00 PM www.CivCastUSA.com/ebidding and City of Lytle City Hall 2:10 PM Zoom Meeting with Link to be Provided through www.CivCastUSA.com	Deadline for Submission of Bids via www.CivCastUSA.com or via Hard Copy Opening of Bids via Teleconference
Monday	September 23, 2024 City of Lytle City Hall	City Council Meeting Award of Bid and Contract

Note: This schedule is preliminary and may be modified at the discretion of the Owner.

**INVITATION TO BID
COMPETITIVE SEALED BID – #2024-08-04
MULTI-COLUMN ELEVATED WATER STORAGE TANK (250,000/400,000 GAL)**

The City of Lytle, Texas is accepting COMPETITIVE SEALED BID for all Bids using CivCast USA (“CivCast”) website www.CivCastUSA.com for all supervision, materials, labor and equipment necessary for the MULTI-COLUMN ELEVATED STORAGE WATER TANK (250,000/400,000 GAL) project in City of Lytle, Texas.

Copies of the bidding documents may be reviewed and obtained from www.CivCastUSA.com: search “ELEVATED WATER STORAGE TANK”. Bidders must register on this website in order to view and/or download specifications, plans, and other related documents for this project. There is NO charge to view or download documents. Historically Underutilized Businesses (HUBs), minority businesses, women's business enterprises, and labor surplus area firms are encouraged to submit a proposal.

A NON-MANDATORY PRE-BID TELECONFERENCE WILL BE HELD VIA ZOOM ON TUESDAY, AUGUST 28, 2024 AT 10:00 AM. A LINK TO THE ZOOM MEETING WILL BE PROVIDED THROUGH WWW.CIVCASTUSA.COM.

BIDS MUST BE RECEIVED VIA E-BIDDING USING THE CIVCAST WEBSITE OR, IF SUBMITTING BY HARD COPY, BY THE CITY SECRETARY OF THE CITY OF LYTLE NO LATER THAN 2:00 PM ON TUESDAY, SEPTEMBER 10, 2024. NO BID WILL BE ACCEPTED AFTER THAT DATE AND TIME. ALL BIDS RECEIVED AFTER THAT DATE AND TIME WILL BE CONSIDERED UNRESPONSIVE. IT IS THE SOLE RESPONSIBILITY OF THE BIDDER TO ENSURE THAT HIS/HER BID IS ACTUALLY SUBMITTED THROUGH THE CIVCAST WEBSITE OR IN THE CITY SECRETARY’S OFFICE PRIOR TO THE BID SUBMISSION DEADLINE.

Any Bids submitted via hard copy for consideration must include one (1) original in hard copy and one (1) electronic version, be clearly marked on the outside of the sealed envelope with the words “COMPETITIVE SEALED BID #2024-08-04, MULTI-COLUMN ELEVATED STORAGE WATER TANK” Attention: City Secretary, and must contain the name of the company submitting the Bid.

BIDS WILL BE PUBLICLY OPENED AND READ VIA TELECONFERENCE VIA ZOOM ON TUESDAY, SEPTEMBER 10, 2024 AT 2:10 P.M. A LINK TO THE ZOOM MEETING WILL BE PROVIDED THROUGH WWW.CIVCASTUSA.COM.

Bid security in the amount of not less than five percent (5%) of the total amount of the Bid must accompany each Bid as a guarantee that the Successful Bidder will enter into a proper Contract and execute Bonds and Guaranties on the forms provided within eight (8) calendar days after the date Contract Documents are received by the Contractor.

Upon consideration of the Bids, the City Council plans to award a Contract; however, the City reserves the right to reject any or all bids, to waive any or all irregularities, formalities or technicalities, and to accept any bid that it deems advantageous to the City. Bids shall be valid for a period of ninety (90) days from the date Bids are opened.

Each bidder agrees to waive any claim it has or may have against the city, the Engineer, and their respective employees, arising out of or in connection with the administration, evaluation or recommendation of any bid. The Successful Bidder will be required to furnish a performance bond and a payment bond each in an amount of 100% of the total contract price.

1st Advertisement: The Devine News, August 14, 2024

2nd Advertisement: The Devine News, August 21, 2024

COMPETITIVE SEALED BID – #2024-08-04
CITY OF LYTLE MULTI-COLUMN ELEVATED STORAGE WATER TANK
(250,000/400,000 GAL)
SCOPE OF WORK AND SPECIAL CONDITIONS

I. SCOPE OF WORK

The scope of work under this bid shall include all materials, labor, equipment, supervision, and incidentals for construction of Elevated Water Storage Tank. Work of the Contract includes, but is not limited to the following:

1. The bid is for two tank size options (0.25 MG and 0.40 MG), flex base access road, chain link fencing and gate, influent and distribution pipeline connection to the existing water line, site lighting. Only one of the two tank sizes will be constructed.

All work shall be performed in accordance with the Construction Plans developed for the project which are available from www.CivCastUSA.com and Technical Specifications provided herein.

II. RESPONSIBILITIES OF THE CONTRACTOR

The bidder must be capable of performing all responsibilities normally associated with providing multi-column elevated storage tanks, flex base access road, chain link fencing and gate, influent and distribution pipeline connection to the existing water line, site lighting in accordance with the Construction Plans developed for the Project and Technical Specifications provided herein. The successful bidder shall furnish all supervision, materials, labor, and equipment for work delineated above.

III. CONSTRUCTION SCHEDULE

Following award of bid, City and the City's Engineer will meet with the successful bidder to develop and submit a construction schedule for the total scope of work. City may also request successful bidder to develop and submit a construction schedule for phase of the project if applicable. The successful bidder will be required to complete the entire scope of work as outlined in Section I above within **400** calendar days after the date of the first written notice to proceed issued by the City. The work to be performed shall be commenced within ten (10) calendar days after the date a written notice to proceed has been issued to successful bidder by the City. Construction activity is allowed Monday through Friday, 7:00 a.m. to 7:00 p.m. Saturday and Sunday, 9:00 a.m. to 6:00 p.m., unless otherwise permitted by the Director of Public Works in compliance with the City's noise regulations.

IV. USE OF SUBCONTRACTORS

The City specifically prohibits the use of subcontractors without written authorization. Authorized subcontractors are subject to the same insurance requirements as stated in the Contractor Insurance Requirements provided in this Bid.

V. SAFETY REGULATIONS

The successful bidder's personnel shall wear orange safety vests on all job sites. Work gloves and other appropriate clothing/shoes shall be worn. The successful bidder's personnel must have received the appropriate safety training prior to start of work.

VI. TRAFFIC CONTROL PLANS

Contractor will be responsible for installing and maintaining a Traffic Control Plan contained in the Construction Plans if applicable.

VII. SUBSURFACE UTILITY EXPLORATION

It is not represented that Construction Plans show all existing utility structures and infrastructure. It is the Contractor's responsibility to determine the depth, location and their existence which may conflict with the proposed construction by referring to available records, consulting appropriate municipal departments and utility Owners and by making necessary exploration and excavations. All investigative work will be done and all repairs required after completion of investigative work shall be performed by the Contractor at no additional cost to the project, unless otherwise stated in the contract documents. Whatever existing utilities, not indicated on the Construction Plans, present obstructions to grade and alignment of pipe, immediately notify the City and City's Engineer, who without delay, will determine whenever existing utilities are to be relocated, or grade and alignment of proposed pipe changed. When necessary to move services, poles, guy wires, decorative lights, pipelines, or other obstructions, the Contractor shall contact and coordinate and make arrangements with Owners of said utilities. The City will not be liable for damages on account of delays due to changes or adjustments made by Owners of privately owned utilities and faulty workmanship by Owners of privately owned utilities which hinder progress of work regardless of work authorized by the City or other entities. It is the Contractor's responsibility to install the proposed utilities and maintain proper clearances with all existing utilities and meet the regulatory requirements. Any damage to existing sprinklers or sanitary sewer service lines shall be repaired to the City's satisfaction at no additional cost to the project.

In the event a utility (shown or not shown on the plan drawings) including but not limited to gas, electric, telephone, cable, standard lighting and decorating lighting, petroleum or petroleum related pipelines is exposed due to excavation and is in conflict, the appropriate company shall be contacted by the Contractor. The Contractor shall make a concerted effort to the City's Engineer's satisfaction to identify the utility (if unknown) and avoid any conflict with the utility. The Contractor shall provide all the necessary documentation for the efforts extended by the Contractor in locating the utility. The documentation shall be either telephone conversation memos, letters, meeting on site and other coordination efforts utilized to identify the utility or pipeline. The City's Engineer will review all the documentation provided by the Contractor. In the event of a conflict with the utility, and the City's Engineer concurs that the Contractor had made a concerted effort to avoid the conflict and in spite of his effort, the conflict cannot be avoided without the utility being relocated, the City will assist in coordinating the relocation efforts of the utility with the

pertinent company. (The Contractor is still responsible for coordinating efforts with the utility or the pipeline company.) The Contractor during the period the utility is being relocated, will move his crew(s) to other areas at his own expense. The Contractor will not be due any compensation for delays or downtime resulting from the coordination and relocation efforts performed by the Contractor or the utility Owner due to the utility conflict. The Contractor may request additional time if the relocation effort substantially hinders his construction effort. No additional payment will be made. If the Contractor chooses to assist the utility or pipeline company in the performance of their work, he shall be doing that at his own risk. The City will not be responsible for costs incurred by the Contractor from providing such assistance to the utility or pipeline companies.

The Contractor is made aware and shall make provisions in his unit price bid to allow for changes in alignment (vertical and horizontal) of the proposed utility (storm, water, sanitary sewer or force main) and roadway during construction to avoid conflicts, conditions encountered in the field, and to expedite construction. The Contractor is made aware that the water line may be required to be installed at a deeper elevation than shown on the plan drawings to avoid conflicts and to maintain clearances with utilities. No additional payment shall be made for the increased installation efforts expended by the Contractor. The City will not be responsible for any claims for downtime costs resulting from such conflicts. If the change in alignment results in increased quantities of the pertinent item, the Contractor shall be paid at the established bid unit price in the Contract.

INSTRUCTIONS TO BIDDERS

1. BIDS, PREPARATION AND SUBMITTAL

Bidders must utilize the Bid Form and must submit either via e-bidding using www.CivCastUSA.com website or, if submitting by hard copy, one (1) original in hard copy and one (1) electronic version of the sealed bid/written quote/proposal as required in the Invitation to Bid to the City Secretary prior to the response due date and time as described in the Invitation to Bidders. Bidders are strongly encouraged to submit their bid via e-bidding using www.CivCastUSA.com. Failure to submit the required bid documents may result in the bid being declared unresponsive to specification and may not be further evaluated.

For Bids submitted by hard copy, all figures must be written in ink or typed. Figures written in pencil or erasures are not acceptable. However, mistakes may be crossed out, corrections inserted and initialed in ink by the person signing the Bid Form. No oral, telegraphic, telephonic, e-mailed or facsimile bids will be considered. For additional instructions related to Bid Preparation, please see the General Conditions of Bidding contained herein.

2. INTENT OF BID DOCUMENTS

Bidders should fully inform themselves as to all conditions and matters which can in any way affect the costs thereof. Should a bidder find discrepancies in, or omission from, the bid documents or should there be any doubt as to their meaning and intent, the Bidder should notify the City or the City's Engineer by submitting a question through www.CivCastUSA.com prior to the last day for inquiries and clarifications as outlined in the Bid Summary Schedule and obtain clarification prior to submitting a bid.

The submission of a bid by Bidder shall be conclusive evidence that the Bidder is fully acquainted with and satisfied as to character, quality and quantity of equipment and/or services to be furnished.

3. PRE-BID CONFERENCE

A non-mandatory pre-submittal conference will be held via Zoom on Day of the Week, August 28, 2024 at 10:00 AM. A link for the Zoom meeting will be provided through www.CivCastUSA.com.

4. DELIVERY OF BIDS

Bids received prior to the time of the opening will be kept securely unopened. Bids received after the time specified in the Invitation to Bid shall be considered late and shall be returned unopened. The person whose duty it is to open the bids will decide when the specified time has arrived for the opening of the bids. No responsibility will be attached to an officer of the City for the premature opening of a bid not properly addressed and identified. No oral, telegraphic, telephonic, e-mailed or facsimile bids will be considered.

5. SIGNATURES ON BIDS SUBMITTED IN HARD COPY

All Bid responses submitted in hard copy are required to be signed by an authorized representative of the bidding entity. Bid responses received unsigned will result in the bid being declared unresponsive to specification and may not be further evaluated.

6. BID ALTERATION/WITHDRAWAL

Bids cannot be altered or amended after the Bid Deadline. For Bids submitted via hard copy, the signer of the bid, guaranteeing authenticity, must initial any interlineations, alteration, or erasure made before the Bid Deadline. Hard copy bids may be withdrawn by written request signed by the bidder prior to the Bid Deadline; however, such written request must be received by the City in the normal course of business and prior to the Bid Deadline. Negligence on the part of the bidder in preparing the bid represents no right for withdrawal after the Bid Deadline. No bids may be withdrawn for a period of ninety (90) calendar days after the Bid Deadline.

7. DISQUALIFICATIONS OF BIDDERS

The bidders may be disqualified and their bids and proposals not considered for the following reasons, including, but not limited to:

- Reason for believing collusion exists between bidders.
- The bidder being an interested party in any litigation against the City.
- Failure to use the Bid Form furnished by the City.
- The bidder lacks necessary experience, qualifications or financial capability to complete the project in the manner required by these bid documents.
- Failure to comply with any of the requirements contained herein.
- Lack of signature by an authorized representative on the Bid Form for bids submitted via hard copy.
- Failure to properly complete the Bid Form.
- Bidder is indebted to the City.
- Communicating with an elected official regarding this bid or its award.

Bidders may be required to show evidence that they have successfully completed an equivalent project within the past three (3) years to qualify for this work.

8. BID OPENINGS

All bids submitted in compliance with the Bid Deadline will be opened publicly and read via teleconference via Zoom, at the date and time shown in the Invitation to Bidders. A link to the Zoom meeting will be provided through www.CivCastUSA.com. However, the reading of a bid at bid opening should not be construed as a comment on the responsiveness of such bid or as any indication that the City accepts such bid as responsive. The City will make a determination as to the responsiveness of bids submitted based upon compliance with all applicable laws, City of Lytle Purchasing Guidelines, and project documents, including, but not limited to, the project specifications and contract

documents. The City will notify the successful bidder upon award of the contract, and, according to State law, all bids received will be available for inspection at that time, unless otherwise provided by law.

9. BASIS OF AWARD

It is the intent of the City to award the Contract to the lowest responsible bidder in compliance with Section 252.043 of the Texas Local Government Code. It shall be based on all factors which have a bearing on price and performance of the items in the user environment. All bids are subject to re-tabulation. Compliance with all bid requirements, delivery and needs of the using department are considerations in evaluating bids.

The City of Lytle reserves the right to contact any offer, or at any time, to clarify, verify or request information with regard to any bid. The City reserves the right to waive any formality or irregularity, to make awards to more than one offer or, or to reject any or all bids.

10. BID TABULATION

Bidders desiring a copy of the bid tabulation may download a copy from www.CivCastUSA.com.

11. PROTESTS

All protests regarding the bid solicitation process must be submitted in writing to the City within five (5) working days following the opening of the bids. This includes all protests relating to advertising of bid notices, deadlines, bid opening, and all other related procedures under the Texas Local Government Code, as well as any protests relating to alleged improprieties or ambiguities in the specifications.

This limitation does not include protests relating to staff recommendations as to award of this bid. Protests relating to staff recommendations may be directed to the City Administrator within five (5) working days of the staff recommendation memo. Unless otherwise provided by law, all staff recommendations will be made available for public review prior to consideration by the City Council.

GENERAL CONDITIONS OF BIDDING

This Bid does not commit the City of Lytle to award a contract or to pay any costs incurred as a result of preparing such a response. The City reserves the right to accept or reject any and all responses received in response to this request, to negotiate with all qualified respondents or to cancel in part or in its entirety this Bid if it is in the best interest of the City.

A contract based on the awarded bid will be executed. This should be considered and reflected in the proposal.

BIDDING

1. **PRICING:** Price(s) quoted must be held firm for a minimum of ninety (90) days from the date of bid closing. In the case of estimated requirement contract bid, the prices must remain firm for the period as specified in the bid. "Discount from list" bids are not acceptable unless specifically requested in the bid.
2. **QUANTITIES:** In the case of estimated requirements contract bid, quantities appearing are estimated as realistically as possible. However, the City reserves the right to increase, decrease or delete any item or items of material to be furnished while continuing to pay the price quoted on this bid regardless of quantity. The successful bidder shall have no claim against the City for anticipated profits for the quantities called for, diminished, or deleted.
3. **ERROR-QUANTITY:** Bids must be submitted on units of quantity specified, extended, and show total. In the event of discrepancies in extension, the unit prices shall govern.
4. **F.O.B./DAMAGE:** Quotations shall be bid freight on board (F.O.B.) delivered to the designated job site in Lytle, Texas and shall include all delivery and packaging costs. The City assumes no liability for goods delivered in damaged or unacceptable condition. The successful bidder shall handle all claims with carriers, and in case of damaged goods, shall ship replacement goods immediately upon notification by the City.
5. **DELIVERY PROMISE-PENALTIES:** Bids MUST show the number of calendar days required to place the material in the possession of the City. Do not quote shipping dates. When delivery delay can be foreseen, the bidder shall give prior written notice to the City, who shall have the right, in its sole discretion, to extend the delivery date if reasons for delay appear acceptable. Default in promised delivery, without acceptable reasons, or failure to meet specifications, authorizes the City to purchase the goods elsewhere, and charge any increase in cost and handling to the defaulting bidder.
6. **DESCRIPTIONS:** Any reference to model and/or make/manufacture used in bid/proposal specifications is descriptive, not restrictive. It is to be used to indicate the type and quality desired. Qualifications on items of like quality will be considered.

7. EXCEPTIONS/SUBSTITUTIONS: All submittals meeting the intent of this bid/request for proposal will be considered for award. Bidders taking exception to the specifications, or offering substitutions, shall state these exceptions in the section provided or by attachment as part of the qualifications. The absence of such a list shall indicate that the Bidder has not taken exceptions and shall hold the Bidder responsible to perform in strict accordance with the specifications of the invitation. The City of Lytle reserves the right to accept any and all or none of the exception(s)/substitution(s) deemed to be in the best interest of the City.
8. PROPRIETARY INFORMATION: If a bid/proposal contains proprietary information, the respondent must declare such information as proprietary if respondent does not want information to become public. Any proprietary information must be indicated in the index and clearly identified in the qualifications.
9. CORRESPONDENCE: This bid number must appear on ALL correspondence, inquiries, bid submittal documents, etc. pertaining to this Invitation for Bid.
10. ADDENDA: Any interpretations, corrections or changes to this Invitation for Bid and specifications will be made via www.CivCastUSA.com. Sole issuing authority of addenda shall be vested in the City of Lytle's Engineer.
11. CHANGE ORDERS: No oral statement of any person shall modify or otherwise change, or affect the terms, conditions or specifications stated in the resulting contract. All change orders to the contract will be made in writing by the City.
12. INQUIRIES: Any inquiries concerning the bid documents shall be submitted to the City's Engineer through www.CivCastUSA.com. Inquiries are permitted until the deadline as indicated in the Bid Schedule Summary. Necessary replies will be issued to bidders of record as addenda, which become a part of the bidding documents. Oral instructions do not form a part of the bidding documents. Any attempt on the part of a bidder or his representative to contact an elected official regarding this bid or its award will disqualify the bidder.

PERFORMANCE

13. MINIMUM STANDARDS FOR RESPONSIBLE PROSPECTIVE BIDDERS: A prospective bidder must affirmatively demonstrate bidders' responsibility. A prospective bidder must meet the following requirements:
 - A. Have adequate financial resources, or the ability to obtain such resources as required;
 - B. Be able to comply with the required or proposed delivery schedule;
 - C. Have a satisfactory record of performance;
 - D. Have a satisfactory record of integrity and ethics; and
 - E. Be otherwise qualified and eligible, as determined by the City, to receive an award.

The City may request representation and other information sufficient to determine bidders' ability to meet these minimum standards listed above.

14. **ASSIGNMENT:** The successful bidder shall not sell, assign, transfer or convey this Contract in whole or in part, without the prior written consent of the City.
15. **SPECIFICATION-SAMPLES:** Any catalog, brand name, or manufacturer's reference used is considered to be descriptive, not restrictive, and is indicative of the type and quality the City desires to purchase. Bids on brands of like nature and quality may be considered unless specifically excluded. If bidding on other than reference, bid must certify article offered is equivalent to specifications and it is subject to approval by the using department and the Purchasing Division. Samples, if required, shall be furnished free of expense to the City. **SAMPLES SHOULD NOT BE ENCLOSED WITH BID UNLESS REQUESTED.**
16. **PACKAGING:** Unless otherwise indicated, items will be new, unused, and in first class condition in containers suitable for damage-free shipment and storage.
17. **DELIVERY:** Deliveries will be acceptable only during normal working hours at the designated City Municipal Facility or Job Site. The place of delivery shall be set forth in the purchase order. The terms of this agreement are "no arrival, no sale".
18. **TITLE AND RISK OF LOSS:** The title and risk of loss of goods shall not pass to the City until the City actually receives and takes possession of the goods at the point(s) of delivery.
19. **PATENT RIGHTS:** The Bidder agrees to indemnify and hold the City harmless from any claim involving patent right infringement or copyrights on goods supplied.
20. **ETHICS:** The respondent shall not offer or accept gifts or anything of value nor enter into any business arrangement with any employee, official or agent of the City of Lytle.

PURCHASE ORDERS AND PAYMENT

21. **PURCHASE ORDERS:** A purchase order(s) shall be generated by the City to the successful bidder. The purchase order number must appear on all itemized invoices and packing slips. The City will not be held responsible for any work orders placed and/or performed without a valid current purchase order number. Payment will be made for all services rendered and accepted by the contract administrator for which a valid invoice has been received.
22. **BID SECURITY/BOND REQUIREMENTS:** If required, bid security shall be submitted with bids. Any bid submitted without bid bond, or cashiers/certified check, shall be considered non-responsive and will not be considered for award. Performance and/or payment bonds, when required, shall be submitted to the City, prior to commencement of any work pursuant to the agreement provisions.

23. **APPROPRIATION CLAUSE:** The City of Lytle is a Texas type A municipal City operated and funded on an October 1 to September 30 basis. Accordingly, the City reserves the right to terminate, without liability to the City, any contract for which funding is not available.
24. **TAXES:** The City is exempt from Federal Manufacturer's Excise, and State sales taxes. **TAX MUST NOT BE INCLUDED IN the PROPOSAL PRICING.** Tax exemption certificates will be executed by the City and furnished upon request by the Finance Director.
25. **PAYMENT TERMS:** Payment terms are Net 30 upon receipt and acceptance by the City for item(s) and/or service(s) ordered and delivered after receipt of a valid invoice, in accordance with the State of Texas Prompt Payment Act, Chapter 2251, Texas Government Code. Prompt payment discounts may be used by the City in determining the lowest responsible bidder. Successful respondent is required to pay subcontractors within ten (10) days of work performed.
26. **APPLICATIONS FOR PAYMENT:** Each Application for Payment shall be based on the most recent schedule of value submitted by the Contractor in accordance with the Contract Documents. The schedule of value shall allocate the entire Contract Amount among the various portions of the Work. The schedule of value shall be prepared in such form and supported by such data to substantiate its accuracy as the Engineer and Owner may require. This schedule, unless objected to by the Engineer or Owner, shall be used as a basis for reviewing the Contractor's Applications for Payment.

Applications for Payment shall show the percentage of completion of each portion of the Work as of the end of the period covered by the Application for Payment. The Contractor shall confirm the quantities with City inspector prior to submitting the payment application to the Engineer. Following receipt of the application by the Engineer and if approved by the Engineer, the Engineer will submit a written recommendation to the City for payment processing (less retainage).

CONTRACT

27. **CONTRACT PERIOD/RENEWAL OPTIONS:** In the case of an annual contract bid, the contract shall be for a predetermined period as specified in the Invitation for Bids. If a clause for option to renew for additional period(s) is(are) included, renewal(s) will be based solely upon the option and written agreement between both the City and the Contractor. Either party dissenting will terminate the contract in accordance with its initial specified term.
28. **INTERLOCAL AGREEMENT:** Successful bidder agrees to extend prices to all entities that have entered into or will enter into joint purchasing Interlocal Cooperation Agreements with the City. The City has executed Interlocal Agreements, as permitted under Section 791.025 of the Texas Government Code with certain other governmental entities. The successful bidder may be asked to provide products/services, based upon bid price, to any other participant in which the City has entered into an Interlocal Agreement for purchasing.

29. **ELECTRONIC PROCUREMENT:** The City of Lytle has adopted policies and procedures complying with Local Government Code Section 252.0415, Section 271.906 and Section 2155.062 of the Texas Government Code. The City of Lytle may receive submittals in electronic form in response to procurement requests. However, a proposal that is submitted non-electronically by the due date and time will be accepted and then entered electronically by Purchasing after the proposal opening.
30. **AUDIT:** The City reserves the right to audit the records and performance of successful bidder during the term of the contract and for three (3) years thereafter.
31. **SUCCESSFUL BIDDER SHALL:** Defend, indemnify and save harmless the City and all its officers, agents and employees and all entities, their officers, agents and employees who are participating in this contract from all suits, actions or other claims of any character, name and description brought for or on account of any injuries, including death, or damages received or sustained by any person, persons, or property on account of any negligent act or fault of the successful bidder, or of any agent, officer, director, representative, employee, subcontractor or supplier in the execution of, or performance under, any contract which may result from bid award. Successful bidder shall pay any judgment with cost which may be obtained against the City and participating entities growing out of such injury or damages.
32. **TERMINATION FOR DEFAULT:** The City reserves the right to enforce the performance of this contract in any manner prescribed by law or deemed to be in the best interest of the City in the event of breach or default of this contract. The City reserves the right to terminate the contract immediately in the event the successful bidder fails to: (1) meet delivery schedules; or (2) otherwise perform in accordance with these specifications.

In the event the successful respondent shall fail to perform, keep or observe any of the terms and conditions to be performed, kept or observed, the City of Lytle shall give the successful respondent written notice of such default; and in the event said default is not remedied to the satisfaction and approval of the City within seven (7) working days of receipt of such notice by the successful respondent, default will be declared and all the successful Respondent's rights shall terminate. Respondent, in submitting this bid, agrees that the City of Lytle shall not be liable to prosecution for damages in the event that the City declares the respondent in default.

Breach of contract or default authorizes the City to, among other things, award to another bidder, purchase elsewhere and charge the full increase in cost and handling to the defaulting successful bidder.

33. **ACCEPTABILITY:** All articles enumerated in the bid shall be subject to inspection by a City officer or employee designated for the purpose. If found inferior to the quality called for, or not equal in value to the specifications, deficient in workmanship or otherwise, this fact shall be certified to the City Administrator who shall have the right to reject the whole or any part of the same. Work determined to be contrary to specifications must be replaced by the bidder and at its expense. All disputes concerning quality of supplies utilized in the performance of this bid will be determined solely by the City Administrator or designated representative.
34. **REMEDIES:** The successful bidder and the City agree that each party has all rights, duties, and remedies available as stated in the Uniform Commercial Code and any other available remedy, whether in law or equity.
35. **VENUE:** This contract will be governed and construed according to the laws of the State of Texas. This contract is performable in Atascosa County, Texas.
36. **SILENCE OF SPECIFICATION:** The apparent silence of these specifications as to any detail or to the apparent omission from it of a detailed description concerning any point shall be regarded as meaning that only the best commercial practices are to prevail. All interpretations of these specifications shall be made on the basis of this statement.
37. **NO PROHIBITED INTEREST:** The bidder acknowledges and represents they are aware of the laws regarding conflicts of interest. In compliance with Local Government Code §176.006, as amended, all respondents shall submit a completed conflict of interest questionnaire as provided herein with their bid submittal.
38. **DECEPTIVE TRADE PRACTICES/UNFAIR BUSINESS PRACTICES:** By submission of a bid response, the respondent represents and warrants that it has not been the subject of allegations of Deceptive Trade Practices violations under Tex. Bus. & Com. Code Chapter 17 or allegations of any unfair business practice in any administrative hearing or court suit that the respondent has not been found to be liable for such practices in such proceedings.
39. **FELONY CRIMINAL CONVICTIONS:** The respondent represents and warrants that neither the Respondent nor the Respondent's employees have been convicted, or have a pending felony criminal offense, or that, if such a conviction has occurred, the Respondent has fully advised the City of Lytle as to the facts and circumstances surrounding the conviction.
40. **SEVERABILITY:** If any section, subsection, paragraph, sentence, clause, phrase or word of these requirements or specifications shall be held invalid, such holding shall not affect the remaining portions of these requirements and the specifications and it is hereby declared that such remaining portions would have been included in these requirements and the specifications as though the invalid portion had been omitted.
41. **FORCE MAJEURE:** If, by reason of Force Majeure, either party hereto shall be rendered unable wholly or in part to carry out its obligations under this contract, then

such party shall give notice and full particulars of such Force Majeure in writing to the other party within a reasonable time after occurrence of the event or cause relied upon, and the obligation of the party giving such notice, so far as it is affected by such Force Majeure, shall be suspended during the continuance of the inability then claimed, except as hereinafter provided, but for no longer period, and such party shall endeavor to remove or overcome such inability with all reasonable dispatch. The term Force Majeure as employed herein, shall mean acts of God, strikes, lockouts, or other industrial disturbances, act of public enemy, orders of any kind of government of the United States or the State of Texas or any civil or military authority, insurrections, riots, epidemics, landslides, lightning, earthquake, fires, hurricanes, storms, floods, washouts, droughts, arrests, restraint of government and people, civil disturbances, explosions, breakage or accidents to machinery, pipelines, or canals, or other causes not reasonable within the control of the party claiming such inability. It is understood and agreed that the settlement of strikes and lockouts shall be entirely within the discretion of the party having the difficulty, and that the above requirement that any Force Majeure shall be remedied with all reasonable dispatch shall not require the settlement of strikes and lockouts by acceding to the demands of the opposing party or parties when such settlement is unfavorable in the judgment of the party having the difficulty.

42. CERTIFICATE OF INTERESTED PARTIES (FORM 1295): Section 2252.908 of the Texas Government Code states that a governmental entity or state agency may not enter into certain contracts with a business entity unless the business entity submits a disclosure of interested parties to the governmental entity or state agency at the time the business entity submits the signed contract to the governmental entity or state agency. The law applies only to a contract of a governmental entity or state agency that either (1) requires an action or vote by the governing body of the entity or agency before the contract may be signed or (2) has a value of at least \$1 million.

A business entity must enter the required information on Form 1295 online at <https://www.ethics.state.tx.us/File/> and print a copy of the completed form, which will include a certification of filing that will contain a unique certification number. An authorized agent of the business entity must sign the printed copy. The completed Form 1295 with the certification of filing must be filed with City.

CITY OF LYTLE CONTRACTOR INSURANCE REQUIREMENTS

Contractors providing good, materials and services for the City of Lytle shall, during the term of the contract with the City or any renewal or extension thereof, provide and maintain the types and amounts of insurance set forth herein. All insurance and certificate(s) of insurance shall contain the following provisions:

1. Name the City, TRC Engineers, Inc., its officers, agents, representatives, and employees, name any lender whose loan is secured by a lien against the Work, name landowners of offsite construction laydown or easement areas, and others as required by the Construction Documents, as additional insureds as to all applicable coverage with the exception of workers compensation insurance.
2. Provide for at least thirty (30) days prior written notice to the City for cancellation, non-renewal, or material change of the insurance.
3. Provide for a waiver of subrogation against the City for injuries, including death, property damage, or any other loss to the extent the same is covered by the proceeds of insurance.

Insurance Company Qualification: All insurance companies providing the required insurance shall be authorized to transact business in Texas and rated at least "A" by AM Best or other equivalent rating service.

Certificate of insurance: A certificate of insurance evidencing the required insurance shall be submitted with the contractor's bid or response to proposal. If the contract is renewed or extended by the City, a certificate of insurance shall also be provided to the City prior to the date the contract is renewed or extended.

Type of Contract

Type and amount of Insurance

Public Works and Construction

General Liability insurance for personal injury (including death) and property damage with a minimum of \$1 Million Dollars per occurrence and \$2 Million Dollars aggregate, including advertising injury, products coverage and (XCU) Explosion, collapse and underground (If high risk or dangerous activities) Umbrella Coverage or Excess Liability Coverage of \$2 Million Dollars Statutory Workers compensation insurance as required by state law

Professional Services

Professional Liability Insurance with a minimum of \$1 Million Dollars per occurrence and \$2 Million Dollars aggregate.

(If size or scope of project warrant) Umbrella Coverage or Excess Liability Coverage of \$2 Million Dollars

Special Events

General Liability insurance for personal injury (including death) and property damage with a minimum of \$1 Million Dollars per occurrence and \$2 Million Dollars aggregate, including coverage for advertising injury and products coverage

Statutory Workers compensation insurance as required by state law

(If the contractor serves alcoholic beverages) Liquor Liability with a minimum of \$1 Million Dollars per Occurrence and \$2 Million Aggregate.

(If high risk or dangerous activities) Umbrella Coverage or Liability Excess Coverage of \$ 2 Million Dollars

(If automobile or limousine service is involved even if volunteers) Automobile Liability with a minimum of \$1 Million Dollars combined single limit.

SCHEDULE OF DRAWINGS
COMPETITIVE SEALED BID – #2024-08-04

ELEVATED WATER STORAGE TANK

<u>Sheet No.</u>	<u>Drawing Title</u>
G1	COVER SHEET
G2	GENERAL NOTES
G3	LEGENDS & ABBREVIATIONS
G4	PROPOSED OVERALL SITE PLAN 0.25 MG TANK
G5	PROPOSED OVERALL SITE PLAN 0.40 MG TANK
C1	EROSION AND TRAFFIC CONTROL DETAILS
M1	PROPOSED TANK LOGO DETAILS
M2	PROPOSED ELEVATED TANK DETAILS 0.25 MG TANK
M3	PROPOSED ELEVATED TANK DETAILS 0.40 MG TANK
M4	MECHANICAL DETAILS 1
M5	MECHANICAL DETAILS 2
M6	MECHANICAL DETAILS 3
E1	ELECTRICAL LEGEND & ABBREVIATION
E2	ONE LINE DIAGRAM - 0.25 AND 0.40 MG TANK
E3	ELECTRICAL OVERALL SITE PLAN – 0.25 AND 0.40 MG TANK
E4	ELECTRICAL ELEVATED TANK DETAILS – 0.25 AND 0.40 MG TANK
E5	ELECTRICAL DETAILS – 0.25 AND 0.40 MG TANK

SUPPLEMENTAL INFORMATION

Texas Government Code Section 2252.002 Non-resident bidders. A governmental entity may not award a governmental contract to a nonresident bidder unless the nonresident underbids the lowest bid submitted by a responsible resident bidder by an amount that is not less than the amount by which a resident bidder would be required to underbid the nonresident bidder to obtain a comparable contract in the state in which the nonresident’s principal place of business is located.

In order to make this determination, please answer the following questions:

1.

Address and phone number of your principal place of business:
2.

Name and address of principal place of business, and phone number of your company’s majority owner:
3.

Name and address of principal place of business, and phone number of your company’s ultimate parent company:

MINORITY/WOMAN-OWNED BUSINESS PARTICIPATION

It is the policy of the City of Lytle to involve small businesses and qualified minority/women-owned businesses to the greatest extent possible in the procurement of goods, equipment, services and construction projects. To assist us in our record keeping, please list below the names of the minority or woman-owned firms you would be utilizing in this bid, and note the monetary involvement:

NAME OF FIRM	TELEPHONE #	\$ INVOLVEMENT

BID FORM

CITY OF LYTLE MULTI-COLUMN ELEVATED WATER STORAGE TANK PROPOSAL I – 250,000 GALLON TANK BID				
ITEM NO.	NO. OF UNITS	UNIT	ITEM AND UNIT PRICE (FILL IN BOTH SCRIPT AND FIGURES)	TOTAL AMOUNT
For furnishing all labor, materials, equipment, and superintendence for the proposed project, including:				
P.I.1.	1	LS	For furnishing the mobilization to the site at project commencement and de-mobilization from the site at project end, as described in these specifications, for the sum of (this line item cost shall not exceed 5% of total proposal amount): Dollars Cents (\$ _____) per lump sum	\$ _____
P.I.2.	1	LS	For furnishing the required Performance and Payment Bonds for the project, as described in these specifications, for the sum of: Dollars Cents (\$ _____) per lump sum	\$ _____
P.I.3.	1	LS	For furnishing and installing 250,000 gallon multi-column (legged) elevated water storage tank , including foundation, support base, steel tank, piping, painting, logos, disinfection, accessories, sitework, driveway/road, electrical, etc., and all other items not described in other Bid Items as detailed in these specifications and as shown on the plans, complete in place ready for use by the Owner, for the sum of: Dollars Cents (\$ _____) per lump sum	\$ _____

CITY OF LYTTLE
MULTI-COLUMN ELEVATED WATER STORAGE TANK
PROPOSAL I – 250,000 GALLON TANK BID

ITEM NO.	NO. OF UNITS	UNIT	ITEM AND UNIT PRICE (FILL IN BOTH SCRIPT AND FIGURES)	TOTAL AMOUNT
For furnishing all labor, materials, equipment, and superintendence for the proposed project, including:				
P.I.4.	1	LS	For furnishing all materials, equipment, labor and superintendence and incidental work to shroud the tank during all blasting and painting work on the tank exterior, as specified and shown on the plans, as detailed in these specifications, complete in place, ready for use by the Owner, for the sum of: _____ _____ Dollars _____ Cents (\$ _____) per lump sum	\$ _____
P.I.5.	1	LS	For furnishing and installing OSHA-required trench excavation protection for piping installation, complete in place, for the sum of: _____ _____ Dollars _____ Cents (\$ _____) per lump sum	\$ _____
P.I.6.	1	LS	For furnishing and installing the exterior colored lighting, electrical wire/conduit, controls, and accessories as detailed in these specifications and as shown on the plans, complete in place, for the sum of: _____ _____ Dollars _____ Cents (\$ _____) per lump sum	\$ _____

CITY OF LYTLE
MULTI-COLUMN ELEVATED WATER STORAGE TANK
PROPOSAL I – 250,000 GALLON TANK BID

ITEM NO.	NO. OF UNITS	UNIT	ITEM AND UNIT PRICE (FILL IN BOTH SCRIPT AND FIGURES)	TOTAL AMOUNT
For furnishing all labor, materials, equipment, and superintendence for the proposed project, including:				
P.I.7.	1	LS	For furnishing and installing intruder-resistant chain link security fencing and gates, as detailed in the plans and specifications, complete in place, for the sum of: _____ _____ Dollars _____ Cents (\$ _____) per lump sum	\$ _____
P.I.8.	1	LS	For furnishing all labor, materials, equipment and superintendence for installing Loaming and Hydroseeding , including watering and acquiring sufficient growth coverage, complete in place, ready for use by the Owner, for the sum of: _____ _____ Dollars _____ Cents (\$ _____) per lump sum	\$ _____
P.I.9.	1	LS	For preparation and maintenance of Storm Water Pollution Prevention Plan (SWP3) including all reports and records, all pollution control devices and measures necessary to maintain and complete the SWP3 plan that are not a separate bid item (including installation, maintenance and removal of such items as required), costs for the Contractor's Notice of Intent application fee costs for the annual Water Quality fee, Costs for personnel to inspect the SWP3's protective measures, costs for all pollution control measures that may be required outside the right-of-way or easement area such as construction staging areas, preparation and submittal of Notice of Termination, submittal of Notice of Change letter (if required), and all other requirements found in the TPDES General Permit No. TXR 150000, for the sum of: _____ _____ Dollars _____ Cents (\$ _____) per lump sum	\$ _____

CITY OF LYTLE
MULTI-COLUMN ELEVATED WATER STORAGE TANK
PROPOSAL I – 250,000 GALLON TANK BID

ITEM NO.	NO. OF UNITS	UNIT	ITEM AND UNIT PRICE (FILL IN BOTH SCRIPT AND FIGURES)	TOTAL AMOUNT
For furnishing all labor, materials, equipment, and superintendence for the proposed project, including:				
TOTAL PROPOSAL I BID (250,000 Gal): (SUMMATION OF ITEMS P.I.1 THROUGH P.I.9) Dollars Cents				\$

**CITY OF LYTTLE
ELEVATED WATER STORAGE TANK
PROPOSAL II – 400,000 GALLON TANK BID**

ITEM NO.	NO. OF UNITS	UNIT	ITEM AND UNIT PRICE (FILL IN BOTH SCRIPT AND FIGURES)	TOTAL AMOUNT
For furnishing all labor, materials, equipment, and superintendence for the proposed project, including:				
P.II.1	1	LS	For furnishing the mobilization to the site at project commencement and de-mobilization from the site at project end, as described in these specifications, for the sum of (this line item cost shall not exceed 5% of total proposal amount): _____ _____ Dollars _____ Cents (\$ _____) per lump sum	\$ _____
P.II.2	1	LS	For furnishing the required Performance and Payment Bonds for the project, as described in these specifications, for the sum of: _____ _____ Dollars _____ Cents (\$ _____) per lump sum	\$ _____
P.II.3	1	LS	For furnishing and installing 400,000 gallon multi-column (legged) elevated water storage tank, including foundation, support base, steel tank, piping, painting, logos, disinfection, accessories, sitework, driveway/road, electrical, etc., and all other items not described in other Bid Items as detailed in these specifications and as shown on the plans, complete in place ready for use by the Owner, for the sum of: _____ _____ Dollars _____ Cents (\$ _____) per lump sum	\$ _____

**CITY OF LYTTLE
ELEVATED WATER STORAGE TANK
PROPOSAL II – 400,000 GALLON TANK BID**

ITEM NO.	NO. OF UNITS	UNIT	ITEM AND UNIT PRICE (FILL IN BOTH SCRIPT AND FIGURES)	TOTAL AMOUNT
For furnishing all labor, materials, equipment, and superintendence for the proposed project, including:				
P.II.4	1	LS	For furnishing all materials, equipment, labor and superintendence and incidental work to shroud the tank during all blasting and painting work on the tank exterior, as specified and shown on the plans, as detailed in these specifications, complete in place, ready for use by the Owner, for the sum of: _____ Dollars _____ Cents (\$ _____) per lump sum	\$ _____
P.II.5	1	LS	For furnishing and installing OSHA-required trench excavation protection for piping installation, complete in place, for the sum of: _____ Dollars _____ Cents (\$ _____) per lump sum	\$ _____
P.II.6	1	LS	For furnishing and installing the exterior colored lighting, electrical wire/conduit, controls, and accessories as detailed in these specifications and as shown on the plans, complete in place, for the sum of: _____ Dollars _____ Cents (\$ _____) per lump sum	\$ _____

**CITY OF LYTTLE
ELEVATED WATER STORAGE TANK
PROPOSAL II – 400,000 GALLON TANK BID**

ITEM NO.	NO. OF UNITS	UNIT	ITEM AND UNIT PRICE (FILL IN BOTH SCRIPT AND FIGURES)	TOTAL AMOUNT
For furnishing all labor, materials, equipment, and superintendence for the proposed project, including:				
P.II.7	1	LS	For furnishing and installing intruder-resistant chain link security fencing and gates, as detailed in the plans and specifications, complete in place, for the sum of: _____ _____ Dollars _____ Cents (\$ _____) per lump sum	\$ _____
P.II.8	1	LS	For furnishing all labor, materials, equipment and superintendence for installing Loaming and Hydroseeding, including watering and acquiring sufficient growth coverage, complete in place, ready for use by the Owner, for the sum of: _____ _____ Dollars _____ Cents (\$ _____) per lump sum	\$ _____
P.II.9	1	LS	For preparation and maintenance of Storm Water Pollution Prevention Plan (SWP3) including all reports and records, all pollution control devices and measures necessary to maintain and complete the SWP3 plan that are not a separate bid item (including installation, maintenance and removal of such items as required), costs for the Contractor's Notice of Intent application fee costs for the annual Water Quality fee, Costs for personnel to inspect the SWP3's protective measures, costs for all pollution control measures that may be required outside the right-of-way or easement area such as construction staging areas, preparation and submittal of Notice of Termination, submittal of Notice of Change letter (if required), and all other requirements found in the TPDES General Permit No. TXR 150000, for the sum of: _____ _____ Dollars _____ Cents (\$ _____) per lump sum	\$ _____

CITY OF LYTLE ELEVATED WATER STORAGE TANK PROPOSAL II – 400,000 GALLON TANK BID				
ITEM NO.	NO. OF UNITS	UNIT	ITEM AND UNIT PRICE (FILL IN BOTH SCRIPT AND FIGURES)	TOTAL AMOUNT
For furnishing all labor, materials, equipment, and superintendence for the proposed project, including:				
TOTAL PROPOSAL II BID (400,000 Gal): (SUMMATION OF ITEMS P.II.1 THROUGH P.II.9) _____ _____ Dollars _____ Cents				 \$ _____

BID SUMMARY	
TOTAL PROPOSAL I BID (250,000 Gal):	\$
TOTAL PROPOSAL II BID (400,000 Gal):	\$

In submitting this Bid, Bidder represents the following:

- a. Bidder has examined copies of these bidding and contract documents and of the following Addenda (receipt of which is hereby acknowledged):

Addenda: _____

Date: _____ Signature: _____

- b. Bidder has familiarized itself with the nature and extent of these documents, and all local conditions and Laws and Regulations that in any manner may affect cost of fulfilling the terms of contract.
- c. Bidder has given the Owner written notice of all conflict, errors, or discrepancies that it has discovered in these documents and the written resolution thereof by the City is acceptable to Bidder.
- d. This Bid is genuine and not made in the interest of or on behalf of any undisclosed person, firm or corporation and is not submitted in conformity with any agreement or titles of any group, association, organization or corporation. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid. Bidder has not solicited or induced any person, firm, or corporation to refrain from bidding. Bidder has not sought by collusion to obtain for itself any advantage over any other bidder or over the City.
- e. Bidder hereby certifies that the bid prices contained in this bid have been carefully reviewed and are submitted as correct and final.
- f. This Bid will remain open and subject to acceptance for sixty (60) days after the day of Bid opening.
- g. As required by Chapter 2270, Government Code, Contractor hereby verifies that it does not boycott Israel and will not boycott Israel through the term of this Agreement. For purposes of this verification, "boycott Israel" means refusing to deal with, terminating business activities with, or otherwise taking any action that is intended to penalize, inflict economic harm on, or limit commercial relations specifically with Israel, or with a person or entity doing business in Israel or in an Israeli-controlled territory, but does not include an action made for ordinary business purposes.
- h. Foreign Terrorists Organizations. Pursuant to Chapter 2252, Texas Government Code, Contractor represents and certifies that, at the time of execution of this Agreement neither Contractor, nor any wholly owned subsidiary, majority-owned subsidiary, parent company or affiliate of the same (i) engages in business with Iran, Sudan, or any foreign terrorist organization as described in Chapters 806 or 807 of the Texas Government Code, or Subchapter F of Chapter 2252 of the Texas Government Code, or (ii) is a company listed by the Texas Comptroller of Public Accounts under Sections 806.051, 807.051, or 2252.153 of the Texas Government Code. The term "foreign terrorist organization" in this paragraph has the meaning assigned to such term in Section 2252.151 of the Texas Government Code.
- i. Bidder further certifies and agrees to furnish any and/or all product/service upon which prices are extended at the price offered; and accepts all of the terms and conditions of the Invitation to Bid, Specifications, Instructions to Bidders, General Conditions for Bidding and any Special Conditions contained herein.
- j. Bidder hereby certifies that, if this bid is accepted, the undersigned Bidder shall enter into a contract with the City of Lytle to furnish the services as specified or indicated in these Bid documents for the price indicated in this Bid and in accordance with the other terms and conditions of such contract documents.

(Signature on next page)

BIDDER:

Company: _____ Date: _____

Signature: _____

Printed Name: _____ Title: _____

Address: _____

City, State & Zip: _____

Telephone Number: _____ Fax: _____

E-mail address: _____

Federal EID #/SSN #: _____

**STATEMENT OF STATUTORY COMPLIANCE
SB 13, 19, 89 & 2116 VERIFICATION FORM**

Pursuant to Senate Bill 13 of the 87th regular Texas Legislature session:

Verification Regarding Boycotting Energy Companies – Pursuant to Chapter 2274, Texas Government Code, Contractor verifies (1) it does not boycott energy companies, and (2) it will not boycott energy companies during the term of this Agreement. Contractor acknowledges this Agreement may be terminated and payment withheld if this verification is inaccurate. (Note: This provision only applies in a contract that (1) has a value of \$100,000 or more that is to be paid wholly or partly from public funds and (2) is with a for-profit entity, not including a sole proprietorship, that has ten (10) or more full-time employees.)

Pursuant to Senate Bill 19 of the 87th regular Texas Legislature session:

Discrimination Against Firearm Entities – In accordance with Texas Government Code Chapter 2274, Contractor verifies that it does not have a practice, policy, guidance, or directive that discriminates against a firearm entity or firearm trade association; and will not discriminate during the term of the contract against a firearm entity or firearm trade association. This section only applies if: (i) Contractor has ten (10) or more full-time employees and (ii) this Agreement has a value of \$100,000 or more to be paid under the terms of this Agreement; and does not apply: (i) if Contractor is a sole proprietor, a non-profit entity, or a governmental entity; (ii) to a contract with a sole-source provider; or (iii) to a contract for which none of the bids from a company were able to provide the required certification.

Pursuant to Senate Bill 2116 of the 87th regular Texas Legislature session:

Section 2274.0102, prohibits a governmental entity from entering into a contract or other agreement relating to “critical infrastructure” (defined to mean a communication infrastructure system, cybersecurity system, electric grid, hazardous waste treatment system, or water treatment facility) in this state with a company if the city knows that the company is: (1) owned by or the majority of stock or other ownership interest of the company is held or controlled by: (a) individuals who are citizens of China, Iran, North Korea, Russia, or other designated countries; or (b) a company or other entity, including a governmental entity, that is owned or controlled by citizens of or is directly controlled by the government of China, Iran, North Korea, Russia, or other designated countries; or (2) headquartered in China, Iran, North Korea, Russia, or other designated countries.

Pursuant to Section 2270.001, 2270.002, 808.001, Texas Government Code:

1. “Boycott Israel” means refusing to deal with, terminating business activities with, or otherwise taking any action that is intended to penalize, inflict economic harm on, or limit commercial relations specifically with Israel, or with a person or entity doing business in Israel or in an Israeli-controlled territory, but does not include an action made for ordinary business purposes; and
2. “Company” has the meaning assigned by Section 808.001, except that the term does not include a sole proprietorship.

I, _____ (*person name*), the undersigned representative of _____ (*company or business name*) _____ (*hereinafter referred to as Company*) being an adult over the age of eighteen (18) years of age, do hereby depose and verify under oath that the company named-above, under the provisions of Subtitle F, Title 10, Government Code Chapter 2270; depose and verify under oath that the Company, under the provisions of Subtitle A, Title 8, Government Code, is amended by adding Chapter 809; do hereby depose and verify under oath that the Company, under the provisions of Subtitle F, Title 10, Government Code, is amended by adding Chapter 2274 will not discriminate and/or boycott any of these provisions outlined and defined in House Bills 13, 19 and 89.

SIGNATURE OF COMPANY REPRESENTATIVE

DATE

On this the ____ day of _____, 2024, personally appeared _____, the above-named person, who after by me being duly sworn, did swear and confirm that the above is true and correct.

NOTARY SEAL

NOTARY SIGNATURE

DATE

REFERENCES

Each Bidder is to provide a minimum of three (3) verifiable commercial business references from which the Bidder has performed work.

1. Company Name: _____

Address: _____

Contact Person: _____

Telephone: _____

Brief description of project: _____

2. Company Name: _____

Address: _____

Contact Person: _____

Telephone: _____

Brief description of project: _____

3. Company Name: _____

Address: _____

Contact Person: _____

Telephone: _____

Brief description of project: _____

SUPPLEMENTAL INFORMATION – CONTRACT DEVELOPMENT

Please provide the following information for contract development.

Is your firm?

1. Sole Proprietorship	☐	YES	☐	NO
2. Partnership	☐	YES	☐	NO
3. Corporation	☐	YES	☐	NO

If company is a sole proprietorship, list the owner's full legal name:

If company is a partnership, list the partner's full legal name(s):

If company is a corporation, list the full legal name as listed on the corporate charter:

Is this firm a minority, or woman-owned business enterprise?

☐ NO ☐ YES If yes, specify (☐) MBE (☐) WBE

Has this firm been certified as a minority/woman-owned business enterprise by any governmental agency? ☐ NO ☐ YES

If yes, specify governmental agency: _____

Date of certification: _____

CONFLICT OF INTEREST QUESTIONNAIRE

CONFLICT OF INTEREST QUESTIONNAIRE		FORM CIQ
	OFFICE USE ONLY	
This questionnaire is being filed in accordance with Chapter 176 of the Local Government Code by a person who has a business relationship as defined by Section 176.001(1-a) with the City of Lytle and the person meets the requirements under Section 176.006(a). By law this questionnaire must be filed with the City Secretary of the City of Lytle not later than the 7th business day after the date the person becomes aware of facts that require the statement to be filed. See Section 176.006, Local Government Code. A person commits an offense if the person knowingly violates Section 176.006, Local Government Code. An offense under this section is a Class C misdemeanor.	Date Received:	
1. Name of person who has a business relationship with the City of Lytle.		
2. ☐ Check this box if you are filing an update to a previously filed questionnaire. (The law requires that you file an updated completed questionnaire with the City Secretary not later than the 7th business day after the date the originally filed questionnaire becomes incomplete or inaccurate.)		
3. Name of local government officer with whom filer has employment or other business relationship. Name of Officer This section must be completed for each officer with whom the filer has an employment or other business relationship as defined by Section 176.001(1-a), Local Government Code. Attach additional pages to this Form CIQ as necessary. Is the local government officer named in this section receiving or likely to receive taxable income, other than investment income, from the filer of questionnaire? Yes _____ No _____ A. Is the filer of the questionnaire receiving or likely to receive taxable income, other than investment income, from or at the direction of the local government officer named in this section AND the taxable income is not from the City of Lytle? Yes _____ No _____ B. Is the filer of this questionnaire employed by a corporation or other business entity with respect to which the local government officer serves as an officer or director, or holds an ownership of 10 percent or more? Yes _____ No _____ C. Describe each employment or business relationship with the local government officer named in this section.		
4. _____ Signature of person doing business with the government entity _____ Date		

FORM 1295

CONFLICT OF INTERESTED PARTIES

FORM 1295

Complete Nos. 1 - 4 and 6 if there are interested parties.
Complete Nos. 1, 2, 3, 5, and 6 if there are no interested parties.

OFFICE USE ONLY

1 Name of business entity filing form, and the city, state, and country of the business entity's place of business

2 Name of governmental entity or state agency that is a party to the contract for which the form is being filed.

3 Provide the identification number used by the governmental entity or state agency to track or identify the contract and provide a description of the goods or services to be provided under the contract.

4	Name of Interested Party	City, State, Country place of business,	Nature of Interest (check applicable)	
			Controlling	Intermediary

5 Check only if there is NO Interested Party. ☐

6 AFFIDAVIT

I swear, or affirm, under penalty of perjury, that the above disclosure is true and correct.

Signature of authorized agent of contracting business entity

AFFIX NOTARY STAMP / SEAL ABOVE

Sworn to and subscribed before me, by the said _____, this the _____ day of _____, 20 _____, to certify which, witness my hand and seal of office.

Signature of officer administering oath

Printed name of officer administering oath

Title of officer administering oath.

STATEMENT OF BIDDER'S QUALIFICATIONS

All questions must be answered, and the data given must be clear and comprehensive. This statement must be notarized. If necessary, questions may be answered on separate attached sheets. The Bidder may submit any additional information they desire.

Name of Bidder: _____ Date Organized: _____

Address: _____ Date Incorporated: _____

Number of Years in contracting business under present name: _____

CONTRACTS ON HAND:

Contract	Amount \$	Completion Date
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Type of work performed by your company: _____

Have you ever failed to complete any work awarded to you? _____

Have you ever defaulted on a contract? _____

List the projects most recently completed by your firm (include project of similar importance):

Project	Amount \$	Mo/Yr Completed
_____	_____	_____
_____	_____	_____
_____	_____	_____

Major equipment available for this contract: _____

Attach resume(s) for the principal member(s) of your organization, including the officers as well as the proposed superintendent for the project.

Credit available: \$ _____ Bank reference: _____

(Signature on next page)

The undersigned hereby authorized and requests any person, firm, or corporation to furnish any information requested by the _____ in verification of the recitals comprising this Statement of Bidder's Qualifications.

Executed this _____ day of _____ 2024

By: (signature) _____ Title: _____

(print name) _____

**FORM CONTRACT
AGREEMENT FOR PROJECT**

COUNTY OF ATASCOSA

STATE OF TEXAS

**§ AGREEMENT BETWEEN THE
§ CITY OF LYTLE, TEXAS
§ AND _____
§ FOR ELEVATED WATER STORAGE TANK
§ CSB - #2024-08-04**

This Agreement is made and entered into by and between the City of Lytle, Texas, a municipal corporation situated in Atascosa County, Texas ("City") and _____, ("Contractor") hereinafter identified.

I. SCOPE OF WORK

Contractor shall provide all supervision, labor, materials and equipment necessary for the project identified as City of Lytle Elevated Water Storage Tank, COMPETITIVE SEALED BID – #2024-08-04 (hereinafter "Work"). Such Work shall be performed in accordance with the terms and conditions of the City's Specifications for same, a copy of which is attached hereto and incorporated herein for all purposes as Exhibit "A", and the Contractor's Proposal in response thereto, (hereinafter "Contractor's Proposal"), a copy of which is attached hereto and incorporated herein for all purposes as Exhibit "B". The Contract consists of the following:

- a) This Contract by and between the City and Contractor (hereinafter "Contract");
- b) The City's Specifications for the Work
- c) The Contractor's Proposal dated _____
- d) The Contractor's Payment Bond for the Work
- e) The contractor's Performance Bond for the Work
- f) Construction Schedule Established for the Work.

In the event there exists a conflict between any of the terms, clauses, or phrases in the foregoing documents, priority of interpretation shall be in the following order: this Contract, COMPETITIVE SEALED BID, and Contractor's Proposal. These documents shall be referred to collectively as "Contract Documents."

II. SCHEDULE FOR COMPLETION / LIQUIDATED DAMAGES / DELAYS

SCHEDULE FOR COMPLETION. Prior to starting Work, the Contractor and the City shall meet to develop a Construction Schedule for the Work pursuant to Scope of Work and Special Conditions contained in the contract documents. The Construction Schedule shall be signed by the Contractor and the City and become a part of this Contract. The Contractor shall submit any major revisions to the approved Construction Schedule as the Work progresses to the City for review. The approved Construction Schedule may only be modified upon the written approval of City. A written notice to proceed will be issued to the Contractor by the City for the Work. The Work to be performed under this Contract shall be commenced within ten (10) calendar days after the date the written notice to proceed for a particular street has been issued to Contractor by the City. Contractor shall sign on the notice to proceed that acknowledges their agreement to the

number of days established by the Construction Schedule. Contractor shall fully complete the entire Scope of Work to the satisfaction of the City within **400** calendar days after the date of the first written notice to proceed has been issued by the City.

LIQUIDATED DAMAGES. The parties acknowledge that adherence by Contractor to the approved Construction Schedule and times set forth herein for completion of the Project is essential to this Contract. It is agreed by the parties that the actual damages which might be sustained by City by reason of the breach by Contractor of its promise to timely complete the Work in accordance with the provisions hereof are uncertain and would be difficult to ascertain. It is further agreed that the sum of one thousand dollars (\$1,000.00) for each day that completion of the Project or any portion of the Work is overdue according to the Construction Schedule would be reasonable and just compensation for such breach, and Contractor hereby promises to pay such sum as liquidated damages, and not as a penalty, in the event of such breach. Any liquidated damages shall be deducted from Contractor's final payment under this Contract.

DELAYS. The Contractor shall be entitled to an extension of time specified in the Construction Schedule under this Contract only when claim for such extension is submitted to the City in writing by the Contractor within seven (7) calendar days from and after the time when any alleged cause of delay shall occur; and then only when such extension of time is approved by the City. In adjusting the Contract working time for the completion of the Work, unforeseeable causes defined herein shall be taken into consideration. No allowances shall be made for delays or suspension of the performance of the Work due to the fault of the Contractor. Unforeseeable Cause is defined as:

- a) An act of God in the form of unusually severe weather conditions, including storms, flood, fire or similar event, that could not have been anticipated or guarded against and which materially affects the work site, including access or egress thereto; or
- b) A riot or war situation actually involving the site or actually preventing the Contractor from working on the site, but not including any situation involving suppliers off-site other than those essential suppliers as identified to City.

No event shall be deemed an Unforeseeable Cause for the purposes of this Contract unless it actually and directly necessitates a delay in the Work which could not be otherwise remedied by taking reasonably prudent steps, and the Contractor could not reasonably adjust the schedule of the remaining Work to deal with, make up for, or otherwise work around the delays resulting from the Unforeseeable Cause(s).

Notwithstanding any other term contained in the Contract Documents, no adjustment to working time shall be made if, concurrently with the equitable cause for delay, there existed a cause for delay due to the fault or negligence of the Contractor, his agents, employees or subcontractors; and no adjustment shall be made to the Contract price and the Contractor shall not be entitled to claim or receive any additional compensation as a result of or arising out of any delay resulting in adjustment to the working time hereunder, including delays caused by the acts or negligence of the City. Notwithstanding any other provision of the Contract Documents, all claims for extension of working time must be submitted in accordance with the terms specified in the Contract Documents, and no act of the City shall be deemed a waiver or entitlement of such extension.

III. CONTRACT PRICE

Compensation for Work satisfactorily performed hereunder shall be in an amount not to exceed the sum of _____ (\$_____). City shall issue progress payments in accordance with the terms of this Contract.

IV. PROGRESS PAYMENTS

Progress payments for Work completed shall be paid in the following manner: Percentage of completion for materials and labor satisfactorily completed on a monthly basis: ninety (90%) percent of amount billed with ten (10%) percent retained until the entire Contract is completed. Contractor shall furnish City with appropriate documentation evidencing Contractor's payment for all work performed or materials provided by subcontractors. If Contractor is unable to produce such documentation evidencing payment, City may withhold that portion of the payment due to such subcontractor(s), without penalty, until Contractor provides documentation evidencing to City that Contractor has paid all such costs and that there is no existing claim by such subcontractors.

The final payment request from Contractor shall include the release of ten percent (10%) retainage and shall be submitted to the City upon final completion and acceptance of the Work.

Release of Liens. A partial release of liens must be provided with each payment application. A final release of liens must be provided to the City by the Contractor for the entire Work prior to release of the final ten percent (10%) retainage.

V. GENERAL PROVISIONS

QUALITY OF WORK. All Work shall be completed in a workman-like manner to the satisfaction of City and in compliance with all codes, ordinances, and other applicable federal, state, and local laws. Contractor shall be responsible for initial core testing of the Work. However, if any section of the Work fails such core testing, Contractor shall be required to tear out and replace such failing sections of the Work at its sole expense any and all costs associated with retesting such failing sections of the Work. Upon satisfactory completion of all Work hereunder as determined by City and prior to payment of final invoice by City, Contractor shall provide City with a release of all liens and waiver of claims from subcontractors. Contractor's requirement to provide such release shall be a condition precedent to City's remittance of final payment under this Contract.

PLAN AND SCALE DRAWING. The Contractor shall utilize the construction plans and drawings furnished by City to complete the Work.

LICENSES REQUIRED. To the extent required by law, all Work shall be performed by individuals duly licensed and authorized by law to perform such Work. The City specifically prohibits the use of subcontractors without written authorization. In the event Contractor receives written authorization from the City to engage subcontractors to perform Work hereunder, Contractor shall fully pay such subcontractor and in all instances remain responsible for the proper completion of the Work hereunder.

CHANGE ORDERS. All change orders shall be in writing and signed by the project Engineer, City and Contractor and shall be incorporated in and become part of the Contract Documents.

INSURANCE. Contractor warrants that it has obtained and will maintain throughout the duration of the Work, insurance covering injury to its employees and third parties, including coverage for bodily injury and property damage resulting from, related to or arising out of Contractor's Work. Such insurance shall cover acts and omissions of Contractor, its employees, agents, and subcontractors. Contractor shall provide a certificate of insurance showing the City as additional insured and providing such types and amounts of coverage as required in the City's Specifications for the Work attached hereto as Exhibit "A". Such certificate of insurance shall provide that the City is to receive thirty (30) days written notice of cancellation.

PERMITS. Contractor shall at its own expense obtain all permits necessary for the Work to be performed.

REMOVAL OF DEBRIS. Contractor agrees to remove all debris and leave the premises in a clean condition acceptable to the City.

DAMAGES. Contractor shall make every reasonable effort to protect the work area from loss or damage. Any portion of the work area damaged by Contractor during the course of the Work must be repaired by Contractor at no additional cost to the City. Damages shall include, but not be limited to, any damage caused by the Contractor to fences, yards, shrubs, or open public spaces. Any repair work shall match the existing condition of the items and area damaged.

DISPUTE RESOLUTION. The parties agree that they shall first attempt to resolve disputes hereunder by the use of non-binding mediation.

WARRANTY. Contractor warrants all Work for a period of twenty-four (24) months following the date of final acceptance of the Work by the City.

TERMINATION. City may terminate this Contract upon ten (10) days prior written notice to Contractor.

TAXES. The Contractor shall pay sales, consumer, use, and similar taxes that are legally required when the Contract is executed.

SAFETY. The Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs, including all those required by law in connection with performance of the Contract. The Contractor shall promptly remedy damages and loss to property caused in whole or in part by the Contractor, its employees, agents, subcontractors, or by any other third party for whose acts the Contractor may be liable.

VENUE. The laws of the State of Texas shall govern the interpretation, validity, performance and enforcement of this Contract. The parties agree that this Contract is performable in Atascosa County, Texas, and that exclusive venue shall lie in Atascosa County, Texas.

INDEPENDENT CONTRACTOR. Contractor covenants and agrees that Contractor is an independent contractor and not an officer, agent, servant or employee of City; that Contractor shall have exclusive control of and exclusive right to control the details of the Work performed hereunder and all persons performing same, and shall be responsible for the acts and omissions of its officers, agents, employees, contractors, subcontractors and consultants and shall indemnify City from all claims and damages resulting from this Work; that the doctrine of respondent superior shall not apply as between City and Contractor, its officers, agents, employees, contractors, subcontractors and consultants, and nothing herein shall be construed as creating a partnership or joint enterprise between City and Contractor.

SEVERABILITY. The provisions of this Contract are severable. If any paragraph, section, subdivision, sentence, clause, or phrase of this Contract is for any reason held to be contrary to the law or contrary to any rule or regulation having the force and effect of the law, such decisions shall not affect the remaining portions of the Contract. However, upon the occurrence of such event, either party may terminate this Contract by giving the other party thirty (30) days written notice.

ENTIRE AGREEMENT. This Contract and its attachments embody the entire agreement between the parties and may only be modified in writing if executed by both parties.

CONTRACT INTERPRETATION. Although this Contract is drafted by City, should any part be in dispute, the parties agree that the Contract shall not be construed more favorably for either party.

SUCCESSORS AND ASSIGNS. This Contract shall be binding upon the parties hereto, their successors, heirs, personal representatives and assigns.

HEADINGS. The headings of this Contract are for the convenience of reference only and shall not affect in any manner any of the terms and conditions hereof.

IN WITNESS WHEREOF, the parties have executed this Contract by signing below. The effective date of this Contract shall be the date of City Council approval.

CITY OF LYTLE, TEXAS

By: _____

Printed Name: _____

Title: Mayor _____

Date: _____

ATTEST:

Paola L. Rios
City Secretary

CONTRACTOR

By: _____

Printed Name: _____

Title: _____

Date: _____

ATTEST:

Corporate Secretary

BID BOND

KNOW ALL MEN BY THESE PRESENTS, that we the undersigned, _____
as PRINCIPAL, and _____, as SURETY are held and firmly
bound unto hereinafter called the "Owner", in the penal sum of Dollars, (\$_____), lawful
money of the United States, for the payment of which sum well and truly to be made, we bind
ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally,
firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the Principal has submitted the
Accompanying Bid, dated _____, for _____

NOW, THEREFOR, if the Principal shall not withdraw said Bid within the period specified therein
after the opening of the same, or, if no period be specified, within thirty (30) days after the said
opening, and shall within the period specified therefor, or if no period be specified, within ten (10)
days after the prescribed forms are presented to him for signature, enter into a written contract
with the Owner in accordance with the Bid as accepted, and give bond with good and sufficient
surety or sureties, as may be required, for the faithful performance and proper fulfillment of such
contract; or in the event of the withdrawal of said Bid within the period specified, or the failure to
enter into such Contract and give such bond within the time specified, if the Principal shall pay
the Owner the difference between the amount specified in said Bid and the amount for which the
local Public Agency may procure the required work or supplies or both, if the latter be in excess
of the former, then the above obligation shall be void and of no effect, otherwise to remain in full
force and virtue.

IN WITNESS THEREOF, the above-bounded parties have executed this instrument under their
several seals this _____ day of _____, the name and corporate seal of
each corporate party being hereto affixed and these present signed by its undersigned
representative, pursuant to authority of its governing body.

Attest: _____ By: _____
Affix
Corporate
Seal

Attest: _____ By: _____
Affix
Corporate
Seal

Attest: _____ By: _____
Affix
Corporate
Seal

Countersigned
By: _____
* Attorney-in Fact, State _____

PAYMENT BOND

STATE OF TEXAS

CITY OF LYTLE, ATASCOSA COUNTY

KNOW ALL MEN BY THESE PRESENTS: That _____
_____ of the City of _____, County of _____,
and State of _____, as Principal, and _____
authorized under the laws of the State of Texas to
act as Surety on bonds for Principals, are held and firmly bound unto City of Lytle (Owner) in the
penal sum of _____ Dollars
(\$_____), for the payment whereof, the said Principal and Surety bind
themselves and their heirs, administrators, executors, officers, directors, shareholders, partners,
successors and assigns, jointly and severally, by these presents.

WHEREAS, the Principal has entered into a certain written contract with the Owner, dated
the _____ day of _____, 2024, for

PROJECT TITLE
COMPETITIVE SEALED BID – #2024-08-04
CITY OF LYTLE, ATASCOSA COUNTY, TEXAS

which contract is hereby referred to and made a part hereof as fully and to the same extent as if
copied at length herein.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH that if the said
Principal shall pay all claimants supplying labor and material to him or a subcontractor in the
prosecution of the work provided for in said contract, then, this obligation shall be void; otherwise
to remain in full force and effect. Provided, however, that this bond is executed pursuant to
provisions of Chapter 2253, Texas Government Code as amended and all liabilities on this bond
shall be determined in accordance with provisions of said Article to same extent as if it were
copied at length herein.

Surety, for value received, stipulates and agrees that no change, extension of time,
alteration or addition to the terms of the contract, or to the work performed thereunder, or the
documents, plans, specifications or drawings accompanying the same, shall in anywise affect its
obligation on this bond, and it does hereby waive notice of any such change, extension of time,
alteration or addition to the terms of the contract or to the work to be performed thereunder.

IN WITNESS WHEREOF, the said Principal and Surety have signed and sealed this instrument this _____ day of _____, 2024.

Principal _____

Surety _____

By _____

By _____

Name _____

Name _____

Title _____

Title _____

Address _____

Address _____

Email Address _____

Telephone _____

The name and address of the Resident Agent of Surety is:

Telephone _____

Note: Bond shall be issued by a solvent Surety company authorized to do business in Texas and shall meet any other requirements established by law or by Owner pursuant to applicable law. A copy of surety agent's "Power of Attorney" must be attached hereto.

PERFORMANCE BOND

STATE OF TEXAS

CITY OF LYTLE, ATASCOSA COUNTY

KNOW ALL MEN BY THESE PRESENTS: That _____
_____ of the City of _____, County of
_____, and State of _____, as Principal, and

authorized under the laws of the State of Texas to act as Surety on bonds for Principal, are held
and firmly bound unto City of Lytle (Owner) in the penal sum of
_____ Dollars (\$_____),
for the payment whereof, the said Principal and Surety bind themselves and their heirs,
administrators, executors, officers, directors, shareholders, partners, successors and assigns,
jointly and severally, by these presents.

WHEREAS, the Principal has entered into a certain written contract with the Owner, dated
the _____ day of _____, 2024, for

PROJECT TITLE
COMPETITIVE SEALED BID – #2024-08-04
CITY OF LYTLE, ATASCOSA COUNTY, TEXAS

which contract is hereby referred to and made a part hereof as fully and to the same extent as if
copied at length herein.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH, that if the said
Principal shall faithfully perform said Contract and shall in all respects fully and faithfully observe
and perform all and singular the covenants, conditions and agreements in and by said Contract
agreed and covenanted by the Principal to be observed and performed during the original term of
the Contract and any extensions thereof that may be granted by Owner, and during the life of any
guaranty or warranty required under the Contract, and according to the true intent and meaning
of said Contract and the Contract Documents and the Plans and Specifications related thereto,
then this obligation shall be void; otherwise to remain in full force and effect. Provided, however,
that this bond is executed pursuant to provisions of Chapter 2253, Texas Government Code as
amended and all liabilities on this bond shall be determined in accordance with provisions of said
Article to same extent as if it were copied at length herein.

Surety, for value received, stipulates and agrees that no change, extension of time, alteration or
addition to the terms of the Contract, or to the work performed thereunder, or the plans,
specifications, or drawings accompanying the same, shall in anywise affect its obligation on this
bond, and it does hereby waive notice of any such change, extension of time, alteration or addition
to the terms of the contract, or to the work to be performed thereunder.

IN WITNESS WHEREOF, the said Principal and Surety have signed and sealed this instrument this _____ day of _____, 2024.

Principal

Surety

By _____

By _____

Name _____

Name _____

Title _____

Title _____

Address _____

Address _____

Email Address _____

Telephone _____

The name and address of the Resident Agent of Surety is:

Telephone _____

Note: Bond shall be issued by a solvent Surety company authorized to do business in Texas and shall meet any other requirements established by law or by Owner pursuant to applicable law. A copy of surety agent's "Power of Attorney" must be attached hereto.

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APPENDIX

Appendix A – Geotechnical Report

Appendix B – FAA Determination Letters

Appendix C – Temporary Construction Easements

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PREVAILING WAGE SCALE

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Superseded General Decision Number: TX20230007

State: Texas

Construction Types: Heavy and Highway

Counties: Atascosa, Bandera, Bastrop, Bell, Bexar, Brazos, Burleson, Caldwell, Comal, Coryell, Guadalupe, Hays, Kendall, Lampasas, McLennan, Medina, Robertson, Travis, Williamson and Wilson Counties in Texas.

HEAVY (excluding tunnels and dams, not to be used for work on Sewage or Water Treatment Plants or Lift / Pump Stations in Bell, Coryell, McClellon and Williamson Counties) and HIGHWAY Construction Projects

Note: Contracts subject to the Davis-Bacon Act are generally required to pay at least the applicable minimum wage rate required under Executive Order 14026 or Executive Order 13658. Please note that these Executive Orders apply to covered contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but do not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(1).

If the contract is entered into on or after January 30, 2022, or the contract is renewed or extended (e.g., an option is exercised) on or after January 30, 2022:	. Executive Order 14026 generally applies to the contract. . The contractor must pay all covered workers at least \$17.20 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in 2024.
If the contract was awarded on or between January 1, 2015 and January 29, 2022, and the contract is not renewed or extended on or after January 30, 2022:	. Executive Order 13658 generally applies to the contract. . The contractor must pay all covered workers at least \$12.90 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on that contract in 2024.

The applicable Executive Order minimum wage rate will be adjusted annually. If this contract is covered by one of the Executive Orders and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must still submit a conformance request.

Additional information on contractor requirements and worker protections under the Executive Orders is available at

<http://www.dol.gov/whd/govcontracts>.

Modification Number	Publication Date
0	01/05/2024

SUTX2011-006 08/03/2011

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER (Paving and Structures).....	\$ 12.56	**
ELECTRICIAN.....	\$ 26.35	
FORM BUILDER/FORM SETTER Paving & Curb.....	\$ 12.94	**
Structures.....	\$ 12.87	**
LABORER Asphalt Raker.....	\$ 12.12	**
Flagger.....	\$ 9.45	**
Laborer, Common.....	\$ 10.50	**
Laborer, Utility.....	\$ 12.27	**
Pipelayer.....	\$ 12.79	**
Work Zone Barricade Servicer.....	\$ 11.85	**
PAINTER (Structures).....	\$ 18.34	
POWER EQUIPMENT OPERATOR: Agricultural Tractor.....	\$ 12.69	**
Asphalt Distributor.....	\$ 15.55	**
Asphalt Paving Machine.....	\$ 14.36	**
Boom Truck.....	\$ 18.36	
Broom or Sweeper.....	\$ 11.04	**
Concrete Pavement Finishing Machine.....	\$ 15.48	**
Crane, Hydraulic 80 tons or less.....	\$ 18.36	
Crane, Lattice Boom 80 tons or less.....	\$ 15.87	**
Crane, Lattice Boom over 80 tons.....	\$ 19.38	
Crawler Tractor.....	\$ 15.67	**
Directional Drilling Locator.....	\$ 11.67	**
Directional Drilling Operator.....	\$ 17.24	
Excavator 50,000 lbs or Less.....	\$ 12.88	**
Excavator over 50,000 lbs...	\$ 17.71	
Foundation Drill, Truck Mounted.....	\$ 16.93	**
Front End Loader, 3 CY or Less.....	\$ 13.04	**
Front End Loader, Over 3 CY.	\$ 13.21	**
Loader/Backhoe.....	\$ 14.12	**
Mechanic.....	\$ 17.10	**
Milling Machine.....	\$ 14.18	**
Motor Grader, Fine Grade....	\$ 18.51	
Motor Grader, Rough.....	\$ 14.63	**
Pavement Marking Machine....	\$ 19.17	
Reclaimer/Pulverizer.....	\$ 12.88	**

Roller, Asphalt.....\$ 12.78 **
Roller, Other.....\$ 10.50 **
Scraper.....\$ 12.27 **
Spreader Box.....\$ 14.04 **
Trenching Machine, Heavy....\$ 18.48

Servicer.....\$ 14.51 **

Steel Worker

Reinforcing.....\$ 14.00 **
Structural.....\$ 19.29

TRAFFIC SIGNALIZATION:

Traffic Signal Installation

Traffic Signal/Light Pole
Worker.....\$ 16.00 **

TRUCK DRIVER

Lowboy-Float.....\$ 15.66 **
Off Road Hauler.....\$ 11.88 **
Single Axle.....\$ 11.79 **
Single or Tandem Axle Dump
Truck.....\$ 11.68 **
Tandem Axle Tractor w/Semi
Trailer.....\$ 12.81 **

WELDER.....\$ 15.97 **

WELDERS - Receive rate prescribed for craft performing
operation to which welding is incidental.

=====
** Workers in this classification may be entitled to a higher
minimum wage under Executive Order 14026 (\$17.20) or 13658
(\$12.90). Please see the Note at the top of the wage
determination for more information. Please also note that the
minimum wage requirements of Executive Order 14026 are not
currently being enforced as to any contract or subcontract to
which the states of Texas, Louisiana, or Mississippi, including
their agencies, are a party.

Note: Executive Order (EO) 13706, Establishing Paid Sick Leave
for Federal Contractors applies to all contracts subject to the
Davis-Bacon Act for which the contract is awarded (and any
solicitation was issued) on or after January 1, 2017. If this
contract is covered by the EO, the contractor must provide
employees with 1 hour of paid sick leave for every 30 hours
they work, up to 56 hours of paid sick leave each year.
Employees must be permitted to use paid sick leave for their
own illness, injury or other health-related needs, including
preventive care; to assist a family member (or person who is
like family to the employee) who is ill, injured, or has other
health-related needs, including preventive care; or for reasons
resulting from, or to assist a family member (or person who is
like family to the employee) who is a victim of, domestic
violence, sexual assault, or stalking. Additional information
on contractor requirements and worker protections under the EO
is available at
<https://www.dol.gov/agencies/whd/government-contracts>.

Unlisted classifications needed for work not included within
the scope of the classifications listed may be added after
award only as provided in the labor standards contract clauses

(29CFR 5.5 (a) (1) (iii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of ""identifiers"" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than ""SU"" or ""UAVG"" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the ""SU"" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date

for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

- * an existing published wage determination
- * a survey underlying a wage determination
- * a Wage and Hour Division letter setting forth a position on a wage determination matter
- * a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour National Office because National Office has responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISION"

SECTION 01 03 00
SPECIAL INSTRUCTIONS

PART 1 - GENERAL

1.01 TRAFFIC CONTROL

- A. The CONTRACTOR will be responsible for furnishing and using all barricades, warning lights, signs, etc. necessary to protect his work and maintain traffic flow satisfactory to the OWNER, ENGINEER, and TxDOT (if applicable). Warning devices shall be as required in the Texas Manual on Uniform Traffic Control Devices. Construction shall be scheduled to cause the least amount of disruption to traffic. All work scheduling shall be coordinated with the City or County staff, and be approved by the City or County staff before work can proceed. No separate payment will be made for traffic control required to be added to the project to address health and safety issues.
- B. Traffic Control plans and details provided (if applicable) in the plans are to show a minimum expectation required by the CONTRACTOR and may not cover all specific construction means and methods proposed by the CONTRACTOR. Alternate plans may be presented for approval by the OWNER and ENGINEER by the CONTRACTOR. All plans shall be sealed by a professional engineer registered in the State of Texas. The OWNER or ENGINEER may require additional warning devices be installed at any time on the project to address health and safety issues at no additional cost to the OWNER.

1.02 STAKING FOR CONSTRUCTION

- A. The CONTRACTOR will provide all construction staking services for the project. The cost of these services will be reflected in the unit price amount in the bid form. No separate payment will be made.
- B. TRC Engineers, Inc. provided topographical surveying services for the design portion of this project. Information to the CONTRACTOR for construction staking may be available from TRC Engineers, Inc.

1.03 WATER

- A. Water required for water jetting, flooding, testing and construction will be provided by OWNER at no cost to the CONTRACTOR. The CONTRACTOR shall provide temporary water piping, valves, transportation, etc. to the project location as required. Contractor shall INSTALL meter on City main to account for water use.

1.04 POWER FOR CONSTRUCTION

- A. The electrical service to the site will be provided by the CONTRACTOR. The CONTRACTOR shall furnish and install all necessary temporary wiring, and furnish and install area distribution boxes so located that the individual trades may use their own construction type extension cords to obtain adequate power and artificial lighting at all points where required by inspectors and for safety. All necessary permits shall be acquired by the CONTRACTOR.
- B. Each consecutive priority item shall be completed as soon as possible. This is not to preclude work on lesser priority items if there are long lead delivery requirements on materials for the

higher priority items. However, as materials become available, the higher priority item shall be completed first.

1.05 SUBMITTAL DATA

A. Submittal Procedure

1. The CONTRACTOR shall furnish Submittals for any and all such parts of the work and equipment as set forth in the specifications and indicated on the plans. The procedures for review of the submittals shall be as follows:
 - a. The CONTRACTOR shall submit to the ENGINEER for his review, four (4) prints of drawings, plus whatever number of prints the CONTRACTOR desires to be returned to himself. The submitted prints shall be accompanied by a letter of transmittal, in duplicate of drawings, titles, and other requirements. The letter of transmittal shall be of the form supplied by or approved by the ENGINEER. If advance approval is obtained by OWNER and ENGINEER, electronic submission of certain submittals may be acceptable.
 - b. When a drawing is satisfactory to the ENGINEER, the number of prints the CONTRACTOR desires returned to him will be stamped or marked, "No Exceptions Taken" or "Make Corrections Noted", will be dated, and will be returned to the CONTRACTOR by letter.
 - c. Should a drawing be unsatisfactory to the Engineer, he will stamp thereon "Revise and Resubmit", or "Rejected", and will return one (1) or more copies thereof to the CONTRACTOR with the necessary corrections and changes indicated. The CONTRACTOR must make such corrections and changes, and again submit at least four (4) prints of the drawings for approval. The CONTRACTOR shall revise and resubmit the working drawings, as required by the ENGINEER, until satisfactory review thereof is obtained.
 - d. The CONTRACTOR shall allow sufficient time for preliminary review, correction, and resubmission, and final review of all working (shop) drawings. The CONTRACTOR should allow not less than fourteen (14) days for each review. Drawings of items critical to job progress, when requested in writing by the CONTRACTOR, will be given priority review.

B. Submittal Format

1. Submittals shall be printed on heavy, first quality paper, 8-1/2" x 11" size with standard 3-hole punching. If pre-approved, electronic submittals may be acceptable. Drawings and diagrams shall be reduced to 8-1/2" x 11" or 11" x 17".
2. All materials and equipment submitted for review shall meet the following criteria: Each sheet of descriptive literature submitted shall be marked by the CONTRACTOR to identify the material or equipment as follows:
 - a. Equipment and materials descriptive literature and drawings shall show the specification paragraph for which the equipment applies, and shall list equipment tag numbers applicable.

- b. Submittal sheets or drawings showing more than the particular item under consideration shall have crossed out all but the pertinent description of the item for which review is requested.
- c. Equipment and materials descriptive literature not readily cross-referenced with the drawings or specifications shall be identified by a suitable notation.

C. Submittal Content

- 1. The submittals shall show that all requirements of the specification section have been met. The submittals shall contain the following information as applicable:
 - a. Equipment, function, normal operating characteristics, and limiting conditions.
 - b. Assembly, installation, alignment, adjustment, and checking instructions.
 - c. Outline, cross-section, and assembly drawings; engineering data; and wiring diagrams.
 - d. Test data and performance curves, where applicable.
 - e. The operational and maintenance manual for the equipment item and/or system as designated elsewhere within these specifications shall be submitted.
 - f. Working Drawings
 - 1) Items for which working drawings are required include, but are not limited to, the non-equipment items listed in Table 1, and as set forth elsewhere within these specifications.
 - 2) The drawings shall be numbered consecutively and shall accurately and distinctly present the following:
 - a) All working and erection dimensions.
 - b) Arrangement and sectional views.
 - c) Necessary details, including complete information for making connections between functional parts.
 - d) Kinds of materials and finishes.
 - e) Parts list and description thereof.
 - 3) Each drawing shall be dated and shall bear the name of the project, names of equipment or materials, and the location where the equipment or materials are to be installed in the project. The Engineer may decline to consider any working drawings, which do not contain complete data on the work and full information on related matters.
 - 4) If working drawings show departures from the contract requirements, the CONTRACTOR shall make specific mention thereof in a letter attached to

the submittal form; otherwise, review of such submittals will not constitute acceptance of the departure from the contract.

- 5) No Work called for by working drawings shall be initiated until the said drawings have been accepted by the ENGINEER.

PART 2 - WATER ITEMS

2.01 MATERIALS FOR WATER MAIN CONSTRUCTION

- A. All pipe, fittings, and valves shall be new. All water pipe shall be approved by the Underwriters laboratories for fire protection, approved by the National Sanitation Foundation and installed according to manufacturer's specifications and SECTION 33 05 32 – WATER MAIN CONSTRUCTION of these specifications.
- B. All fittings and valves for WATER MAIN CONSTRUCTION shall be mechanical joint or as specified on the plans.

2.02 WATER MAIN – RESTRAINED JOINTS

- A. All fittings for the proposed water main projects shall include meg-a-lug restrained joints. This shall include valves and fire hydrants.

2.03 WATER LINE DISINFECTION

- A. The CONTRACTOR's unit price bid costs shall include the services of a certified laboratory to perform the "Bac-T" tests for the newly installed water mains/services. The sample shall be acquired by a direct employee of the lab. Samples acquired by the CONTRACTOR will not be acceptable. Sampling and testing shall meet all requirements of TCEQ. The Owner's representative will be notified of when the sample will be acquired. The CONTRACTOR shall submit the name of the laboratory to the ENGINEER for approval. There will be no separate pay for these services.

2.04 ABANDONMENT OF EXISTING WATER LINES

- A. The project will parallel several existing water lines. It will be the CONTRACTOR's responsibility to take these existing water lines out of service, whether or not the lines to be abandoned are indicated on the plans. The CONTRACTOR shall plug the existing lines to be abandoned with an approved fitting. This work shall be deemed incidental to the project. No separate payment will be made.

2.05 ADJUSTING EXISTING MANHOLES AND VALVE COVERS

- A. The CONTRACTOR will adjust all existing manholes (to include telephone, electrical, sanitary sewer or other), valve covers (to include water, gas, or other) within the construction area to meet the grade of the finished elevation. The following procedure will be followed where the valve or manhole is in an area that is to be excavated and new base material installed or existing base material re-constructed:
 1. Locate and accurately tie down by measurements from identifiable objects (such as power poles, fire hydrants, fences, etc.) all existing manholes and valve covers for future use.

2. Remove and lower existing manholes and valve boxes to an elevation below the finished subgrade. The depths on manholes shall be sufficient that on reconstruction, the manhole shall be low enough to provide an adequate cone section and manhole ring and cover.
3. A steel plate of sufficient size shall be placed over the open manhole and/or box riser at subgrade elevation.
4. Placement and compaction of all crushed stone base material shall be made within the construction area to achieve compaction over the entire street.
5. The CONTRACTOR shall then relocate all manholes and valve steel covers from tie downs in #1 and remove steel covers.
6. Manholes and valve box covers shall be reconstructed to finished asphalt grade. Backfill around the reconstructed covers shall be concrete to top of base material grade.
7. Final placement and compaction of the Hot Mix (unless otherwise shown on the plans) shall follow. Extreme care shall be taken in the lowering of manholes to avoid any dirt, gravel, concrete or other foreign material from falling into manhole. Should this occur, the CONTRACTOR shall remove the foreign material immediately in order to avoid stopping the flow of sewage.

END OF SECTION

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SECTION 01 11 00
SUMMARY OF WORK

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Terms and Conditions and other sections, apply to this Section.

1.02 WORK COVERED BY CONTRACT DOCUMENTS

- A. Project Identification: Project consists of construction of the Lytle Elevated Water Storage Tank.
 - 1. Project Locations:
 - a. Elevated Water Storage Tank – 16013 Dickens Bluff, Lytle, Texas 78052
 - 2. OWNER: City of Lytle, Texas
- B. ENGINEER Identification: The Contract Documents were prepared for the Project by TRC Engineers, Inc., 505 East Huntland Drive, Suite 250, Austin, Texas 78752.
- C. The proposed project includes but is not limited to:
 - 1. Elevated Water Storage Tank (Bid includes that for 250,000 gal. and 400,000 gal. options).
 - a. Multi-column elevated water storage tank.
 - b. Electrical work.
 - c. Piping.
 - d. Sitework, grading, fencing, electrical, etc.

1.03 CONTRACTS

- A. Project will be constructed under one single contract.

1.04 USE OF PREMISES

- A. General: The CONTRACTOR shall have such use of the plant site property as designated by the OWNER. The CONTRACTOR'S use of premises is limited only by OWNER'S right to perform work or to retain other contractors on portions of Project.
- B. Other contractors may be present on the plant site. The CONTRACTOR shall coordinate with the contractors and provide access as required.

1.05 SPECIFICATION FORMATS AND CONVENTIONS

- A. Specification Format: The Specifications are organized into Divisions and Sections using the 16-division format and CSI/CSC's "MasterFormat" numbering system.
 - 1. Section Identification: The Specifications use section numbers and titles to help cross-referencing in the Contract Documents. Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete. Consult the table of contents at the beginning of the Project Manual to determine numbers and names of sections in the Contract Documents.
- B. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 - 1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.
 - 2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by CONTRACTOR. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by CONTRACTOR or by others when so noted.

END OF SECTION

SECTION 01 12 25
WARRANTIES AND BONDS

PART 1 - GENERAL

1.01 CONTRACTOR REQUIREMENTS INCLUDED, BUT NOT LIMITED TO

- A. Compile specified warranties and bonds.
- B. Co-execute submittals when so specified.
- C. Review submittals to verify compliance with Contract Documents.
- D. Submit to the ENGINEER for review and transmittal to OWNER.

1.02 RELATED REQUIREMENTS

- A. SECTION 00 21 00 - INSTRUCTIONS TO BIDDERS
- B. Conditions of the Contract: PERFORMANCE BOND and PAYMENT BOND.
- C. CONTRACT AGREEMENT.
- D. SECTION 01 77 00 - CLOSEOUT PROCEDURES.

1.03 SUBMITTAL REQUIREMENTS

- A. Assemble warranties, bonds and service and maintenance contracts, executed by each of the respective manufacturers, suppliers, and subcontractors.
- B. One (1) electronic copy in Portable Document Format (PDF) of all submittals and re-submittals shall be submitted suitable for distribution over electronic mail or File Transfer Protocol (FTP). For final approved submittals provide PDF and two (2) hard copies.
- C. Table of Contents: Neatly typed, in orderly sequence. Provide complete information for each item.
 - 1. Product or work item.
 - 2. Firm, with name of principal, address, and telephone number.
 - 3. Scope.
 - 4. Date of beginning of warranty, bond or service and maintenance contract.
 - 5. Duration of warranty, bond, or service maintenance contract.
 - 6. Provide information for OWNER'S personnel:
 - a. Proper procedure in case of failure.
 - b. Instances that might affect the validity of warranty or bond.

7. CONTRACTOR, name of responsible principal, address, and telephone number.

1.04 FORMS OF SUBMITTALS

A. Prepare in duplicate packets.

B. Format:

1. Size 8-1/2 in. x 11 in., punch sheets for standard 3-post binder.

a. Fold larger sheets to fit into binders.

2. Cover: Identify each packet with typed or printed title "WARRANTIES AND BONDS".
List:

a. Title of Project.

b. Name of CONTRACTOR.

C. Binders: Commercial quality, three-post binder, with durable and cleanable plastic covers and maximum post width of two (2) inches.

1.05 WARRANTY SUBMITTAL REQUIREMENTS

A. For all major pieces of equipment, submit a warranty from the equipment manufacturer. The manufacturer's warranty period shall be concurrent with the CONTRACTOR'S for two (2) years, unless otherwise specified, commencing at the time of final acceptance of entire project by the OWNER.

B. The CONTRACTOR shall be responsible for obtaining certificates for equipment warranty for all major equipment specified. The ENGINEER reserves the right to request warranties for equipment not classified as major. The CONTRACTOR shall still warrant equipment not considered to be "major" in the CONTRACTOR'S two (2) years warranty period even though certificates of warranty may not be required.

C. For certain pieces of equipment, the OWNER may require a warranty of longer duration. The requirement for a warranty of longer duration shall be specified in individual sections of the Specifications.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 19 00
COMMISSIONING

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. The CONTRACTOR shall be responsible for startup and commissioning.
- B. This Section shall also define the timelines and minimum acceptable conditions for Substantial Completion. This Section does not eliminate any other requirements as defined in the Contract Documents.
- C. The contract period listed in the bid document) is based on Substantial Completion, as defined in the General Conditions, including the entire project being made operational. The Final Completion contract period (30 days), as defined in the General Conditions, is based on completion of all punch list items and demolition of existing facilities as shown on the Drawings.
- D. Related Sections include the following:
 - 1. SECTION 01 77 00 – CLOSEOUT PROCEDURES
 - 2. SECTION 01 79 00 – DEMONSTRATION AND TRAINING

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 STARTUP PLAN

- A. Prior to any startup operations, the CONTRACTOR shall be responsible for preparation of a Startup Plan (Plan). A Commissioning Team (Team) shall be assembled comprised of City of Lytle operations staff, construction CONTRACTOR personnel, City engineering staff, ENGINEER or contract operations personnel to complete startup activities. The Team shall be available to assist in Plan development and to advise which resources shall be used for each portion of the startup. The Plan shall be prepared for each phase of construction by the CONTRACTOR and submitted to the ENGINEER for approval when construction of each phase is 90 percent complete.
- B. The following startup procedures, at a minimum, shall be required:
 - 1. A plan and schedule to meet equipment and performance tests, including dates and test periods. The CONTRACTOR shall designate the test date (minimum 14 days in advance) to arrange for observation by appropriate City of Lytle personnel.
 - 2. Delivery of O&M materials, spare parts lists, publications on the equipment and materials, and suppliers and service contacts.
 - 3. Pre-startup training requirements to cover laboratory, classroom, and hands-on training.
 - 4. A plan to bring the system to the operational level.

3.02 INSPECTIONS

- A. Pre-Final Inspection, Punch List and Final Inspection are defined in SECTION 01 77 00 – CLOSEOUT PROCEDURES. These inspections shall occur after startup and commissioning, as described previously.
- B. Pre-Startup, Dry Run and Wet Run Inspections shall also occur with their own punch lists as deemed appropriate by the Commissioning Team.
- C. All appropriate City of Lytle personnel must be notified (minimum 14 days in advance) about the date, time, and location of the inspections. These inspections shall provide the opportunity to question the construction CONTRACTOR and to witness the testing. City of Lytle operations personnel shall attend the inspections at the discretion of the Commissioning Team.

3.03 FINAL OPERATING PERMITS

- A. All permits shall be finalized and, when possible, obtained at least sixty (60) days before the expiration date of the construction permit.

3.04 DRY RUN INSPECTION

- A. Before the Wet Run Tests, the CONTRACTOR shall conduct a dry-run inspection on installed equipment and systems. The CONTRACTOR, ENGINEER and manufacturers' representatives shall attend. Other attendance shall be at discretion of the Commissioning Team.
- B. An Inspection Record shall be used to document the Dry-Run Inspection. This form shall be prepared and submitted by the CONTRACTOR for approval prior to the inspection.
- C. During the inspection, the manufacturers' representatives or CONTRACTOR shall check the equipment for proper mounting, direction of rotation or travel, proper lubrication with the type of lubricants recorded and properly filled, clearances, alignments, undue noise and vibration, safety devices, and general operation. The CONTRACTOR shall remove all rags, stones, paper, and other debris; check for obstructions in the piping; check all gates and valves for proper operation and seating; and ensure all safety chains and guards are in place. Malfunctions shall be scheduled for corrective action and time shall be arranged for the operator's dry-run training and the wet-run testing of the facilities.

3.05 WET-RUN TESTS

- A. The CONTRACTOR shall meet the following:
 - 1. The CONTRACTOR shall provide all transfer pumps, controls, temporary piping, etc. required for the wet run tests.
 - 2. Temporary piping at road crossings shall not impede operations, as determined by the ENGINEER.
- B. The CONTRACTOR shall conduct Wet-Run Tests after the Dry-Run Inspection and before Commissioning. The CONTRACTOR, ENGINEER and manufacturer's representative shall attend. Other attendance shall be at discretion of the Commissioning Team. The same form used in the Dry-Run Inspection shall be used in the Wet-Run Tests. The Wet Run Tests shall include, but not be limited to, the following tasks:

1. Checking all piping and valves for leaks.
 2. Inspecting operation of all gates and valves.
 3. Inspecting operation of all pumps.
 4. Operating all mechanical devices under hydraulic load.
 5. Checking all instrumentation and analytical devices for proper operation.
 6. Inspecting all flow meters, temperature and pressure indicators, and other sensors.
- C. All deficiencies found during the inspection and testing shall be corrected before startup. The CONTRACTOR must demonstrate that all equipment is properly broken in, all equipment not to be used immediately is properly protected, and all laboratory equipment is inspected for proper calibration and operation.

3.06 FACILITY WALK-THROUGH

- A. As soon as the system(s) are operating and City of Lytle facility acceptance has occurred, a ribbon cutting ceremony followed by a walk-through will be scheduled by the OWNER, which shall be accommodated by the CONTRACTOR. CONTRACTOR shall provide a tent and chairs for 25 attendees.
- B. This walk-through will ensure understanding of the project by all concerned and will enhance community relations. Invited personnel shall include, but not be limited to, City Management; TCEQ; local community leaders; the ENGINEER; and the CONTRACTOR.

3.07 POST START UP

- A. Post-startup activities shall include confirming that the system(s) are operating as planned and establishing training programs to ensure continued facility operation.
- B. Training shall be as described in SECTION 01 43 33 – MANUFACTURER’S FIELD SERVICES.
- C. It is envisioned that the CONTRACTOR will maintain an appropriate level of staff at the facility resolving punch list items, establishing landscape and irrigation, etc., during the time it takes for the solids portion of the facility to be commissioned.

END OF SECTION

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SECTION 01 29 00
PRICE AND PAYMENT PROCEDURES

PART 1 - GENERAL

1.01 ADMINISTRATIVE SUBMITTALS

- A. Schedule of Values: Submit schedule on CONTRACTOR'S standard form.
- B. Schedule of Estimated Progress Payments:
 - 1. Submit with initially acceptable schedule of values.
 - 2. Submit adjustments thereto with Application for Payment.
- C. Application for Payment: In accordance with the General Conditions and any modifications there to as specified herein.
- D. Final Application for Payment: As specified herein.

1.02 SCHEDULE OF VALUES

- A. Reference the General Conditions.
- B. Format:
 - 1. Prepare a separate schedule of values for each schedule of work under the Agreement.
 - 2. Lump Sum Work:
 - a. Provide separate value for each item or task on the progress schedule.
 - b. An unbalanced or front-end loaded schedule will not be acceptable.
 - c. List separately such items as Bonds and insurance premiums, mobilization, demobilization and contract closeout, facility startup, and other appropriate Division 1 activities.
 - d. The maximum percentage of mobilization/demobilization (combined) cost shall be no greater than 3% (three percent) of the total contract value.
 - 3. Summation of the complete schedule of values representing all work under the Agreement to equal the Contract Price.

1.03 SCHEDULE OF ESTIMATED PROGRESS PAYMENTS

- A. Show estimated payment requests throughout Contract Times aggregating initial Contract Price.
- B. Base estimated progress payments on initially acceptable progress schedule. Adjust to reflect subsequent adjustments in progress schedule and Contract Price as reflected by modifications to the Contract Documents.

1.04 APPLICATION FOR PAYMENT

- A. Reference the General Conditions.
- B. Transmittal Summary Form: Provided by CONTRACTOR. Attach one Summary Form with each Application for Payment for each schedule, include Request for Payment of Materials and Equipment on Hand as applicable. Execute certification by authorized Officer of CONTRACTOR.
- C. Use Application for Payment Form acceptable to OWNER and ENGINEER.
 - 1. Provide separate form for each schedule as applicable.
 - 2. Include accepted schedule of values for each schedule or portion of work, the price breakdown for work, a listing of OWNER-selected equipment, if applicable, and allowances, as appropriate.
- D. Preparation:
 - 1. Round values to nearest dollar.
 - 2. List each Change Order and written Amendment executed prior to date of submission as separate line item. Totals to equal those shown on the Summary sheet for each schedule as applicable.
 - 3. Submit Application for Payment, including a Transmittal Summary Form and detailed Application for Payment Form for each schedule as applicable, a listing of materials on hand for each schedule as applicable, and such supporting data as may be requested by ENGINEER.

1.05 PAYMENT

- A. General: Progress payment will be made monthly on the date established at the preconstruction meeting.
- B. Payment for all work shown or specified in the Contract Documents is included in the Contract Price.
- C. Payment for Mobilization/Demobilization: Partial payment for mobilization/demobilization will be as follows. The adjusted contract amount for construction items as used below is defined as the Total Contract Amount less the amount for mobilization.
 - 1. When 1 percent of the adjusted contract amount for construction items is earned, 33 percent of the mobilization/demobilization amount or 1 percent of the Total Contract Amount.
 - 2. When 5 percent of the adjusted contract amount for construction items is earned, 50 percent of the mobilization/demobilization amount or 1.5 percent of the Total Contract Amount, whichever is less, will be paid less any previous payments under this item.
 - 3. When 10 percent of the adjusted contract amount for construction items is earned, 67 percent of the mobilization/demobilization amount or 2 percent of the Total Contract Amount, whichever is less, will be paid less any previous payments under this item.

4. Upon completion of all work under this contract, payment for the remainder of mobilization/demobilization amount will be made.

1.06 NONPAYMENT FOR REJECTED OR UNUSED PRODUCTS

A. Payment will not be made for following:

1. Loading, hauling, and disposing of rejected material.
2. Quantities of material wasted or disposed of in manner not called for under Contract Documents.
3. Rejected loads of material, including material rejected after it has been placed by reason of failure of CONTRACTOR to conform to provisions of Contract Documents.
4. Material not unloaded from transporting vehicle.
5. Defective work not accepted by OWNER.
6. Material remaining on hand after completion of work.

1.07 PARTIAL PAYMENT FOR STORED MATERIALS AND EQUIPMENT

- A. Partial Payment: Reference the General Conditions. No partial payments will be made for materials and equipment delivered or stored on site unless Shop Drawings or preliminary operation and maintenance manuals are acceptable to ENGINEER.
- B. Final Payment: Will be made only for materials incorporated in work; remaining materials for which partial payments have been made, to revert to CONTRACTOR unless otherwise agreed, and partial payments made for those items will be deducted from final payment.

1.08 FINAL APPLICATION FOR PAYMENT

- A. Reference the General Conditions.
- B. Prior to submitting final application, make acceptable delivery of required documents.
1. Affidavit of Bills Paid.
 2. Certification of Completion
 3. Other documentation that may be required elsewhere in the Contract Documents.

END OF SECTION

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SECTION 01 31 19
PROGRESS SCHEDULES AND MEETINGS

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. During construction, the CONTRACTOR will be required to submit monthly progress reports to the OWNER and attend monthly construction meetings (as required) at the project location.

1.02 NARRATIVE PROGRESS REPORT

- A. The CONTRACTOR shall prepare and submit to the OWNER a written report, on a monthly basis, to include, as a minimum:
 - 1. Summary of Work completed during the past period between Narrative Progress Reports.
 - 2. Work planned during the next period.
 - 3. Explanation of differences between summary of Work completed and Work planned in previously submitted Narrative Progress Report.
 - 4. Current and anticipated delaying factors and their estimated impact on other activities and completion Milestones.
 - 5. Corrective action taken or proposed.
 - 6. The report format shall be submitted by the CONTRACTOR and approved by the OWNER and ENGINEER.
 - 7. The report shall be submitted to the OWNER at the Monthly Progress Meetings.

1.03 PRECONSTRUCTION MEETING

- A. Schedule: Meeting shall be prior to the start of work at a time and place designated by the CONTRACTOR and agreed upon by OWNER and ENGINEER.
- B. Attendance
 - 1. OWNER Representative
 - 2. ENGINEER
 - 3. Project Manager
 - 4. CONTRACTOR & Key Subcontractors
- C. Agenda
 - 1. Health & Safety
 - 2. Roles and Responsibilities

3. General contract terms
4. Supervision
5. Schedules and seasonal limitations
6. Submittals
7. Approvals and testing
8. Clearances and notices
9. Construction procedures
10. Payments and estimates
11. Labor requirements
12. Construction Completion Documentation

1.04 PROGRESS MEETINGS (AS REQUIRED)

- A. The CONTRACTOR will schedule and administer the progress meetings and specially called meetings throughout the progress of the work.
 1. Prepare or designate preparer of the agenda for the meetings.
 2. Distribute written notice of each meeting four (4) days in advance of meeting date.
 3. Make physical arrangements for meetings.
 4. Preside at meetings.
 5. Record or designate recorder of the minutes; include significant proceedings and decisions.
 6. Reproduce and distribute copies within seven (7) days after each meeting.
 - a. To participants in the meeting.
 - b. To parties affected by decisions made at the meeting.
- B. Schedule: Meetings will be scheduled a minimum of once each month at a time designated by the CONTRACTOR and agreed upon by OWNER and ENGINEER.
- C. Attendance
 1. ENGINEER
 2. CONTRACTOR
 3. Subcontractor's as pertinent to agenda

4. OWNER Representative

D. Agenda

1. Review and approve minutes of previous meeting.
2. Review of work progress since previous meeting.
3. Field observations, problems, and conflicts.
4. Problems which impede constructing schedule.
5. Review of off-site fabrication and delivery schedules.
6. Corrective measures and procedures to regain projected schedule.
7. Revisions to construction schedule.
8. Progress schedule during the succeeding work period.
9. Coordination of schedules.
10. Review of submittal schedules.
11. Review of Request for Information Status.
12. Review of proposed changes for effect on construction schedule and on completion date.
13. Review of Quality Assurance / Quality Control (QA/QC) reports.
14. Review of Punch List.
15. Safety report.
16. Review new business.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

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SECTION 01 32 33
CONSTRUCTION PHOTOGRAPHS

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Photographic requirements for construction photographs and submittals.

1.02 DEFINITIONS

- A. Pre-construction Photographs: Photographs taken, in sufficient numbers and detail, prior to date of commencement of the Work, to show original construction site conditions.
- B. Progress Photographs: Photographs, taken throughout the duration of construction at regular intervals and from fixed vantage points, pre-approved by the ENGINEER, that document progress of the Work.
- C. Finished Photographs: Photographs, taken by a professional photographer near Date of Substantial Completion and before OWNER'S acceptance of the Work, that are suitable for framing and for use in brochures or on the Internet.
- D. Aerial Photographs: Photographs, taken from an aircraft by a professional aerial photographer near Date of Substantial Completion and before OWNER'S acceptance of the Work, that are suitable for framing and for use in brochures or on the Internet.

1.03 SUBMITTALS

- A. Format and Media. Digital photography shall be used. Submit color photographs, unless otherwise specified.
 - 1. Digital Photography. Use 10.1-megapixel density or greater for photographs. Scanned photographs must equal or exceed 600 dots per inch when scanned from 4 in. by 6 in. prints. Submit digital photographic files on USB Flash Drives (min. 3 copies) to OWNER, ENGINEER, and CONTRACTOR. Format disks for Windows operating system and in JPEG (Joint Photographic Experts Group) format.
- B. Submittal Quantities and Frequencies
 - 1. Pre-construction Photographs
 - a. A preconstruction video recording of the entire project site, access points, perimeter fencing, features adjacent to access roads, and all access roads, including roads, within 1 mile of the plant site shall be required.
 - b. A minimum of 60 photos shall be taken prior to any work being done. These photos will be taken at all areas and surround areas where construction will take place.
 - c. Submit digital set of Pre-construction Photographs prior to first Application for Payment.

2. Progress Photographs

- a. Each month, a minimum of 30 exposures shall be taken as directed by ENGINEER. Plan a minimum of two photo events per month (once every two weeks), more as required per construction progress.
- b. Submit digital set of Progress Photographs with each Application for Payment. Monthly Applications for Payment shall be deemed incomplete if not accompanied by the required Progress Photographs. The CONTRACTOR'S failure or election to not submit a monthly Application for Payment shall not affect the requirement for monthly Progress Photographs.

3. Finished Photographs

- a. All photos and videos that were taken at the beginning (pre-construction) shall be taken from the same vantage point after all work (including re-vegetation) has been completed.
- b. Submit one set of Finished Digital Photographs after Date of Substantial Completion and prior to final payment. Each set shall contain photo from each of the vantage points pre-approved by the ENGINEER. Vantage points for Finished Photographs will be approved separately from vantage points approved for Progress Photographs.

4. Final Aerial Photograph

- a. Upon completion of the project, the CONTRACTOR shall have made a color aerial photograph of the project as directed by the OWNER/ENGINEER. The photograph shall be of such view and angle and shall be taken at such time as directed by the OWNER/ENGINEER.

C. Labeling. Digital photographs shall be provided with an electronic file (Microsoft Office compatible or PDF) photo log containing the following information:

1. Name of Project, address of Project and Job Number.
2. Name and address of CONTRACTOR.
3. Date photograph was taken.
4. Location photo was taken from, direction of view (i.e. N, S, NW, etc.), and short description of photo subject.
5. Name and address of professional photographer who took the photograph, if applicable.

D. Photographic prints, photographic files and disks shall become the property of the OWNER. Photographs specified herein shall not be published without written consent by the OWNER. Photos shall remain copyrighted by photographer.

1.04 QUALITY ASSURANCE

- A. CONTRACTOR shall be responsible for the quality of and timely execution and submittal of photographs.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 PRE-CONSTRUCTION PHOTOGRAPHS

- A. Prior to commencement of construction operations, photograph the site to show original site and surrounding area conditions including initial construction corridor, detour routes, staging or storage areas, and outfall location.
- B. Pre-construction Photographs shall indicate condition of the following:
 - 1. Roads, streets, highways.
 - 2. Yards (near side and far side of street).
 - 3. House walks and sidewalks.
 - 4. Curbs.
 - 5. Areas between walks and curbs.
 - 6. Particular features (e.g. yard lights, shrubs, fences, trees).
- C. Show the location of vantage points and direction of shots on a key plan of the site.

3.02 PROGRESS PHOTOGRAPHS

- A. Progress Photographs document monthly advancement of the Work. Select vantage points for each shot to best show status of construction and progress since last photograph submittal. Select camera stations that will require little or no movement or adjustment over the duration of construction.
- B. Take monthly Progress Photographs at regular intervals to coincide with cutoff dates associated with each Application for Payment.

END OF SECTION

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SECTION 01 33 00
SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, and specific city/utility/owner requirements or provisions apply to this Section.
- B. The contractor, sub-contractors, vendors, suppliers, manufacturers, etc. and any other trade providing submittals on the project **will not** be paid by the OWNER for submittal preparation.

1.02 SUMMARY

- A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other miscellaneous submittals, including but not limited to the following:
 - 1. Security plan.
 - 2. Contractor's construction schedule
 - 3. Shop drawings.
 - 4. Product data.
 - 5. Quality assurance and quality control submittals, including, but not limited to, calculations, mix designs, and substantiating test results.
- B. Administrative Submittals: Refer to other Division 1 Sections and other Contract Documents for requirements for administrative submittals. Such submittals include, but are not limited to, the following:
 - 1. Permits.
 - 2. Applications for Payment.
 - 3. Performance and Payment bonds.
 - 4. Insurance certificates.

1.03 RELATED WORK

- 1. SECTION 01 29 00 - PRICE AND PAYMENT PROCEDURES for submitting Applications for Payment.
- 2. SECTION 01 31 19 - PROGRESS SCHEDULES AND MEETINGS for submitting schedules and reports, including CONTRACTOR's Construction Schedule and the Submittals Schedule.

3. SECTION 01 32 33 - CONSTRUCTION PHOTOGRAPHS for submitting periodic construction photographs.
4. SECTION 01 43 00 - QUALITY ASSURANCE QUALITY CONTROL for submitting test and inspection reports and Delegated-Design Submittals.
5. SECTION 01 77 00 - CLOSEOUT PROCEDURES for submitting Record Drawings, and Record Product Data.
6. SECTION 00 61 00 - WARRANTIES AND BONDS for submitting warranties.
7. SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA for operation and maintenance manual requirements. See Table 1 for submittal requirements for specific items.

1.04 DEFINITIONS

- A. Action Submittals: Written and graphic information that requires ENGINEER'S responsive action.
- B. Informational Submittals: Written information that does not require ENGINEER'S approval. Submittals may be rejected for not complying with requirements.

1.05 SUBMITTAL PROCEDURES

1.06 SUBMITTAL DATA

- A. Submittal Procedure: The CONTRACTOR shall furnish Submittals for any and all such parts of the work and equipment as set forth in the specifications and indicated on the plans. The procedures for review of the submittals shall be as follows:
 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. ENGINEER reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
 3. The CONTRACTOR shall submit to the ENGINEER for his review, four (4) prints of drawings, plus whatever number of prints the CONTRACTOR desires to be returned to himself. The submitted prints shall be accompanied by a letter of transmittal, in duplicate of drawings, titles, and other requirements. The letter of transmittal shall be of the form supplied by or approved by the ENGINEER. If advance approval is obtained by OWNER and ENGINEER, electronic submission of certain submittals may be acceptable.
 4. When a drawing is satisfactory to the ENGINEER, the number of prints the CONTRACTOR desires returned to him will be stamped or marked, "No Exceptions Taken" or "Make Corrections Noted", will be dated, and will be returned to the CONTRACTOR by letter.

5. Should a drawing be unsatisfactory to the Engineer, he will stamp thereon "Revise and Resubmit", or "Rejected", and will return one (1) or more copies thereof to the CONTRACTOR with the necessary corrections and changes indicated. The CONTRACTOR must make such corrections and changes, and again submit at least four (4) prints of the drawings for approval. The CONTRACTOR shall revise and resubmit the working drawings, as required by the ENGINEER, until satisfactory review thereof is obtained.
 6. The CONTRACTOR shall allow sufficient time for preliminary review, correction, and resubmission, and final review of all working (shop) drawings. Drawings of items critical to job progress, when requested in writing by the CONTRACTOR, will be given priority review.
- B. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on ENGINEER'S receipt of submittal.
1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. ENGINEER will advise CONTRACTOR when a submittal being processed must be delayed for coordination.
 2. If intermediate submittal is necessary, process it in same manner as initial submittal.
 3. Allow 15 days for processing each resubmittal.
 4. Revise and Resubmit
 5. Action Not Required
- C. Submittal Format
1. Submittals shall be printed on heavy, first quality paper, 8-1/2" x 11" size with standard 3-hole punching. If pre-approved, electronic submittals may be acceptable. Drawings and diagrams shall be reduced to 8-1/2" x 11" or 11" x 17".
 2. All materials and equipment submitted for review shall meet the following criteria: Each sheet of descriptive literature submitted shall be marked by the CONTRACTOR to identify the material or equipment as follows:
 - a. Equipment and materials descriptive literature and drawings shall show the specification paragraph for which the equipment applies, and shall list equipment tag numbers applicable.
 - b. Submittal sheets or drawings showing more than the particular item under consideration shall have crossed out all but the pertinent description of the item for which review is requested.
 - c. Equipment and materials descriptive literature not readily cross-referenced with the drawings or specifications shall be identified by a suitable notation.
- D. Submittal Content

1. The submittals shall show that all requirements of the specification section have been met. The submittals shall contain the following information as applicable:
 - a. Equipment, function, normal operating characteristics, and limiting conditions.
 - b. Assembly, installation, alignment, adjustment, and checking instructions.
 - c. Outline, cross-section, and assembly drawings; engineering data; and wiring diagrams.
 - d. Test data and performance curves, where applicable.
 - e. The operational and maintenance manual for the equipment item and/or system as designated shall be submitted, or as required elsewhere within these specifications.
 - f. Working Drawings:
 - 1) Items for which working drawings are required include, but are not limited to, the non-equipment items listed in Table 1, and as set forth elsewhere within these specifications.
 - 2) The drawings shall be numbered consecutively and shall accurately and distinctly present the following:
 - a) All working and erection dimensions.
 - b) Arrangement and sectional views.
 - c) Necessary details, including complete information for making connections between functional parts.
 - d) Kinds of materials and finishes.
 - e) Parts list and description thereof.
 - 3) Each drawing shall be dated and shall bear the name of the project, names of equipment or materials, and the location where the equipment or materials are to be installed in the project. The Engineer may decline to consider any working drawings, which do not contain complete data on the work and full information on related matters.
 - 4) If working drawings show departures from the contract requirements, the CONTRACTOR shall make specific mention thereof in a letter attached to the submittal form; otherwise, review of such submittals will not constitute acceptance of the departure from the contract.
 - 5) No Work called for by working drawings shall be initiated until the said drawings have been accepted by the ENGINEER.

1.07 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Bar-Chart Schedule: Prepare a fully developed, horizontal bar-chart-type, Contractor's construction schedule in electronic format. Submit initial schedule prior to or at the Pre-construction conference and submit updated schedules at each regularly scheduled Project Meeting and with each pay application and as directed by the ENGINEER.
1. Provide a separate time bar for each significant construction activity. Provide a continuous vertical line to identify the first working day of each week. Use the same breakdown of units of the Work as indicated in the "Schedule of Values."
 2. Within each time bar, indicate estimated completion percentage in 10 percent increments. As Work progresses, place a contrasting mark in each bar to indicate Actual Completion.
 3. Prepare the schedule on a sheet, or series of sheets, of sufficient width to show data for the entire construction period.
 4. Secure time commitments for performing critical elements of the Work from parties involved. Coordinate each element on the schedule with other construction activities; include minor elements involved in the sequence of the Work. Show each activity in proper sequence. Indicate graphically the critical path items and the sequences necessary for completion of related portions of the Work.
 5. Indicate the phases of work in which subcontractors will be participating. Subcontractors shall be indicated by name.
 6. Coordinate the Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittal Schedule, progress reports, payment requests, and other schedules.
 7. Indicate substantial completion in advance of the date established for Final Completion to allow time for the Engineer's procedures necessary for certification of Substantial and Final Completion.
- B. Work Stages: Indicate important stages of construction for each major portion of the Work, including submittal review, testing, and installation.
- C. Cost Correlation: At the head of the schedule, provide a cost correlation line, indicating planned and actual costs. On the line, show dollar volume of Work performed as of the dates used for preparation of applications for payment. Refer to Article 14, "General Conditions", Payment to Contractor and Completion for cost reporting and payment procedures.
- D. Distribution: Following response to the initial schedule submittal, print and distribute copies to the Engineer, subcontractors, suppliers, and other parties required to comply with scheduled dates. Keep a copy at the Project Site at all times.
1. When revisions are made, distribute to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in construction activities.

- E. Schedule Updating: Revise the schedule after each meeting, event, or activity where revisions have been recognized or made and as requested by the Engineer. Issue the updated schedule concurrently with the report of each meeting, or as requested by the Engineer.
- F. The Contractor shall also provide a Four (4) Week Look-Ahead schedule at each progress meeting and with each pay request. This schedule shall show, by day of the week, the previous two (2) weeks construction activities performed and the planned construction activities of the following four (4) weeks.
- G. The Contractor shall submit the updated Overall and Four Week Look-Ahead schedules to the Engineer with the Contractors monthly pay request. The schedules must be acceptable to the Engineer and approved prior to the Engineer approving the pay request.

1.08 ACTION SUBMITTALS

- A. General: Prepare and submit Action Submittals required by individual Specification Sections.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 - 1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
 - 2. Mark each copy of each submittal to show which products and options are applicable.
 - 3. Include the following information, as applicable:
 - a. Manufacturer's written recommendations.
 - b. Manufacturer's product specifications.
 - c. Manufacturer's installation instructions.
 - d. Manufacturer's catalog cuts.
 - e. Wiring diagrams showing factory-installed wiring.
 - f. Printed performance curves.
 - g. Operational range diagrams.
 - h. Compliance with recognized trade association standards.
 - i. Compliance with recognized testing agency standards.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
 - 1. Preparation: Include the following information, as applicable:
 - a. Dimensions.
 - b. Identification of products.

- c. Fabrication and installation drawings.
 - d. Roughing-in and setting diagrams.
 - e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
 - f. Shopwork manufacturing instructions.
 - g. Templates and patterns.
 - h. Schedules.
 - i. Notation of coordination requirements.
 - j. Notation of dimensions established by field measurement.
- 2. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.
 - 3. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 30 by 40 inches.
- D. Coordination Drawings: Comply with requirements in Division 1 Section "Project Management and Coordination."
- E. Samples: Prepare physical units of materials or products, including the following:
- 1. Comply with requirements in Division 1.
 - 2. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - a. Submit one full set of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. ENGINEER will return submittal with options selected.
 - 3. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from the same material to be used for the Work, cured, and finished in manner specified, and physically identical with the product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Submit three sets of Samples. ENGINEER will retain one Sample sets; remainder will be returned.
 - 4. Preparation: Mount, display, or package Samples in manner specified to facilitate review of qualities indicated. Prepare Samples to match ENGINEER'S sample where so indicated. Attach label on unexposed side.

5. Submit Samples for review of kind, color, pattern, and texture for a final check of these characteristics with other elements and for a comparison of these characteristics between final submittal and actual component as delivered and installed.
 6. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
- F. Product Schedule or List: Prepare a written summary indicating types of products required for the Work and their intended location.
- G. Delegated-Design Submittal: Comply with requirements in Division 1 SECTION 01 43 00 – QUALITY ASSURANCE QUALITY CONTROL.
- H. Submittals Schedule: Comply with requirements in Division 1.
- I. Application for Payment: Comply with requirements in Division 1.
- J. Schedule of Values: Comply with requirements in Division 1.
- K. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Use sample form at end of Section.
- 1.09 INFORMATIONAL SUBMITTALS
- A. General: Prepare and submit Informational Submittals required by other Specification Sections.
1. Certificates and Certifications: Provide a notarized statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
 2. Test and Inspection Reports: Comply with requirements in SECTION 01 43 00 - QUALITY ASSURANCE QUALITY CONTROL.
- B. CONTRACTOR's Construction Schedule: Comply with requirements in SECTION 01 31 19 - PROGRESS SCHEDULES AND MEETINGS.
- C. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names, and addresses of architects and owners, and other information specified.
- D. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements.
- E. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.
- F. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements and, where required, is authorized for this specific Project.

- G. **Manufacturer Certificates:** Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements. Include evidence of manufacturing experience where required.
- H. **Material Certificates:** Prepare written statements on manufacturer's letterhead certifying that material complies with requirements.
- I. **Material Test Reports:** Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements.
- J. **Compatibility Test Reports:** Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- K. **Field Test Reports:** Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements.
- L. **Product Test Reports:** Prepare written reports indicating current product produced by manufacturer complies with requirements. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- M. **Research/Evaluation Reports:** Prepare written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project.
- N. **Maintenance Data:** Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements in Division 1 Section "Closeout Procedures."
- O. **Design Data:** Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.
- P. **Manufacturer's Instructions:** Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer.
- Q. **Manufacturer's Field Reports:** Prepare written information documenting factory-authorized service representative's tests and inspections.

1.10 INSURANCE CERTIFICATES AND BONDS

- A. Prepare written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.

1.11 CONSTRUCTION PHOTOGRAPHS

- A. Comply with requirements in SECTION 01 32 33 – CONSTRUCTION PHOTOGRAPHS.

1.12 QUALITY ASSURANCE AND QUALITY CONTROL SUBMITTALS

- A. Submit quality assurance and quality control submittals, including design data, certifications, manufacturer's instructions, manufacturer's field reports, materials test results, field testing and inspection reports, density test results, and other quality-control submittals as required under other Sections of the Specifications.
- B. Certifications: Where other Sections of the Specifications require certification that a product, material, or installation complies with specified requirements, submit a certification from the manufacturer or responsible Engineer certifying compliance with specified requirements.
 - 1. Signature: Certification shall be signed by an officer of the corporation or other individual authorized to sign documents on behalf of the company.
- C. Calculations: When required in the technical specifications, calculations shall be prepared and stamped by a Professional Engineer registered in the State of Texas.
- D. Concrete, Controlled Low Strength material, Asphalt Stabilized Base and Hot Mix Asphaltic Concrete Mix Designs and Substantiating Test Data: Requirements for submittal of mix design and substantiating test data are specified in the applicable Technical Specification Section. Each separate batch plant supplying ASB, HMAC, and/or concrete shall submit mix designs to the Owner's Representative for review.

1.13 PREPARATION AND SUBMITTAL OF CONSTRUCTION RECORD DRAWINGS

- A. The CONTRACTOR's Superintendent will maintain a set of redlines noting any changes in ink during construction of the Project. The following shall be adhered to and provided (as a minimum) for the redline submittal.
 - 1. General
 - a. Notes shall be sufficiently clear to allow a draftsman to easily make the necessary changes without the need for field checks and interpretation.
 - b. One complete set of Construction Record redlines will be submitted prior to the final pay request and forwarded to the Owner.
 - 2. Specific Requirements
 - a. Type, name, and model numbers of all valves (with # of turns to open/close), air release valves, drain and fire hydrants noted at locations installed.

- b. Installed locations of all assignments, appurtenances and elevations which differ from those indicated on the Drawings.
 - c. Pipe manufacturer type and classification noted in sufficient detail to determine location and extent of each type or classification installed.
 - d. Modification to any standard or special details noted.
 - e. Location and description of pipe closures.
 - f. Thrust blocking locations and restrained pipe lengths, approximate dimensions and quantities noted.
 - g. Location, type, and quantity of all additions and deletions.
 - h. Changes in grade.
 - i. Changes in structure locations.
- B. The above list is not intended to be complete. Any information noted which could be used for future maintenance, location, and construction projects is encouraged to be noted on the redlines.

1.14 CONSTRUCTION DIARIES

- A. The CONTRACTOR shall prepare a daily construction diary recording as a minimum the following information concerning events at the site and submit duplicate copies to the OWNER's Representative at weekly intervals. The copies are to be signed by the project Superintendent as defined in the General Conditions.
- 1. Work performed.
 - 2. Approximate count of CONTRACTOR's personnel, by classification, on the site.
 - 3. List of subcontractors and personnel by classification on the site.
 - 4. List of all equipment on the site by make and model.
 - 5. High and low temperatures together with general weather conditions.
 - 6. Start time and finish time of day's work.
 - 7. Accidents and/or unusual events.
 - 8. Meetings and significant decisions made.
 - 9. Stoppages, delays, shortages and/or losses.
 - 10. Meter readings and/or similar recordings.
 - 11. Emergencies procedures that may have been needed.
 - 12. Orders and requests of governing authorities.

13. Change Orders received and implemented.
14. Services connected and/or disconnected.
15. Installed equipment and/or system tests and/or startups and results.
16. Partial completions and/or occupancies.
17. Date of substantial completion certified.

1.15 CONTRACTOR'S REVIEW

- A. Review each submittal and check for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to ENGINEER.
- B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of CONTRACTOR's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

1.16 ENGINEER'S ACTION

- A. General: ENGINEER will not review submittals that do not bear CONTRACTOR's approval stamp and will return them without action.
- B. Action Submittals: ENGINEER will review each submittal, make marks to indicate corrections or modifications required, and return it. ENGINEER will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:
 1. No Exceptions Taken
 2. Make Corrections Noted
 3. Revise and Resubmit
 4. Action Not Required
- C. Informational Submittals: ENGINEER will review each submittal and will not return it or will reject and return it if it does not comply with requirements. ENGINEER will forward each submittal to appropriate party.
- D. Submittals not required by the Contract Documents will not be reviewed and may be discarded.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 43 00
QUALITY ASSURANCE QUALITY CONTROL

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve CONTRACTOR of responsibility for compliance with the Contract Document requirements.
 - 1. Specified tests, inspections, and related actions do not limit CONTRACTOR'S quality-control procedures that facilitate compliance with the Contract Document requirements.
 - 2. Requirements for CONTRACTOR to provide quality-control services required by ENGINEER, OWNER, or authorities having jurisdiction are not limited by provisions of this Section.
- C. See individual specification sections for specific test and inspection requirements.

1.02 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and ensure that proposed construction complies with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that completed construction complies with requirements. Services do not include contract enforcement activities performed by ENGINEER.
- C. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

1.03 DELEGATED DESIGN

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of CONTRACTOR by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to ENGINEER.

1.04 SUBMITTALS

- A. Qualification Data: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

- B. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit a statement, signed, and sealed by the responsible design professional, for each product and system specifically assigned to CONTRACTOR to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.
- C. Reports: Prepare and submit certified written reports that include the following:
1. Revise list below to suit Project.
 2. Date of issue.
 3. Project title and number.
 4. Name, address, and telephone number of testing agency.
 5. Dates and locations of samples and tests or inspections.
 6. Names of individuals making tests and inspections.
 7. Description of the Work and test and inspection method.
 8. Identification of product and Specification Section.
 9. Complete test or inspection data.
 10. Test and inspection results and an interpretation of test results.
 11. Ambient conditions at time of sample taking and testing and inspecting.
 12. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 13. Name and signature of laboratory inspector.
 14. Recommendations on retesting and reinspecting.
- D. Permits, Licenses, and Certificates: For OWNER'S records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.05 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- B. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

- C. If more detailed requirements are needed, add this information to specific individual Sections. Examples include Installer employing workers trained and approved by manufacturer, Installer being acceptable to manufacturer, and Installer being an authorized representative of manufacturer for both installation and maintenance.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance.
- F. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.
- G. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
 - 1. Requirement for specialists shall not supersede building codes and similar regulations governing the Work, nor interfere with local trade-union jurisdictional settlements and similar conventions.
- H. Testing Agency Qualifications: An agency with the experience and capability to conduct testing and inspecting indicated, as documented by the latest ASTM standards that specializes in types of tests and inspections to be performed.

1.06 QUALITY CONTROL

- A. OWNER Responsibilities: Where quality-control services are indicated as OWNER'S responsibility, OWNER will engage a qualified testing agency to perform these services.
 - 1. OWNER will furnish CONTRACTOR with names, addresses, and telephone numbers of testing agencies engaged and a description of the types of testing and inspecting they are engaged to perform.
 - 2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to CONTRACTOR.
- B. CONTRACTOR Responsibilities: Unless otherwise indicated, provide quality-control services specified and required by authorities having jurisdiction.
 - 1. Where services are indicated as CONTRACTOR'S responsibility, engage a qualified testing agency to perform these quality-control services.
 - a. CONTRACTOR shall not employ the same entity engaged by OWNER, unless agreed to in writing by OWNER.
 - 2. Notify testing agencies at least 48 hours in advance of time when Work that requires testing or inspecting will be performed.

3. Where quality-control services are indicated as CONTRACTOR'S responsibility, submit a certified written report, in duplicate, of each quality-control service.
 4. Testing and inspecting requested by CONTRACTOR and not required by the Contract Documents are CONTRACTOR'S responsibility.
 5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Special Tests and Inspections: OWNER will engage a testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of OWNER.
1. Testing agency will notify ENGINEER and CONTRACTOR promptly of irregularities and deficiencies observed in the Work during performance of its services.
 2. Testing agency will submit a certified written report of each test, inspection, and similar quality-control service to ENGINEER with copy to CONTRACTOR and to authorities having jurisdiction.
 3. Testing agency will submit a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
 4. Testing agency will interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
 5. Testing agency will retest and reinspect corrected work.
- D. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing.
- E. Retesting/Reinspecting: Regardless of whether original tests or inspections were CONTRACTOR'S responsibility, provide quality-control services, including retesting and reinspecting, for construction that revised or replaced Work that failed to comply with requirements established by the Contract Documents.
- F. Testing Agency Responsibilities: Cooperate with ENGINEER and CONTRACTOR in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify ENGINEER and CONTRACTOR promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 3. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through CONTRACTOR.
 4. Do not release, revoke, alter, or increase requirements of the Contract Documents or approve or accept any portion of the Work.
 5. Do not perform any duties of CONTRACTOR.

- G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 4. Facilities for storage and field-curing of test samples.
 5. Delivery of samples to testing agencies.
 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 7. Security and protection for samples and for testing and inspecting equipment at Project site.
- H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.07 PAYMENT FOR LABORATORY TESTING SERVICES

- A. Testing to be paid by CONTRACTOR. All standard testing to be paid in this manner. All additional testing required due to a CONTRACTOR failure shall be paid by CONTRACTOR.
1. The CONTRACTOR shall furnish, at his own expense, materials, or specimens for testing.
 2. The CONTRACTOR shall furnish at his own expense, suitable evidence that the materials he proposes to incorporate into the work are in accordance with the specifications. Mill tests for reinforcing steel and cement will be acceptable if it is definite that the test sheets apply to the material being furnished. Manufacturers or supplier's test results will be acceptable for such items as pipe, valves, etc. when it is definite that the material being furnished is in accordance with the manufacturers or supplier's specifications to which the test results apply. Supplier's evidence of quality will be acceptable as long as the material is secured from the sources to which the evidence applies.
- B. The ENGINEER may have further inspection and tests made by the laboratory or may make tests himself, to ensure that the CONTRACTOR is complying with the specifications. The correction or removal of such unsatisfactory work and the replacement with satisfactory work shall be performed by the CONTRACTOR at his own expense and is understood to be fully included in his CONTRACTOR requirements, without any additional compensation or claims upon the OWNER.

- C. Tests indicating non-compliance with the Contract Documents shall be paid for by the CONTRACTOR.
- D. Inspection or testing performed exclusively for the CONTRACTOR'S convenience shall be borne by the CONTRACTOR.
- E. The CONTRACTOR shall submit to the ENGINEER, for approval, the name of the testing company to be used by the CONTRACTOR. The testing company and its subcontractors shall be certified by AASHTO or U.S. Army Corps of Engineers.
- F. No separate payment will be made for testing.

1.08 EQUIPMENT TESTING

- A. Upon completion of the Work and prior to final acceptance and payment, test equipment as specified or required for compliance with Contract Documents. Manufacturer's authorized representative(s) shall be present at site to inspect, check and approve equipment and installation prior to start-up and test; and to supervise testing of equipment.
- B. Adjust or replace equipment which does not meet requirements of Contract Documents during test at no additional cost to OWNER.
- C. Include costs of equipment testing in the price of equipment to be installed when applicable.

1.09 MATERIAL TESTING

- A. Representatives of the testing laboratory shall have access to the Work at all times. Provide facilities for access in order that laboratory may perform its functions properly.
- B. Testing Schedules
 - 1. Consult testing laboratory in advance to determine time required to perform tests and issue each of the findings. Include required time within construction schedule.
 - 2. When changes of the construction schedule are necessary, coordinate such changes with the testing laboratory as required.
- C. All samples for testing, unless otherwise provided elsewhere in these Specifications, shall be taken by the testing laboratory. All sampling equipment and personnel shall be provided by the testing laboratory unless otherwise specified. All deliveries of samples to the testing laboratory shall be performed by the testing laboratory unless otherwise specified.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 43 33
MANUFACTURER'S FIELD SERVICES

PART 1 - GENERAL

1.01 SUMMARY

- A. This section includes general requirements for services to be provided by manufacturer's field representatives including training of OWNER'S personnel and preparation of equipment installation reports.

1.02 DEFINITIONS

- A. Person-Day: One person for 8 hours within regular CONTRACTOR working hours.

1.03 QUALIFICATION OF MANUFACTURER'S REPRESENTATIVE

- A. The technician shall be an authorized representative of the manufacturer, factory trained, and experienced in the technical applications, installation, operation, and maintenance of respective equipment, subsystem, or system. The proposed representative shall be subject to acceptance by the OWNER. No substitute representatives will be allowed unless prior written approval by the OWNER has been given.

1.04 FULFILLMENT OF SPECIFIED MINIMUM SERVICES

- A. Where manufacturers' services are specified, furnish manufacturer's qualified representative for a sufficient period of time to perform all specified functions at no additional cost to the OWNER.
- B. Schedule manufacturer's onsite services to avoid conflicting with other onsite testing or other manufacturer's onsite services. Determine that all conditions necessary to allow successful testing have been met before scheduling services.
- C. Only those days of service approved by ENGINEER will be credited to fulfill the specified minimum services.
- D. Manufacturer's onsite services to include at a minimum:
 - 1. Assistance during installation to include observation, guidance, instruction of the CONTRACTOR'S assembly, erection, installation, or application procedures.
 - 2. Inspection, checking, and adjustment as required for equipment to function as warranted by manufacturer and necessary to furnish written approval of installation.
 - 3. Revisiting the site as required to correct problems and until installation and operation are acceptable to the OWNER.
 - 4. Resolution of assembly or installation problems attributable to, or associated with, the respective manufacturer's products and systems.
 - 5. Assistance during functional and performance testing, and startup demonstration and until product acceptance by the OWNER.

6. Training of OWNER'S personnel in the operation and maintenance of respective product as required herein.
7. Completion of equipment installation report with applicable certificates for proper installation and initial, interim, and final test or service.

1.05 TRAINING OWNER'S PERSONNEL

- A. Furnish trained, articulate personnel to coordinate and expedite training. Personnel shall be familiar with operation and maintenance manual information furnished by the manufacturer.
- B. Furnish manufacturer's' representatives for onsite hands-on training for OWNER'S personnel on operation and maintenance of specified product (system, subsystem, component) and as may be required in applicable Specifications.
- C. Prestartup Training
 1. Coordinate training sessions with the OWNER'S operating personnel and manufacturers' representatives, and with submission of operation and maintenance manuals.
- D. Post-Startup Training
 1. If required in Specifications, furnish and coordinate training of OWNER'S operating personnel by respective manufacturer's representatives.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. This section covers the Project requirements for utilities, site security, access roads and parking, and related items to be provided by the CONTRACTOR throughout the duration of the Project.
- B. The CONTRACTOR's bid cost shall include communication with all utility companies, applications, permits, fees, equipment, installation of all required materials, removal of materials after construction, etc. required for temporary facilities to the acceptance of the OWNER.
- C. Water and electricity supply for construction shall be acquired by the CONTRACTOR from the utility provider for electrical supply and for potable water and usage will be paid by the CONTRACTOR. The CONTRACTOR shall coordinate and install, at his expense, any meters required for water and electrical service and remove them at the end of construction. Services shall be independent of OWNER's existing services.
- D. The CONTRACTOR shall prepare and install Project Signs.
- E. Temporary utilities include, but are not limited to, the following:
 - 1. Sewers and drainage.
 - 2. Water service and distribution.
 - 3. Sanitary facilities, including toilets, wash facilities, and drinking-water facilities.
 - 4. Heating and cooling facilities.
 - 5. Ventilation.
 - 6. Electric power service.
 - 7. Lighting.
- F. Support facilities include, but are not limited to, the following:
 - 1. Temporary roads and paving.
 - 2. Dewatering facilities and drains.
 - 3. Project identification and temporary signs.
 - 4. Waste disposal facilities.
 - 5. Storage and fabrication sheds.
 - 6. Temporary stairs.

7. Construction aids and miscellaneous services and facilities.
8. Safety facilities required per OSHA requirements, for the safe access by OWNER and ENGINEER. Representatives to inspect all facilities and structures as determined by the ENGINEER. The CONTRACTOR shall provide any and all required personnel lifting devices, cranes, hoists, scaffolding, safety cages, ladders (tied-off), temporary walkways, etc. or other equipment for OWNER representatives to access all facilities as required by ENGINEER. It is the ENGINEER's decision on facilities that require inspection and the proximity of personnel to the inspected facilities. CONTRACTOR shall provide all safe access per OSHA for these requirements.

G. Security and protection facilities include, but are not limited to, the following:

1. Environmental protection.
2. Stormwater control.
3. Tree and plant protection.
4. Site enclosure fence.
5. Security enclosure and lockup.
6. Barricades, warning signs, and lights.
7. Fire protection.

1.02 QUALITY ASSURANCE

- A. Standards: Comply with ANSI A10.6, NECA's "Temporary Electrical Facilities," and NFPA 241.
 1. Trade Jurisdictions: Assigned responsibilities for installation and operation of temporary utilities are not intended to interfere with trade regulations and union jurisdictions.
 2. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.03 PROJECT CONDITIONS

- A. Temporary Utilities: At earliest feasible time, when acceptable to OWNER, change over from use of temporary service to use of permanent service.
 1. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before OWNER'S acceptance, regardless of previously assigned responsibilities.
- B. Conditions of Use: The following conditions apply to use of temporary services and facilities by all parties engaged in the work:

1. Keep temporary services and facilities clean and neat.
2. Relocate temporary services and facilities as required by progress of the Work.

1.04 USE CHARGES

- A. General: Cost or use charges for temporary facilities are not chargeable to OWNER or Engineer and shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to, the following:
1. OWNER'S construction forces.
 2. Occupants of Project.
 3. Engineer.
 4. Testing agencies.
 5. Personnel of authorities having jurisdiction.
 6. Owner's inspectors.

1.05 TEMPORARY LIGHT AND POWER

- A. The CONTRACTOR shall make temporary service connections for their construction needs that is independent of the City's connections, including but not limited to:
1. Set up an account with City in the CONTRACTOR's name. All bills from City will be sent to the CONTRACTOR for payment.
 2. Make all contact with City, prepare service application as needed and pay all application, service, and installation costs.
 3. Through City, install electric meter to provide all electric usage for temporary services during construction, including OWNER / ENGINEER office.
 4. Pay all usage costs for installed meter during construction.
 5. Following construction, remove meter and all systems related to temporary service to the satisfaction of the OWNER. Pay all bills owed to City.
- B. The CONTRACTOR shall furnish all temporary light and power, complete with wiring, lamps, and similar equipment as required to adequately light all work areas and with sufficient power capacity to meet the needs of the OWNER and ENGINEER. The CONTRACTOR shall make all necessary arrangements with the temporary construction facilities for the OWNER for temporary electric service and pay all expenses in connection therewith.
- C. Provide properly configured NEMA polarized outlets to prevent insertion of 110-120 volt plugs into higher voltage outlets. For connection of power tools and equipment, provide outlets equipped with ground-fault circuit interrupters, reset button and pilot light.

- D. Provide grounded extension cords. Use "hard-service" cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords if more than one length is required.
- E. Provide general service incandescent lamps as required for adequate illumination. Provide guard cages or tempered glass enclosures, where exposed to breakage. Provide exterior fixtures where exposed to moisture.

1.06 TEMPORARY AIR AND WATER

- A. The CONTRACTOR shall provide all air and water, including temporary piping and appurtenances, as may be required for the cleaning and testing of pipelines and equipment necessary for the work. Temporary piping and appurtenances shall be removed upon approval of equipment being tested.
- B. Temporary connection could be made to the proposed supply mains to be constructed by the CONTRACTOR. Temporary connections shall include but not be limited to:
 - 1. Setup an account in the CONTRACTOR's name with the City. All bills from the City will be sent to the CONTRACTOR for payment.
 - 2. Make contact with City for temporary service, to include application submittal and payment of all associated fees and installation cost for the connection to the main.
 - 3. Install or have installed by the City the water meter and any other facilities required by the City.
 - 4. Install a Reduced Pressure Zone (RPZ) valve assembly to prevent backflow in the event of a pressure failure.
 - 5. Temporary water service will be for CONTRACTOR's use and for the temporary office buildings, including the OWNER / ENGINEER's office.
 - 6. Following construction, remove the water meter and all systems related to the temporary service to the satisfaction of the OWNER. Pay all bills owed to the City.
- C. The CONTRACTOR shall supply all necessary tools, hose and pipe, and shall make necessary arrangements for securing and transporting such water and shall take water in such a manner, and at such times, that will not produce a harmful drain or decrease of pressure in the City's water system. Temporary lines shall be removed when no longer required.

1.07 TEMPORARY SANITARY FACILITIES

- A. All temporary piping and connections are the CONTRACTOR's responsibilities and shall be removed by the CONTRACTOR following its use, to the satisfaction of the OWNER. Any temporary connection to the sanitary system shall be approved by the OWNER.
- B. The CONTRACTOR shall furnish temporary sanitary facilities at the site, as provided herein, for the needs of all construction workers and others performing Work or furnishing services on the Project.

- C. Provide temporary toilets, wash facilities, and drinking-water fixtures. Comply with regulations and health codes for type, number, location, operation, and maintenance of fixtures and facilities.
 - 1. Disposable Supplies: Provide toilet tissue, paper towels, paper cups, and similar disposable materials for each facility. Maintain adequate supply. Provide covered waste containers for disposal of used material.
 - 2. Toilets: Install self-contained toilet units.
- D. Sanitary facilities shall be of reasonable capacity, properly maintained throughout the construction period, and obscured from public view to the greatest practical extent. If toilets of the chemically treated type are used, at least one toilet shall be furnished for each twenty (20) employees. The CONTRACTOR shall enforce the use of such sanitary facilities by all personnel at the site.
- E. At no time shall the CONTRACTOR or subcontractors use the sanitary facilities for the OWNER/ENGINEER'S Field Office.

1.08 FIRE EXTINGUISHERS

- A. Provide portable UL-rated, Class A fire extinguishers for temporary offices and similar spaces. In other locations, provide portable UL-rated Class ABC dry chemical extinguishers or a combination of NFPA recommended Classes for the exposure. Comply with NFPA 10 and 241 for classification, extinguishing agent and size required by location and class of fire exposure.

1.09 LAYOUT OF TEMPORARY FACILITIES

- A. Before starting the work, the CONTRACTOR shall submit to the ENGINEER his requirements for space for temporary structures and storage of materials. The CONTRACTOR shall submit to the ENGINEER for approval, his proposed plan and layout for all temporary offices, sanitary facilities, temporary construction roads, storage buildings, storage yards, temporary water service and distribution, temporary power service and distribution, and temporary telephone service.

1.10 STORAGE BUILDINGS

- A. The CONTRACTOR shall erect, or provide as approved, temporary storage buildings as required for the protection of mechanical and electrical equipment and materials as recommended by manufacturers of such equipment and materials. The buildings shall be provided with environmental control systems that meet recommendations of manufacturers of all equipment and materials stored in the buildings. The buildings shall be of sufficient size and so arranged or partitioned to provide security for their contents and provide ready access for inspection and inventory. At or near the completion of the work, and as directed by the ENGINEER, the temporary storage buildings shall be dismantled, removed from the site, and remain the property of the CONTRACTOR.
- B. Combustible materials (paints, solvents, fuels, etc.) shall be stored in a well-ventilated building removed from other buildings.

1.11 STORAGE YARDS

- A. The CONTRACTOR shall construct temporary storage yards for the storage of materials that are not subject to damage by weather conditions. Materials such as pipe and reinforcing and structural steel shall be stored on pallets or racks, off the ground, and in a manner that allows ready access for inspection and inventory.

1.12 CONTRACTOR'S WORK AREA

- A. The CONTRACTOR shall limit his operations and storage of equipment and materials to the areas designated and as directed by the ENGINEER.
- B. The CONTRACTOR shall erect a suitable fence around each tree or group of trees shown as "protected" or "to be saved" on the plans. Any such trees damaged shall be repaired or replaced, as directed by the ENGINEER, at the CONTRACTOR'S expense.
- C. Except as provided herein, no private property, or other area adjacent to the plant site shall be used for storage of the CONTRACTOR'S equipment and materials unless prior written approval is obtained from the legal owner.
- D. The CONTRACTOR shall maintain the area during construction and shall proceed with his work in an orderly manner, maintaining the construction site free of debris and unnecessary equipment or materials.
- E. At all times, maintain areas covered by the Contract and public properties free from accumulations of waste, debris, and rubbish caused by construction operations.
- F. Cleaning and disposal operations shall comply with local ordinances and antipollution laws. Do not burn or bury rubbish and waste materials on the project site. Do not dispose of volatile wastes such as mineral spirits, oil, chemicals, or paint thinner in storm or sanitary drains. Do not dispose of wastes into streams or waterways.
- G. Wet down dry materials and rubbish to minimize dust and prevent blowing dust.
- H. Provide approved containers for collection and disposal of waste materials, debris, and rubbish and make arrangements for appropriate periodic emptying of the containers.

1.13 PROTECTION OF PUBLIC AND PRIVATE PROPERTY

- A. The CONTRACTOR shall protect, shore, brace, support and maintain all underground pipes conduits, drains, and other underground construction uncovered or otherwise affected by the CONTRACTOR'S operations. All pavement, surfacing, driveways, curbs, walks, buildings, utility poles, guy wires, fences, and other surface structures affected by construction operations, together with all sod and shrubs in yards, parkways, and medians, shall be restored to their original condition, whether within or outside the easement/right-of-way. All replacements shall be made with new materials.
- B. The CONTRACTOR shall be responsible for all damage to streets, roads, curbs, sidewalks, highways, shoulders, ditches, embankments, culverts, bridges, or other public or private property, which may be caused by transporting equipment, materials, or men to or from the Work, whether by him or his Subcontractors. The CONTRACTOR shall make satisfactory and acceptable arrangements with the OWNER of, or the agency having jurisdiction over, the

damaged property concerning its repair or replacement, or payment of costs incurred in connection with the damage.

- C. All fire hydrants and water control valves shall be kept free from obstruction and available for use at all times.

1.14 TEMPORARY ACCESS ROADS AND PARKING SPACE

- A. The CONTRACTOR shall construct temporary construction access roads and detours as are required to execute the work. The roads shall meet with the approval of the ENGINEER and OWNER, and be maintained in good condition until no longer needed; at which time the temporary roads shall be removed and the area left in a condition satisfactory to the ENGINEER.
- B. The CONTRACTOR shall construct temporary parking facilities for his employees, his Sub-contractor's employees, other employees, and the ENGINEER.

1.15 PROTECTION OF THE FINISHED CONSTRUCTION

- A. The CONTRACTOR shall assume the responsibility for the protection of all finished construction and shall repair and restore any and all damage to finished work to its original or better state.
- B. Where responsibility can be determined, the cost for replacement or repair of damaged work shall be charged to the party responsible. If responsibility cannot be fixed, the cost shall be borne by the CONTRACTOR.
- C. Wheeling of any loads over finished floors, either with or without plank protection, shall not be permitted in anything except rubber-tired wheelbarrows, buggies, trucks, or dollies. This applies to all finished floors and to all exposed concrete floors as well as those covered with composition tile or other applied surfacing and shall apply to all trades.
- D. Where structural concrete has the finished surface, care shall be taken to avoid marking or damaging those surfaces.

1.16 TEMPORARY SIGNS

- A. Furnish and install the project signs indicated in the Contract Documents. Signs shall be placed as directed by the ENGINEER; and shall be maintained in good condition for the life of the construction period.
- B. Remove signs at final acceptance, unless otherwise directed.

1.17 SECURITY

- A. The CONTRACTOR shall be responsible for protection of the site, and all work, materials, equipment, and existing facilities thereon, against vandals and other unauthorized persons.
- B. No claim shall be made against the OWNER by reason of any act of an employee or trespasser, and CONTRACTOR shall make good all damage to the OWNER'S property resulting from CONTRACTOR'S failure to provide security measures.

1.18 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Locate field offices, storage sheds, sanitary facilities, and other temporary construction and support facilities for easy access.
2. Maintain support facilities until near Substantial Completion. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to OWNER.

B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate to support loads and to withstand exposure to traffic during construction period. Locate temporary roads and paved areas within construction limits indicated on Drawings.

1. Provide a reasonably level, graded, well-drained subgrade of satisfactory soil material, compacted to not less than 95 percent of maximum dry density in the top 6 in.

C. Dewatering Facilities and Drains: Comply with requirements in applicable specification sections for temporary drainage and dewatering facilities and operations not directly associated with construction activities included in individual sections. Where feasible, use same facilities. Maintain Project site, excavations, and construction free of water.

1. Dispose of rainwater in a lawful manner that will not result in flooding project or adjoining property nor endanger permanent work or temporary facilities.
2. Before connection and operation of permanent drainage piping system, provide temporary drainage where roofing or similar waterproof deck construction is completed.

D. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Containerize and clearly label hazardous, dangerous, or unsanitary waste materials separately from other waste.

E. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate. Cover finished, permanent stairs with protective covering of plywood or similar material so finishes will be undamaged at time of acceptance.

F. Fuel Storage: Temporary fuel storage will comply with TCEQ regulations. Provide secondary containment.

G. Worker Housing: The CONTRACTOR shall not be allowed to provide temporary housing of their workforce on the job site or other City of Seguin property.

1.19 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects. Avoid using tools and equipment that produce harmful noise. Restrict use of noisemaking tools and equipment to hours that will minimize complaints from persons or firms near Project site.

- B. Stormwater Control: Provide earthen embankments and similar barriers in and around excavations and subgrade construction, sufficient to prevent flooding by runoff of stormwater from heavy rains.
- C. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from construction damage. Protect tree root systems from damage, flooding, and erosion.
- D. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.
- E. Barricades, Warning Signs, and Lights: Comply with standards and code requirements for erecting structurally adequate barricades. Paint with appropriate colors, graphics, and warning signs to inform personnel and public of possible hazard. Where appropriate and needed, provide lighting, including flashing red or amber lights.
- F. Temporary Fire Protection: Until fire-protection needs are supplied by permanent facilities, install, and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.
 - 1. Provide fire extinguishers, installed on walls on mounting brackets, visible and accessible from space being served, with sign mounted above.
 - a. Field Offices: Class A stored-pressure water-type extinguishers.
 - 2. Store combustible materials in containers in fire-safe locations.
 - 3. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire-protection facilities, stairways, and other access routes for firefighting. Prohibit smoking in hazardous fire-exposure areas.
 - 4. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition.

1.20 REMOVAL OF TEMPORARY FACILITIES AND UTILITIES

- A. At such time or times any temporary construction facilities and utilities are no longer required for the work, the CONTRACTOR shall notify the ENGINEER of his intent and schedule for removal of the temporary facilities and utilities and obtain the ENGINEER'S approval before removal. As approved, the CONTRACTOR shall disconnect and/or dismantle the temporary facilities and utilities and remove them from the site as his property. Leave the site in such condition as specified, as directed by the ENGINEER, and/or as shown on the Plans.
- B. In unfinished areas, the condition of the site shall be left in a condition that will restore original drainage, evenly graded, seeded or planted as necessary, and left with an appearance equal to, or better than original.
- C. Maintain facilities in good operating condition until removal. Protect from damage caused by freezing temperatures and similar elements.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
 2. Prevent water-filled piping from freezing. Maintain markers for underground lines. Protect from damage during excavation operations.
- D. Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
1. Materials and facilities that constitute temporary facilities are the property of CONTRACTOR.
 2. Remove temporary paving not intended for or acceptable for integration into permanent paving. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
 3. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements in the Contract Documents.

1.21 PAYMENT

- A. The work specified in this Section shall be considered incidental and payment will be included as part of the appropriate lump sum or unit prices stated in the Proposal.

END OF SECTION

ENVIRONMENTAL PROTECTION PROCEDURES

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. The work covered by this Section consists of furnishing all labor, materials and equipment and performing all work required for the prevention of environmental pollution in conformance with applicable laws and regulations, during and as the result of construction operations under this Contract. For the purpose of this Specification, environmental pollution is defined as the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to man; or degrade the utility of the environment for aesthetic and/or recreational purposes.
- B. The control of environmental pollution requires consideration of air, water, and land, and involves management of noise and solid waste, as well as other pollutants.
- C. Schedule and conduct all work in a manner that will minimize the erosion of soils in the area of the work. Provide erosion control measures such as sedimentation or filtration systems, berms, silt fences, seeding, mulching or other special surface treatments as are required to prevent silting and muddying of streams, rivers, impoundments, lakes, etc. All erosion control measures shall be in place in an area prior to any construction activity in that area.
- D. These Specifications are intended to ensure that construction is achieved with a minimum of disturbance to the existing ecological balance between a water resource and its surroundings. These are general guidelines. It is the CONTRACTOR'S responsibility to determine the specific construction techniques to meet these guidelines.
- E. All phases of sedimentation and erosion control shall comply with and be subject to the approval of the Texas Commission on Environmental Quality (TCEQ) and the U.S. Environmental Protection Agency (EPA).

1.02 APPLICABLE REGULATIONS

- A. Comply with all applicable Federal, State, and local laws and regulations concerning environmental pollution control and abatement.

1.03 NOTIFICATIONS

- A. The ENGINEER will notify the CONTRACTOR in writing of any observed non-compliance with the foregoing provisions or of any environmentally objectionable acts and corrective action to be taken. State or local agencies responsible for verification of certain aspects of the environmental protection requirements shall notify the CONTRACTOR in writing, through the ENGINEER, of any non-compliance with State or local requirements. The CONTRACTOR shall, after receipt of such notice from the ENGINEER or from the regulatory agency through the ENGINEER, immediately take corrective action. Such notice, when delivered to the CONTRACTOR or its authorized representative at the site of the work, shall be deemed sufficient for the purpose. If the CONTRACTOR fails or refuses to comply promptly, the OWNER may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to any such stop orders shall be made the subject of

a claim for extension of time or for excess costs or damages by the CONTRACTOR unless it is later determined that the CONTRACTOR was in full compliance.

1.04 IMPLEMENTATION

- A. Prior to commencement of the work, meet with the OWNER to develop mutual understandings relative to compliance with this provision and administration of the environmental pollution control program.
- B. Remove temporary environmental control features, when approved by the ENGINEER, and incorporate permanent control features into the project at the earliest practicable time.

1.05 PROTECTION OF WATERWAYS

- A. The CONTRACTOR shall observe the rules and regulations of the State of Texas and agencies of the U.S. Government prohibiting the pollution of any lake, stream, river, or wetland by the dumping of any refuse, rubbish, dredge material, or debris therein.
- B. CONTRACTORS are specifically cautioned that disposal of materials into any waters of the State must conform with the requirements of the TCEQ, and an applicable permit from the U.S. Army Corps of Engineers.
- C. The CONTRACTOR shall be responsible for providing holding ponds or an approved method which will handle, carry through, or divert around his work all flows, including storm flows and flows created by construction activity, so as to prevent silting of waterways or flooding damage to the property or adjacent properties.
 - 1. Any materials removed from water bodies are to be dewatered in a manner that prevents silting or return of material to water body.
 - 2. Liquid/solid separation to be performed mechanically, by gravity separation in holding ponds or by other means that comply with the requirements. Holding ponds to incorporate means to remove liquid such as filtered riser pipes, decant pipes, underdrains, etc.
- D. The CONTRACTOR is responsible for researching the need for a U.S. EPA NPDES (Stormwater Pollution Prevention Plan) permit for the construction site. If one is required, the CONTRACTOR is responsible for obtaining the permit and for monitoring the site per the permit requirements until final completion. Costs associated with this activity shall be included in the CONTRACTOR'S bid.

1.06 DISPOSAL OF EXCESS EXCAVATION AND OTHER WASTE MATERIALS

- A. Material not suitable for backfill and other waste material must be disposed of at sites approved by the OWNER and ENGINEER. Excess excavated material suitable for backfill, but not used, shall be spread, and compacted in the designated spoils area as shown on the Drawings.
- B. Unacceptable disposal sites, include, but are not limited to, sites within a wetland or critical habitat and sites where disposal will have a detrimental effect on surface water or groundwater quality.
- C. The CONTRACTOR may make his own arrangements for disposal subject to submission of proof to the ENGINEER that the OWNER of the proposed site(s) has a valid fill permit issued

by the appropriate governmental agency and submission of a haul route plan including a map of the proposed route(s).

- D. The CONTRACTOR shall provide watertight conveyance of any liquid, semi-liquid, or saturated solids which tend to bleed or leak during transport. No liquid loss from transported materials will be permitted whether being delivered to the construction site or being hauled away for disposal. Fluid materials hauled for disposal must be specifically acceptable at the selected disposal site.

1.07 USE OF CHEMICALS

- A. All chemicals used during project construction or furnished for project operation, whether herbicide, pesticide, disinfectant, polymer, reactant or of other classification, must show approval of either the U.S. EPA or the U.S. Department of Agriculture or any other applicable regulatory agency. Use of all such chemicals and disposal of residues shall be in conformance with the manufacturer's instructions.
- B. Any oil or other hydrocarbon spilled or dumped on the OWNER'S site during construction must be excavated and completely removed from the site prior to final acceptance. Soil contaminated by the CONTRACTOR'S operations shall become the property of the CONTRACTOR, who will bear all costs of testing and disposal.
- C. If the OWNER is using or storing any chemicals on-site, the following steps shall be completed before a CONTRACTOR commences work:
 - 1. The OWNER will inform CONTRACTOR of his rights under the Texas Hazards Communication Act.
 - 2. The OWNER will provide a copy of the Chemical List giving the hazardous chemicals to which the CONTRACTOR, his employees and agents may be exposed to on the project site.
 - 3. The OWNER will provide copies of all MSDSs to the CONTRACTOR for the hazardous chemicals which he may be exposed to on the project site.
 - 4. The OWNER will inform the CONTRACTOR of his obligation to inform his employees and agents of each of the above requirements.
 - 5. The CONTRACTOR shall provide MSDSs for all hazardous chemicals he may bring onto the project site that OWNER'S employees may be exposed to.
 - 6. The CONTRACTOR shall sign a Contractor Acknowledgement certifying that he has received the information provided by the OWNER on hazardous chemicals and maintain the Acknowledgement with the original Contract.

1.08 PAYMENT

- A. The work specified in this Section shall be considered incidental and payment will be included as part of the appropriate lump sum or unit prices specified in the Bid Form.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 EROSION CONTROL

- A. Provide positive means of erosion control such as shallow ditches or small berms around construction to carry off surface water. Erosion control measures, such as siltation basins, mulching, jute netting and other equivalent techniques, shall be used as appropriate. Flow of surface water into excavated areas shall be prevented. Ditches around construction area shall also be used to carry away water resulting from dewatering of excavated areas. At the completion of the work, ditches shall be backfilled, berms removed, and the ground surface restored to original condition.

3.02 PROTECTION OF STREAMS

- A. Care shall be taken to prevent, or reduce to a minimum, any damage to any stream from pollution by debris, sediment, or other material, or from the manipulation of equipment and/or materials in or near such streams. Water that has been used for washing or processing, or that contains oils or sediments that will reduce the quality of the water in the stream, shall not be directly returned to the stream. Such waters shall be diverted through a settling basin or filter before being directed into the streams.
- B. The CONTRACTOR shall not discharge water from dewatering operations directly into any live or intermittent stream, channel, wetlands, surface water or any storm sewer. Water from dewatering operations shall be treated by filtration, settling basins, or other approved method to reduce the amount of sediment contained in the water.
- C. All preventative measures shall be taken to avoid spillage of petroleum products and other pollutants. In the event of any spillage, prompt remedial action shall be taken in accordance with a contingency action plan approved by the TCEQ. CONTRACTOR shall submit two copies of approved contingency plans to the ENGINEER.
- D. Water being flushed from structures or pipelines after disinfection, with a chlorine residue of 1 mg/L or greater, shall be treated with a dechlorination solution, in a method approved by the ENGINEER, prior to discharge.

3.03 PROTECTION OF LAND RESOURCES

- A. Land resources within the project boundaries and outside the limits of permanent work shall be restored to a condition, after completion of construction that will appear to be natural and not detract from the appearance of the project. Confine all construction activities to areas shown on the Drawings.
- B. Outside of areas requiring earthwork for the construction of the new facilities, the CONTRACTOR shall not deface, injure, or destroy trees or shrubs, nor remove or cut them without prior approval. No ropes, cables, or guys shall be fastened to or attached to any existing nearby trees for anchorage unless specifically authorized by the ENGINEER. Where such special emergency use is permitted, first wrap the trunk with a sufficient thickness of burlap or rags over which softwood cleats shall be tied before any rope, cable, or wire is placed. The CONTRACTOR shall in any event be responsible for any damage resulting from such use.

- C. Where trees may possibly be defaced, bruised, injured, or otherwise damaged by the CONTRACTOR'S equipment, dumping or other operations, protect such trees by placing boards, planks, or poles around them. Monuments and markers shall be protected similarly before beginning operations near them.
- D. Any trees or other landscape feature scarred or damaged by the CONTRACTOR'S equipment or operations shall be restored as nearly as possible to its original condition. The ENGINEER will decide what method of restoration shall be used and whether damaged trees shall be treated and healed or removed and disposed of.
 - 1. All scars made on trees by equipment, construction operations, or by the removal of limbs larger than 1 in. in diameter shall be coated as soon as possible with an approved tree wound dressing. All trimming or pruning shall be performed in an approved manner by experienced workmen with saws or pruning shears. Tree trimming with axes will not be permitted.
 - 2. Climbing ropes shall be used where necessary for safety. Trees that are to remain, either within or outside established clearing limits, that are subsequently damaged by the CONTRACTOR and are beyond saving in the opinion of the ENGINEER, shall be immediately removed and replaced.
- E. The locations of the CONTRACTOR'S storage, and other construction buildings, required temporarily in the performance of the work, shall be cleared portions of the job site or areas to be cleared as shown on the Drawings and shall require written approval of the ENGINEER and shall not be within wetlands or floodplains. The preservation of the landscape shall be an imperative consideration in the selection of all sites and in the construction of buildings. Drawings showing storage facilities shall be submitted for approval of the ENGINEER.
- F. If the CONTRACTOR proposes to construct temporary roads or embankments and excavations for plant and/or work areas, he/she shall submit the following for approval at least ten days prior to scheduled start of such temporary work.
 - 1. A layout of all temporary roads, excavations, and embankments to be constructed within the work area.
 - 2. Details of temporary road construction.
 - 3. Drawings and cross sections of proposed embankments and their foundations, including a description of proposed materials.
 - 4. A landscaping drawing showing the proposed restoration of the area. Removal of any trees and shrubs outside the limits of existing clearing area shall be indicated. The drawing shall also indicate location of required guard posts or barriers required to control vehicular traffic passing close to trees and shrubs to be maintained undamaged. The drawing shall provide for the obliteration of construction scars as such and shall provide for a natural appearing final condition of the area. Modification of the CONTRACTOR'S approved drawings shall be made only with the written approval of the ENGINEER. No unauthorized road construction, excavation or embankment construction including disposal areas will be permitted.
- G. Remove all signs of temporary construction facilities such as haul roads, work areas, structures, foundations of temporary structures, stockpiles of excess or waste materials, or any other

vestiges of construction as directed by the ENGINEER. It is anticipated that excavation, filling and plowing of roadways will be required to restore the area to near natural conditions which will permit the growth of vegetation thereon. The disturbed areas shall be prepared and seeded as described in SECTION 32 92 30 - LOAMING AND HYDROSEEDING, or as approved by the ENGINEER.

- H. All debris and excess material shall be disposed of outside wetland or floodplain areas in an environmentally sound manner.

3.04 PROTECTION OF AIR QUALITY

- A. Burning. The use of burning at the project site for the disposal of refuse and debris will not be permitted, unless approved by the OWNER.
- B. Dust Control. The CONTRACTOR will be required to maintain all excavations, embankment, stockpiles, access roads, plant sites, waste areas, borrow areas, and all other work areas within or without the project boundaries free from dust which could cause the standards for air pollution to be exceeded, and which would cause a hazard or nuisance to others.
- C. An approved method of stabilization consisting of sprinkling or other similar methods will be permitted to control dust. The use of petroleum products is prohibited. The use of chlorides may be permitted with approval from the ENGINEER.
- D. Sprinkling, to be approved, must be repeated at such intervals as to keep all parts of the disturbed area at least damp at all times, and the CONTRACTOR must have sufficient suitable equipment on the job to accomplish this if sprinkling is used. Dust control shall be performed as the work proceeds and whenever a dust nuisance or hazard occurs, as determined by the ENGINEER.

3.05 MAINTENANCE OF POLLUTION CONTROL FACILITIES DURING CONSTRUCTION

- A. During the life of this Contract, maintain all facilities constructed for pollution control as long as the operations creating the particular pollutant are being carried out or until the material concerned has become stabilized to the extent that pollution is no longer being created.

3.06 NOISE CONTROL

- A. The CONTRACTOR shall make every effort to minimize noises caused by its operations. Equipment shall be equipped with silencers or mufflers designed to operate with the least possible noise in compliance with State and Federal regulations.

END OF SECTION

SECTION 01 57 23

STORMWATER POLLUTION PREVENTION PLAN

PART 1 - GENERAL

1.01 PREPARATION AND NOTIFICATION PHASE

A. Stormwater Pollution Prevention Plan (SWP3)

1. The CONTRACTOR shall be responsible for preparation of the Stormwater Pollution Prevention Plan (SWP3) and submitting the plan to the Texas Commission on Environmental Quality (TCEQ). The CONTRACTOR shall incorporate as a part of the SWP3 all necessary erosion control details and notes required by applicable law and as shown on the drawings, **including all necessary materials and labor necessary to construct the items called for in the SWP3**. The SWP3 shall include all elements required by TPDES General Permit No. TXR150000 as issued by TCEQ, effective date, January 28, 2022. The SWP3 must be retained on-site at all times during the construction of the project. The CONTRACTOR shall complete the document in Attachment 1 and insert into the SWP3.

B. Notice of Intent and Construction Site Notice

1. The CONTRACTOR shall submit a Notice of Intent (NOI) to the Texas Commission on Environmental Quality. The application fee and annual Water Quality Fee shall be paid for by the CONTRACTOR. A Construction Site Notice and NOI are required for areas where the land disturbed is equal to or greater than five (5) acres. For disturbed areas where the acreage is between one (1) and five (5) acres, only a Construction Site Notice is required. A copy of the NOI (and/or Construction Site Notice) shall be given to the City. Both forms shall be posted at the project site in a location where it is readily available for viewing by the general public, local, state, and federal authorities.
2. An Authorized Representative of the CONTRACTOR shall sign the NOI and/or Construction Site Notice, and Attachment 1. The authorized representative must be someone at or near the top of the management chain, such as the president, vice president, or a general partner, who has been delegated the authority to sign and certify this type of document. See 30 TAC, 305.44 of the TCEQ Rules and Regulations for requirements related to Application for Permit.
3. A NOI must be postmarked at least seven (7) days before construction begins. If the NOI form is submitted electronically via the STEERS Program, construction may begin the same day as the NOI is submitted.

1.02 MEASUREMENT

- A. The NOI, SW3P and all erosion control measures called for in the SW3P (e.g., rock berms, silt fence, construction entrances, etc.) shall be measured as a Lump Sum. All incidental erosion, sediment and water pollution control devices and measures required, both temporary and permanent, shall be considered subsidiary to the bid item "Stormwater Pollution Prevention Plan" and no direct measurement will be made. Preparation and updating of the "Stormwater Pollution Prevention Plan" including all reports and records to be maintained shall not be measured but shall be considered subsidiary to the bid item "Stormwater Pollution Prevention Plan."

1.03 PAYMENT

- A. All erosion, sediment and water pollution control devices and measures required, both temporary and permanent, shall be bid as a lump sum price for the bid item “Stormwater Pollution Prevention Plan.” Preparation and updating of the “Stormwater Pollution Prevention Plan” including all reports and records to be maintained shall be included in the lump sum price for the bid item “Stormwater Pollution Prevention Plan.” The lump sum bid price for the “Stormwater Pollution Prevention Plan” will be full compensation for furnishing all labor, materials and equipment necessary to install, maintain, and remove (if required) all items and actions necessary to maintain and complete the “Stormwater Pollution Prevention Plan” requirements for this project.
- B. Costs for the CONTRACTOR’S Application Fee for the NOI and the annual Water Quality Fee shall be included in the lump sum bid for the “Stormwater Pollution Prevention Plan.”
- C. Costs for personnel to inspect the protective measures that are a part of the “Stormwater Pollution Prevention Plan” shall be included in the lump sum bid for the “Stormwater Pollution Prevention Plan.”
- D. Pollution control measures may be applicable to CONTRACTOR operations outside the right of way and easement area where such work is necessary as a result of roadway related construction such as construction and haul roads, field offices, equipment and supply areas, and material sources. Pollution control measures outside the right of way will not be measured for payment but shall be performed at the CONTRACTOR'S expense.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 CONSTRUCTION/IMPLEMENTATION PHASE

- A. Once the NOI has been mailed, the CONTRACTOR may start construction of the project as early as seven (7) days after the NOI is postmarked, or immediately if the NOI is submitted electronically through STEERS. The CONTRACTOR must: (a) implement the controls, (b) inspect and maintain the controls, (c) maintain records of construction activities, (d) update/change the plan to keep it current, and (e) have plans accessible as outlined in the SWP3.

1. Implement Controls

- a. The first action that should be taken is to construct or perform the controls that were selected for the SWP3. The controls must be installed and/or constructed in the order indicated in the sequence of major activities. Stabilization measures must be applied within the time frame specified in the permit.
- b. To ensure that controls are adequately implemented, it is important that the work crews who install the measures are experienced and/or adequately trained. Improperly installed controls can have little or no effect and may actually increase the pollution of stormwater. It is also important that all other workers on the construction site be made aware of the controls so that they do not inadvertently disturb or remove them.

2. Inspect and Maintain Controls

- a. Inspection and maintenance of the protective measures that are part of this plan are as important to pollution prevention as proper planning, design/selection, and installation. The CONTRACTOR shall provide for the systematic inspection of the SWP3 Controls.
- b. Inspection - Inspection shall be at least every fourteen (14) days and within 24-hours after the end of a storm of 0.5 in. or more, or every seven (7) days. All disturbed areas of the site, areas for material storage, locations where vehicles enter or exit the site, and all of the erosion and sediment controls that were identified as part of the plan must be inspected. Controls must be in good operating condition until the area they protect has been completely stabilized and the construction activity is complete. The inspector for the CONTRACTOR shall sign all inspection reports.
- c. Maintenance/repairs - The inspector must record any damages or deficiencies in the control measures on an inspection report form provided for this purpose. These reports document the maintenance and repair and to prove that inspection and maintenance were performed. The CONTRACTOR shall correct damages or deficiencies as soon as practicable after the inspection but in no case later than seven (7) days after the inspection. Any changes that may be required to correct deficiencies in the SWP3 shall also be completed and dated in the document as soon as practicable after the inspection but in no case later than seven (7) days after the inspection.

3. Maintain Records of Construction Activities

- a. In addition to the inspection and maintenance reports, the inspector shall keep records of the construction activity on the site. In particular, the inspector shall keep a record of the following information:
 - 1) The dates when major grading activities occur in a particular area.
 - 2) The dates when construction activities cease in an area, temporarily or permanently.
 - 3) The dates when an area is stabilized, temporarily or permanently.
- b. These records can be used to make sure that areas where there is no construction activity will be stabilized within the required time frame.

4. Update/Change the Plan

- a. For a construction activity to be in full compliance with its TPDES Construction General Permit, and for the SWP3 to be effective, the plan must accurately reflect site features and operations. When it does not, the plan must be changed. The plan must also be changed if the operators observe that it is not effective in minimizing pollutant discharge from the site.

5. Provide for Plan Location and Access

- a. The General Permit has specific requirements regarding plan location and access.

- b. Plan location: A copy of the SWP3 must be kept at the construction site from the time construction begins until the site is finally stabilized.
- c. Access: Although plans and associated records are not necessarily required to be submitted to the State, these documents must be made available upon request to the State or local agency who is approving erosion and sediment control plans, or stormwater pollution prevention plans. If site stormwater runoff is discharged to a municipal separate storm sewer system, the plans must be made available upon request to the municipal operator of the system.

3.02 FINAL STABILIZATION/TERMINATION PHASE

- A. Operators of a construction site must continue to comply with permit conditions until:
 - 1. They no longer meet the definition of an Operator of a construction site; or
 - 2. The construction activity is complete, all disturbed soils have been finally stabilized, and temporary erosion and sediment controls have been or will be removed.
- B. A permittee should submit a Notice of Termination (NOT) to inform TCEQ that he/she is no longer an Operator of the construction activity.
- C. Final Stabilization
 - 1. Final stabilization is defined by the General Permit as meaning that all soil disturbing activities at the site have been completed, and that a uniform perennial vegetative cover with a density of 70 percent of the native background vegetated cover (i.e., original conditions) for unpaved areas not covered by permanent structures has been established or equivalent permanent stabilization measures (such as the use of riprap, gabions, or geotextiles) have been employed.
- D. Notice of Termination
 - 1. A notice shall be completed and submitted to TCEQ and the OWNER when the site has been finally stabilized or when an Operator of a construction activity changes. Information to be included on the notice includes the location of the construction site; the name, address, and telephone number of the Operator terminating coverage; the TPDES General Permit number; an indication of why coverage under the permit should be terminated for the Operator; and a signed certification statement.
 - 2. Note that when there is a change in operators of a construction activity, the new Operator must submit a NOI to be covered by the permit at least seven (7) days before the change in Operator.
- E. Record Retention
 - 1. Following the termination of construction activities, the permittees must keep a copy of the SWP3, all reports and actions required by the General Permit, and all the data used to complete the NOI for a period of at least three years following final stabilization. Prior to submitting the NOT, the CONTRACTOR shall furnish the OWNER copies of all NOIs, certificates, and inspection forms for record retention purposes.

ATTACHMENT 1
Stormwater Pollution Prevention Plan
Roles and Responsibilities

STORMWATER POLLUTION PREVENTION PLAN
ROLES AND RESPONSIBILITIES

This is a shared Stormwater Pollution Prevention Plan (SWP3) between the below Primary Operators.
The role of each Operator is listed below.

PRIMARY OPERATOR (CITY OF SEGUIN):

SIGNATURE: _____
PRINTED NAME: _____
ADDRESS: _____

RESPONSIBILITIES:

- ☒ Operational control over plans and specifications, including the ability to make modifications to those plans.
- ☐ Day-to-day operational control of activities necessary to ensure compliance with the SWP3 for the site.

PRIMARY OPERATOR (CONTRACTOR):

SIGNATURE: _____
PRINTED NAME: _____
ADDRESS: _____

RESPONSIBILITIES:

- ☐ Operational control over plans and specifications, including the ability to make modifications to those plans.
- ☒ Day-to-day operational control of activities necessary to ensure compliance with the SWP3 for the site.

END OF SECTION

SECTION 01 61 00
MATERIALS AND EQUIPMENT

PART 1 - GENERAL

1.01 DESCRIPTION

- A. All materials, appliances and types of construction shall be in accordance with the Specifications and shall, further, conform to the requirements of applicable laws, ordinances, and codes.
- B. All materials and equipment shall be new, unused, and designed as specified. They shall be of standard first-grade quality, produced by expert workmen, and be intended for the use for which they are offered. Materials or equipment which are inferior or of a lower grade than indicated, specified, or required will not be accepted.
- C. The quality of workmanship and materials entering into the Work under each Section shall conform to the requirements of pertinent sections, clauses, paragraphs, and sentences, both directly and indirectly applicable thereto, of the Specifications.
- D. Equipment and appurtenances shall be designed in conformity with AWWA, NSF, ASME, AIEE, and NEMA standards and shall be of rugged construction and of sufficient strength to withstand all stresses, which may occur during fabrication, test, transportation, installation, and all conditions of operation. Protect bearings and moving parts against wear by bushings or other approved means and fully lubricate readily accessible devices. Design details for appearance as well as utility. Protruding members, joints, corners, gear covers, and the like shall be finished in appearance. Grind exposed welds smooth. Miter corners of structural shapes.

1.02 MANUFACTURER

- A. Submit names of proposed manufacturers, material men and dealers who are to furnish materials, fixtures, equipment, appliances, or other appurtenances for review as early as possible to afford proper investigation and checking. No manufacturer will be approved for materials or equipment to be furnished under this Contract unless he shall be of good reputation and have a plant of ample capacity suited to the efficient production of the materials or equipment offered. He shall, upon request, be required to submit evidence that he has manufactured a similar product to the one specified and that it has been previously used for a like purpose for a sufficient length of time to demonstrate that it will fulfill all requirements of the Project.
- B. The availability of the manufacturer's service facilities for the maintenance of equipment offered will be considered in the evaluation.
- C. All transactions with the manufacturers or subcontractors shall be through the CONTRACTOR.
- D. Any two (2) or more pieces of material or equipment of the same kind, type or classification being used for identical types of service, shall be made by the same manufacturer.

1.03 SAMPLES

- A. When required, the CONTRACTOR shall submit for approval typical samples of materials and appliances. Identify samples by tags and submit sufficiently in advance of the time when they

are to be incorporated into the work so rejections will not cause delay. A letter of transmittal, in triplicate, from the CONTRACTOR requesting approval shall accompany all such samples.

1.04 EQUIVALENT QUALITY

- A. As required in other sections for these specifications, certain equipment items and materials must be “pre-approved” prior to bid for use on this project.
- B. For those items not requiring pre-bid approval, whenever in the Contract Documents an article, material, apparatus, equipment, or process is called for by trade name of a patentee, manufacturer or dealer, or by reference to catalogue of a manufacturer or dealer, it shall be understood as intending to mean and specify the article, material, apparatus, equipment or process designated, or any approved equal in quality, finish, design, efficiency, and durability and equally serviceable for the purpose for which it is intended. Upon rejection of material or equipment submitted as the equivalent of that specifically named in the Contract, the CONTRACTOR shall proceed immediately to furnish the designated material or equipment.

1.05 DELIVERY, STORING, CARE AND PROTECTION

- A. The CONTRACTOR shall deliver materials in ample quantities to ensure the most speedy and uninterrupted progress of the work, so as to complete the work within the allotted time. The CONTRACTOR shall also coordinate deliveries in order to avoid delay in or impediment of the progress of the work of any related contractor. Shipment by weights shall show the weights. Under no circumstances shall equipment be delivered to the site more than one month prior to anticipated installation without written authorization from the ENGINEER.
- B. The CONTRACTOR shall be solely responsible for properly storing and providing protection of all materials, equipment and the entire work furnished under this Contract from the time such materials and equipment are delivered at the site of the work until final acceptance of the entire work. He shall at all times take necessary precautions to prevent injury or damage by water or by inclemency of weather to such materials, equipment, and work. All injury or damage to materials, equipment or work shall be corrected by the CONTRACTOR.
- C. Factory assembled parts and components shall not be disassembled for shipment unless permission is received in writing from the ENGINEER. Finished surfaces of all exposed parts shall be properly protected against adverse conditions that may prevail from time of shipment until ready for operation.
- D. All finished surfaces of all exposed flanges shall be protected by wooden blank flanges, stoutly built, and securely bolted.
- E. Finished iron and steel surfaces not painted shall be protected against rust and corrosion.
- F. After hydrostatic or other tests, all entrapped water shall be drained, and care taken to prevent the entrance of water during shipment, storage, and handling.
- G. Each box or package shall be legibly marked to show its net weight and contents.
- H. At the time of shipment, the shipping list, original bill of lading, shipping memorandum and invoice shall be mailed in triplicate to the ENGINEER. Each shipping list shall give the description and net weight of each item, and gross weight of the shipment. Shipment will not be accepted until the list has been received.

- I. Demurrage, or other charges resulting from failure to furnish these items, shall be absorbed by the CONTRACTOR.
- J. The CONTRACTOR shall make suitable provision for the handling and delivery of all equipment and material at the site.
- K. Stack materials in an approved manner for convenience in counting. Do not place materials directly on the ground.
- L. Box, crate or otherwise completely enclose and protect equipment during shipment, handling, and storage. Protect equipment from exposure to the elements and keep thoroughly dry at all times.
- M. Protect painted surfaces against impact, abrasion, discoloration, and other damage. Repaint painted surfaces which are damaged prior to acceptance of equipment in accordance with SECTION 09 96 00 – HIGH PERFORMANCE COATINGS.
- N. Protect electrical equipment, controls and insulation against moisture or water damage. Connect space heaters provided in the equipment storage areas and operate at all times until equipment is placed in service. Store pumps, motors, electrical equipment, and other equipment having antrification or sleeve bearings in weathertight buildings that are maintained at a minimum temperature of 60°F.

1.06 SPARE PARTS

- A. Spare parts shall be packed in wooden crates with the contents clearly marked on the outside of the crate. Crates shall not exceed 24"x24"x24" in dimension. Equipment shall be lubricated for long term storage per manufacturer's recommendation.

1.07 TOOLS

- A. Any special tools (including grease guns or other lubricating devices) which may be necessary for the adjustment, operation, and maintenance of any equipment shall be furnished with the respective equipment.
- B. Only one toolbox shall be provided as part of this project. The CONTRACTOR shall provide one Knack Model 4830 steel toolbox of sufficient capacity for all tools and special tools provided.

1.08 WARRANTY

- A. Unless specified otherwise, all equipment and materials furnished under this contract shall be warranted for a period of two (2) years following testing, start-up, and final acceptance by the ENGINEER and OWNER.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 INSTALLATION OF EQUIPMENT

- A. The CONTRACTOR shall have on hand equipment and machinery of ample capacity to facilitate this work and to handle emergencies normally encountered in work of this character.

- B. Erect equipment on the foundations at the locations and elevations shown on the Drawings, unless otherwise directed during installation.
- C. Furnish, install, and protect necessary anchor and attachment bolts and other appurtenances needed for the installation of the devices included in the equipment specified. Anchor bolts shall be of ample size and strength for the purpose intended. Furnish templates and working drawings for installation.
- D. The CONTRACTOR shall, at his own expense, furnish all materials and labor for, and shall properly bed in cement grout as specified, each piece of equipment of its supporting base resting on masonry or concrete foundations. Grout shall completely fill the space between the equipment base and the foundation.

END OF SECTION

SECTION 01 77 00
CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Drawings and general provisions of the Contract, including General Terms and Conditions other sections, apply to this Section.
- B. Provide operation and maintain information as described in Table 1 - Submittal and O&M Summary at the end of SECTION 01 78 23 – OPERATION AND MAINTENANCE DATA.

1.02 RELATED WORK

- A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Inspection procedures.
 - 2. Project Record Documents.
 - 3. Operation and maintenance manuals.
 - 4. Warranties.
 - 5. Instruction of OWNER'S personnel.
 - 6. Final cleaning.
- B. Related Sections include the following:
 - 1. SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA for operation and maintenance manual requirements.
 - 2. SECTION 00 61 00 – WARRANTIES AND BONDS for warranty and bond requirements.
 - 3. Individual specification sections for specific closeout and special cleaning requirements for products of those Sections.

1.03 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
 - 1. Address issues on the ENGINEER'S punch list that have not been completed and corrected, the value of items on the list, and reasons why the Work is not complete.
 - 2. Advise OWNER of pending insurance changeover requirements.

3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Obtain and submit releases permitting OWNER unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
5. Prepare and submit Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
6. Deliver tools, spare parts, extra materials, and similar items to location designated by OWNER. Label with manufacturer's name and model number where applicable.
7. Make final changeover of permanent locks and deliver keys to OWNER. Advise OWNER'S personnel of changeover in security provisions.
8. Complete startup testing of systems.
9. Submit test/adjust/balance records.
10. Terminate and remove temporary facilities from Project site, along with construction tools, and similar elements.
11. Advise OWNER of changeover in utilities.
12. Submit changeover information related to OWNER'S occupancy, use, operation, and maintenance.
13. Complete final cleaning requirements, including touchup painting.
14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, ENGINEER will either proceed with inspection or notify CONTRACTOR of unfulfilled requirements. ENGINEER will prepare the Certificate of Substantial Completion after inspection or will notify CONTRACTOR of items, either on CONTRACTOR'S list or additional items identified by ENGINEER, that must be completed or corrected before certificate will be issued.

1. Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

1.04 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:

1. Submit a final Application for Payment in accordance with the requirements of the Special Conditions.

2. Submit copy of ENGINEER'S Substantial Completion inspection list of items to be completed or corrected (punch list). The copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 4. Instruct OWNER'S personnel in operation, adjustment, and maintenance of products, equipment, and systems.
- B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, ENGINEER will either proceed with inspection or notify CONTRACTOR of unfulfilled requirements. ENGINEER will prepare a final Certificate for Payment after inspection or will notify CONTRACTOR of construction that must be completed or corrected before certificate will be issued.
1. Request re-inspection when the work identified in previous inspections as incomplete is completed or corrected.

1.05 PROJECT RECORD DOCUMENTS

- A. General: Do not use Project Record Documents for construction purposes. Protect Project Record Documents from deterioration and loss. Provide access to Project Record Documents for ENGINEER'S reference during normal working hours.
- B. Record Drawings: Maintain and submit one set of blue- or black-line white prints of Contract Drawings and Shop Drawings.
1. Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.
 - a. Give particular attention to information on concealed elements that cannot be readily identified and recorded later.
 - b. Accurately record information in an understandable drawing technique.
 - c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
 - d. Mark Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. Where Shop Drawings are marked, show cross-reference on Contract Drawings.
 2. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.
 3. Mark important additional information that was either shown schematically or omitted from original Drawings.
 4. Note Construction Change Directive numbers, Change Order numbers, alternate numbers, and similar identification where applicable.

5. Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location. Organize into manageable sets; bind each set with durable paper cover sheets. Include identification on cover sheets.
 - C. Electronic Data: Submit to ENGINEER electronic data of all buried/exposed utilities, basin structures, and buildings including elevations of buried pipe fittings, electrical duct banks, and electrical conduit.
 - D. Miscellaneous Record Submittals: Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.
- 1.06 OPERATION AND MAINTENANCE MANUALS
- A. Reference SECTION 01 78 23 – OPERATION AND MAINTENANCE DATA.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.01 DEMONSTRATION AND TRAINING

- A. Instruction: Instruct OWNER'S personnel on how to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
1. Provide instructors experienced in operation and maintenance procedures.
 2. Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at the start of each season.
 3. Schedule training with OWNER with at least seven (7) days' advance notice.
 4. Coordinate instructors, including providing notification of dates, times, length of instruction, and course content.
- B. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections. For each training module, develop a learning objective and teaching outline. Include instruction for the following:
1. System design and operational philosophy.
 2. Review of documentation.
 3. Operations.

4. Adjustments.
5. Troubleshooting.
6. Maintenance.
7. Repair.

3.02 FINAL CLEANING

- A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - f. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - g. Sweep concrete floors broom clean in unoccupied spaces.
 - h. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - i. Remove labels that are not permanent.
 - j. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
 - 1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.

- k. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - l. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - m. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - n. Clean ducts, blowers, and coils if units were operated without filters during construction.
 - o. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
 - p. Leave Project clean and ready for occupancy.
- B. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on OWNER'S property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION

SECTION 01 78 23
OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Drawings and general provisions of the Contract, including General Terms and Conditions and other sections, apply to this Section.
- B. Submit O&M Manuals for equipment and processes as described in Table 1 - Submittal and O&M Summary at end of this Section.

1.02 RELATED WORK

- A. This Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory.
 - 2. Emergency manuals.
 - 3. Operation manuals for systems, subsystems, and equipment.
 - 4. Maintenance manuals for the care and maintenance of systems and equipment.
- B. Related Sections include the following:
 - 1. SECTION 01 77 00 - CLOSEOUT PROCEDURES for submitting operation and maintenance manuals.
 - 2. Individual specification sections for specific operation and maintenance manual requirements for products in those Sections.
- C. O&M Requirements
 - 1. O&M data, submittals and related documentation shall be included for the specific materials as described in Table 1 at the end of this Section.
 - 2. Number of Copies:
 - a. One (1) electronic copy in Portable Document Format (PDF) of all submittals and re-submittals shall be submitted suitable for distribution over electronic mail or File Transfer Protocol (FTP). Other file formats may be used upon approval of Owner and Engineer.
 - b. Final approved submittals, provide PDF and two (2) hard copies.

1.03 COORDINATION

- A. Where operation and maintenance documentation includes information on installations by more than one factory-authorized service representative, assemble and coordinate information furnished by representatives and prepare manuals.

1.04 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

PART 2 - PRODUCTS

2.01 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

- A. Organization: Include a section in the directory for each of the following:
 - 1. List of documents.
 - 2. List of systems.
 - 3. List of equipment.
 - 4. Table of contents.
- B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
- C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
- D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with the same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.02 MANUALS, GENERAL

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
 - 1. Title page.
 - 2. Table of contents.
 - 3. Manual contents.

- B. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:
1. Subject matter included in manual.
 2. Name and address of Project.
 3. Name and address of OWNER.
 4. Date of submittal.
 5. Name, address, and telephone number of CONTRACTOR.
 6. Name and address of ENGINEER.
 7. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2 in. by 11 in. paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
 - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
 2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
 3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software CD's for computerized electronic equipment.
 4. Supplementary Text: Prepared on 8-1/2 in. by 11 in., 20 lb./sq. ft. white bond paper.
 5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

- a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
- b. If drawings are too large to be used as foldouts, fold, and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.03 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
 - 1. System, subsystem, and equipment descriptions.
 - 2. Performance and design criteria.
 - 3. Operating standards.
 - 4. Operating procedures.
 - 5. Operating logs.
 - 6. Wiring diagrams.
 - 7. Control diagrams.
 - 8. Piped system diagrams.
 - 9. Precautions against improper use.
 - 10. License requirements including inspection and renewal dates.
- B. Descriptions: Include the following:
 - 1. Product name and model number.
 - 2. Manufacturer's name.
 - 3. Equipment identification with serial number of each component.
 - 4. Equipment function.
 - 5. Operating characteristics.
 - 6. Limiting conditions.
 - 7. Performance curves.
 - 8. Engineering data and tests.
 - 9. Complete nomenclature and number of replacement parts.

- C. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
 2. Equipment or system break-in procedures.
 3. Routine and normal operating instructions.
 4. Regulation and control procedures.
 5. Instructions on stopping.
 6. Normal shutdown instructions.
 7. Seasonal and weekend operating instructions.
 8. Required sequences for electric or electronic systems.
 9. Special operating instructions and procedures.
- D. Source Information: List each product included in manual, identified by product name, and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- E. Product Information: Include the following, as applicable:
1. Product name and model number.
 2. Manufacturer's name.
 3. Color, pattern, and texture.
 4. Material and chemical composition.
 5. Reordering information for specially manufactured products.
- F. Maintenance Procedures: Include manufacturer's written recommendations and the following:
1. Inspection procedures.
 2. Types of cleaning agents to be used and methods of cleaning.
 3. List of cleaning agents and methods of cleaning detrimental to product.
 4. Schedule for routine cleaning and maintenance.
 5. Repair instructions.
- G. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.
- I. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- J. Piped Systems: Diagram piping as installed and identify color-coding where required for identification.

PART 3 - EXECUTION

3.01 MANUAL PREPARATION

- A. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
 - 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 - 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by OWNER'S operating personnel.
- B. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 - 1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
- C. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.
 - 1. Do not use original Project Record Documents as part of operation and maintenance manuals.
- D. Comply with SECTION 01 77 00 - CLOSEOUT PROCEDURES for the schedule for submitting operation and maintenance documentation.
- E. One (1) electronic copy in Portable Document Format (PDF) of all submittals and re-submittals shall be submitted suitable for distribution over electronic mail or File Transfer Protocol (FTP). For final approved submittals provide PDF and two (2) hard copies.

Table 1 - Submittal and O&M Summary
(Additional requirements may be described in individual specification sections)

Item Description	Submittal Required	O&M Manual Required	Working Drawing Required	O&M Instruction Required
Structural Concrete	X			
Reinforcing Steel	X			
Misc. & Structural Steel	X		X	
Elevated Storage Tank	X	X	X	
Valves	X	X		X
Piping/Fittings	X			
Electrical Equipment/Controls	X	X	X	
Trench Safety Plan	X		X	
SWPPP	X			
Protective Coatings Systems	X	X		
Bedding and Backfill Material	X			
Fencing/Gates	X	X		
Lighting	X	X	X	X
Painting	X			

END OF SECTION

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SECTION 01 79 00
DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.01 SUMMARY

- A. This section includes general requirements for services to be provided by manufacturer's field representatives including training of OWNER'S personnel and preparation of equipment installation reports.

1.02 DEFINITIONS

- A. Person-Day: One person for 8 hours within regular CONTRACTOR working hours.

1.03 QUALIFICATION OF MANUFACTURER'S REPRESENTATIVE

- A. The technician shall be an authorized representative of the manufacturer, factory trained, and experienced in the technical applications, installation, operation, and maintenance of respective equipment, subsystem, or system. The proposed representative shall be subject to acceptance by the OWNER. No substitute representatives will be allowed unless prior written approval by the OWNER has been given.

1.04 FULFILLMENT OF SPECIFIED MINIMUM SERVICES

- A. Where manufacturers' services are specified, furnish manufacturer's qualified representative for a sufficient period of time to perform all specified functions at no additional cost to the OWNER.
- B. Schedule manufacturer's onsite services to avoid conflicting with other onsite testing or other manufacturer's onsite services. Determine that all conditions necessary to allow successful testing have been met before scheduling services.
- C. Only those days of service approved by ENGINEER will be credited to fulfill the specified minimum services.
- D. Manufacturer's onsite services to include at a minimum:
 - 1. Assistance during installation to include observation, guidance, instruction of the CONTRACTOR'S assembly, erection, installation, or application procedures.
 - 2. Inspection, checking, and adjustment as required for equipment to function as warranted by manufacturer and necessary to furnish written approval of installation.
 - 3. Revisiting the site as required to correct problems and until installation and operation are acceptable to the OWNER.
 - 4. Resolution of assembly or installation problems attributable to, or associated with, the respective manufacturer's products and systems.
 - 5. Assistance during functional and performance testing, and startup demonstration and until product acceptance by the OWNER.

6. Training of OWNER'S personnel in the operation and maintenance of respective product as required herein.
7. Completion of equipment installation report with applicable certificates for proper installation and initial, interim, and final test or service.

1.05 TRAINING OWNER'S PERSONNEL

- A. Furnish trained, articulate personnel to coordinate and expedite training. Personnel shall be familiar with operation and maintenance manual information furnished by the manufacturer.
- B. Furnish manufacturer's' representatives for onsite hands-on training for OWNER'S personnel on operation and maintenance of specified product (system, subsystem, component) and as may be required in applicable Specifications.
- C. Prestartup Training
 1. Coordinate training sessions with the OWNER'S operating personnel and manufacturers' representatives, and with submission of operation and maintenance manuals.
- D. Post-Startup Training
 1. If required in Specifications, furnish and coordinate training of OWNER'S operating personnel by respective manufacturer's representatives.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 02 06 10
GEOTECHNICAL DATA

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The OWNER has obtained geotechnical information, which may include laboratory test results, logs of borings, and recommendations from geotechnical consultants. That information is included in the Appendices of these specifications. The CONTRACTOR shall be familiar with the subsurface materials and conditions on the Project and shall be knowledgeable of how they will affect the Work. The following is a partial listing of sources of information available to the CONTRACTOR about subsurface materials and conditions: the geotechnical information provided by the OWNER; geologic maps, publications and reports available from the University of Texas Bureau of Economic Geology at the J.J. Pickle Research Center in Austin, Texas; subcontractors familiar with local ground conditions; and, local consulting geologists and geotechnical engineers. The CONTRACTOR may make their own subsurface investigations.
- B. The soil information provided in the geotechnical report is representative of the specific bore locations only. Neither the OWNER or ENGINEER guarantee the soil conditions where bores were not acquired. For preparation of the bid costs, it shall be the CONTRACTOR'S responsibility to determine the soil conditions for the project.

END OF DOCUMENT

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SECTION 02 41 16
STRUCTURE DEMOLITION

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. CONTRACTOR shall provide all labor, materials, equipment, and superintendence to provide the demolition work.
- B. Demolition shall be as described herein and as shown on the project drawings.

1.02 PROTECTION

- A. Perform demolition in such a manner as to eliminate hazards to persons and property; to minimize interference with use of adjacent areas, utilities, and structures or interruption of use of such utilities; and to provide free passage to and from such adjacent areas of site.
- B. Provide safeguards, including warning signs, barricades, temporary fences, warning lights, and other similar items that are required for protection of all personnel during demolition and removal operations.
- C. Maintain fences, barricades, lights, and other similar items around exposed excavations until such excavations have been completely filled.
- D. Prevent spread of flying particles and dust. Sprinkle rubbish and debris with water to keep dust to a minimum. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to ice, flooding, or pollution.
- E. Before beginning any demolition work, the CONTRACTOR shall survey the site and examine the drawings and specifications to determine the extent of the work. The CONTRACTOR shall take necessary precautions to avoid damages to existing items to remain in place, to be reused, or to remain the property of the OWNER; any damaged items shall be repaired or replaced as approved by the ENGINEER.
- F. The work shall comply with the requirements of SECTION 01 57 19 – ENVIRONMENTAL PROTECTION PROCEDURES.
- G. Refer to the appendix for information about the presence of lead paint at the sites.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 GENERAL

- A. CONTRACTOR shall comply with all applicable laws, codes, ordinances, and regulations and shall obtain and pay for all necessary permits.
- B. All materials on the project that are identified to be disposed of, shall be disposed of legally, off the site, by CONTRACTOR, who will, upon removal from the site, have the rights of salvage of materials.

- C. CONTRACTOR shall visit the site of the work and examine the premises to fully understand all the existing conditions relative to the work. No increase in cost or extension of performance time will be considered for failure to know the conditions of the site and structures.
- D. The OWNER assumes no responsibility for the actual condition of the structures to be demolished or modified.
- E. No fires will be permitted on site.
- F. The use of explosives will not be permitted on the project.
- G. CONTRACTOR is responsible for protection of persons and property, including safe working conditions throughout work progress. Provide safeguards, including warning signs, barricades, temporary fences, warning lights, and other similar items that are required for protection of all personnel during demolition and removal operations. Erect fences, barricades, guardrails, lights, and other similar items around exposed excavations. Maintain safeguards until excavations have been completely filled.
- H. The OWNER and ENGINEER do not guarantee the accuracy of the demolition drawings provided herein nor do they guarantee that drawings are furnished for all structures. The CONTRACTOR shall inspect the existing sites and perform any investigations needed to determine the actual field conditions for preparation of his bid.
- I. All above ground structures, piping, access, equipment and electrical will be removed and disposed of offsite in accordance with the regulations of the Texas Commission on Environmental Quality (TCEQ). Submit landfill manifests to the OWNER.
- J. Remove abandoned pipe that would interfere with installation of new pipe and new construction.
- K. Salvage Rights
 - 1. CONTRACTOR shall have salvage rights to all materials removed.
- L. Unless noted otherwise in the Geotechnical reports, for areas where facilities are demolished, all installed backfill material shall be placed in maximum 8" lifts achieving minimum densities of 95%. A density test shall be obtained from each lift, one for every 400 SF of installed backfill, and a minimum of two densities per lift for any structure.
- M. Topsoil shall be placed over entire disturbed area and area shall be seeded per the contract documents.

END OF SECTION

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 SCOPE

- A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mix design, placement procedures, and finishes.

1.02 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume.

1.03 SUBMITTALS

- A. Product Data: For each type of manufactured material and product indicated.
- B. Design Mixes: For each concrete mix. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Indicate amounts of mix water to be withheld for later addition at Project site.
- C. Steel Reinforcement Shop Drawings: Details of fabrication, bending, and placement, prepared according to ACI 315, "Details and Detailing of Concrete Reinforcement." Include material, grade, bar schedules, stirrup spacing, bent bar diagrams, arrangement, and supports of concrete reinforcement. Include special reinforcement required for openings through concrete structures.
- D. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork. Design and engineering of formwork are Contractor's responsibility.
- E. Welding Certificates: Copies of certificates for welding procedures and personnel.
- F. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated, based on comprehensive testing of current materials.
- G. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:
 - 1. Cementitious materials and aggregates.
 - 2. Form materials and form-release agents.
 - 3. Wall ties & wall tie hole sealing process.
 - 4. Steel reinforcement and reinforcement accessories.
 - 5. Admixtures.

6. Waterstops.
7. Curing materials.
8. Floor and slab treatments.
9. Bonding agents.
10. Adhesives.
11. Vapor retarders.
12. Epoxy joint filler.
13. Joint-filler strips.
14. Repair materials.

H. Minutes of preinstallation conference.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed concrete Work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.
 1. Manufacturer must be certified according to the National Ready Mixed Concrete Association's Certification of Ready Mixed Concrete Production Facilities.
- C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated.
 1. Personnel conducting field tests shall be qualified as ACI Concrete Field-Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, each aggregate from one source, and each admixture from the same manufacturer.
- E. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code--Reinforcing Steel."
- F. ACI Publications: Comply with the following, unless more stringent provisions are indicated:
 1. ACI 301, "Specification for Structural Concrete."
 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in SECTION 01 31 19 – PROGRESS SCHEDULES AND MEETINGS.

1. Before submitting design mixes, review concrete mix design and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for testing & concrete design mixes.
 - c. Ready-mix concrete producer.
 - d. Concrete subcontractor.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle steel reinforcement to prevent bending and damage.

1. Avoid damaging coatings on steel reinforcement.

PART 2 - PRODUCTS

2.01 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
1. Plywood, metal, or other approved panel materials.
 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. B-B (Concrete Form), Class 1, or better, mill oiled and edge sealed.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- D. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.
- E. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 in. by 3/4 in., minimum.
- F. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

- G. Form Ties: Factory-fabricated, removable, or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
1. Furnish units that will leave no corrodible metal closer than 1 in. to the plane of the exposed concrete surface.
 2. Furnish ties that, when removed, will leave holes not larger than 1 in. diameter in concrete surface.
 3. Furnish ties with integral water-barrier plates to walls of all fluid containing structures.
 4. Through wall tapered ties are acceptable with the usage of “Greenstreak’s P120 X-Plug”.

2.02 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Plain-Steel Wire: ASTM A 1064/A 1064M.
- C. Plain-Steel Welded Wire Fabric: ASTM A 1064, fabricated from as-drawn steel wire into flat sheets.

2.03 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete, and as follows:
1. For concrete surfaces exposed to view where legs of wire bar support contact forms, use CRSI Class 1 plastic-protected or CRSI Class 2 stainless-steel bar supports.
- B. Joint Dowel Bars: Plain-steel bars, ASTM A 615/A 615M, Grade 60. Cut bars true to length with ends square and free of burrs.

2.04 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I/II.
1. Fly Ash: ASTM C 618, Class C or F.
- B. Normal-Weight Aggregate: ASTM C 33, uniformly graded, and as follows:
1. Class: Severe weathering region, but not less than 3S.
 2. Class: Moderate weathering region, but not less than 3M.
 3. Class: Negligible weathering region, but not less than 1N.
 4. Nominal Maximum Aggregate Size: 1-1/2 in.
 5. Nominal Maximum Aggregate Size: 1 in.

6. Nominal Maximum Aggregate Size: 3/4 in.
7. Combined Aggregate Gradation: Well graded from coarsest to finest with not more than 18 percent and not less than 8 percent retained on an individual sieve, except that less than 8 percent may be retained on coarsest sieve and on No. 50 sieve, and less than 8 percent may be retained on sieves finer than No. 50.

C. Water: Potable and complying with ASTM C 94.

2.05 ADMIXTURES

- A. General: Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material and to be compatible with other admixtures and cementitious materials. Do not use admixtures containing calcium chloride.
- B. Air-Entraining Admixture: ASTM C 260.
- C. Water-Reducing Admixture: ASTM C 494, Type A.
- D. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
- E. Water-Reducing and Accelerating Admixture: ASTM C 494, Type E.
- F. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
- G. Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.
 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Catexol 1000CL; Axim Concrete Technologies.
 - b. MCI 2000 or MCI 2005; Cortec Corporation.
 - c. DCI or DCI-S; W. R. Grace & Co., Construction Products Div.
 - d. Rheocrete 222+; Master Builders, Inc.
 - e. FerroGard-901; Sika Corporation.

2.06 WATERSTOPS

- A. Strip Waterstops: Manufactured rectangular or trapezoidal strip.
 1. Products: Subject to compliance with requirements, provide the following:
 - a. Hydrotite CJ-1020-2K-ADH with Leakmaster.

2.07 VAPOR RETARDERS

- A. Vapor Retarder: ASTM E 1745, Class C, of one of the following materials; or polyethylene sheet, ASTM D 4397, not less than 10 mil thick:

- 1. Nonwoven, polyester-reinforced, polyethylene coated sheet; 10 mil thick.

2.08 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.
- C. Moisture Barrier: ASTM C 171, polyethylene film or white burlap-polyethylene sheet, heavy duty, 10 mil thick minimum.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.
- F. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
- G. Products: Subject to compliance with requirements, provide one of the following:

- 1. Evaporation Retarder
 - a. Cimfilm; Axim Concrete Technologies.
 - b. Finishing Aid Concentrate; Burke Group, LLC (The).
 - c. Spray-Film; ChemMasters.
 - d. Aquafilm; Conspec Marketing & Manufacturing Co., Inc.
 - e. Sure Film; Dayton Superior Corporation.
 - f. Eucobar; Euclid Chemical Co.
 - g. Vapor Aid; Kaufman Products, Inc.
 - h. Lambco Skin; Lambert Corporation.
 - i. E-Con; L&M Construction Chemicals, Inc.
 - j. Confilm; Master Builders, Inc.
 - k. Waterhold; Metalcrete Industries.
 - l. Rich Film; Richmond Screw Anchor Co.

- m. SikaFilm; Sika Corporation.
 - n. Finishing Aid; Symons Corporation.
 - o. Certi-Vex EnvioAssist; Vexcon Chemicals, Inc.
2. Clear, Waterborne, Membrane-Forming Curing Compound:
- a. AH Clear Cure WB; Anti-Hydro International, Inc.
 - b. Klear Kote WB II Regular; Burke Chemicals.
 - c. Safe-Cure & Seal 20; ChemMasters.
 - d. High Seal; Conspec Marketing & Manufacturing Co., Inc.
 - e. Safe Cure and Seal; Dayton Superior Corporation.
 - f. Aqua Cure VOX; Euclid Chemical Co.
 - g. Cure & Seal 309 Emulsion; Kaufman Products Inc.
 - h. Glazecote Sealer-20; Lambert Corporation.
 - i. Dress & Seal WB; L&M Construction Chemicals, Inc.
 - j. Vocomp-20; W. R. Meadows, Inc.
 - k. Metcure; Metalcrete Industries.
 - l. Cure & Seal 150E; Nox-Crete Products Group, Kinsman Corporation.
 - m. Rich Seal 14 percent E; Richmond Screw Anchor Co.
 - n. Kure-N-Seal WB; Sonneborn, Div. of ChemRex, Inc.
 - o. Florseal W.B.; Sternson Group.
 - p. Cure & Seal 14 percent E; Symons Corporation.
 - q. Seal Cure WB 150; Tamms Industries Co., Div. of LaPorte Construction Chemicals of North America, Inc.
 - r. Hydro Seal; Unitex.
 - s. Starseal 309; Vexcon Chemicals, Inc.

2.09 RELATED MATERIALS

- A. Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
- B. Epoxy Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Shore A hardness of 80 per ASTM D 2240.

- C. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy-Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class and grade to suit requirements, and as follows:
 - 1. Type II, non-load bearing, for bonding freshly mixed concrete to hardened concrete.
 - 2. Types I and II, non-load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
 - 3. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.10 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 in. and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 in. to 1/4 in. or coarse sand as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than 4,100 psi at twenty-eight (28) days when tested according to ASTM C 109/C 109M.
- B. Repair Topping: Traffic-bearing, cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 in.
 - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 in. to 1/4 in. or coarse sand as recommended by topping manufacturer.
 - 4. Compressive Strength: Not less than 5,700 psi at twenty-eight (28) days when tested according to ASTM C 109/C 109M.
- C. Clarifier Trough Repair: Single component, microsilica modified repair mortar with an integral corrosion inhibitor, Eucocrete or approved equal.
 - 1. Primer: Duralprep A.C. or approved equal for both concrete and reinforcing steel.

2. Compressive Strength: Not less than 8,500 psi at twenty-eight (28) days when tested according to ASTM C 109/C 109M.

2.11 CONCRETE MIXES

- A. Prepare design mixes for each type and strength of concrete determined by either laboratory trial mix or field test data bases, as follows:
 1. Proportion normal-weight concrete according to ACI 211.1 and ACI 301.
- B. Use a qualified independent testing agency for preparing and reporting proposed mix designs for the laboratory trial mix basis.
- C. Footings, Piers, Foundation Walls, Slab-On-Grade & Containment Walls: Proportion normal-weight concrete mix as follows:
 1. Compressive Strength (28 Days): 4,000 psi.
 2. Minimum Cementitious Materials Content 540 lb./cu. Yd.
 3. Slump for Concrete Containing High-Range Water-Reducing Admixture: 6 to 8 inches
- D. Lean concrete: Proportion normal-weight concrete mix as follows:
 1. Compressive Strength (28 Days): 2,000 psi.
 2. Minimum Cementitious Materials Content 300 lb./cu. Yd.
 3. Slump for Concrete Containing High-Range Water-Reducing Admixture: 6 to 8 inches
- E. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 1. Fly Ash: 20 percent.
- F. Maximum Water-Cementitious Materials Ratio: 0.42 for all concrete (not applicable to lean concrete and flowable fill).
- G. Air Content: Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content of 2 to 4 percent, unless otherwise indicated.
- H. Do not air entrain concrete for trowel-finished interior floors and suspended slabs. Do not allow entrapped air content to exceed 3 percent.
- I. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- J. Admixtures: Use admixtures according to manufacturer's written instructions.
 1. Use water-reducing admixture or high-range water-reducing admixture (superplasticizer) in concrete, as required, for placement and workability.

2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for all wastewater treatment plan structures, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.

2.12 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.13 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and ASTM C 1116 and furnish batch ticket information.
 1. When air temperature is between 85°F and 90°F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90°F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.01 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until concrete structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
 1. Class A, 1/8 in.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood inserts for forming keyways, reglets, recesses, and the like, for easy removal.
 1. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

- H. Chamfer exterior corners and edges of permanently exposed concrete. Do not chamfer corners where concrete abuts other concrete or asphalt.
- I. Form openings, chases, offsets, sinkages, keyways, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.02 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor bolts, accurately located, to elevations required.

3.03 REMOVING AND REUSING FORMS

- A. General: Formwork, for sides of beams, walls, columns, and similar parts of the Work, that does not support weight of concrete may be removed after cumulatively curing at not less than 50°F for 72 hours after placing concrete provided concrete is hard enough to not be damaged by form-removal operations and provided curing and protection operations are maintained.
- B. Leave formwork, for beam soffits, joists, slabs, and other structural elements, that supports weight of concrete in place until concrete has achieved the following:
 - 1. Twenty-eight (28) day design compressive strength.
 - 2. Determine compressive strength of in-place concrete by testing representative field- or laboratory-cured test specimens according to ACI 301.
 - 3. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- C. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- D. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by ENGINEER.

3.04 VAPOR RETARDERS

- A. Vapor Retarder: Place, protect, and repair vapor-retarder sheets according to ASTM E 1643 and manufacturer's written instructions.

3.05 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire fabric in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.06 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by ENGINEER.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 2. Submit proposed location of construction joints to Engineer for approval prior to beginning of work.
 - 3. Form from preformed galvanized steel, plastic keyway-section forms, or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-1/2 in. into concrete.
 - 4. Space vertical joints in walls as indicated.
 - 5. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Use only where shown in the Construction Documents. Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness, as follows:
 - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 in. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8 in. wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

- D. Dowel Joints: Install dowel sleeves and dowels or dowel bar and support assemblies at joints where indicated.
 - 1. Use dowel sleeves or lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.07 WATERSTOPS

- A. Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, bonding or mechanically fastening and firmly pressing into place. Install in longest lengths practicable.

3.08 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement, unless approved by Engineer.
- C. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation.
- D. Deposit concrete in forms in horizontal layers no deeper than 24 in. and in a manner to avoid inclined construction joints. Place each layer while preceding layer is still plastic, to avoid cold joints.
 - 1. Consolidate placed concrete with mechanical vibrating equipment. Use equipment and procedures for consolidating concrete recommended by ACI 309R.
 - 2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the vibrator. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mix constituents to segregate.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 - 1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 2. Maintain reinforcement in position on chairs during concrete placement.
 - 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 - 4. Slope surfaces uniformly to drains where required.

5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, free of humps or hollows, before excess moisture or bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When air temperature has fallen to or is expected to fall below 40°F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50°F and not more than 80°F at point of placement.
 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.
- G. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows, when hot-weather conditions exist:
1. Cool ingredients before mixing to maintain concrete temperature below 90°F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
 3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.09 FINISHING FORMED SURFACES

- A. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections exceeding 1/8 in. in height.
1. Apply to concrete surfaces not exposed to public view or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, damp proofing, veneer plaster, or painting.
- B. Rubbed Finish: Apply the following to smooth-formed finished concrete that will be exposed to public view:
1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
 2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part Portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white

Portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.

- C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.10 FINISHING FLOORS AND SLABS

- A. General: Comply with recommendations in ACI 302.1R for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes.
 - 1. Apply scratch finish to surfaces indicated and to surfaces to receive concrete floor topping or mortar setting beds for ceramic or quarry tile, Portland cement terrazzo, and other bonded cementitious floor finishes.
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
 - 1. Apply float finish to surfaces indicated, to surfaces to receive trowel finish, and to floor and slab surfaces to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.
- D. Trowel Finish: After applying float finish, apply first trowel finish and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 - 1. Apply a trowel finish to surfaces indicated and to floor and slab surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic, or quarry tile set over a cleavage membrane, paint, or another thin film-finish coating system
 - 2. Finish and measure surface so gap at any point between concrete surface and an unlevleed freestanding 10 ft. long straightedge, resting on two high spots and placed anywhere on the surface, does not exceed the following:
 - a. 1/8 in.
- E. Trowel and Fine-Broom Finish: Apply a partial trowel finish, stopping after second troweling, to surfaces indicated and to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. Immediately after second troweling, and when concrete is still plastic, slightly scarify surface with a fine broom.
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with ENGINEER before application.

3.11 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates of manufacturer furnishing machines and equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel-finish concrete surfaces.

3.12 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with recommendations in ACI 305R for hot-weather protection during curing. Moisture cure all fluid containing structures a minimum of 120 hours after placement
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb./sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing by one or a combination of the following methods:
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces, by one or a combination of the following methods:
 1. Moisture Curing: Keep surfaces continuously moist for not less than five days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12 in. lap over adjacent absorptive covers.

2. **Moisture-Retaining-Cover Curing:** Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 in., and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer recommends for use with floor coverings.
3. **Curing Compound:** Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
4. **Curing and Sealing Compound:** Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process twenty-four (24) hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.13 CONCRETE SURFACE REPAIRS

- A. **Defective Concrete:** Repair and patch defective areas when approved by ENGINEER. Remove and replace concrete that cannot be repaired and patched to ENGINEER's approval.
- B. **Patching Mortar:** Mix dry-pack patching mortar, consisting of one part Portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. **Repairing Formed Surfaces:** Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 in. in any dimension in solid concrete but not less than 1 in. in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by ENGINEER.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 in. wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 2. After concrete has cured at least fourteen (14) days, correct high areas by grinding.
 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 in. to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 6. Repair defective areas, except random cracks and single holes 1 in. or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least 3/4 in. clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mix as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least seventy-two (72) hours.
- E. Perform structural repairs of concrete, subject to ENGINEER's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to ENGINEER'S approval.

3.14 FIELD QUALITY CONTROL

- A. Testing Agency: CONTRACTOR will engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement. Sampling and testing for quality control may include those specified in this Article. Testing agency shall be approved by ENGINEER.
- B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 - 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mix exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 - 2. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.
 - 3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
 - 4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40°F and below and when 80°F and above, and one test for each composite sample.
 - 5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
 - 6. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of five standard cylinder specimens for each composite sample.
 - a. Cast and field cure one set of five standard cylinder specimens for each composite sample.
 - 7. Compressive-Strength Tests: ASTM C 39; test two laboratory-cured specimens at seven (7) days, two at twenty-eight (28) days and one at fifty-six (56) days if required.
 - a. Test two field-cured specimens at seven (7) days and two at twenty-eight (28) days.
 - b. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at age indicated.
- C. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
- D. Strength of each concrete mix will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

- E. Test results shall be reported in writing to ENGINEER, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at twenty-eight (28) days, concrete mix proportions and materials, compressive breaking strength, and type of break for both seven (7) and twenty-eight (28) days tests.
- F. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by ENGINEER but will not be used as sole basis for approval or rejection of concrete.
- G. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by ENGINEER. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by ENGINEER.

3.15 CONCRETE STRUCTURE TOLERANCES

- A. Variation from the Plumb
 - 1. In the lines and surfaces of columns, walls, and in arises: in 10 ft., 1/4 in.; in any story or 20 ft. maximum, 3/8 in.; in 40 ft. or more, 3/4 in.
 - 2. For exposed corner control-joint grooves and other conspicuous lines: in any bay or 20 ft. maximum, 1/4 in.; in 40 ft. or more, 1/2 in.
- B. Variation from the Level or From the Grades Shown
 - 1. In floors, ceilings, and beam soffits: in 10 ft., 1/4 in.; in any bay or 20 ft. maximum, 3/8 in.; in 40 ft. or more, 3/4 in.
 - 2. For exposed horizontal grooves and other conspicuous lines: in any bay or 20 ft. maximum, 1/4 in.; in 40 ft. or more, 1/2 in.
- C. Variation of the linear building lines from established position in plan and related position of walls and partitions: in any bay or 20 ft. maximum, 1/4 in.; in 40 ft. or more, 1/2 in.
- D. Variation in the sizes and location of sleeves, floor openings and wall openings: 1/4 in.
- E. Variation of cross-sectional dimensions in the thickness of slabs and walls: minus, 1/4 in.; plus, 1/2 in.
- F. Footings
 - 1. Variation in dimension in plan: minus, 1/2 in.; plus, 2 in.
 - 2. Misplacement or eccentricity: 2 percent of the footing width in the direction of misplacement but not more than 2 in.
 - 3. Reduction in thickness: minus 5 percent of specified thickness.

- G. Variation from established lines and grades in sidewalks, plazas, outdoor concrete slabs, curb, and gutter sections: in 10 ft., 1/4 in.; in 1 ft., 1/8 in.

END OF SECTION

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SECTION 03 60 00
NON-SHRINK GROUT

PART 1 - GENERAL

1.01 SCOPE

- A. This section specifies requirements for nonmetallic non-shrink grout for leveling column base plates, steel beams bearing on concrete, machinery, and other equipment, for anchoring handrail posts into sleeves embedded in concrete, and at all other locations shown or reasonably implied by the drawings.

1.02 RELATED WORK

- A. Review DIVISION 5 - METALS and the drawings for non-shrink grout requirements.
- B. Review DIVISION 11 - EQUIPMENT and the drawings for non-shrink grout requirements under machinery and equipment baseplates.

1.03 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM C 309 - Liquid Membrane-Forming Compounds for Curing Concrete.
 - 2. ASTM C 33 - Standard Specifications for Concrete Aggregates.
- B. Corps of Engineers (CRD): CRD C-621, Corps of Engineers' Specifications for Non-shrink Grout.

1.04 SUBMITTALS

- A. Submit the following information on proposed products for approval by the ENGINEER before delivery to the project.
 - 1. Manufacturer's technical literature including manufacturer's specifications for mixing and placing of the grout.
 - 2. Test results of test performed by a certified independent testing laboratory showing conformance to the following:
 - a. CRD C-621
 - b. The requirements of this specification.
- B. One (1) electronic copy in Portable Document Format (PDF) of all submittals and re-submittals shall be submitted suitable for distribution over electronic mail or File Transfer Protocol (FTP). For final approved submittals provide PDF and two (2) hard copies.

1.05 MANUFACTURER'S ASSISTANCE

- A. Manufacturers of proprietary products shall make available, at no additional cost to the OWNER and upon seventy-two (72) hours notification, the service of a qualified, full-time employee to aid in assuring proper use of the product under job conditions.

1.06 DELIVERY AND STORAGE

- A. Non-shrink grout shall be delivered to the project in unopened containers and shall bear intact manufacturer's labels.
- B. Store all non-shrink grout material in dry shelter and protect from moisture.
- C. Containers that are torn or damaged such that the non-shrink grout material has been exposed to the elements shall be discarded.

1.07 MEASUREMENT AND PAYMENT

- A. The exact dimensions for machinery and equipment bases will depend upon the dimensions of the actual machinery and equipment furnished. No change in the contract price will be allowed if the dimensions are different from those shown on the drawings.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Non-shrink grout shall be a pre-blended factory-packaged material manufactured, under rigid quality control, specifically for use in transferring heavy loads. The non-shrink grout shall conform to the following requirements:
 - 1. Grout shall contain nonmetallic natural aggregate and shall be non-staining and non-corrosive.
 - 2. Acceptable products are Gifford-Hill "Supreme," Master Builders' "Masterflow 713," or approved equal.
 - 3. Corps of Engineers CRD C-621.
 - 4. Resist attack by oil and water.
 - 5. Have a minimum initial setting time of approximately one (1) hour at 70°F.
 - 6. Have a minimum compressive strength of 6,500 psi at twenty-eight (28) days.
 - 7. Free of gas-producing or gas-releasing agents.
- B. Water used for mixing the grout shall be potable.
- C. Clean pea gravel conforming to ASTM C 33 coarse aggregate graded so that at least 90 percent passes a 3/8 in. sieve and 90 percent is retained by a No. 4 sieve.
- D. Membrane-Forming Curing Compound: Commercial curing compound conforming to ASTM C 309, which will not permanently discolor the grout.

PART 3 - EXECUTION

3.01 PROCEDURES

- A. Installation methods and procedures shall conform to the printed instructions of the grout manufacturer and these specifications. Where there is a conflict between these specifications and the printed instructions of the grout manufacturer, the printed instructions of the grout manufacturer shall take precedence.

3.02 SURFACE PREPARATIONS

- A. Remove all defective concrete, laitance, dirt, oil, grease, and other foreign material from concrete surfaces by bush-hammering, chipping, or other similar means, until a sound, clean concrete surface is achieved.
- B. Lightly roughen the concrete, but not enough to interfere with the proper placement of grout.
- C. Remove foreign materials from all surfaces in contact with grout.
- D. Align, level, and maintain final positioning of all components to be grouted. Coat shims with a thin film of grease or wax to facilitate removal.
- E. Provide relief holes, if required, to avoid trapping air beneath the base plate.
- F. Take special precautions during extreme weather conditions according to the manufacturer's written instructions.
- G. Saturate all concrete surfaces with clean water for the period of time specified by the manufacturer. Remove excess water and leave none standing.
- H. Immediately before grouting clean any contaminated surfaces.

3.03 FORMWORK

- A. Build leak-proof forms that are strong and securely anchored and shored to withstand grout pressures. Forms shall be built high enough to provide a "head" of grout where it is required to force grout into difficult locations.
- B. Provide enough clearance between the formwork and the area to be grouted to permit proper placement of grout.

3.04 MIXES

- A. For less than a 4 in. clearance, or where size or shape of space makes grouting difficult, grout mix shall consist of grout material and water.
- B. For greater than 4 in. clearances where coarse aggregate will not obstruct free passage of the grout, the grout may be extended by adding clean pea gravel if allowed or recommended by the grout manufacturer. Follow the manufacturer's recommendation for the maximum amount of pea gravel that may be added.
- C. Use the minimum amount of water necessary to produce a flowable grout without causing either segregation or bleeding.

3.05 MIXING

- A. Mixing of non-shrink grout shall be in strict conformance to the recommendations of the grout manufacturer.
- B. Mix grout as close to the work area as possible and transport the mixture quickly and in a manner that does not permit segregation of materials.
- C. After the grout has been mixed, DO NOT add more water for any reason.

3.06 PLACING

- A. Place non-shrink grouting material quickly and continuously by the most practical means permissible: pouring, pumping or under gravity pressure. Do not use either pneumatic-pressure or dry packing methods without written permission of the ENGINEER.
- B. Follow established concreting procedures observing precautions for hot and cold weather concreting.
- C. When practical, apply grout from one side only to avoid entrapping air.
- D. Final installation shall be thoroughly compacted and free from air pockets. To facilitate placement, a 1/2 in. to 1 in. chain or metal strap may be pulled back and forth under the equipment during grouting. Remove chain or strap before initial set takes place.
- E. Do not vibrate the placed grout mixture or allow it to be placed if the area is being vibrated by nearby equipment, except when approved by the grout manufacturer.
- F. Do not remove leveling shims for at least forty-eight (48) hours after grout has been placed. After shims have been removed, fill voids with non-shrink grout.

3.07 CURING

- A. Cure grout for three days after placing by keeping wet and covering with curing paper by coating with a concrete membrane-forming curing compound or by other approved method.

END OF SECTION

SECTION 05 80 00
MISCELLANEOUS METALS

PART 1 - GENERAL

1.01 SCOPE

- A. Requirements for furnishing and installing miscellaneous metal items. Included are all materials and parts necessary to properly complete each item, even though all materials and parts may not be shown or specified.
- B. Review drawings and other sections of the specifications for the extent of miscellaneous metal work required. All metal work not included under other sections of the specifications shall be furnished and installed under this Section.
- C. Furnish all bolts, anchors, sleeves, and other devices to be built into construction for support of miscellaneous metal items. Where applicable, include placing instructions and templates to ensure proper installation.
- D. Pipe sleeves for mechanical and electrical work are to be provided under DIVISION 26 - ELECTRICAL.
- E. Requirements shown on the drawings or in other specifications will supersede requirements shown in this specification.

1.02 RELATED DOCUMENTS

- A. SECTION 09 96 00 – PROTECTIVE COATINGS

1.03 SUBMITTALS

- A. Submit the following information for review. Do not begin fabrication until after submittals have been reviewed.
 - 1. Design Calculations: Signed and sealed by a qualified professional engineer registered in the State of Texas. Include the following:
 - a. Structure name.
 - b. Name of manufacturer.
 - c. Name of CONTRACTOR.
 - d. Structure dimensions, including width, length, height, for all parts of the structure.
 - e. Indicate compliance with AISC standards for hot-rolled steel and AISI standards for cold-rolled steel, including edition dates of each standard.
 - f. Governing building code and year of edition.

- g. Design Loads: Include dead load, live load, collateral loads, deflection, wind loads/speeds and exposure, seismic zone, or effective peak velocity-related acceleration/peak acceleration, and auxiliary loads (cranes, etc.).
 - h. Load Combinations: Indicate that loads were applied acting simultaneously with concentrated loads, according to governing building code.
- 2. Shop Drawings
 - a. Submit shop drawings on all fabricated and cast items. Indicate thickness, type, grade, class, and finish of metal. Show construction details, reinforcement, anchorage interface relation with adjacent construction, and mark numbers. For members to be shop primed, show surface preparation, and brand name and manufacturer's number designation of primer proposed for use.
 - b. The use of reproductions of the contract drawings by any contractor, subcontractor, erector, fabricator, or metal supplier, in lieu of preparation of shop drawings signifies his acceptance of all information shown thereon as correct, and obligates himself to any job expense, real or implied, arising due to any errors that may occur thereon. In addition, all references to ENGINEER including professional seals, must be removed if the reproduction of the contract drawings are used as shop drawings.
- 3. Manufacturer's Product Data: Manufacturer's product data shall contain sufficient information to evaluate conformance to specifications and produce suitability for intended use. Submit test reports from accredited independent testing laboratories where specified. Submit manufacturer's product data for the following products:
 - a. Expansion Anchors: Certified pullout and shear capacities shall be included in the submittal.
 - b. Standard cast products.
- 4. Test Reports for Foreign Manufactured Material: When foreign manufactured material is proposed for use, the material shall be tested for conformance to ASTM requirements by a certified independent testing laboratory located in the United States. Certification from any other source is not acceptable. Furnish copies of the test reports for review. Do not begin fabrication until the material has been accepted. The cost of testing shall be borne by the supplier.
- 5. Welding Procedure: Submit written description as required to illustrate each welding procedure for welds that are not prequalified per AWS D1.1, Structural Welding Code - Steel. Submit certification of all welders performing work on project.
- 6. One (1) electronic copy in Portable Document Format (PDF) of all submittals and re-submittals shall be submitted suitable for distribution over electronic mail or File Transfer Protocol (FTP). For final approved submittals provide PDF and two (2) hard copies.

1.04 MEASUREMENT AND PAYMENT

- A. No separate payment will be made for metal fabrications under this Section.

1.05 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM A 36/A36M - Specification for Structural Steel
2. ASTM A 53 - Specification for Pipe, Steel, Black and Hot Dipped, Zinc-Coated Welded and Seamless
3. ASTM A 123 - Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products
4. ASTM A 153- Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware
5. ASTM A193/A193M - Specification for Alloy-Steel and Stainless-Steel Bolting Materials for High Temperature or High-Pressure Service and other Special Purpose Applications
6. ASTM A 276 - Specification for Stainless and Heat Resisting Steel Bars and Shapes
7. ASTM A283/A283M - Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
8. ASTM A 307 - Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
9. ASTM F3125/F3125M - Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength
10. ASTM A 384 - Standard Practice for Safeguarding against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies
11. ASTM A 480 - Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
12. ASTM A653/A653M - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
13. ASTM A 526 - Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality
14. ASTM A 780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
15. ASTM B221 - Standard Specification for Aluminum and Aluminum Alloy Extrudes Bars, Rods, Shapes, and Tubes

16. ASTM B 633 - Specification for Electro-Deposited Coatings of Zinc on Iron and Steel
17. ASTM E 488 - Standard Test for Strength of Anchors in Concrete
18. ASTM A 501 - Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
19. ASTM F 593 - Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
20. ASTM F 594 - Specification for Stainless Steel Nuts

B. American Welding Society (AWS)

1. AWS D1.1- Structural Welding Code - Steel

C. American Institute of Steel Construction (AISC):

1. Specification for Structural Steel Building Allowable Stress Design (Ninth Edition).
2. Code of Standard Practice for Steel Buildings and Bridges.

D. Steel Structures Painting Council (SSPC):

1. SSPC SP3 - Power Tool Cleaning
2. SSPC SP6 - Commercial Blast Cleaning
3. SSPC SP10- Near-White Blast Cleaning

E. Federal Specifications:

1. FS-S-325 - Shield, Expansion; Nail, Expansion; and Nail, Drive Screw (Devices, Anchoring, Masonry)

1.06 SUBSTITUTIONS

- A. Substitution of rolled sections, details or products is not permitted without prior written approval. If items shown or specified are not readily obtainable, permission to substitute for the specified item may be requested by the CONTRACTOR. Substitutions may be allowed on items of equal or superior properties which conform to design criteria.

1.07 GAUGES

- A. US standard for sheet and plate.

1.08 QUALIFICATION OF WELDERS

- A. Welding must be performed by certified welders. Steel welders must be qualified by procedures of AWS D1.1, Structural Welding Code - Steel, using procedures, materials, and equipment of the type required for the work.

- B. Welders' Certificates: Submit certification of welders employed on the work, verifying AWS qualification within the previous twelve (12) months.

1.09 CODE REQUIREMENTS

- A. Design of steel fabrications shall conform to the requirements of the following codes:
 - 1. AISC Specifications for Structural Steel for Building, Allowable Stress Design (Ninth Edition).
 - 2. International Building Code.

1.10 INSPECTION AND TESTING

- A. The materials and workmanship covered in this specification may be inspected by the OWNER, the ENGINEER, or the OWNER'S designated testing laboratory. The testing laboratory will be employed and paid by the CONTRACTOR. Inspection may be performed in the mill, shop, or field as deemed necessary. Inspection in no way relieves the CONTRACTOR from his responsibility to furnish satisfactory materials. The right to reject material at any time before final acceptance is reserved if material and workmanship do not conform to drawings and specifications.

1.11 FIELD MEASUREMENTS

- A. Prior to fabrication, take necessary field measurements of previously installed construction so that work will fit properly. Members that do not fit properly must be replaced unless approval for their modification has been obtained from the ENGINEER.

1.12 DELIVERY AND STORAGE

- A. Schedule material delivery so that items may be erected promptly after arrival. If materials must be stored at the project site, they shall be stored above-ground on platforms, skids, or other supports. Material stored at the site shall be kept free of dirt, mud, grease, or oil. Protect stored material from corrosion.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Carbon Steel Shapes, Plates, and Bars
 - 1. Steel shapes and bars shall conform to ASTM A 36 unless otherwise specified or noted on the drawings.
 - 2. Steel plate, including plate to be bent or formed cold, shall conform to ASTM A 36 with a minimum yield strength of 36,000 psi except that plate conforming to ASTM A 283, Grade C, may be used at steel strap anchors.
 - 3. Use carbon steel except where otherwise specified or noted on the drawings.
- B. Steel Pipe: Conform to ASTM A 53, Type E, or S, Grade B, welded or seamless, Schedule 40. No hydrostatic tests are required.

- C. Steel Tubing: Conform to ASTM A 500 or ASTM A 501, Grade B.
- D. Stainless Steel: Where indicated on the drawings as “stainless steel,” “stn. steel,” or “SS,” use stainless steel of the type shown. Where the type is not shown, use stainless steel Type 304 for nonwelded items and Type 304L for welded items. Stainless steel shall conform to the following requirements:
 - 1. Bars and Shapes: ASTM A 276.
 - 2. Finish shall conform to ASTM A 480 as follows:
 - a. Sheet - No. 1 finish.
 - b. Strip - No. 1 finish.
 - c. Plate - hot-rolled and annealed or heat treated, and blast cleaned or pickled.
- E. Galvanized Sheet Steel: Conform to ASTM A 653/A653M, Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Drip Process.
- F. Carbon Steel Bolts and Washers: Conform to ASTM A 307 or ASTM A 325, with suitable nuts and washers, as noted on the drawings. Washer bearing on timber shall be malleable iron. Washers bearing on metal shall be cast steel. Where type is not noted on the drawings, provide ASTM A 307. Use carbon steel bolts except where indicated otherwise on the drawings.
- G. Stainless Steel Bolts and Washers: Bolts per ASTM F 593; nuts per ASTM 594, Type 316; wide coarse threads.
- H. Anchor Bolts
 - 1. Stainless steel anchor bolts shall be Type 304 (unless otherwise described in other specifications in this document or as shown on the drawings) conforming to ASTM A 193. Use stainless steel anchor bolts where shown on the drawings as “stainless steel,” “stainless steel,” or “SS.” Provide stainless steel anchor bolts with suitable stainless-steel nuts and oversize washers.
 - 2. Provide anchor bolts for all equipment and machinery when anchor bolts are not furnished by the manufacturer. Anchor bolt type, size, length, projection, etc., shall conform to the requirements of the equipment and machinery manufacturer.
 - 3. Provide templates to accurately position the anchor bolts in the forms.
- I. Concrete Anchors: Concrete anchors are inserted into holes and drilled in hardened concrete and shall be one of the following types, unless noted otherwise on the drawings:
 - 1. Adhesive Epoxy Anchors: Concrete anchors which are submerged, in splash zones, in enclosed spaces over liquids, or anchoring vibrating equipment shall be epoxy adhesive anchors. Adhesive anchors may be used at all locations where concrete anchors are required. Unless noted otherwise on drawings, epoxy systems shall be Sika/FI System with Sikadur Injection Gel Epoxy, Master Builders Concrete Epoxy Cartridge Dispensing System, Concrete Paste LPL, or equal. Threaded rods shall be ASTM F 593, type 316 studs. Where adhesive anchors, or connected metal, are exposed to direct

sunlight, the anchors shall be certified to maintain at least 90 percent of their rated strength (tested at 73°F) when tested at 160°F.

2. Expansion Anchors: Where concrete anchors are indicated and adhesive anchors are not required, wedge type anchors made with ASTM A 276, Type 316 stainless steel shall be used anchors shall be KWIK Bolt II by Hilti, Inc., or approved equal.
 3. Expansion anchors shall be installed in accordance with the manufacturer's recommendations.
 4. A list of standard materials used in the manufacture of the anchor components, including designated material specification (AISI, ASTM, etc.), as well as pullout and shear values attained from tests performed by a certified independent testing laboratory in accordance with ASTM E 488, shall be submitted to the ENGINEER for review. The submittal shall also include the manufacturer's installation instructions.
- J. Abrasive Cast Aluminum Nosings: All concrete stairs shall have nosings. Nosings for concrete stairs shall be cast aluminum not less than 3 in. from front to back, not less than 5/16 in. thick and 6 in. shorter than the tread width. The top of the nosing shall have a hatched, abrasive surface. The nosing shall have anchors on the underside. Place one anchor at each end and stagger intermediate anchors approximately 13 in. apart. No finish is required. Provide abrasive cast aluminum nosings for all concrete stairs and landings.
- K. Aluminum Grating (unless noted otherwise): Grating shall be fabricated from I-shaped bars, alloy 6063-T6, with swaged cross bars spaced on 4" centers. Bearing bars shall be spaced on 1 - 3/16" centers. Grating shall be minimum 1.5" thick. Top surface of bearing bars shall be serrated to provide a non-slip surface.
- L. Stainless Steel Grating (unless noted otherwise): Grating shall be fabricated from round bars, Type 316 stainless steel with cross bars on 4" centers. Bearing bars shall be on 1 - 3/16" centers. Grating shall be 1- 1/2" thick. Top surface shall be non-serrated.
- M. Lintels (unless noted otherwise): Lintels shall be steel angles with dimensions 5 - 1/2" x 4 - 1/2" with a thickness of 5/16". Lintels shall be painted in accordance with SECTION 09 96 00 - PROTECTIVE COATINGS.
- N. Grout: Conform to the requirements of SECTION 03 60 00, NON-SHRINK GROUT.
- O. Paint for Shop Primer
1. For steel in buildings, use a primer suitable for use with coating system for interior exposure as specified in SECTION 09 96 00 - PROTECTIVE COATINGS.
 2. For steel exposed to the weather, use a primer suitable for use with the paint system as specified in SECTION 09 96 00 - PROTECTIVE COATINGS.
 3. For all submerged steel, use a primer suitable for use with a paint system as specified in SECTION 09 96 00 - PROTECTIVE COATINGS.
- P. Galvanizing Repair Coating: Hot applied zinc-based solder conforming the requirements of ASTM A 780.

2.02 FABRICATION

A. General Fabrication Requirements

1. Assembly: Where practical, fit and assemble items in the shop and deliver to the site ready for installation.
2. Use materials of the size and thicknesses shown, or if not shown, of the required size and thickness to produce adequate strength and durability in the finished product for the intended use. Work to the dimensions shown or in accordance with job measurements. Use type of materials shown or specified for the various components of the work.
3. From exposed work true-to-line and level with accurate angles and surfaces and sharp, straight edges. Ease exposed edges to a radius of approximately 1/32 in. Form bent metal corners to the smallest radius possible without causing grain separation or otherwise impairing the work.
4. Joints exposed to the weather shall be formed to exclude water. All joints shall be flush and smooth.
5. All shop connections shall be welded except where welding is not practical or unless shown otherwise on the drawings. Where screws or bolts cannot be avoided, conceal fasteners where possible or countersink heads, screw up tight and nick threads to prevent loosening.
6. Weld joints continuously except where skip welding is permitted as shown on the drawings. In all lapped or "tee" splices or other joints where intermittent filler welds are allowed, the edges of fraying surfaces shall be continuously seal welded in accordance with the required strength weld. Grind exposed welds smooth and flush to match and blend with adjoining surfaces.
7. Welding process and procedures shall be the most suitable process for the connection as selected by the CONTRACTOR and approved by the ENGINEER. The CONTRACTOR'S purpose welding process shall be shown on the shop drawings. All shop and field welding must be performed by qualified welders who hold current welding certificates.
8. Provide for anchorage of the type shown, or as required, coordinated with the supporting structure. Fabricate and space anchoring devices as shown and as required to provide adequate support of the work.
9. Curt, reinforce, drill, and tap miscellaneous metal work as may be required to receive other items of work.
10. Where possible, all cuts shall be cut or flame-cut with automatic guided equipment. Any edges requiring cutting with a handheld torch shall be ground neat, smooth, and straight. Edges shall be ground free of sharp edges, burrs, and weld splatters. All fits shall be accurate and neat.
11. Re-entrant corners shall be free of notches or sharp corners. Provide a 1 in. radius unless noted otherwise on drawings.

12. Bolt holes shall be punched and drilled, or sub-punched and reamed. If holes are flame-cut, they shall be burned undersize and reamed to correct size.

B. Steel Fabrication

1. Fabrication of steel items shall conform to AISC Code of Standard Practice for Steel Buildings and Bridges and AISC Steel Construction Manual.
2. Welding shall conform to the requirements of AWS D1.1, Structural Welding Code - Steel. Welding not governed by the above shall be performed in accordance with best modern practice for strength and durability.
3. Construct steel frames for approved fire doors according to the requirements of authority having jurisdiction for class of opening indicated or specified. Frames which bear Underwriter Laboratories label for class of opening required will be the basis of acceptance. Authorized construction details and requirements for approved fire door frames take precedence over project details or specifications, except where thicker gauges than those required for approval are specified.
4. Loose lintels shall have a minimum bearing of 8 in. on each end unless shown otherwise. All lintels shall be hot dip galvanized.

- C. Stainless Steel Fabrication: Carbon steel tools or lifting devices shall not come in direct contact with items being fabricated of stainless steel. Should carbon steel inadvertently come in contact with the stainless steel, the stainless steel must be cleaned of any embedded carbon steel particles.

D. Aluminum Fabrication

1. Fabrication of aluminum items shall conform to the Aluminum Association's "Specifications for Aluminum Structures."
2. Welding shall conform to the requirements of AWS D1.2, Structural welding Code - Aluminum. Welding not governed by the above shall be performed in accordance with best modern practice for strength and durability. When possible, all welding shall be done in the shop.
3. All aluminum surfaces shall have a mill finish free from die markings, scratches, welding discolorations, or other surface blemishes.
4. Aluminum surfaces that will be in contact with concrete or steel shall be given a heavy coat of alkali-resistant bituminous paint, or other coating recommended by the manufacturer that will provide equivalent protection. The coating shall not be visible in the completed installation.

2.03 GALVANIZING

- A. All carbon steel items shown on the drawings to be galvanized or specified to be galvanized shall be hot dip galvanized after fabrication. Galvanize in accordance with ASTM A 123 or ASTM A 153, as applicable.
- B. The CONTRACTOR shall safeguard against warpage and distortion during hot dip galvanizing as specified in ASTM A 384. Any member or assembly that is warped or distorted must be

straightened. Any member or assembly that cannot be straightened must be replaced at no additional cost to the OWNER.

2.04 SHOP PRIME

- A. Shop prime all carbon steel members or assemblies that are not shown or specified to be galvanized or that are not encased in concrete. Stainless steel and aluminum items shall not be shop primed. Before assembly, paint surfaces that will be inaccessible after fabrication. Primer shall be applied in accordance with the paint manufacturer's recommendations and instructions. Surface preparation shall produce the profile recommended by the paint manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Prior to installation, inspect surfaces to which miscellaneous metal items will be attached. Verify that field conditions are acceptable and are ready to receive work. If the condition of the surface is such that it will adversely affect installation, do not proceed with installation until corrective measures have been taken. Beginning of installation means erector accepts existing conditions.
- B. Verify that aluminum surfaces that will be in contact with concrete or steel have been coated as specified.

3.02 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Supply items required to be cast into concrete or embedded in masonry with setting templates to appropriate sections.
- C. All stainless-steel threads to be coated with an anti-seizing compound prior to installing the nuts.

3.03 INSTALLATION

- A. Accurately set work to established lines and elevations and securely fasten in accordance with approved shop drawings and provisions of this Section.
- B. The CONTRACTOR shall be fully responsible for furnishing and installing any temporary braces, ties, or shoring necessary to hold secure and safe all items under the action of wind and erection loads imposed thereon until construction is completed.

3.04 WELDING

- A. Welding Steel: Conform to requirements of AWS D1.1, Structural Welding Code - Steel.
- B. Welding Aluminum: Conform to requirements of AWS D1.2, Structural Welding Code - Aluminum.

3.05 ERECTION OF STEEL ITEMS

- A. Erection of steel items must conform to AISC specification, Structural Steel for Buildings. Field-fabricated bolt holes, when required, shall be drilled; or as an alternate, they may be flame-cut undersize and reamed to correct size.

3.06 ERECTION TOLERANCES

- A. Maximum Variation from Plum: 1/4 in. per story, non-cumulative.
- B. Maximum Offset from True Alignment: 1/4 in.

3.07 CONCRETE STEP NOSINGS

- A. Set nosings level and straight and at proper height to finish flush with adjacent concrete surfaces. Nosing shall be centered on tread approximately 3 in. short of each end of the tread. Verify that nosings are firmly anchored in place with anchors attached to the underside.
- B. Clean all cement from the surface of the nosings.

3.08 GROUTING

- A. All bolt-down assemblies shall have grout pads under the base plates. Grout for baseplates, etc., shall be as specified in SECTION 03 60 00 - NON-SHRINK GROUT.

3.09 COATING REPAIRS

- A. Thoroughly clean field welds, abrasions, and damaged or defective areas of shop-primed or galvanized surfaces.
- B. Painted Surfaces: Prepare the surface as previously specified for shop painting. After the surface is prepared, apply a heavy coat of matching shop paint.
- C. Galvanized Surfaces: Prepare the damaged surface and apply a minimum of 2 mils of the specified galvanized repair coating in conformance with the requirements of ASTM A 780. Where the repair coating manufacturer's recommendations are more stringent than ASTM A 780, the manufacturer's recommendations shall be followed.

3.10 FIELD PAINTING

- A. Field painting shall conform to the following. Where practical, final coats may be applied in the shop.
- B. Steel in Buildings: Paint system as specified in SECTION 09 96 00 – PROTECTIVE COATINGS.
- C. Steel Exposed to Weather: Paint system as specified in SECTION 09 96 00 – PROTECTIVE COATINGS.
- D. All Submerged Carbon Steel: Coal-tar paint system as specified in SECTION 09 96 00 – PROTECTIVE COATINGS.

3.11 PROTECTION OF ERECTED MISCELLANEOUS METAL ITEMS

- A. After erection, the miscellaneous metal items must be protected to prevent damage prior to final acceptance of the project. All items shall be free from scratches, nicks, gouges, dents, concrete splatter, paint splatter, or other foreign material. Material damaged in a manner that will affect durability, strength, or appearance which cannot be repaired to the satisfaction of the ENGINEER must be replaced without additional cost to the OWNER.
- B. Stainless steel items shall be cleaned of all rust spots caused by carbon steel embedded particles where carbon steel items have come in contact with the stainless steel. All carbon steel embedded particles shall be removed to prevent further rust spots from forming.

END OF SECTION

SECTION 09 96 00
HIGH PERFORMANCE COATINGS

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. The work included in this section of the specifications consists of the complete furnishing, application and appurtenances for the high-performance coatings required as herein described and as shown on the plans. The objective of these specifications is to provide the material and workmanship necessary to produce a first-class job.
- B. The products described herein shall be provided by Tnemec Company, Inc. without exception.

1.02 RELATED WORK

- A. Drawings and general provisions of the Contract, including General and Special Conditions and DIVISION 01 - GENERAL REQUIREMENTS sections, apply to this Section.

1.03 SUBMITTALS

- A. Product Data: For each paint system indicated. Include block fillers and primers.
 - 1. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.
 - 2. Number of Copies: Submit six (6) copies of each submittal, unless otherwise indicated. ENGINEER will return two (2) copies.

1.04 QUALITY ASSURANCE

- A. General: Quality assurance procedures and practices shall be utilized to monitor all phases of surface preparation, application and inspection throughout the duration of the project. Procedures or practices not specifically defined herein may be utilized provided they meet recognized and accepted professional standards and are approved by the ENGINEER.
- B. Surface Preparation: Surface preparation will be based upon comparison with: "Pictorial Surface Preparation Standards and Guides for Painting Steel Surfaces" ASTM Designation D2200-17, "Standard Practice of Evaluating Degree of Rusting on Painted Surfaces" ASTM D160, "Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning" SSPC-VIS 1, ASTM D 4417-91, Method A and/or Method C, and "Visual Standard for Surfaces of New Steel Air blast Cleaned with Sand Abrasive" NACE Number 2. In all cases the written standard shall take precedence over the visual standard. In addition, NACE Standard SP0178 Visual Aid, along with the Visual Comparator, shall be used to verify the surface preparation of welds.
- C. Application: No coating or paint shall be applied when:
 - 1. The surrounding air temperature or the temperature of the surface to be coated or painted is below the minimum surface temperature for the products specified herein.
 - 2. Rain, snow, fog or mist is present.

3. The temperature is less than 5°F above the dew point.
 4. The air temperature is expected to drop below the minimum temperature for the products specified within six hours after application of coating. Dew point shall be measured by use of an instrument such as a Sling Psychrometer in conjunction with U.S. Department of Commerce Weather Bureau Psychrometric Tables. If any of the above conditions are prevalent, coating or painting shall be delayed or postponed until conditions are favorable. The day's coating or painting shall be completed in time to permit the film sufficient drying time prior to damage by atmospheric conditions.
- D. Coating Thickness: Thickness of coatings and paint shall be measured/checked according to the procedures outlined in SSPC-PA 2, 2018 Edition. Dry film thickness shall be a Level 2 as defined in Paragraph 9.2, excepting that no single gage reading shall be less than 80 percent of the specified dry film thickness. Areas that fail to meet these criteria shall be corrected at no expense to the OWNER. Use of an instrument such as a Tooke Gauge, precision groove grinder, etc. is permitted if a destructive test is deemed necessary by the ENGINEER and the total DFT is less than 50 mils.
- E. Holiday (Pinhole) Testing: The integrity of coated surfaces scheduled for immersion shall be tested for holidays in accordance with NACE Standard SP0188. For dry films less than 20 mils, a non-destructive holiday detector shall not exceed 67.5 volts, nor shall destructive holiday detector exceed the voltage recommended by the manufacturer of the coating system. A solution of 1 oz. non-sudsing type wetting agent, such as Kodak Photo-Flo, and 1 gal. of tap water shall be used to perform the holiday testing. For coating thickness at 20 mils and greater, a high voltage Tinker & Rasor AP/W holiday tester shall be used. Contact coating manufacturer for voltage recommendations and curing parameters.
1. All pinholes and/or holidays shall be marked and repaired in accordance with the manufacturer's printed recommendations and retested. No pinholes or other irregularities will be permitted in the final coating.
- F. Inspection Devices: The CONTRACTOR shall furnish, until final acceptance of coating and painting is accepted, inspection devices in good working condition for detection of holidays and measurement of dry film thickness of coating and paint. The CONTRACTOR shall also furnish U.S. Department of Commerce, National Bureau of Standards certified thickness calibration plates and/or plastic shims, depending upon the thickness gauge used, to test the accuracy of dry film thickness gauges and certified instrumentation to test the accuracy of holiday detectors. Dry film gauges and holiday detectors shall be made available for the ENGINEER'S use at all times until final acceptance of application. Holiday detection devices shall be operated in the presence of the ENGINEER.
- G. Inspection: Inspection for this project shall consist of 'hold point' inspections. The ENGINEER or his representative shall inspect the surface prior to abrasive blasting, after abrasive blasting but prior to application of coating materials, and between subsequent coats of material. Final inspection shall take place after all coatings are applied, but prior to placing the tank in service. CONTRACTOR will insure that sufficient rigging is in place so that the ENGINEER or his representative shall be able to conduct the required inspections.
- H. Warranty Inspection: Warranty inspection shall be conducted during the eleventh month following acceptance of all coating and painting work. All defective work shall be repaired in accordance with this specification and to the satisfaction of the ENGINEER and/or OWNER.

1.05 CONTRACTOR

- A. The CONTRACTOR shall have three years practical experience and successful history in the application of specified products to surfaces of the treatment plants. Upon request, he shall substantiate this requirement by furnishing a list of references and job completions.
- B. The CONTRACTOR shall submit with his bid a written statement by the coatings manufacturer stating that the CONTRACTOR is familiar with the materials specified and has workers capable of performing the work specified herein.
- C. The personnel performing the work shall be knowledgeable and have the required experience and skill to adequately perform the work for this project, in accordance with SSPC-PA1, "Shop, Field and Maintenance Coating of Metals".

1.06 SAFETY AND HEALTH REQUIREMENTS

- A. General: In accordance with requirements set forth by regulatory agencies applicable to the construction industry and manufacturer's printed instructions and appropriate technical bulletins and manuals, the CONTRACTOR shall provide and require use of personal protective lifesaving equipment for persons working on or about the project site.
- B. Head and Face Protection and Respiratory Devices: Equipment shall include protective helmets, which shall be worn by all persons while in the vicinity of the work. In addition, workers engaged in or near the work site during sandblasting shall wear eye and face protection devices and air purifying, half-mask or mouthpiece respirators with appropriate filters. Barrier creams shall be used on any exposed areas of skin.
- C. Ventilation: Where ventilation is used to control hazardous exposure, all equipment shall be explosion-proof. Ventilation shall reduce the concentration of air contaminants to the degree a hazard does not exist. Air circulation and exhausting of solvent vapors shall be continued until coatings have fully cured.
- D. Sound Levels: Whenever the occupational noise exposure exceeds maximum allowable sound levels, the CONTRACTOR shall provide and require the use of approved ear protective devices.
- E. Illumination: Adequate illumination shall be provided while work is in progress, including explosion-proof lights and electrical equipment. Whenever required by the ENGINEER, the CONTRACTOR shall provide additional illumination and necessary supports to cover all areas to be inspected. The ENGINEER and/or Inspector shall determine the level of illumination.
- F. Temporary Ladders and Scaffolding: All temporary ladders and scaffolding shall conform to applicable safety requirements. They shall be erected where requested by the ENGINEER to facilitate inspection and be moved by the CONTRACTOR to locations requested by the ENGINEER.

1.07 PRODUCT DELIVERY, STORAGE & HANDLING

- A. All materials shall be brought to the jobsite in original sealed containers. They shall not be used until the ENGINEER has inspected the contents and obtained data from information on containers or label. Materials exceeding storage life recommended by the manufacturer shall be rejected.
- B. All coatings and paints shall be stored in enclosed structures to protect them from weather and excessive heat or cold. Flammable coatings and paints must be stored to conform with City,

County, State and Federal safety codes for flammable coating or paint materials. At all times coatings and paints shall be protected from freezing.

- C. Coating materials and thinners of other manufacturers not being used for this project shall not be allowed on the project site.

1.08 DEFINITIONS

- A. General: Standard coating terms defined in ASTM D 16 apply to this Section.

1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
2. Eggshell refers to low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.
3. Semigloss refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.
4. Full gloss refers to high-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Materials specified are those that have been evaluated for the specific service. Products of the **Tnemec Company, Inc.** shall be used, without exception.
- B. Manufacturer's color charts shall be submitted to the ENGINEER at least thirty (30) days prior to coating and/or paint application. General Contractor and Painting Contractor shall coordinate work so as to allow sufficient time (normally seven to ten days) for paint to be delivered to the job site.
- C. Any paint systems not covered in this specification shall be as recommended by Tnemec Company, Inc.

2.02 GENERAL REQUIREMENTS

- A. All materials shall be lead-free as defined by the Consumer Product Safety Act, Part 1303.
- B. All zinc dust pigment contained in any zinc-rich material shall meet the requirements of ASTM D 520 Type III as regards zinc content and purity.
- C. No coatings shall contain Methylene Dianiline (MDA). All coatings, including all colors, shall be lead-free.
- D. All catalyzed polyurethane products shall meet the minimum requirements of SSPC Paint Specification Number 36, Level 3 Performance Level.

2.03 HOT DIP GALVANIZING

- A. This section applies to all equipment items and related appurtenances specified to be hot dip galvanized, as described herein or as shown on the plans.
- B. Galvanizing shall conform to the Standard Specifications of ASTM A-123, as applicable latest edition of Zinc (Hot-Galvanized) Coating on Structural Steel Shapes, Plates and Bars and their products. Zinc used for hot dipped galvanizing shall conform to ASTM Designation B-6-70. Galvanizing shall be performed after components are completely fabricated.
- C. Pieces shall be fabricated in maximum sizes suitable for shipping and galvanizing. The equipment shall be designed and fabricated per ASTM A-143, A-384, and A-385 for bolt-together field assembly. No field welding on hot dipped galvanized equipment will be permitted.
- D. Minor defects in the hot dipped galvanizing coating caused by shipping; handling or installation shall be repaired after equipment installation. The defects shall be thoroughly cleaned and wire brushed to remove all foreign substances, wiped clean with a suitable solvent, thoroughly dried, and coated with at least 3 mils of a zinc rich compound specifically formulated for touch-up galvanizing and conforming to USN Specification MIL-P-21035B or USAF Specification MIL-P-32550 (1).
- E. All galvanized members delivered to the job site shall be stored by the CONTRACTOR in a position whereby they are raised off the ground and separated with strip spacers to provide free access of air to all parts of the surface. Stored members shall also be inclined in such a manner as to give maximum drainage. Resinous wood may not be used for spacers or packing of hot dip galvanized members.

2.04 PAINT COLORS

- A. Buildings - Colors for buildings, including Interior, Exterior, and Trimwork, shall be as selected by the OWNER prior to application.
- B. Piping - All exposed piping for the project shall be uncoated as delivered from the supplier. No asphalt coatings will be accepted for exposed piping. All exposed piping shall be painted as specified herein. The colors for piping shall be as follows:

PIPE USAGE	COLOR OF PIPE
Potable Water (Hot or Cold)	Lt. Blue (Cold); Lt. Blue with 6 in. red bands spaced 30 in. apart (Hot)
Non-Potable Water or Reuse Water (Hot or Cold)	Safety Purple
Chlorine Solution	Safety Yellow with Red Bands*
Liquid Alum	Safety Yellow with Orange Bands*
Sodium Hypochlorite (Bleach)	Safety Yellow with Red Bands*
Polymer	White with Safety Green Bands*
Waste Activated Sludge	Med. Brown
Thickened Waste Activated Sludge	Med. Brown
Return Activated Sludge (RAS)	Med. Brown
Grease (Lubrication)	Black with Yellow Bands*
Secondary Scum	Med. Gray

PIPE USAGE	COLOR OF PIPE
Drain Lines	Med. Gray
Valve Wheels and Tops	Safety Red
Compressed Air	Lt. Green
Power Conduit	Safety Orange
Reclaimed Water Lines	Safety Purple w/ black lettering
Raw Sewage	Med. Grey
Effluent after Clarification	Dark Green
Potable Water Valve Cast Iron Covers	Lt. Blue
Sewer/NPW Cast Iron Covers	Safety Purple w/ black lettering
* Bands are six (6) inches wide and spaced five (5) feet apart. The lines that are less than five (5) feet long will have the band centered on the pipe.	

- C. Provide a complete color-coding system consisting of preprinted labels and banding as manufactured by Brady; Seton or equal.
- D. Colors listed are general. Actual colors will be selected based on a comparison to the existing plant color codes, except as otherwise indicated; samples shall be furnished for all pipe paint colors; with chips from existing piping where new service lines are connecting.
- E. Pipe Identification
1. Piping system identification shall comply with the requirements of ANSI A13.1.
 2. Location. Locate lettering, pipe markers and flow discretion arrows where piping is exposed in finished spaces; in machine rooms; in accessible maintenance spaces such as shafts, tunnels and plenums; and in exterior non-concealed locations such as rooftops and chiller yards, as follows:
 - a. Near each valve and control device.
 - b. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - c. Near penetrations through walls, floors, ceilings, and non-accessible enclosures.
 - d. At access doors, manholes, and similar access points that permit view of concealed piping.
 - e. Near major equipment items and other points of origination and termination.
 - f. Spaced at maximum intervals of 50 ft. along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - g. On piping above removable acoustical ceilings.
 - h. Two (2) labels minimum each room, crawl space or compartment, unless otherwise approved.

3. Metal Tags. Where the outside diameter of pipe or pipe covering is 5/8 in. or smaller, aluminum or stainless-steel tags shall be provided instead of lettering. Tags shall be stamped as specified and shall be fastened to the pipe with suitable chains. Pipe identified with tags shall be color coded as specified.
4. Labels and directional arrows. Lettering shall be painted or stenciled on piping or shall be applied as snap-on markers. Snap-on markers shall be plastic sleeves, Brady "Bradysnap-On B-915" or Seton "Setmark". Letter size shall be as follows:

Outside Diameter of Pipe or Covering	Minimum Height of Letters
5/8 in. and smaller	Metal tags – 1/4 in.
3/4 in. to 4 in.	3/4 in.
5 in. and larger	2 in.

- a. At each label, arrows indicating direction of flow shall point away from label. If flow may be in both directions, use double headed arrows.
 - b. Lettering shall bear the full pipe system name as scheduled.
- F. Miscellaneous – Colors for components not described above shall be as selected by the OWNER prior to application.

2.05 PAINTING

- A. The work proposed herein shall consist of all labor, materials, equipment, etc. necessary to provide the painting system specified herein for those components which require a paint system, as described herein and as shown on the plans. The work shall consist primarily of cleaning the surfaces of all scale, loose paint, and sediment, and painting to the treatment unit steel components to the specifications which follow herein.
- B. The objective of these specifications is to provide the material and workmanship necessary to produce a first-class job. All painting shall be done strictly in accordance with the manufacturer's instructions and shall be performed in a manner satisfactory to the ENGINEER.
- C. CONTRACTOR responsibilities

1. The CONTRACTOR is required to submit the following upon selection:
 - a. CONTRACTOR qualifications certifying experience and references for the work contemplated.
 - b. Safety Program in writing and a schedule of regularly scheduled safety orientation meetings.
 - c. Detailed work schedule.
 - d. Quality Control program.

2.06 COATING REQUIREMENTS

- A. REFERENCE SPECIFICATIONS AND STANDARDS

1. Without limiting the general aspects of other requirements of these specifications, all surface preparation, coating and painting of interior and exterior surfaces and inspection shall conform to the applicable requirements of SSPC (Society for Protective Coatings), NACE International, ASTM (American Society for Testing and Materials), AWWA and the manufacturer's printed instructions.
 - a. ASTM (American Society for Testing and Materials)
 - 1) ASTM D 520; Standard Specification for Zinc Dust Pigment
 - 2) ASTM D 4417; Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel
 - 3) ASTM E 337; Standard Practice Test Method for Measuring Humidity with a Psychrometer
 - 4) ASTM D2200; Standard Practice for Use of Pictorial Surface Preparation Standards and Guides for Painting Steel Surface
 - 5) ASTM D610; Standard Practice of Evaluating Degree of Rusting on Painted Surfaces
 - b. ASSP (American Society of Safety Professionals)
 - 1) ASSP Z9.4 Abrasive-Blasting Operations – Ventilation and Safe Practices for Fixed Location Enclosures
 - c. Consumer Product Safety Act, Part 1303
 - d. ICRI (International Concrete Restoration Institute)
 - 1) Guideline No. 03732; Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays
 - e. NACE International
 - 1) NACE Publication TPC2; Coatings and Linings for Immersion Service: Chapter 1 Safety, Chapter 2 Surface Preparation, Chapter 3 Curing, and Chapter 4 Inspection
 - 2) NACE Standard SP0178; Standard Recommended Practice –Design, Fabrication, and Surface Finish Practices for Tanks and Vessels to be Lined for Immersion Service
 - 3) NACE Standard SP0188; Standard Recommended Practice – Discontinuity (Holiday) Testing of Protective Coatings on Conductive Substrates
 - 4) NACE Standard SP0287; Field Measurement of Surface Profile of Abrasive Blast-Cleaned Steel Surfaces Using a Replica Tape
 - 5) NACE Standard SP0288; Inspection of Linings on Steel and Concrete
 - f. OSHA (Occupational Safety & Health Administration)

- 1) 1915.35; Standards – 29 CFR – Painting
- g. SSPC (Society for Protective Coatings)
 - 1) SSPC-SP2; Hand Tool Cleaning
 - 2) SSPC-SP3; Power Tool Cleaning
 - 3) SSPC-SP13; Surface Preparation of Concrete
 - 4) SSPC-PA-1; Shop, Field and Maintenance Coating of Metals
 - 5) SSPC-PA-2; Procedure for Determining Conformance to Dry Coating Thickness Requirements
 - 6) SSPC-PA-3; Guide to Safety in Paint Application
 - 7) SSPC-Guide 12; Guide for Illumination of Industrial Coating Project
 - 8) SSPC-VIS 1-89; Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning
 - 9) SSPC Paint Spec 36; Two-Component Weatherable Aliphatic Polyurethane Topcoat, Performance-Based
- h. AMPP (SSPC/NACE) Joint Standards
 - 1) SSPC-SP5/NACE 1; White Metal Blast Cleaning
 - 2) SSPC-SP6/NACE 3; Commercial Blast Cleaning
 - 3) SSPC-SP7/NACE 4; Brush-Off Blast Cleaning
 - 4) SSPC-SP10/NACE 2; Near-White Metal Blast Cleaning
 - 5) SSPC-SP13/NACE 6; Surface Preparation of Concrete
- i. NAPF (National Association of Pipe Fabricators)
 - 1) NAPF 500-03-01; Solvent Cleaning
 - 2) NAPF 500-03-04; Abrasive Blast Cleaning for Ductile Iron Pipe
 - 3) NAPF 500-03-05; Abrasive Blast Cleaning for Cast Ductile Iron Fittings
2. The ENGINEER'S decision shall be final as the interpretation and/or conflict between any of the referenced specifications and standards contained herein.

2.07 MATERIAL PREPARATION

- A. Mix and thin materials according to manufacturer's latest printed instructions.
- B. Do not use materials beyond manufacturer's recommended shelf life.

- C. Do not use mixed materials beyond manufacturer's recommended pot life.
- D. Do not split kits of multi-component products.

2.08 SUBMERGED & INTERMITTENTLY SUBMERGED COATING SCHEDULE

- A. The number of coats called for in this schedule shall be considered minimum. If more coats are required for complete coverage and uniform appearance, they shall be applied. The Owner will select colors from standard manufacturer's color samples.

- 1. Miscellaneous steel fabrications, carbon steel pipe, valves, etc. (not described as stainless steel or galvanized).

- a. Surface Preparation Prior to Abrasive Blast Cleaning: Weld flux and spatter shall be removed by power tool cleaning. Sharp projections shall be ground to a smooth contour. All welds shall be ground to a smooth contour as per NACE Standard SP0178, Designation D.

- b. Surface Preparation: SSPC-SP10 Near-White Metal Blast Cleaning. Anchor profile shall be angular with a 3.0 mil profile as per ASTM D 4417, Method C or NACE Standard SP0287.

- c. Coating System

- 1) First Coat: Tnemec Series 66 Hi-Build Epoxoline applied at 3.0 to 5.0 dry mils.
- 2) Stripe Coat: Tnemec Series 66 Hi-Build Epoxoline applied by brush to all weld seams, edges, corners, nuts, bolts, etc.
- 3) Second Coat: Tnemec Series G435 Perma-Glaze applied at 20.0 to 40.0 dry mils.

- d. Total minimum dry film thickness shall be 23.0 mils.

- 2. Ductile Iron Piping, Valves & Fittings in Immersion:

- a. Surface Preparation

- 1) Clean all surfaces as per NAPF 500-03-01 Solvent Cleaning to remove all oil, grease, factory-applied tars and/or bitumastic coatings and all other soluble contaminants.
- 2) b. Prepare ductile iron pipe as per NAPF 500-03-04 Abrasive Blast Cleaning for Ductile Iron Pipe providing a minimum 1.5 mil angular anchor profile.
- 3) c. Prepare ductile iron valves and fittings as per NAPF 500-03-05 Abrasive Blast Cleaning for Cast Ductile Iron Fittings.
- 4) d. If existing ductile is factory coated with Tnemec Series N140, please follow recoat windows listed on the current product data sheet.

- b. Coating System

- 1) First Coat: Tnemec Series 66 Hi-Build Epoxoline applied at 4.0 to 6.0 dry mils.
 - 2) Stripe Coat: Tnemec Series 66 Hi-Build Epoxoline applied by brush to all weld seams, edges, corners, nuts, bolts, etc.
 - 3) Second Coat: Tnemec Series G435 Perma-Glaze applied at 20.0 to 30.0 dry mils.
- c. Total minimum dry film thickness shall be 26.0 mils.

2.09 TANK INTERIOR COATING SYSTEM

A. High-Build, Zinc/Epoxy System

1. Weld Preparation: Weld flux and spatter shall be removed by power tool cleaning. Sharp projections shall be ground to a smooth contour. All welds shall be ground to a smooth as per NACE Standard SP0178m Designation D.
2. Surface Preparation: SSPC-SP10/NACE 2 Near-White Metal Blast Cleaning. An angular profile of 2.0 to 3.0 mils as per ASTM D 4417, Method C or NACE Standard RP0287 is required.
3. Coating System
 - a. First Coat: Tnemec Series 94-H2O Hydro-Zinc applied at 2.5 to 3.5 dry mils. Thin only with approved thinner.
 - b. Stripe Coat: Tnemec Series 21-1255 Beige Epoxoline applied by brush to all weld seams, edges, corners, bolts, nuts and other difficult to coat areas. Thin only with approved thinner.
 - c. Second Coat: Tnemec Series 21-WH16 Off-White Epoxoline applied at 15.0 to 18.0 dry mils. Thin only with approved thinner.
4. Total dry film thickness shall be a minimum of 19.0 mils.

2.10 TANK EXTERIOR COATING SYSTEMS

A. Three-Coat Polyurethane System:

1. Weld Preparation: Weld flux and spatter shall be removed by power tool cleaning. Sharp projections shall be ground to a smooth contour. All welds shall be ground to a smooth contour as per NACE Standard SP0178, Designation D.
2. Surface Preparation: SSPC-SP10/NACE 2 Near-White Metal Blast Cleaning. An angular profile of 1.5 to 2.5 mils as per ASTM D 4417, Method C or NACE Standard RP0287 is required.
3. Coating System:
 - A. First Coat: Tnemec Series 94-H2O Hydro-Zinc applied at 2.5 to 3.5 dry mils. Thin only with approved thinner.

- B. Stripe Coat: Tnemec Series 66 Hi-Build Epoxoline applied by brush and scrubbed into all weld seams, edges, corners, nuts, bolts, and all other difficult to coat areas.
- C. Second Coat: Tnemec Series 66 Hi-Build Epoxoline applied at 4.0 to 6.0 dry mils. Thin only with approved thinner.
- D. Third Coat: Tnemec Series 1094 Endura-Shield applied at 3.0 to 5.0 dry mils. Thin only with approved thinner.
- E. Logo(s): Tnemec Series 700 HydroFlon applied at 2.0 to 3.0 dry mils. Thin only with approved thinner.
- F. Total dry film thickness shall be a minimum of 9.5 mils.

2.11 NON-SUBMERGED PAINTING SCHEDULE

- A. The number of coats called for in this schedule shall be considered minimum. If more coats are required for complete coverage and uniform appearance, they shall be applied. The Owner will select colors from standard manufacturer's color samples.

1. Exterior Exposed Ferrous Metals

- a. Surface Preparation Prior to Abrasive Blast Cleaning: Weld flux and spatter shall be removed by power tool cleaning. Sharp projections shall be ground to a smooth contour. All welds shall be ground to a smooth contour as per NACE Standard SP0178, Designation D.
- b. Surface Preparation: SSPC-SP6 Commercial Blast Cleaning. Anchor profile shall be angular with a 1.5 to 2.0 mil profile as per ASTM D 4417, Method C or NACE Standard SP0287.
- c. Coating System
 - 1) First Coat: Tnemec Series 90G-1K97 Tneme-Zinc applied at 2.5 to 3.5 dry mils.
 - 2) Stripe Coat: Tnemec Series 66 Hi-Build Epoxoline applied by brush and scrubbed into all weld seams. In addition to weld seams, all edges, corners, bolts, rivets, pits, etc. shall receive a stripe coat.
 - 3) Second Coat: Tnemec Series 66 Hi-Build Epoxoline applied at 4.0 to 6.0 dry mils.
 - 4) Third Coat: Tnemec Series 1094 Endura-Shield applied at 2.0 to 3.0 dry mils.
- d. Total minimum dry film thickness shall be 8.5 mils.

2. Interior Exposed Structural & Miscellaneous Steel, Piping, Valves, Etc.

- a. Surface Preparation Prior to Abrasive Blast Cleaning: Weld flux and spatter shall be removed by power tool cleaning. Sharp projections shall be ground to a smooth contour. All welds shall be ground to a smooth contour as per NACE Standard SP0178, Designation D for Lap, Butt & Fillet Welds.

- b. Surface Preparation: SSPC-SP6 Commercial Blast Cleaning. Anchor profile shall be angular with a 1.5 to 2.0 mil profile as per ASTM D 4417, Method C or NACE Standard SP0287.
 - c. Coating System
 - 1) First Coat: Tnemec Series 90G-1K97 Tneme-Zinc applied at 2.5 to 3.5 dry mils.
 - 2) Second Coat: Tnemec Series 66 Hi-Build Epoxoline applied at 4.0 to 6.0 dry mils.
 - 3) Third Coat: Tnemec Series 66 Hi-Build Epoxoline applied at 4.0 to 6.0 dry mils.
 - d. Total minimum dry film thickness shall be 10.5 mils.
3. Exposed Ductile Piping, Valves & Fittings
- a. Surface Preparation
 - 1) Clean all surfaces as per NAPF 500-03-01 Solvent Cleaning to remove all oil, grease, factory-applied tars and/or bitumastic coatings and all other soluble contaminants.
 - 2) Prepare ductile iron pipe as per NAPF 500-03-04 Abrasive Blast Cleaning for Ductile Iron Pipe providing a minimum 1.5 mil angular anchor profile.
 - 3) Prepare ductile iron valves and fittings as per NAPF 500-03-05 Abrasive Blast Cleaning for Cast Ductile Iron Fittings.
 - 4) If existing ductile is factory coated with Tnemec Series N140, please follow recoat windows listed on the current product data sheet.
 - b. Coating System
 - 1) First Coat: Tnemec Series N69 Hi-Build Epoxoline II applied at 6.0 to 8.0 dry mils.
 - 2) Second Coat: Tnemec Series N69 Hi-Build Epoxoline II applied at 6.0 to 8.0 dry mils.
 - 3) Third Coat: Tnemec Series 1094 Endura-Shield applied at 2.0 to 3.0 dry mils.
 - c. Total minimum dry film thickness shall be 14.0 mils.
4. Exterior Exposed Factory Primed Metal
- a. Surface Preparation: All surfaces shall be dry, clean and free of all contaminants. Clean all surfaces as per SSPC-SP2 or SP3 Hand or Power Tool Cleaning. Apply a test patch to ensure compatibility.
 - b. Coating System

- 1) First Coat: Tnemec Series 1 Omnithane applied at 2.5 to 3.5 dry mils.
 - 2) Second Coat: Tnemec Series 1094 Endura-Shield applied at 2.0 to 3.0 dry mils.
 - c. Total minimum dry film thickness shall be 4.5 mils.
 5. Interior Exposed Factory Primed Metal
 - a. Surface Preparation: All surfaces shall be dry, clean and free of all contaminants. Clean all surfaces as per SSPC-SP2 or SP3 Hand or Power Tool Cleaning. Apply a test patch to ensure compatibility.
 - b. Coating System
 - 1) First Coat: Tnemec Series 1 Omnithane applied at 2.5 to 3.5 dry mils.
 - 2) Second Coat: Tnemec Series 66 Hi-Build Epoxoline applied at 4.0 to 6.0 dry mils.
 - c. Total minimum dry film thickness shall be 6.5 mils.
- B. WARNING
1. The CONTRACTOR is responsible for any and all claims for creating a nuisance and/or paint damage during the progress of the surface preparation and/or painting and is especially forewarned of this responsibility so that he may exert all possible precaution and care for protection of property.
 2. The CONTRACTOR shall observe all the applicable parts of the Williams-Steiger Occupational Safety and Health Act of 1970 and ALL its subsequent amendments and revisions while coating the tank.
- C. INSPECTION
1. Testing methods for holidays and dry film thickness are explained above. The CONTRACTOR shall furnish and have on site one Holiday Detector and one Mikrotest Gauge to use on this project. The CONTRACTOR shall provide such scaffolding or hanging chairs necessary for the ENGINEER to make routine inspection of all the CONTRACTOR'S work.

PART 3 - EXECUTION

3.01 GENERAL

- A. All surface preparation, coating and painting shall conform to applicable standards of the Society for Protective Coatings, and the manufacturer's printed instructions. Material applied prior to approval of the surface by the ENGINEER, shall be removed and re-applied to the satisfaction of the ENGINEER at the expense of the CONTRACTOR.
- B. All work shall be performed by skilled craftsmen qualified to perform the required work in a manner comparable with the best standards of practice. Continuity of personnel shall be maintained, and transfers of key personnel shall be coordinated with the ENGINEER.

- C. The CONTRACTOR shall provide a supervisor at the work site during cleaning and application operations. The supervisor shall have the authority to sign change orders, coordinate work and make decisions pertaining to the fulfillment of the contract.
- D. Dust, dirt, oil, grease or any foreign matter that will affect the adhesion or durability of the finish must be removed by washing with clean rags dipped in an approved cleaning solvent and wiped dry with clean rags.
- E. Coating and painting systems include surface preparation, prime coating and finish coatings. Unless otherwise approved in writing by the ENGINEER, prime coating shall be field applied. Where prime coatings are shop applied, the CONTRACTOR shall instruct suppliers to provide the prime coat compatible with the finish coat specified. Any off-site work, which does not conform to this specification, is subject to rejection by the ENGINEER. Shop applied prime coatings, which are damaged during transportation, construction or installation shall be thoroughly cleaned and touched up in the field as directed by the ENGINEER. The CONTRACTOR shall use repair procedures, which insure the complete protection of all adjacent primers. The specified repair method and equipment may include wirebrushing, hand or power tool cleaning or dry air blast cleaning. In order to prevent injury to surrounding painted areas, blast cleaning may require use of lower air pressure, smaller nozzle and abrasive particle sizes, or shorter blast nozzle distance or uneconomical to touch-up, then the item shall be re-cleaned and coated or painted as directed by the ENGINEER.
- F. The CONTRACTOR'S coating and painting equipment shall be designed for application of materials specified and shall be maintained in first class working condition. Compressors shall have suitable traps and filters to remove water and oils from the air. The CONTRACTOR'S equipment shall be subject to approval of the ENGINEER.
- G. Application of the first coat shall follow immediately after surface preparation and cleaning and stripe coat, if applicable, before rust bloom occurs or the same day, whichever is less. Any cleaned areas not receiving first coat within this period shall be re-cleaned prior to application of first coat. Use of dehumidification equipment shall be first reviewed by the ENGINEER prior to deviating from this provision.
- H. Prior to assembly, all surfaces made inaccessible after assembly shall be prepared as specified herein and shall receive the coating or paint system specified.

3.02 SURFACE PREPARATION

- A. The latest version of the following surface preparation specifications of the Society for Protective Coatings shall form a part of this specification:
 - 1. Solvent Cleaning (SSPC-SP1): Removal of oil, grease, soil and other contaminants by use of solvents, emulsions, cleaning compounds, steam cleaning or similar materials and methods, which involve a solvent or cleaning action.
 - 2. Hand Tool Cleaning (SSPC-SP2): Removal of loose rust, loose mil scale and other detrimental foreign matter to degree specified by hand chipping, scraping, sanding and wirebrushing.
 - 3. Power Tool Cleaning (SSPC-SP3): Removal of loose rust, loose mil scale and other detrimental foreign matter to degree specified by hand chipping, scraping, sanding and wirebrushing.

4. White Metal Blast Cleaning (SSPC-SP5/NACE 1): Blast cleaning to a gray-white uniform metallic color until each element of surface area is free of all visible residues.
 5. Commercial Blast Cleaning (SSPC-SP6/NACE 3): The removal of all visible oil, grease, dirt, dust, mil scale, rust, paint, oxides, corrosion products and other foreign matter by compressed air nozzle blasting centrifugal wheels or other specified method. Discoloration caused by certain stains shall be limited to no more than 33 percent of each square inch of surface.
 6. Brush-Off Blast Cleaning (SSPC-SP7/NACE 4): Blast cleaning to remove loose rust, loose mil scale and other detrimental foreign matter degree specified.
 7. Near White Blast Cleaning (SSPC-SP10/NACE 2): The removal of all visible oil, grease, dirt, dust, mil scale, rust, paint, oxides, corrosion products and other foreign matter by compressed air nozzle blasting, centrifugal wheels or other specified method. Discoloration caused by certain stains shall be limited to no more than 5 percent of each square inch of surface area.
 8. Power Tool Cleaning to Bare Metal (SSPC-SP11): Power tool cleaning to produce a bare metal surface and to retain or produce a minimum 1.0 mil surface profile. This standard is suitable where a roughened, clean, bare metal surface is required, but where abrasive blasting is not feasible or permissible.
 9. Surface Preparation of Concrete (SSPC-SP13/NACE 6): Surface preparation of concrete by mechanical, chemical, or thermal methods prior to the application of bonded protective coating or lining systems.
- B. Slag, weld metal accumulation and spatters not removed by the Fabricator, Erector or Installer shall be removed by chipping and/or grinding. All sharp edges shall be peened, ground or otherwise blunted as required by the ENGINEER. All grinding and finishing of welds, edges, etc. shall be performed prior to solvent cleaning and abrasive blasting. Welds shall be prepared as per NACE Standard SP0178 for all interior and exterior surfaces. Minimum acceptable level of finish shall be Designation “D” unless specified otherwise.
- C. Concrete surfaces shall be abrasive blasted to produce a minimum surface profile of equal to 40-grit sandpaper with no loose concrete remaining. This preparation will be followed by vacuum cleaning to remove all dust, dirt or friable substances leaving clean, dust free surfaces for resurfacing. Concrete surfaces rubbed smooth shall not be considered an acceptably prepared surface.
1. Prepare concrete surfaces in accordance with manufacturer’s instructions, SSPC-SP 13/NACE 6 and ICRI 03732.
 2. Allow concrete to cure for a minimum of twenty-eight (28) days.
 3. Test concrete for moisture in accordance with ASTM D 4263 and F 1869.
 4. Abrasive blast surface to remove laitance and solid contaminants and to provide clean, sound substrate with uniform anchor profile.
 5. Fill holes, pits, voids, and cracks with Thnemec Series 215 Epoxy Surface or Series 218 MortarClad.

6. Ensure surfaces are clean, dry, and free of oil, grease, chalk, form release agents, and other contaminants.
- D. Field blast cleaning for all surfaces shall be by dry method unless otherwise directed. Blast nozzles shall be venturi-type nozzles with a minimum pressure at the nozzle of 90 psi. The use of copper slag and coal slag is not permitted.
- E. Particle size of abrasives used in blast cleaning shall be that which will produce a 1.5 – 3.0 mil (37.5 microns - 65.0 microns) surface profile or in accordance with recommendations of the manufacturer of the specified coating or paint system to be applied.
- F. If the profile of the blasted steel exceeds the profile specified above, the CONTRACTOR shall be required to do one or both of the following:
 1. Re-blast the surface using a finer aggregate in order to produce the required profile.
 2. Apply a thicker prime coat, if possible, given the limitations of the products being applied, in order to adequately cover the blast profile
- G. Abrasive used in blast cleaning operations shall be new, washed, graded and free of contaminants that would interfere with adhesion of coating or paint and shall not be reused unless specifically approved in writing by the ENGINEER.
- H. During blast cleaning operations, caution shall be exercised to insure that existing coatings or paint are not exposed to abrasion from blast cleaning.
- I. The CONTRACTOR shall keep the area of his work and the surrounding environment in a clean condition. He shall not permit blasting materials to accumulate as to constitute a nuisance or hazard to the accomplishment of the work, the operation of the existing facilities or to the surrounding environment.
- J. Post-Blast Cleaning: All surfaces, interior and exterior, shall be washed and subsequently tested for the presence of non-visible contaminants immediately after abrasive blasting.
 1. Surface shall be checked in three locations for the presence of chlorides, free iron and sulfates. New tanks shall be tested prior to abrasive blasting, tanks being rehabilitated shall be tested prior to blasting. If blisters are present in existing tank, testing shall also be performed after abrasive blasting. These tests are an Iron Test (Fe^{2+}), Chloride Test and Sulfate Test. Testing shall be carried out as per SSPC Technology Guide 15 “Field Methods for Retrieval and Analysis of Soluble Salts on Steel and Other Nonporous Substrates”. The maximum limits for these contaminants shall be:
 - a. The maximum level of chlorides is 30 milligrams per square meter or 3 micrograms per square centimeter.
 - b. The maximum level of sulfates is 100 milligrams per square meter or 10 micrograms per square centimeter.
 - c. The maximum level of ferrous ions (Fe^{2+}) is 50 milligrams per square meter or 5 micrograms per square centimeter.

- d. Contamination levels above these limits will require additional washing and retesting at no additional to the Owner in accordance with this Specification until the surface is under the allowable limits.
- 2. Contractor shall provide a written statement from paint manufacturer stating that the maximum acceptable levels are not less than those listed herein. Results of the testing shall be provided to the Owner before any coatings are applied.
- 3. The following test kits are approved for use on this project:
 - a. Chlor*Rid Chlor*Test Kit
 - b. KTA SCAT Test Kit
 - c. Test kits from other vendors shall be submitted to the Engineer for review and acceptance before use.
- 4. Surfaces which subsequently exhibit flash rusting shall be recleaned as per this specification at no additional cost to the Owner.
- K. Pitted areas on ferrous metal scheduled for immersion shall be repaired by either filling with Tnemec Series 215 Epoxy Surfacer or by welding. Pit filler shall be installed after the prime (first) and stripe coats but prior to finish coats. Epoxy filler shall be feathered smooth. No protrusions or spatter will be allowed. Pits deeper than 1/8 in. shall be filled by welding.
- L. Specific Surface Preparation: Surface preparation for the specific systems shall be as noted in Sections 2.08 and 2.09 under the specific systems.

3.03 GENERAL APPLICATION

- A. Coating and paint application shall conform to the requirements of the Society for Protective Coatings Paint Application Specification SSPC-PA1, latest revision, for "Shop, Field and Maintenance Painting", the American Water Works Association and the manufacturer of the coating and paint materials.
- B. Thinning shall be permitted only as recommended by the manufacturer and approved by the ENGINEER.
- C. Each application of coating or paint shall be applied evenly, free of brush marks, sags, runs, with no evidence of poor workmanship. Care shall be exercised to avoid lapping on glass or hardware. Coatings and paints shall be sharply cut to lines. Finished surfaces shall be free from defects or blemishes.
- D. Protective coverings or drop cloths shall be used to protect floors, fixtures, and equipment. Care shall be exercised to prevent coatings or paints from being spattered onto surfaces, which are not to be coated or painted. Surfaces from which materials cannot be removed satisfactorily shall be recoated or repainted as required to produce a finish satisfactory to the ENGINEER.
- E. When two coats of coating or paint are specified, where possible, the first coat shall contain sufficient approved color additives to act as an indicator of coverage or the two coats must be of contrasting color.

- F. Film thickness per coat specified in Part 2 are the minimum required. If brush or roller application is deemed necessary, the CONTRACTOR shall apply additional coats as to achieve the specified thickness.
- G. All materials shall be applied as specified.

3.04 COATING SYSTEM APPLICATION

- A. After completion of surface preparation as specified for the specific system, materials shall be applied as noted in Part 2.
- B. Care shall be taken so as to eliminate overspray and dry spray. Where such conditions are encountered, the surface shall be cleaned of all over spray and dry spray prior to the application of the succeeding coat.
- C. Areas rendered inaccessible after erection shall receive the full coating system prior to erection and/or assembly.
- D. Intercoat Cleaning:
 - 1. All exterior surfaces shall be rinsed with an approved cleaning agent blended with clean potable water as per the manufacturer's printed literature and allowed to dry before applying subsequent coat(s). Supplied water shall be fed through a charcoal-filter canister which is changed at recommended intervals as per the manufacturer's instructions. Cleaned surfaces, which are not coated the day of cleaning shall be re-cleaned prior to applying coatings.
 - 2. Interior surfaces may be require cleaning between coats as directed by the Engineer or his representative at no additional cost to the Owner.
 - 3. Approved cleaning agents are:
 - a. Chlor*Rid SP8 Rinse,
 - b. CleanWirx 207,
 - c. Engineer's Approved Alternate

3.05 COLOR SCHEME

- A. The ENGINEER shall select colors for the project. The CONTRACTOR shall submit current charts of the manufacturer's available colors to the ENGINEER thirty-days (30) prior to the start of coating and painting.

3.06 SOLVENT VAPOR REMOVAL

- A. All solvent vapors shall be completely removed by suction-type exhaust fans and blowers before placing closed structures in operating service.
- B. All solvent vapors will be exhausted both during and after coating application as per AWWA D 102 to allow the proper curing of the coating material.

- C. Ventilation shall be continued until such time as the coating has reached “full cure” as specified by the coating manufacturer.

3.07 REPAIRS

- A. After the interior coating system has been installed and holiday tested, repair pinholes and voids as follows:
 - 1. Abrasive blasting shall be in accordance with SSPC-SP10/NACE No.2 Near White Blast Cleaning obtaining a minimal surface profile as specified herein.
 - 2. Power tool cleaning shall be in accordance with SSPC-SP11 Power Tool Cleaning to Bare Metal. Surface profile shall be angular and not less than the surface profile as specified herein.
 - 3. All edges of remaining sound, tightly adhering coating shall be feathered back (beveled) to create a smooth transition from the substrate to the coatings surface. The coating may be considered tightly adhering if an edge cannot be lifted with a dull putty knife.
 - 4. Install the coating system as specified herein to provide a complete and monolithic system, free of voids and pinholes.
- B. For exterior surfaces, repair as follows:
 - 1. Hand or Power Tool Sand as per SSPC-SP2 or SP3 to remove the defect. In cases where the defect extends to the substrate, prepare the surface as per SSPC-SP11 Power Tool Cleaning to Bare Metal, obtaining a minimum anchor profile as specified herein.
 - 2. All edges of remaining sound, tightly adhering coating shall be feathered back (beveled) to create a smooth transition from the substrate to the coatings surface. The coating may be considered tightly adhering if an edge cannot be lifted with a dull putty knife.
 - 3. Install the coating system as specified herein to provide a complete and monolithic system, free of voids and pinholes.

3.08 CLEAN-UP

- A. Upon completion of the work, all staging, scaffolding and containers shall be removed from the site or destroyed in a manner approved by the ENGINEER. Coating or paint spots, oil or stains upon adjacent surfaces shall be removed and the jobsite cleaned. All damage to surfaces resulting from the work of this section shall be cleaned, repaired, or refinished to the satisfaction of the ENGINEER at no cost to the OWNER.

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

- A. This section will be measure in the bid by lump sum for supplying, installing, and testing the high-performance coating.

4.02 PAYMENT

- A. The bid items include all components of the work required for the completion of the job in every respect except as may be otherwise provided in these specifications. CONTRACTOR shall include the furnishing of all materials and labor, including any incidental labor, in its bid prices.

END OF SECTION

SECTION 11 05 16
GENERAL EQUIPMENT REQUIREMENTS

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. The work included in this section of the specifications is applicable to all equipment specifications (DIVISION 11 - EQUIPMENT) and related sections as applicable. If this section is not consistent with the individual equipment sections or the contract drawings, the individual equipment sections and contract drawings shall govern.

1.02 SUBMITTAL DATA AND O & M DATA

- A. Submittal Data and Operation and Maintenance Data for the items of equipment as specified herein shall be furnished in accordance with DIVISION 0 - CONTRACT REQUIREMENTS and DIVISION 1 - GENERAL REQUIREMENTS specifications.
- B. Installation Manuals containing complete information in connection with the assembly, operation, adjustment, maintenance, and repair of the equipment, and a detailed parts list with drawings or photographs shall be furnished in four (4) copies with each unit or part thereof.
- C. One (1) electronic copy in Portable Document Format (PDF) of all submittals and re-submittals shall be submitted suitable for distribution over electronic mail or File Transfer Protocol (FTP). For final approved submittals provide PDF and two (2) hard copies.

1.03 QUALITY ASSURANCE

- A. All royalties and fees for patents covering materials, articles, apparatus, devices, or equipment (as distinguished from processes) shall be included in prices quoted by equipment suppliers. Attention is directed to the requirements of the General Conditions concerning patents.

1.04 EQUIPMENT DELIVERY, STORAGE AND HANDLING

- A. All pieces shall be delivered in the largest pieces practical for field assembly by the CONTRACTOR. Individual pieces shall be permanently tagged with welded erection marks or stainless steel tags cross referenced with information on the manufacturer's erection and assembly drawings. Gear boxes, mechanical and electrical components shall be protected from the weather and suitably packaged to facilitate handling and storage. Special lubricating and rust preventative oils shall be provided to prevent internal corrosion of gear assemblies. All mechanical equipment shall be kept thoroughly dry at all times and shall be stored indoors.
- B. All equipment stored on the job shall be protected and maintained in accordance with the manufacturer's recommendations. Electrical equipment must be stored in weatherproof, ventilated enclosures. Structural materials may be stored outdoors on pallets or other wooden supports provided there is proper support and drainage. Equipment shall not be allowed to contact the ground directly.
- C. Fabricated assemblies shall be shipped in the largest sections permitted by carrier regulations, properly match-marked for ease of field erection.

- D. Electric motors, gears, etc. shall be periodically rotated to prevent freezing, as directed by OWNER.
- E. Anti-friction bearings, if pre-lubricated, shall be protected in accordance with the bearing manufacturer's recommendations against formation of rust during a long period of storage while awaiting completion of installation and start-up of the machine in which they are used. Anti-friction bearings which are not pre-lubricated shall be properly treated in accordance with the bearing manufacturer's recommendation against formation of rust during a long period of storage while waiting completion of installation and start-up by the application of Exxon Rust-Ban No. 392, or equal treatment.

PART 2 - PRODUCTS

2.01 ANCHORAGE AND FASTENERS

- A. Stainless steel fasteners shall be AISI Type 316 stainless steel, unless otherwise directed.
- B. All cast-in-place equipment anchorage, including nuts and washers shall be of AISI Type 316 stainless steel, unless otherwise directed. Anchorage shall be sized, designed, and furnished by the equipment manufacturer. The minimum size of any cast-in-place anchor shall be 3/4 in. diameter.
- C. All installed anchors shall be as recommended by the equipment manufacturer. **Anchorage shall be sized, designed, and furnished by the equipment manufacturer.** Design calculations of each anchor system, to include hole diameter, anchor diameter, embedment, shear, and pull-out forces shall be by a Professional Engineer licensed in the State of Texas. All anchors shall be minimum Type 316 Stainless Steel and embedded with two-part epoxy by Hilti or equal. Expansion anchors shall not be allowed, unless noted otherwise.

2.02 MOTOR CONTROLS

- A. Motor Controls and associated Electrical Work to be provided for the items of equipment as specified herein shall conform to the requirements as outlined in DIVISION 17 - ELECTRICAL of these specifications.
- B. Original Equipment Manufacturer (OEM) provided control panels shall be constructed as specified by DIVISION 11 - EQUIPMENT and shall incorporate the input/output devices shown on the electrical control panel diagrams.
- C. Shop built control panels shall operate as specified by DIVISION 11 - EQUIPMENT or DIVISION 26 - ELECTRICAL and shall be constructed in accordance with DIVISION 26 - ELECTRICAL of these specifications and as shown on the electrical schematic diagrams.
- D. Provide ethernet/network connection for communication with plant SCADA for those items identified.

2.03 MISCELLANEOUS

- A. Each major piece of equipment shall be furnished with a stainless steel nameplate with embossed data securely mounted to the body of the equipment. As a minimum, the nameplate for the pumps shall include the manufacturer's name and model number, serial number, rated flow capacity, head, speed, and all other pertinent data. As a minimum, nameplates for motors shall include the

manufacturer's name and model number, serial number, horsepower, speed, input voltage, amps, number of cycles and power and service factors. Nameplates shall not be painted over.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. The equipment shall be furnished complete by the manufacturer and shall be assembled, erected, and installed by the CONTRACTOR as directed by the manufacturer in his working drawings and written instructions. The installation, alignment, testing, and grouting (if applicable) shall be checked and approved by a factory representative before acceptance (as required in the individual equipment sections):
 - 1. The manufacturer's representative shall inspect the completed installation, and assist the CONTRACTOR in aligning, start-up, and testing. The representative shall also instruct plant personnel in operation and maintenance of the equipment.
 - 2. A written report shall be furnished by the equipment manufacturer and shall describe the representative's observations. This report shall describe in detail any deficiencies noted. All such deficiencies, whether by the manufacturer or CONTRACTOR, shall be corrected at no expense to the OWNER.
 - 3. Prior to final approval, the manufacturer shall submit a letter certifying that the installation meets all requirements of the manufacturer.
- B. Certain equipment items require grouting. Grouting shall be to the dimensions shown on the plans and in accordance with the recommendations of the equipment manufacturer. Unless otherwise specified, minimum acceptable grout thickness shall be 2 in.
- C. Lubricants of the type recommended by the equipment manufacturer shall be furnished and applied by the CONTRACTOR. The CONTRACTOR shall certify that the equipment components have received the proper amount of recommended lubricant.
- D. Except where specifically stated otherwise, all plate and structural members used in the construction of the process equipment shall have a minimum material thickness of 1/4 in.
- E. All welding shall conform to the latest AWS Standards and shall be performed by certified welders. All welding shall use a minimum of 3/16 in. fillets, and shall completely seal all mating surfaces. Skip welding will not be allowed.
- F. All field connections shall be bolted connections designed to resist all static, live and erection loads. Field-welding assemblies will not be allowed. All bolted structural connections shall be gusseted with minimum 3/8 in. thick steel plate. Main structural connections shall use a minimum of two 3/4 in. diameter bolts. Secondary structural connections shall use a minimum of two 5/8 in. diameter bolts.

END OF SECTION

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SECTION 26 00 00
ELECTRICAL GENERAL REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED SECTIONS

- A. Requirements specified within this section apply to Division 26 – ELECTRICAL. Work specified herein shall be performed as if specified in the individual sections.

1.02 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. National Electrical Contractors Association (NECA): National Electrical Installation Standards.
 - 2. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - b. Z535.4, Product Safety Signs and Labels.
 - 3. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
 - 4. Underwriters Laboratories, Inc. (UL).

1.03 GENERAL REQUIREMENTS

- A. Design and submit conduit layout design as required in SECTION 26 05 33 – RACEWAYS AND BOXES.
- B. All conduits and cable identified on the project Conduit and Cable Schedule (s) shall be installed regardless if specifically identified on a plan drawing.

1.04 ELECTRIC AND TELEPHONE SERVICE DIVISION OF RESPONSIBILITY

- A. Incoming aerial electrical service facilities provided by the serving utility as part of its normal obligation to customers is work provided outside this Contract. Under this Contract provide customer required service provisions and electrical work including, but not limited to, primary trench and backfill, primary duct system, transformer pad site preparation, transformer pad, metering components and associated conduit, and secondary facilities. Schedule and coordinate work of serving utility as required to provide electric service to the Work.
- B. Incoming telephone service facilities provided by the serving utilities as part of their normal obligation to customers is work provided outside this Contract. Under this Contract provide customer required service provisions and electrical work including but not limited to, utility trench and backfill and duct system. Schedule and coordinate work of serving utility as required to provide telephone service of the Work.
- C. Interior telecommunications central and station equipment (telephone instruments, telephone switches, data switches, and hubs, servers, software, etc.) is work provided outside this Contract.

Under this Contract provide raceways, outlet and junction boxes, cover plates, pull wires, and other equipment as indicated.

1.05 SUBMITTALS

A. Action Submittals

1. Provide manufacturers' data for the following:
 - a. Electrical service components.
 - b. Nameplates, signs, and labels.

1.06 QUALITY ASSURANCE

- A. Provide the Work in accordance with NFPA 70. Where required by Authority Having Jurisdiction (AHJ), material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ, in order to provide a basis for approval under the NEC.
- B. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories Inc. shall conform to those standards and shall have an applied UL listing mark or label.
- C. Provide materials and equipment acceptable to AHJ for Class, Division, and Group of hazardous area indicated.

1.07 ENVIRONMENTAL CONDITIONS

- A. The following areas are classified hazardous Class I, Division 1, Group D, due to the potential for occurrence of hazardous concentrations of combustible gases, and for exposure to corrosive environment – NONE.
- B. The following areas are classified hazardous, Class I, Division 2, Group D, due to the potential for accumulation of hazardous concentrations of combustible gases, and for exposure to corrosive environment – NONE.
- C. The following areas are classified nonhazardous, wet, and corrosive. Use materials and methods required for such areas. – NONE.
- D. The following areas are classified nonhazardous and wet. Use materials and methods required for such areas.
 1. Outdoor above grade areas not covered above.
 2. Below grade vaults.
- E. The following areas are classified as indoor and dry: – NONE.
- F. The following areas are not classified. Use dust-tight and oil-tight NEMA 12 materials and methods. – NONE.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Where two or more units of the same class of material or equipment are required, provide products of a single manufacturer. Component parts of materials or equipment need not be products of the same manufacturer.
- B. Material and equipment installed in heated and ventilated areas shall be capable of continuous operation at their specified ratings within an ambient temperature range of 40 degrees F to 104 degrees F.
- C. Materials and equipment installed outdoors shall be capable of continuous operation at their specified rating within the ambient temperature range.
- D. Equip panels installed outdoors in direct sun with sun shields.
- E. Electrical ratings of materials and equipment that are reduced by increased elevation shall be derated as required for Site elevation.

2.02 EQUIPMENT FINISH

- A. Manufacturer's standard finish color, except where specific color is indicated. If manufacturer has no standard color, finish equipment as approved by OWNER.

2.03 NAMEPLATES

- A. Material: Laminated plastic.
- B. Attachment Screws: Stainless steel.
- C. Color: Black, engraved to a white core.
- D. Letter Height:
 - 1. Pushbuttons/Selector Switches: 1/8 inch.
 - 2. Other electrical equipment: 3/8 inch.

2.04 SIGNS AND LABELS

- A. Sign size, lettering, and color shall be in accordance with NEMA Z535.4.

PART 3 - EXECUTION

3.01 GENERAL

- A. Electrical Drawings show general locations of equipment, devices, and raceway, unless specifically dimensioned. CONTRACTOR shall be responsible for actual location of equipment and devices and for proper routing and support of raceways, subject to approval of ENGINEER.

- B. Check approximate locations of light fixtures, switches, electrical outlets, equipment, and other electrical system components shown on Drawings for conflicts with openings, structural members, and components of other systems and equipment having fixed locations. In the event of conflicts, notify ENGINEER in writing.
- C. Install work in accordance with NECA Standard of Installation, unless otherwise specified.
- D. Keep openings in boxes and equipment closed during construction.
- E. Lay out work carefully in advance. Do not cut or notch any structural member or building surface without specific approval of ENGINEER. Carefully perform cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, paving, or other surfaces required for the installation, support, or anchorage of conduit, raceways, or other electrical materials and equipment. Following such work, restore surfaces to original condition.

3.02 COMBINING CIRCUITS INTO COMMON RACEWAY

- A. Homerun circuits shown on Drawings indicate functional wiring requirements for power and control circuits. Circuits may be combined into common raceways in accordance with the following requirements:
 - 1. Analog control circuits from devices in same general area to same destination.
 - a. No power or AC discrete control circuits shall be combined in same conduit with analog circuits.
 - b. No Class 2 or Class 3 circuits including, but not limited to, HVAC control circuits, fire alarm circuits, paging system circuits shall be combined with power or Class 1 circuits.
 - c. Analog circuits shall be continuous from source to destination. Do not add TJB, splice, or combine into a multi-pair cable without authorization of ENGINEER.
 - d. Raceways shall be sized per General Circuit and Raceway Schedule and do not exceed 40 percent fill.
 - e. Any field changes which deviate from the Drawings shall be documented on record drawings.
 - 2. Discrete control circuits from devices in the same general area to the same destination.
 - a. No power or analog control circuits shall be combined in same conduit with discrete circuits.
 - b. No Class 2 or Class 3 circuits including, but not limited to, HVAC control circuits, fire alarm circuits, and paging system circuits shall be combined with power or Class 1 circuits.
 - c. Raceways shall be sized per the General Circuit and Raceway Schedule and do not exceed 40 percent fill.
 - d. Any field changes which deviate from the Drawings shall be documented on record drawings.

3. Power circuits from loads in same general area to same source location (such as: panelboard, switchboard, low voltage motor control center, vendor control panel, etc.).
 - a. Lighting Circuits: Combine no more than three circuits to a single raceway. CONTRACTOR shall be responsible for increasing conduit and conductor size if derating is required by NEC.
 - b. Receptacle Circuits, 120-Volt Only: Combine no more than three circuits to a single raceway. Provide a separate neutral conductor for each circuit. CONTRACTOR shall be responsible for increasing conduit and conductor size if derating is required by NEC.
 - c. All Other Power Circuits: Do not combine power circuits without authorization of ENGINEER.

3.03 NAMEPLATES, SIGNS, AND LABELS

A. Arc Flash Protection Warning Signs

1. Field mark all equipment to warn qualified persons of potential arc-flash hazards. Locate marking so to be clearly visible to persons before working on energized equipment.

B. Multiple Power Supply Sign: Install permanent plaque or directory at each service disconnect location denoting other services, feeders, and branch circuits supplying the building, and the area served by each.

C. Equipment Nameplates

1. Provide a nameplate to label electrical equipment including switchgear, switchboards, motor control centers, panelboards, motor starters, transformers, terminal junction boxes, disconnect switches, switches and control stations.
2. Switchgear, motor control center, transformer, and terminal junction box nameplates shall include equipment designation.
3. Disconnect switch, starter, and control station nameplates shall include name and number of equipment powered or controlled by that device.
4. Switchboard and panelboard nameplates shall include equipment designation, service voltage, and phases.

3.04 LOAD BALANCE

- A. Drawings and Specifications indicate circuiting to electrical loads and distribution equipment.
- B. Balance electrical load between phases as nearly as possible on switchboards, panelboards, motor control centers, and other equipment where balancing is required.
- C. When loads must be reconnected to different circuits to balance phase loads, maintain accurate record of changes made, and provide circuit directory that lists final circuit arrangement.

3.05 CLEANING AND TOUCHUP PAINTING

- A. Cleaning: Throughout the Work, clean interior and exterior of devices and equipment by removing debris and vacuuming.
- B. Touchup Paint
 - 1. Touchup scratches, scrapes and chips on exterior and interior surfaces of devices and equipment with finish matching type, color, and consistency and type of surface of original finish.
 - 2. If extensive damage is done to equipment paint surfaces, refinish entire equipment in a manner that provides a finish equal to or better than factory finish, that meets requirements of Specification, and is acceptable to ENGINEER.

3.06 PROTECTION FOLLOWING INSTALLATION

- A. Protect materials and equipment from corrosion, physical damage, and effects of moisture on insulation and contact surfaces.
- B. When equipment intended for indoor installation is installed at CONTRACTOR'S convenience in areas where subject to dampness, moisture, dirt or other adverse atmosphere until completion of construction, ensure adequate protection from these atmospheres is provided and acceptable to ENGINEER.

END OF SECTION

SECTION 26 05 04
BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM)
 - a. A1011/A1011M, Standard Specification for Steel, Sheet, and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low Alloy and High-Strength Low Alloy Formability.
 - b. E814, Method of Fire Tests of Through-Penetration Fire Stops.
2. Canadian Standards Association (CSA).
3. Institute of Electrical and Electronics Engineers, Inc. (IEEE): 18, Standard for Shunt Power Capacitors.
4. International Society of Automation (ISA): RP12.06.01, Wiring Practices for Hazardous (Classified) Locations Instrumentation—Part 1: Intrinsic Safety.
5. National Electrical Manufacturers Association (NEMA)
 - a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
 - b. C12.1, Code for Electricity Metering.
 - c. C12.6, Phase-Shifting Devices Used in Metering, Marking and Arrangement of Terminals.
 - d. ICS 2, Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts.
 - e. ICS 5, Industrial Control and Systems: Control Circuit and Pilot Devices.
 - f. KS 1, Enclosed and Miscellaneous Distribution Switches (600 Volts Maximum).
6. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
7. UL
 - a. 98, Standard for Enclosed and Dead-Front Switches.
 - b. 248, Standard for Low Voltage Fuses.
 - c. 486E, Standard for Equipment Wiring Terminals for use with Aluminum and/or Copper Conductors.

- d. 489, Standard for Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures.
- e. 508, Standard for Industrial Control Equipment.
- f. 810, Standard for Capacitors.
- g. 943, Standard for Ground-Fault Circuit-Interruption.
- h. 1059, Standard for Terminal Blocks.
- i. 1479, Fire Tests of Through-Penetration Fire Stops.

1.02 SUBMITTALS

A. Action Submittals

- 1. Provide manufacturers' data for the following:
 - a. Control devices.
 - b. Control relays.
 - c. Circuit breakers.
 - d. Fused switches.
 - e. Nonfused switches.
 - f. Timers.
 - g. Fuses.
 - h. Magnetic contactors.
 - i. Intrinsic safety barriers.
 - j. Firestopping.
 - k. Enclosures: Include enclosure data for products having enclosures.

PART 2 - PRODUCTS

2.01 MOLDED CASE CIRCUIT BREAKER THERMAL MAGNETIC, LOW VOLTAGE

A. General

- 1. Type: Molded case.
- 2. Trip Ratings: 15 amps to 800 amps.
- 3. Voltage Ratings: 120, 240, 277, 480, and 600V ac.

4. Suitable for mounting and operating in any position.
 5. UL 489.
- B. Operating Mechanism
1. Overcenter, trip-free, toggle type handle.
 2. Quick-make, quick-break action.
 3. Locking provisions for padlocking breaker in OPEN position.
 4. ON/OFF and TRIPPED indicating positions of operating handle.
 5. Operating handle to assume a CENTER position when tripped.
- C. Trip Mechanism
1. Individual permanent thermal and magnetic trip elements in each pole.
 2. Variable magnetic trip elements with a single continuous adjustment 3X to 10X for frames greater than 100 amps.
 3. Two and three pole, common trip.
 4. Automatically opens all poles when overcurrent occurs on one pole.
 5. Test button on cover.
 6. Calibrated for 40 degrees C ambient, unless shown otherwise.
 7. Do not provide single-pole circuit breakers with handle ties where multi-pole circuit breakers are shown.
- D. Short Circuit Interrupting Ratings
1. Equal to, or greater than, available fault current or interrupting rating shown.
 2. Series Connected Ratings: Do not apply series connected short circuit ratings.
- E. Ground Fault Circuit Interrupter (GFCI): Where indicated, equip breaker as specified above with ground fault sensor and rated to trip on 5-mA ground fault within 0.025 second (UL 943, Class A sensitivity, for protection of personnel).
1. Ground fault sensor shall be rated same as circuit breaker.
 2. Push-to-test button.
- F. Magnetic Only Type Breakers: Where shown; instantaneous trip adjustment which simultaneously sets magnetic trip level of each individual pole continuously through a 3X to 10X trip range.

- G. Accessories: Shunt trip, auxiliary switches, handle lock ON devices, mechanical interlocks, key interlocks, unit mounting bases, double lugs as shown or otherwise required. Shunt trip operators shall be continuous duty rated or have coil-clearing contacts.
- H. Connections
 - 1. Supply (line side) at either end.
 - 2. Mechanical wire lugs, except crimp compression lugs where shown.
 - 3. Lugs removable/replaceable for breaker frames greater than 100 amperes.
 - 4. Suitable for 75 degrees C rated conductors without derating breaker or conductor ampacity.
 - 5. Use bolted bus connections, except where bolt-on is not compatible with existing breaker provisions.
- I. Enclosures for Independent Mounting
 - 1. See Article Enclosures.
 - 2. Service Entrance Use: Breakers in required enclosure and required accessories shall be UL 489 listed.
 - 3. Interlock: Enclosure and switch shall interlock to prevent opening cover with switch in the ON position. Provide bypass feature for use by qualified personnel.

2.02 FUSED SWITCH, INDIVIDUAL, LOW VOLTAGE

- A. UL 98 listed for use and location of installation.
- B. NEMA KS 1.
- C. Short Circuit Rating: 200,000 amps rms symmetrical with Class R, Class J, or Class L fuses installed.
- D. Quick-make, quick-break, motor rated, load-break, heavy-duty (HD) type with external markings clearly indicating ON/OFF positions.
- E. Connections
 - 1. Mechanical lugs, except crimp compression lugs where shown.
 - 2. Lugs removable/replaceable.
 - 3. Suitable for 75 degrees C rated conductors at NEC 75 degrees C ampacity.
- F. Fuse Provisions
 - 1. 30-amp to 600-amp rated shall incorporate rejection feature to reject all fuses except Class R.

2. 601-amp rated and greater shall accept Class L fuses, unless otherwise shown.
 - G. Enclosures: See Article Enclosures.
 - H. Interlock: Enclosure and switch to prevent opening cover with switch in ON position. Provide bypass feature for use by qualified personnel.
- 2.03 NONFUSED SWITCH, INDIVIDUAL, LOW VOLTAGE
- A. NEMA KS 1.
 - B. Quick-make, quick-break, motor rated, load-break, heavy-duty (HD) type with external markings clearly indicating ON/OFF positions.
 - C. Lugs: Suitable for use with 75 degrees C wire at NEC 75 degrees C ampacity.
 - D. Auxiliary Contact
 1. Operation: Make before power contacts make and break before power contacts break.
 2. Contact Rating: 7,200VA make, 720VA break, at 600V, NEMA ICS 5 Designation A600.
 - E. Enclosures: See Article Enclosures.
 - F. Interlock: Enclosure and switch to prevent opening cover with switch in ON position. Provide bypass feature for use by qualified personnel.
- 2.04 FUSE, 250-VOLT AND 600-VOLT
- A. Power Distribution, General
 1. Current-limiting, with 200,000 ampere rms interrupting rating.
 2. Provide to fit mountings specified with switches.
 3. UL 248.
 - B. Power Distribution, Ampere Ratings 1 Amp to 600 Amps
 1. Class: RK-1.
 2. Type: Dual element, with time delay.
 3. Manufacturers and Products:
 - a. Bussmann; Types LPS-RK (600 volts) and LPN-RK (250 volts).
 - b. Littelfuse; Types LLS-RK (600 volts) and LLN-RK (250 volts).
 - C. Power Distribution, Ampere Ratings 601 Amps to 6,000 Amps
 1. Class: L.

2. Double O-rings and silver links.
3. Manufacturers and Products:
 - a. Bussmann; Type KRP-C.
 - b. Littelfuse, Inc.; Type KLPC.

D. Cable Limiters

1. 600V or less; crimp to copper cable, bolt to bus or terminal pad.
2. Manufacturer and Product: Bussmann; K Series.

E. Ferrule

1. 600V or less, rated for applied voltage, small dimension.
2. Ampere Ratings: 1/10 amp to 30 amps.
3. Dual-element time-delay, time-delay, or nontime-delay as required.
4. Provide with blocks or holders as indicated and suitable for location and use.
5. Manufacturers:
 - a. Bussmann.
 - b. Littlefuse, Inc.

2.05 PUSHBUTTON, INDICATING LIGHT, AND SELECTOR SWITCH

- A. Contact Rating: 7,200VA make, 720VA break, at 600V, NEMA ICS 5 Designation A600.
- B. Selector Switch Operating Lever: Standard.
- C. Indicating Light: LED, full voltage, push-to-test.
- D. Pushbutton Color
 1. ON or START.
 2. OFF or STOP: Red.
- E. Pushbutton and selector switch lockable in OFF position where indicated.
- F. Legend Plate
 1. Material: Aluminum.
 2. Engraving: Enamel filled in high contrasting color.

3. Text Arrangement: 11-character/spaces on one line, 14-character/spaces on each of two lines, as required, indicating specific function.
4. Letter Height: 7/64 inch.

G. Manufacturers and Products:

1. Heavy-Duty, Oil-Tight Type:
 - a. General Electric Co.; Type CR 104P.
 - b. Square D Co.; Type T.
 - c. Eaton/Cutler-Hammer; Type 10250T.
2. Heavy-Duty, Watertight, and Corrosion-Resistant Type:
 - a. Square D Co.; Type SK.
 - b. General Electric Co.; Type CR 104P.
 - c. Eaton/Cutler-Hammer; Type E34.
 - d. Crouse-Hinds; Type NCS.

2.06 TERMINAL BLOCK, 600 VOLTS

- A. UL 486E and UL 1059.
- B. Size components to allow insertion of necessary wire sizes.
- C. Capable of termination of control circuits entering or leaving equipment, panels, or boxes.
- D. Screw clamp compression, dead front barrier type, with current bar providing direct contact with wire between compression screw and yoke.
- E. Yoke, current bar, and clamping screw of high strength and high conductivity metal.
- F. Yoke shall guide all strands of wire into terminal.
- G. Current bar shall ensure vibration-proof connection.
- H. Terminals
 1. Capable of wire connections without special preparation other than stripping.
 2. Capable of jumper installation with no loss of terminal or rail space.
 3. Individual, rail mounted.
- I. Marking system, allowing use of preprinted or field-marked tags.
- J. Manufacturers

1. Weidmuller, Inc.
2. Ideal.
3. Electrovert USA Corp.

2.07 MAGNETIC CONTROL RELAY

- A. Industrial control with field convertible contacts rated 10 amps continuous, 7,200VA make, 720VA break.
- B. NEMA ICS 2, Designation: A600 (600 volts).
- C. Time Delay Relay Attachment
 1. Pneumatic type, timer adjustable as shown.
 2. Field convertible from ON delay to OFF delay and vice versa.
- D. Latching Attachment: Mechanical latch, having unlatching coil and coil clearing contacts.
- E. Manufacturers and Products
 1. Eaton/Cutler-Hammer; D26 Type M.
 2. General Electric Co.; Type CR120A.
 3. Square D; Type X.

2.08 TIME DELAY RELAY

- A. Industrial relay with contacts rated 5 amps continuous, 3,600VA make, 360VA break.
- B. NEMA ICS 2 Designation: B150 (150 volts).
- C. Solid-state electronic, field convertible ON/OFF delay.
- D. One normally open and one normally closed contact (minimum).
- E. Repeat accuracy plus or minus 2 percent.
- F. Timer adjustment from 1 second to 60 seconds, unless otherwise indicated on Drawings.
- G. Manufacturers and Products
 1. Square D Co.; Type XO.
 2. Eaton/Cutler-Hammer; Type D26MR.
 3. General Electric Co.; Type CR120.

2.09 RESET TIMER

- A. Drive: Synchronous motor, solenoid-operated clutch.
- B. Mounting: Semiflush panel.
- C. Contacts: 10 amps, 120 volts.
- D. Manufacturers and Products
 - 1. Eagle Signal Controls; Bulletin 125.
 - 2. Automatic Timing and Controls; Bulletin 305.

2.10 ELAPSED TIME METER

- A. Drive: Synchronous motor.
- B. Range: 0 hour to 99,999.9 hours, nonreset type.
- C. Mounting: Semiflush panel.
- D. Manufacturers and Products
 - 1. General Electric Co.; Type 240, 2-1/2-inch Big Look.
 - 2. Eagle Signal Controls; Bulletin 705.

2.11 MAGNETIC CONTACTOR

- A. UL listed.
- B. Electrically operated, electrically held.
- C. Main Contacts
 - 1. Power driven in one direction with mechanical spring dropout.
 - 2. Silver alloy with wiping action and arc quenchers.
 - 3. Continuous-duty, rated as shown.
 - 4. Poles: As shown.
- D. Control: As shown.
- E. Auxiliary Contacts: Quantity as shown, rated 7200VA make, 720VA break, at 600V, A600 per NEMA ICS 5.
- F. Enclosures: See Article Enclosures.
- G. Manufacturers and Products

1. Eaton/Cutler-Hammer; Class A201.
2. General Electric Co.; CR 353.
3. Square D Co.; Class 8910.

2.12 PHASE MONITOR RELAY

A. Features

1. Voltage and phase monitor relay shall drop out on low voltage, voltage unbalance, loss of phase, or phase reversal.
2. Contacts: Single-pole, double-throw, 10 amperes, 120/240V ac. Where additional contacts are shown or required, provide magnetic control relays.
3. Adjustable trip and time delay settings.
4. Transient Protection: 1,000V ac.
5. Mounting: Multipin plug-in socket base.

B. Manufacturer and Product: Automatic Timing and Controls; SLD Series.

2.13 MAGNETIC LIGHTING CONTACTOR

A. Comply with NEMA ICS 2; provide UL 508 listing.

B. Electrically operated by dual-acting, single coil mechanism.

C. Inherently interlocked and electrically held in CLOSED position.

D. Main Contacts

1. Double-break, continuous-duty, rated 30 amperes, 600 volts, withstand rating of 22,000 amps rms symmetrical at 250 volts, 14,000 amps rms symmetrical at 480 volts.
2. Marked for electric discharge lamps, tungsten, and general purpose loads.
3. Position not dependent on gravity, hooks, latches, or semi-permanent magnets.
4. Capable of operating in any position.
5. Visual indication for each contact.

E. Auxiliary contact relay for Form 3 control.

F. Fully rated neutral terminal.

G. Provision for remote pilot lamp with use of auxiliary contacts.

H. Clamp type, self-rising terminal plates for solderless connections.

- I. Enclosures: See Article Enclosures.
- J. Manufacturers and Products
 - 1. ASCO.
 - 2. Eaton/Cutler-Hammer; Class A202.
 - 3. General Electric Co.; Class 360 (electrically held).
 - 4. Square D; Class 8903, Type L (electrically held).

2.14 INDUSTRIAL CAPACITORS

- A. UL 810, IEEE 18, and NFPA 70, Article 460.
- B. Three-phase capacitor units containing internally mounted, indicating type, high interrupting-capacity, current-limiting fuses, and discharge resistors.
- C. Enclosure: See Article Enclosures.
- D. Units containing PCB dielectric fluid are unacceptable.
- E. KiloVar Ratings
 - 1. Check motor nameplate and manufacturer's power factor and no-load current data for actual motor installed.
 - 2. Reduce capacitor rating, if required, to not exceed motor manufacturer's recommended maximum size, and to not exceed value required to raise motor no-load power factor to 0.95.
- F. Manufacturers
 - 1. General Electric Co.
 - 2. Square D Co.

2.15 SUPPORT AND FRAMING CHANNELS

- A. Carbon Steel Framing Channel
 - 1. Material: Rolled, mild strip steel, 12-gauge minimum, ASTM A1011/A1011M, Grade 33.
 - 2. Finish: Hot-dip galvanized after fabrication.
- B. Paint Coated Framing Channel: Carbon steel framing channel with electro-deposited rust inhibiting acrylic or epoxy paint.
- C. PVC-Coated Framing Channel: Carbon steel framing channel with 40-mil polyvinyl chloride coating.
- D. Stainless Steel Framing Channel: Rolled, Type 316 stainless steel, 12-gauge minimum.

- E. Extruded Aluminum Framing Channel:
 - 1. Material: Extruded from Type 6063-T6 aluminum alloy.
 - 2. Fittings fabricated from Alloy 5052-H32.
- F. Nonmetallic Framing Channel
 - 1. Material: Fire retardant, fiber reinforced vinyl ester resin.
 - 2. Channel fitting of same material as channel.
 - 3. Nuts and bolts of long glass fiber reinforced polyurethane.
- G. Manufacturers
 - 1. B-Line Systems, Inc.
 - 2. Unistrut Corp.
 - 3. Aickinstrut.

2.16 INTRINSIC SAFETY BARRIER

- A. Provides a safe energy level for exposed wiring in a Class I, Division 1 or Division 2 hazardous area when circuit is connected to power source in nonhazardous area.
- B. Rating: Power source shall be rated 24V dc or 120V ac as shown on Drawings, with not more than 250 volts available under fault conditions.
- C. Contact Rating: 5 amps, 250V ac.
- D. Mounting: Rail or surface.
- E. Manufacturers and Products
 - 1. MTL, Inc.; Series 2000 or Series 3000.
 - 2. R. Stahl, Inc.

2.17 FIRESTOPS

- A. General
 - 1. Provide UL 1479 classified hourly fire rating equal to, or greater than, the assembly penetrated.
 - 2. Prevent the passage of cold smoke, toxic fumes, and water before and after exposure to flame.
 - 3. Sealants and accessories shall have fire-resistance ratings as established by testing identical assemblies in accordance with ASTM E814, by UL, or other testing and inspection agency acceptable to authorities having jurisdiction.

B. Firestop System

1. Formulated for use in through-penetration firestopping around cables, conduit, pipes, and duct penetrations through fire-rated walls and floors.
2. Fill, Void, or Cavity Material: 3M Brand Fire Barrier Caulk CP 25, Putty 303, Wrap/Strip FS195, Composite Sheet CS195 and Penetration Sealing Systems 7902 and 7904 Series.
3. Two-Part, Foamed-In-Place, Silicone Sealant: Dow Corning Corp. Fire Stop Foam, General Electric Co.; Pensil 851.
4. Fire Stop Devices: See SECTION 26 05 33 – RACEWAYS AND BOXES, for raceway and cable fittings.

2.18 ENCLOSURES

- A. Finish: Sheet metal structural and enclosure parts shall be completely painted using an electrodeposition process so interior and exterior surfaces as well as bolted structural joints have a complete finish coat on and between them.
- B. Color: Manufacturer's standard color (gray) baked-on enamel, unless otherwise shown.
- C. Barriers: Provide metal barriers within enclosures to separate wiring of different systems and voltage.
- D. Enclosure Selections: Except as shown otherwise, provide electrical enclosures according to the Area Classification and Material Selection Table on Drawings.

PART 3 - EXECUTION

3.01 GENERAL

- A. Install equipment in accordance with manufacturer's recommendations.

3.02 PUSHBUTTON, INDICATING LIGHT, AND SELECTOR SWITCH

- A. Install heavy-duty, oil-tight type in nonhazardous, indoor, dry locations, including motor control centers, control panels, and individual stations, unless otherwise shown.
- B. Install heavy-duty, watertight and corrosion-resistant type in nonhazardous, outdoor, or normally wet areas, unless otherwise shown.

3.03 INDUSTRIAL CAPACITORS

- A. Provide suitable hangers or mounting brackets for wall or ceiling mounting where necessary.

3.04 SUPPORT AND FRAMING CHANNEL

- A. Install where required for mounting and supporting electrical equipment, raceway, and cable tray systems.
- B. Channel type shall be as indicated in the Area Classification and Material Selection Table on Drawings.

C. Paint cut ends prior to installation with the following:

1. Carbon Steel Channel: Zinc-rich primer.
2. Painted Channel: Rust-inhibiting epoxy or acrylic paint.
3. Nonmetallic Channel: Epoxy resin sealer.
4. PVC-Coated Channel: PVC patch.

3.05 INTRINSIC SAFETY BARRIERS

- A. Install in compliance with ISAmRP12.06.01.
- B. Arrange conductors such that wiring from hazardous areas cannot short to wiring from nonhazardous area.
- C. Stencil “INTRINSICALLY SAFE CIRCUIT” on all boxes enclosing barriers.

3.06 FIRESTOPS

- A. Install in strict conformance with manufacturer’s instructions. Comply with installation requirements established by testing and inspecting agency.
- B. Sealant: Install sealant including forming, packing, and other accessory materials, to fill openings around electrical services penetrating floors and walls, to provide firestops with fire-resistance ratings indicated for floor or wall assembly in which penetration occurs.

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Institute of Electrical and Electronics Engineers (IEEE): C2, National Electrical Safety Code (NESC).
2. National Fire Protection Association (NFPA): 70, National Electrical Code. (NEC).

1.02 SUBMITTALS

A. Action Submittals

1. Shop Drawings:
 - a. Product data for the following:
 - 1) Exothermic weld connectors.
 - 2) Mechanical connectors.
 - 3) Compression connectors.
 - 4) Specialty tools.
 - 5) Ground Rods.
 - 6) Ground Wells.

1.03 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ)

1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
2. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories, Inc. shall conform to those standards and shall have an applied UL listing mark.

PART 2 - PRODUCTS

2.01 GROUND ROD

A. Material: Copper

B. Diameter: Minimum 3/4 inch.

C. Length: 10 feet.

2.02 GROUND CONDUCTORS

A. As specified in SECTION 26 05 53 – WIRES AND CABLES.

2.03 CONNECTORS

A. Exothermic Weld Type

1. Outdoor Weld: Suitable for exposure to elements or direct burial.

2. Indoor Weld: Utilize low-smoke, low-emission process.

3. Manufacturers

a. Erico Products, Inc.; Cadweld and Cadweld Exolon.

b. Thermoweld.

B. Compression Type

1. Compress-deforming type; wrought copper extrusion material.

2. Single indentation for conductors 6 AWG and smaller.

3. Double indentation with extended barrel for conductors 4 AWG and larger.

4. Barrels prefilled with oxide-inhibiting and antiseizing compound and sealed.

5. Manufacturers

a. Burndy Corp.; Hyground Irreversible Compression.

b. Thomas and Betts Co.

c. ILSCO.

C. Mechanical Type: Split-bolt, saddle, or cone screw type; copper alloy material.

1. Manufacturers

a. Burndy Corp.

b. Thomas and Betts Co.

2.04 GROUNDING WELLS

A. Ground rod box complete with cast iron riser ring and traffic cover marked GROUND ROD.

B. Manufacturers and Products

1. Christy Co.
2. Lightning and Grounding Systems, Inc.

PART 3 - EXECUTION

3.01 GENERAL

- A. Grounding shall be in compliance with NFPA 70 and IEEE C2.
- B. Ground electrical service neutral at service entrance equipment with grounding electrode conductor to grounding electrode system.
- C. Ground each separately derived system neutral with common grounding electrode conductor to grounding electrode system.
- D. Bond together all grounding electrodes that are present at each building or structure served to form one common grounding electrode system.
- E. Bond together system neutrals, service equipment enclosures, exposed noncurrent-carrying metal parts of electrical equipment, metal raceways, ground conductor in raceways and cables, receptacle ground connections, and metal piping systems.
- F. Shielded Power Cables: Ground shields at each splice or termination in accordance with recommendations of splice or termination manufacturer.
- G. Shielded Instrumentation Cables
 1. Ground shield to ground bus at power supply for analog signal.
 2. Expose shield minimum 1 inch at termination to field instrument and apply heat shrink tube.
 3. Do not ground instrumentation cable shield at more than one point.

3.02 WIRE CONNECTIONS

- A. Ground Conductors: Install in conduit containing power conductors and control circuits above 50 volts.
- B. Nonmetallic Raceways and Flexible Tubing: Install equipment grounding conductor connected at both ends to noncurrent-carrying grounding bus.
- C. Connect ground conductors to raceway grounding bushings.
- D. Extend and connect ground conductors to ground bus in all equipment containing a ground bus.
- E. Connect enclosure of equipment containing ground bus to that bus.
- F. Bolt connections to equipment ground bus.
- G. Bond grounding conductors to metallic enclosures at each end, and to intermediate metallic enclosures.

- H. Junction Boxes: Furnish materials and connect to equipment grounding system with grounding clips mounted directly on box, or with 3/8-inch machine screws.
- I. Metallic Equipment Enclosures: Use furnished ground lug; if none furnished, tap equipment housing and install solderless terminal connected to box with machine screw. For circuits greater than 20 amps use minimum 5/16-inch diameter bolt.

3.03 GROUND RODS

- A. Install full length with conductor connection at upper end.
- B. Install with connection point below finished grade, unless otherwise shown.
- C. Space multiple ground rods by one rod length.
- D. Install to 8 feet below local frost depth.

3.04 GROUNDING WELLS

- A. Install for ground rods located inside buildings, asphalt and paved areas, and where shown on Drawings.
- B. Install riser ring and cover flush with surface.
- C. Place 6 inches of crushed rock in bottom of each well.

3.05 CONNECTIONS

A. General

- 1. Above grade Connections: Install exothermic weld, mechanical, or compression-type connectors; or brazing.
- 2. Below grade Connections: Install exothermic weld or compression type connectors.
- 3. Remove paint, dirt, or other surface coverings at connection points to allow good metal-to-metal contact.
- 4. Notify Owner prior to backfilling ground connections.

B. Exothermic Weld Type

- 1. Wire brush or file contact point to bare metal surface.
- 2. Use welding cartridges and molds in accordance with manufacturer's recommendations.
- 3. Avoid using badly worn molds.
- 4. Mold to be completely filled with metal when making welds.
- 5. After completed welds have cooled, brush slag from weld area and thoroughly clean joint.

C. Compression Type

1. Install in accordance with connector manufacturer's recommendations.
2. Install connectors of proper size for grounding conductors and ground rods specified.
3. Install using connector manufacturer's compression tool having proper sized dies and operate per manufacturer's instructions.

D. Mechanical Type

1. Apply homogeneous blend of colloidal copper and rust and corrosion inhibitor before making connection.
2. Install in accordance with connector manufacturer's recommendations.
3. Do not conceal mechanical connections.

3.06 METAL STRUCTURE GROUNDING

- A. Bond metal sheathing and exposed metal vertical structural elements to grounding system.
- B. Bond electrical equipment supported by metal platforms to the platforms.
- C. Provide electrical contact between metal frames and railings supporting pushbutton stations, receptacles, and instrument cabinets, and raceways carrying circuits to these devices.

3.07 MANHOLE, HANDHOLE AND PULL BOX GROUNDING

- A. Install one ground rod inside each manhole, handhole and pull box larger than 24-inch by 24-inch inside dimensions.
- B. Ground Rod Floor Protrusion: 4 inches to 6 inches above floor.
- C. Make connections of grounding conductors fully visible and accessible.
- D. Connect all noncurrent-carrying metal parts, and any metallic raceway grounding bushings to ground rod with 6 AWG copper conductor.

3.08 TRANSFORMER GROUNDING

- A. Bond neutrals of transformers within buildings to system ground network, and to any additional indicated grounding electrodes.
- B. Bond neutrals of substation transformers to substation grounding grid and system grounding network.
- C. Bond neutrals of pad-mounted transformers to four locally driven ground rod and system ground network.

3.09 LIGHTNING PROTECTION SYSTEMS

- A. Bond lightning protection system ground terminals to building or structure grounding electrode system.

3.10 SURGE PROTECTION EQUIPMENT GROUNDING

- A. Connect surge arrestor ground terminals to equipment ground bus.

END OF SECTION

SECTION 26 05 33
RACEWAYS AND BOXES

PART 1 - GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Association of State Highway and Transportation Officials (AASHTO): HB, Standard Specifications for Highway Bridges.
2. ASTM International (ASTM)
 - a. A123/123M, Standard Specification for Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products.
 - b. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - c. A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - d. C857, Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
 - e. D149, Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies.
3. Telecommunications Industry Association (TIA): 569B, Commercial Building Standard for Telecommunications Pathways and Spaces.
4. National Electrical Contractor's Association, Inc. (NECA): Installation standards.
5. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - b. C80.1, Electrical Rigid Steel Conduit (ERSC).
 - c. C80.3, Steel Electrical Metallic Tubing (EMT).
 - d. C80.5, Electrical Rigid Aluminum Conduit (ERAC).
 - e. C80.6, Electrical Intermediate Metal Conduit (EIMC).
 - f. RN 1, Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
 - g. TC 2, Electrical Polyvinyl Chloride (PVC) Conduit.

- h. TC 3, Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.
 - i. TC 6, Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installation.
 - j. TC 14, Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.
 - k. VE 1, Metallic Cable Tray Systems.
6. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
7. Underwriters Laboratories Inc. (UL)
- a. 1, Standard for Safety for Flexible Metal Conduit.
 - b. 5, Standard for Safety for Surface Metal Raceways and Fittings.
 - c. 6, Standard for Safety for Electrical Rigid Metal Conduit – Steel.
 - d. 6A, Standard for Safety for Electrical Rigid Metal Conduit – Aluminum, Red Brass and Stainless.
 - e. 360, Standard for Safety for Liquid-Tight Flexible Steel Conduit.
 - f. 514B, Standard for Safety for Conduit, Tubing, and Cable Fittings.
 - g. 651, Standard for Safety for Schedule 40 and 80 Rigid PVC Conduit and Fittings.
 - h. 651A, Standard for Safety for Type EB and A Rigid PVC Conduit and HDPE Conduit.
 - i. 797, Standard for Safety for Electrical Metallic Tubing – Steel.
 - j. 870, Standard for Safety for Wireways, Auxiliary Gutters, and Associated Fittings.
 - k. 1242, Standard for Safety for Electrical Intermediate Metal Conduit – Steel.
 - l. 1660, Standard for Safety for Liquid-Tight Flexible Nonmetallic Conduit.
 - m. 1684, Standard for Safety for Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.
 - n. 2024, Standard for Safety for Optical Fiber and Communication Cable Raceway.

1.02 SUBMITTALS

A. Action Submittals

1. Manufacturer's Literature

- a. Rigid galvanized steel conduit.
 - b. Intermediate metal conduit.
 - c. Electric metallic tubing.
 - d. Rigid aluminum conduit.
 - e. PVC Schedule 40 conduit.
 - f. PVC Schedule 80 conduit.
 - g. PVC tubing (Type EB) conduit.
 - h. PVC-coated rigid, galvanized steel, aluminum conduit, submittal to include copy of manufacturer's warranty.
 - i. Flexible metal, liquid-tight conduit.
 - j. Flexible, nonmetallic, liquid-tight conduit.
 - k. Flexible metal, nonliquid-tight conduit.
 - l. Conduit fittings.
 - m. Wireways.
 - n. Surface metal raceway.
 - o. Device boxes for use in hazardous areas.
 - p. Junction and pull boxes used at or below grade.
 - q. Large junction and pull boxes.
 - r. Terminal junction boxes.
- 2. Equipment and machinery proposed for bending metal conduit.
 - 3. Method for bending PVC conduit less than 30 degrees.
 - 4. Conduit Layout
 - a. Provide drawings for underground and concealed conduits including, but not limited to ductbanks, under floor slabs, concealed in floor slabs, and concealed in walls.
 - b. Provide plan and section showing arrangement and location of conduit and duct bank required for:
 - 1) Low and medium voltage feeder and branch circuits.
 - 2) Instrumentation and control systems.

- 3) Communications systems.
 - 4) Empty conduit for future use.
 - c. Electronic CAD; scale not greater than 1 inch equals 20 feet.
 - B. Informational Submittals
 - 1. Manufacturer's certification of training for PVC-coated rigid galvanized steel conduit installer.
- 1.03 QUALITY ASSURANCE
- A. Authority Having Jurisdiction (AHJ)
 - 1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
 - 2. Materials and equipment manufactured within scope of standards published by Underwriters Laboratories, Inc. shall conform to those standards and shall have an applied UL listing mark.
 - B. PVC-Coated, Rigid Galvanized Steel Conduit Installer: Certified by conduit manufacturer as having received minimum 2 hours of training on installation procedures.

PART 2 - PRODUCTS

2.01 CONDUIT AND TUBING

- A. Rigid Galvanized Steel Conduit (RGS)
 - 1. Meet requirements of NEMA C80.1 and UL 6.
 - 2. Material: Hot-dip galvanized with chromated protective layer.
- B. Intermediate Metal Conduit (IMC)
 - 1. Meet requirements of NEMA C80.6 and UL 1242.
 - 2. Material: Hot-dip galvanized with chromated and lacquered protective layer.
- C. Electric Metallic Tubing (EMT)
 - 1. Meet requirements of NEMA C80.3 and UL 797.
 - 2. Material: Hot-dip galvanized with chromated and lacquered protective layer.
- D. Rigid Aluminum Conduit
 - 1. Meet requirements of NEMA C80.5 and UL 6A.

2. Material: Type 6063, copper-free aluminum alloy.
- E. PVC Schedule 40 Conduit
1. Meet requirements of NEMA TC 2 and UL 651.
 2. UL listed for concrete encasement, underground direct burial, concealed or direct sunlight exposure, and 90 degrees C insulated conductors.
 3. Furnish without factory-formed bell.
- F. PVC Schedule 80 Conduit
1. Meet requirements of NEMA TC 2 and UL 651.
 2. UL listed for concrete encasement, underground direct burial, concealed or direct sunlight exposure, and 90 degrees C insulated conductors.
- G. Fiberglass Conduit
1. Meet requirements of NEMA TC 14 and UL 1684.
 2. Winding: Single circuit with angle as close to 54.75 as possible.
 3. Resin System: Epoxy based using an anhydride curing agent.
 4. Use carbon black as ultraviolet inhibitor.
 5. Toxicity: Conduit shall not contain compounds that can release halogens in more than trace amounts when burning.
 6. Dielectric Strength: Exceed 400 volts per mil when tested in accordance with ASTM D149.
 7. Jointing System: Two-part epoxy adhesive supplied by conduit manufacturer.
 8. Manufacturers
 - a. Champion Fiberglass.
 - b. Osburn Associates.
 - c. FRE Composites, Inc.
- H. PVC Tubing (Type EB)
1. Meet requirements of NEMA TC 6 and UL 651A.
 2. UL listed for reinforced concrete encasement and 90 degrees C insulated conductors.
 3. Furnish without factory-formed bell.
- I. PVC-Coated Rigid Galvanized Steel Conduit

1. Meet requirements of NEMA RN 1 and ETL
 2. Material
 - a. Meet requirements of NEMA C80.1 and UL 6.
 - b. Exterior Finish: PVC coating, 40-mil nominal thickness; bond to metal shall have tensile strength greater than PVC.
 - c. Interior finish: Urethane coating, 2-mil nominal thickness.
 3. Threads: Hot-dipped galvanized and factory coated with urethane.
 4. Bendable without damage to interior or exterior coating.
- J. PVC-Coated Rigid Aluminum Conduit
1. Meet requirements of NEMA RN 1.
 2. Material: Type 6063, copper-free aluminum alloy.
 - a. Meet requirements of NEMA C80.5 and UL 6A.
 - b. Exterior Finish: PVC coating, 40-mil nominal thickness; bond to metal shall have tensile strength greater than PVC.
 - c. Interior Finish: Urethane coating, 2-mil nominal thickness.
- K. Flexible Metal, Liquid-Tight Conduit
1. UL 360 listed for 105 degrees C insulated conductors.
 2. Material: Galvanized steel with extruded PVC jacket.
- L. Flexible Metal, Nonliquid-Tight Conduit
1. Meet requirements of UL 1.
 2. Material: Galvanized steel.
- M. Flexible, Nonmetallic, Liquid-Tight Conduit
1. Material: PVC core with fused flexible PVC jacket.
 2. UL 1660 listed for:
 - a. Dry Conditions: 80 degrees C insulated conductors.
 - b. Wet Conditions: 60 degrees C insulated conductors.
 3. Manufacturers and Products
 - a. Carlon; Carflex or X-Flex.

- b. T & B; Xtraflex LTC or EFC.

N. Innerduct

- 1. Resistant to spread of fire, per requirements of UL 2024.
- 2. Smooth or corrugated HDPE.
- 3. Textile Manufacturer: Maxcell, or equal.

2.02 FITTINGS

A. Rigid Galvanized Steel and Intermediate Metal Conduit

1. General

- a. Meet requirements of UL 514B.
- b. Type: Threaded, galvanized. Set screw and threadless compression fittings not permitted.

2. Bushing

- a. Material: Malleable iron with integral insulated throat, rated for 150 degrees C.
- b. Manufacturers and Products
 - 1) Appleton; Series BU-I.
 - 2) O-Z/Gedney; Type HB.

3. Grounding Bushing

- a. Material: Malleable iron with integral insulated throat rated for 150 degrees C, with solderless lugs.
- b. Manufacturers and Products
 - 1) Appleton; Series GIB.
 - 2) O-Z/Gedney; Type HBLG.

4. Conduit Hub

- a. Material: Malleable iron with insulated throat with bonding screw.
- b. UL listed for use in wet locations.
- c. Manufacturers and Products
 - 1) Appleton, Series HUB-B.
 - 2) O-Z/Gedney; Series CH.

- 3) Meyers; ST Series.
- 5. Conduit Bodies
 - a. Sized as required by NFPA 70.
 - b. Manufacturers and Products (For Normal Conditions)
 - 1) Appleton; Form 35 threaded unilets.
 - 2) Crouse-Hinds; Form 7 or Form 8 threaded condulets.
 - 3) Killark; Series O electrolets.
 - 4) Thomas & Betts; Form 7 or Form 8.
 - c. Manufacturers (For Hazardous Locations)
 - 1) Appleton.
 - 2) Crouse-Hinds.
 - 3) Killark.
- 6. Couplings: As supplied by conduit manufacturer.
- 7. Unions
 - a. Concrete tight, hot-dip galvanized malleable iron.
 - b. Manufacturers and Products:
 - 1) Appleton; Series SCC bolt-on coupling or Series EC three-piece union.
 - 2) O-Z/Gedney; Type SSP split coupling or Type 4 Series, three-piece coupling.
- 8. Conduit Sealing Fitting
 - a. Manufacturers and Products
 - 1) Appleton; Type EYF, EYM, or ESU.
 - 2) Crouse-Hinds; Type EYS or EZS.
 - 3) Killark; Type EY or Type EYS.
- 9. Drain Seal
 - a. Manufacturers and Products
 - 1) Appleton; Type EYD.

- 2) Crouse-Hinds; Type EYD or Type EZD.
- 10. Drain/Breather Fitting
 - a. Manufacturers and Products
 - 1) Appleton; Type ECDB.
 - 2) Crouse-Hinds; ECD.
- 11. Expansion Fitting
 - a. Manufacturers and Products:
 - 1) Deflection/Expansion Movement
 - a) Appleton; Type DF.
 - b) Crouse-Hinds; Type XD.
 - 2) Expansion Movement Only
 - a) Appleton; Type XJ.
 - b) Crouse-Hinds; Type XJ.
 - c) Thomas & Betts; XJG-TP.
- 12. Cable Sealing Fitting
 - a. To form watertight nonslip cord or cable connection to conduit.
 - b. For Conductors with OD of 1/2 inch or Less: Neoprene bushing at connector entry.
 - c. Manufacturers and Products
 - 1) Appleton; CG-S.
 - 2) Crouse-Hinds; CGBS.
- B. Electric Metallic Tubing
 - 1. Meet requirements of UL 514B.
 - 2. Type: Steel body and locknuts with steel or malleable iron compression nuts. Set screw and drive-on fittings not permitted.
 - 3. Electro zinc-plated inside and out.
 - 4. Raintight.
 - 5. Coupling Manufacturers and Products

- a. Appleton; Type 95T.
 - b. Crouse-Hinds.
 - c. Thomas & Betts.
 - 6. Connector Manufacturers and Products
 - a. Appleton; Type ETP.
 - b. Crouse-Hinds.
 - c. Thomas & Betts.
- C. Rigid Aluminum Conduit
- 1. General
 - a. Meet requirements of UL 514B.
 - b. Type: Threaded, copper-free. Set screw fittings not permitted.
 - 2. Insulated Bushing
 - a. Material: Cast aluminum, with integral insulated throat, rated for 150 degrees C.
 - b. Manufacturer and Product: O-Z/Gedney; Type AB.
 - 3. Grounding Bushing
 - a. Material: Cast aluminum with integral insulated throat, rated for 150 degrees, with solderless lugs.
 - b. Manufacturer and Product: O-Z/Gedney; Type ABLG.
 - 4. Conduit Hub
 - a. Material: Cast aluminum, with insulated throat.
 - b. UL listed for use in wet locations.
 - c. Manufacturers and Products
 - 1) O-Z/Gedney; Type CHA.
 - 2) Thomas & Betts; Series 370AL.
 - 3) Meyers; Series SA.
 - 5. Conduit Bodies
 - a. Manufacturers and Products (For Normal Conditions)

- 1) Appleton; Form 85 threaded unilets.
 - 2) Crouse-Hinds; Mark 9 or Form 7-SA threaded condulets.
 - 3) Killark; Series O electrolets.
- b. Manufacturers (For Hazardous Locations)
 - 1) Appleton.
 - 2) Crouse-Hinds.
 - 3) Killark.
6. Couplings: As supplied by conduit manufacturer.
7. Conduit Sealing Fitting
 - a. Manufacturers and Products
 - 1) Appleton; Type EYF-AL or EYM-AL.
 - 2) Crouse-Hinds; Type EYS-SA or EZS-SA.
 - 3) Killark; Type EY or Type EYS.
8. Drain Seal
 - a. Manufacturers and Products
 - 1) Appleton; Type EYDM-A.
 - 2) Crouse-Hinds; Type EYD-SA or Type EZD-SA.
9. Drain/Breather Fitting
 - a. Manufacturers and Products
 - 1) Appleton; Type ECDB.
 - 2) Crouse-Hinds; ECD.
10. Expansion Fitting
 - a. Manufacturers and Products
 - 1) Deflection/Expansion Movement: Steel City; Type DF-A.
 - 2) Expansion Movement Only: Steel City; Type AF-A.
11. Cable Sealing Fittings
 - a. To form watertight nonslip cord or cable connection to conduit.

- b. Bushing: Neoprene at connector entry.
 - c. Manufacturer and Product: Appleton; CG-S.
- D. PVC Conduit and Tubing
 - 1. Meet requirements of NEMA TC 3.
 - 2. Type: PVC, slip-on.
- E. Fiberglass Conduit
 - 1. Manufactured by same process as conduit.
 - 2. Supplied by conduit manufacturer.
- F. PVC-Coated Rigid Galvanized Steel Conduit
 - 1. Meet requirements of UL 514B.
 - 2. Fittings: Rigid galvanized steel type, PVC coated by conduit manufacturer.
 - 3. Conduit Bodies: Cast metal hot-dipped galvanized or urethane finish. Cover shall be of same material as conduit body. PVC coated by conduit manufacturer.
 - 4. Finish: 40-mil PVC exterior, 2-mil urethane interior.
 - 5. Overlapping pressure-sealing sleeves.
 - 6. Conduit Hangers, Attachments, and Accessories: PVC-coated.
 - 7. Manufacturers
 - a. Robroy Industries.
 - b. Ocal.
 - 8. Expansion Fitting
 - a. Manufacturer and Product: Ocal; OCAL-BLUE XJG.
- G. PVC-Coated Rigid Aluminum Conduit
 - 1. Meet requirements of UL 514B.
 - 2. Fittings: As listed for rigid aluminum conduit.
 - 3. Finish: 40-mil PVC exterior, 2-mil urethane interior.
 - 4. Overlapping pressure-sealing sleeves.
 - 5. Conduit Hangers, Attachments, and Accessories: PVC-coated.

- 6. Manufacturers
 - a. Robroy Industries.
 - b. Ocal.
- H. Flexible Metal, Liquid-Tight Conduit
 - 1. Metal insulated throat connectors with integral nylon or plastic bushing rated for 105 degrees C.
 - 2. Insulated throat and sealing O-rings.
 - 3. Manufacturers and Products
 - a. Thomas & Betts; Series 5331.
 - b. O-Z/Gedney; Series 4Q.
- I. Flexible Metal, Nonliquid-Tight Conduit
 - 1. Meet requirements of UL 514B.
 - 2. Body: Galvanized steel
 - 3. Throat: Nylon insulated.
 - 4. 1-1/4-Inch Conduit and Smaller: One screw body.
 - 5. 1-1/2-Inch Conduit and Larger: Two screw body.
 - 6. Manufacturer and Product: Appleton; Series 7400.
- J. Flexible, Nonmetallic, Liquid-Tight Conduit
 - 1. Meet requirements of UL 514B.
 - 2. Type: High strength plastic body, complete with lock nut, O-ring, threaded ferrule, sealing ring, and compression nut.
 - 3. Body/compression nut (gland) design to ensure high mechanical pullout strength and watertight seal.
 - 4. Manufacturers and Products
 - a. Carlon; Type LT.
 - b. O-Z/Gedney; Type 4Q-P.
 - c. Thomas & Betts; Series 6300.
- K. Flexible Coupling, Hazardous Locations

1. Approved for use in atmosphere involved.
 2. Rating: Watertight and UL listed for use in Class I, Division 1 and 2 areas.
 3. Outer bronze braid and an insulating liner.
 4. Conductivity equal to a similar length of rigid metal conduit.
 5. Manufacturers and Products
 - a. Crouse-Hinds; Type ECGJH or Type ECLK.
 - b. Appleton; EXGJH or EXLK.
- L. Watertight Entrance Seal Device
1. New Construction
 - a. Material: Oversized sleeve, malleable iron body with sealing ring, pressure ring, grommet seal, and pressure clamp.
 - b. Manufacturer and Product: O-Z/Gedney; Type FSK or Type WSK, as required.
 2. Cored-Hole Application
 - a. Material: Assembled dual pressure disks, neoprene sealing ring, and membrane clamp.
 - b. Manufacturer and Product: O-Z/Gedney; Series CSM.

2.03 OUTLET AND DEVICE BOXES

- A. Sheet Steel: One-piece drawn type, zinc-plated or cadmium-plated.
- B. Cast Metal
1. Box: Malleable iron or Cast ferrous metal.
 2. Cover: Gasketed, weatherproof, malleable iron or cast ferrous metal, with stainless steel screws.
 3. Hubs: Threaded.
 4. Lugs: Cast Mounting.
 5. Manufacturers and Products, Nonhazardous Locations
 - a. Crouse-Hinds; Type FS or Type FD.
 - b. Appleton; Type FS or Type FD.
 - c. Killark.

6. Manufacturers and Products, Hazardous Locations
 - a. Crouse-Hinds; Type GUA or Type EAJ.
 - b. Appleton; Type GR.
- C. Cast Aluminum
 1. Material
 - a. Box: Cast, copper-free aluminum.
 - b. Cover: Gasketed, weatherproof, cast copper-free aluminum with stainless steel screws.
 2. Hubs: Threaded.
 3. Lugs: Cast mounting.
 4. Manufacturers and Products, Nonhazardous Locations
 - a. Crouse-Hinds; Type FS-SA or Type FD-SA.
 - b. Appleton; Type FS or Type FD.
 - c. Killark.
 5. Manufacturers and Products, Hazardous Locations
 - a. Crouse-Hinds; Type GUA-SA.
 - b. Appleton; Type GR.
- D. PVC-Coated Cast Metal
 1. Type: One-piece.
 2. Material: Malleable iron, cast ferrous metal, or cast aluminum.
 3. Coating
 - a. Exterior Surfaces: 40-mil PVC.
 - b. Interior Surfaces: 2-mil urethane.
 4. Manufacturers
 - a. Robroy Industries.
 - b. Ocal.
- E. Nonmetallic

1. Box: PVC.
2. Cover: PVC, weatherproof, with stainless steel screws.
3. Manufacturer and Product: Carlon; Type FS or Type FD, with Type E98 or Type E96 covers.

2.04 JUNCTION AND PULL BOXES

- A. Outlet Box Used as Junction or Pull Box: As specified under Article Outlet and Device Boxes.
- B. Conduit Bodies Used as Junction Boxes: As specified under Article Fittings.
- C. Large Sheet Steel Box
 1. NEMA 250, Type 1.
 2. Box: Code-gauge, galvanized steel.
 3. Cover: Full access, screw type.
 4. Machine Screws: Corrosion-resistant.
- D. Large Cast Metal Box
 1. NEMA 250, Type 4 or 13.
 2. Box: Cast malleable iron, or ferrous metal, electrogalvanized finished with drilled and tapped conduit entrances and exterior mounting lugs.
 3. Cover: Hinged with screws.
 4. Gasket: Neoprene.
 5. Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.
 6. Manufacturers and Products, Surface Mounted Nonhinged Type:
 - a. Crouse-Hinds; Series W.
 - b. O-Z/Gedney; Series Y.
 7. Manufacturer and Product, Surface Mounted, Hinged Type: O-Z/Gedney; Series YW.
 8. Manufacturers and Products, Recessed Type
 - a. Crouse-Hinds; Type WJBF.
 - b. O-Z/Gedney; Series YR.
- E. Large Cast Metal Box, Hazardous Locations
 1. NEMA 250 Type 7 or Type 9 as required for Class, Division, and Group involved.

2. Box: Cast ferrous metal, electro-galvanize finished or copper-free aluminum with drilled and tapped conduit entrances.
 3. Cover: Hinged with screws.
 4. Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.
 5. Manufacturers and Products
 - a. Crouse-Hinds; Type EJB.
 - b. Appleton; Type AJBEW.
- F. Large Cast Aluminum Box
1. NEMA 250 Type 4, 7, 9, or 13.
 2. Box: Cast copper-free aluminum, with drilled and tapped conduit entrances and exterior mounting lugs.
 3. Cover: Nonhinged.
 4. Gasket: Neoprene.
 5. Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.
 6. Manufacturers and Products, Surface Mounted Type
 - a. Crouse-Hinds; Series W-SA.
 - b. O-Z/Gedney; Series YS-A, YL-A.
 - c. Killark.
- G. Large Stainless Steel Box
1. NEMA 250 Type 4X.
 2. Box: 14-gauge, ASTM A240/A240M, Type 304 stainless steel with white enamel painted interior mounting panel.
 3. Cover: Hinged with screws.
 4. Hardware and Machine Screws: ASTM A167, Type 304 stainless steel.
 5. Manufacturers
 - a. Hoffman Engineering Co.
 - b. Robroy Industries.
 - c. Wiegman.

H. Large Steel Box

1. NEMA 250 Type 1 or 3R.
2. Box: 10-gauge steel, with white enamel painted interior and gray primed exterior, over phosphated surfaces. Provide gray finish as approved by Owner.
3. Cover: Hinged with screws.
4. Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.
5. Manufacturers
 - a. Hoffman Engineering Co.
 - b. Robroy Industries.
 - c. Wiegman.

I. Large Nonmetallic Box

1. NEMA 250 Type 4X.
2. Box: High-impact, fiberglass-reinforced polyester or engineered thermoplastic, with stability to high heat.
3. Cover: Hinged with screws.
4. Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.
5. Conduit hubs and mounting lugs.
6. Manufacturers and Products
 - a. Crouse-Hinds; Type NJB.
 - b. Carlon; Series N, C, or H.
 - c. Robroy Industries.

J. Concrete Box, Nontraffic Areas

1. Box: Reinforced, cast concrete with extension.
2. Cover: Steel diamond plate with locking bolts.
3. Cover Marking: ELECTRICAL, TELEPHONE, or as shown.
4. Size: 10 inches by 17 inches, minimum.
5. Manufacturers and Products
 - a. Utility Vault Co.; Series 36-1017.

- b. Christy, Concrete Products, Inc.; N9.
 - c. Quazite; “PG” Style.
- K. Concrete Box, Traffic Areas
 - 1. Box: Reinforced, cast concrete with extension and bottom slab.
 - 2. Cover: Steel checked plate; H/20 loading with screw down.
 - 3. Cover Marking: ELECTRICAL, TELEPHONE, or as shown.
 - 4. Manufacturers and Products
 - a. Christy, Concrete Products, Inc.; B1017BOX.
 - b. Utility Vault Co.; 3030 SB.
- 2.05 TELEPHONE TERMINAL CABINET
 - A. Material: Code-gauge galvanized steel box with hinged doors and 3/4-inch fire-resistant plywood backboard, meeting requirements of telephone service provider.
 - B. Finish: Provide gray finish.
 - C. Minimum Size: 18 inches high by 18 inches wide by 6 inches deep.
- 2.06 TELEPHONE AND DATA OUTLET
 - A. Provide outlet boxes and cover plates meeting requirements of TIA 569B.
- 2.07 TERMINAL JUNCTION BOX
 - A. Cover: Hinged, unless otherwise shown.
 - B. Interior Finish: Paint with white enamel or lacquer.
 - C. Terminal Blocks
 - 1. Separate connection point for each conductor entering or leaving box.
 - 2. Spare Terminal Points: 25 percent, minimum.
- 2.08 SURFACE METAL RACEWAY
 - A. General
 - 1. Meet requirements of UL 5.
 - 2. Material: Two-piece, code-gauge steel.
 - 3. Finish: Factory applied rust inhibiting primer and gray semi-gloss finish suitable for field painting.

4. Configuration: Single, 1-17/32-inch by 2-3/4-inch section, unless otherwise indicated.
- B. Fittings and Accessories
1. Wire clips at 30 inches on center.
 2. Couplings, cover clips, supporting clips, ground clamps, and elbows as required; to comply with manufacturer's recommendations.
- C. Outlets
1. Provide bracket or device covers as required to support wiring devices indicated.
 2. Wiring Devices and Device Plates: In accordance with SECTION 26 05 70 – WIRING DEVICES.
 3. Manufacturers
 - a. The Wiremold Co.
 - b. Walker.

2.09 METAL WIREWAYS

- A. Meet requirements of UL 870.
- B. Type: Steel-enclosed, lay-in type.
- C. Cover: Hinged with friction latch.
- D. Rating: Outdoor raintight.
- E. Finish: Rust inhibiting phosphatizing primer and gray baked enamel.
- F. Hardware: Plated to prevent corrosion; screws installed toward the inside protected by spring nuts or otherwise guarded to prevent wire insulation damage.
- G. Knockouts: Without knockouts, unless otherwise indicated.
- H. Manufacturers
1. Circle AW.
 2. Hoffman.
 3. Square D.

2.10 NONMETALLIC WIREWAY

- A. Rating: Outdoor, corrosion resistant, raintight, NEMA Type 12 and Type 3R.
- B. Type: Fiberglass-enclosed, with removable cover.

- C. Captivated, corrosion-resistant cover screws.
- D. Oil-resistant gaskets.
- E. Meet UL cold impact test to minus 35 degrees C.
- F. Manufacturer: Hoffman.

2.11 CABLE TRAYS

- A. Meet requirements of NEMA VE 1.
- B. Type: Ventilated channel or Ladder Type of welded construction.
- C. Material: Copper-free aluminum alloy 6063-T6 finish.
- D. Dimensions: 12 inches wide, with 6-inch NEMA nominal inside fill depth and fittings with 24 inch bending radius.
- E. Cover: Solid, minimum 20-gauge steel
- F. Barrier Strip: Vertical, solid type, with horizontal fittings and strip clamps.
- G. Fittings of same material as cross-sectional tray area and hardware of same material as cable tray.
- H. Tray Grounding: Conform to NFPA 70 and NEMA VE 1.
- I. Provide next higher NEMA VE 1 class designation than required for support of designed span length.
- J. Design Loads: Use working load adequate for actual cable installed plus 20 percent additional weight allowance for future cables plus 250-pound concentrated static load applied between side rails at midspan, with safety factor of 1.5 in accordance with NEMA VE 1, Table 3-1.
- K. Expansion Joints: NEMA VE 1 for 25 degrees F maximum temperature variation.
- L. Furnish cable tray with no sharp edges, burrs, or weld projections.
- M. Warning Signs: 1-1/2-inch high black lettering on yellow background with legend, "WARNING, NOT TO BE USED AS WALKWAY, LADDER, OR SUPPORT FOR LADDERS OR PERSONNEL."
- N. Manufacturers
 - 1. B-Line Systems, Inc.
 - 2. Square-D.
 - 3. P. W. Industries.
 - 4. T. J. Cope, Inc.

2.12 PRECAST MANHOLES, HANDHOLES AND PULL BOXES

- A. Concrete Strength: Minimum, 3,000 psi compressive, in 28 days.
- B. Loading: AASHTO, H-20 in accordance with ASTM C857.
- C. Access: Provide cast concrete 6-inch or 12-inch risers and access hole adapters between top of manhole and finished grade at required elevations.
- D. Drainage
 - 1. Slope floors toward drain points, leaving no pockets or other nondraining areas.
 - 2. Provide drainage outlet or sump at low point of floor constructed with a heavy, cast iron, slotted or perforated hinged cover, and a minimum 4-inch outlet and outlet pipe.
 - 3. Provide on all four sides.
 - 4. Provide knockout panels or precast individual raceway openings.
 - 5. At entrances where raceways are to be installed by others, provide minimum 12-inch-high by 24-inch-wide knockout panels for future raceway installation.
- E. Embedded Pulling Iron
 - 1. Material: 3/4-inch-diameter stock, fastened to overall steel reinforcement before concrete is placed.
 - 2. Location
 - a. Wall: Opposite each raceway entrance and knockout panel for future raceway entrance.
 - b. Floor: Centered below manhole or handhole cover.
- F. Cable Racks
 - 1. Arms and Insulators: Adjustable, of sufficient number to accommodate cables for each raceway entering or leaving manhole, including spares.
 - 2. Wall Attachment
 - a. Adjustable inserts in concrete walls. Bolts or embedded studs not permitted.
 - b. Insert Spacing: Maximum 3 feet on center for inside perimeter of manhole.
 - c. Arrange in order that spare raceway ends are clear for future cable installation.
- G. Manhole and Pull Box Frames and Covers
 - 1. Material: Machined cast iron.

2. Diameter: 36-1/2 inch.
3. Cover Type: Indented, solid top design, with two drop handles each.
4. Cover Loading: AASHTO H-20.
5. Cover Designation: Cast, on upper side, in integral letters, minimum 2 inches in height, appropriate titles:
 - a. Above 600 Volts: ELECTRIC HV.
 - b. 600 Volts and Below: ELECTRIC LV.
 - c. TELEPHONE.

H. Handhole Frames and Covers

1. Material: Steel, hot-dipped galvanized.
2. Cover Type: Solid, hinged, torsion spring, of nonskid design.
3. Cover Loading: AASHTO H-20.
4. Cover Designation: Burn by welder, on upper side in integral letters, minimum 2 inches in height, appropriate titles:
 - a. 600 Volts and Below: ELECTRIC LV.
 - b. TELEPHONE.

I. Hardware: Steel, hot-dip galvanized.

J. Furnish knockout for ground rod in each handhole and manhole.

K. Manufacturers

1. Utility Vault Co.
2. Penn-Cast Products, Inc.
3. Concrete Conduit Co.
4. Associated Concrete Products, Inc.
5. Pipe, Inc.

2.13 ACCESSORIES

A. Duct Bank Spacers

1. Modular Type
 - a. Nonmetallic, interlocking, for multiple conduit sizes.

- b. Suitable for all types of conduit.
 - c. Manufacturers
 - 1) Underground Device, Inc.
 - 2) Carlon.
2. Template Type
- a. Nonmetallic, custom made one-piece spacers.
 - b. Suitable for all types of conduit.
 - c. Material: HDPE or polypropylene, 1/2-inch minimum thickness.
 - d. Conduit openings cut 1 inch larger than conduit outside diameter.
 - e. Additional openings for stake-down, rebar, and concrete flow through as required.
 - f. Manufacturer and Product: SP Products; Quik Duct.

B. Identification Devices

1. Raceway Tags
- a. Material: Permanent, nylon.
 - b. Shape: Round.
 - c. Raceway Designation: Pressure stamped, embossed, or engraved.
 - d. Tags relying on adhesives or taped-on markers not permitted.
2. Warning Tape
- a. Material: Polyethylene, 4-mil gauge with detectable strip.
 - b. Color: Red.
 - c. Width: Minimum 6 inches.
 - d. Designation: Warning on tape that electric circuit is located below tape.
 - e. Identifying Letters: Minimum 1-inch-high permanent black lettering imprinted continuously over entire length.
 - f. Manufacturers and Products
 - 1) Panduit; Type HTDU.
 - 2) Reef Industries; Terra Tape.

3. Buried Raceway Marker
 - a. Material: Sheet bronze, consisting of double-ended arrows, straight for straight runs and bent at locations where runs change direction.
 - b. Designation: Engrave to depth of 3/32 inch; ELECTRIC CABLES, in letters 1/4-inch high.
 - c. Minimum Dimension: 1/4 inch thick, 10 inches long, and 3/4 inch wide.
- C. Heat Shrinkable Tubing
 1. Material: Heat-shrinkable, cross-linked polyolefin.
 2. Semi-flexible with meltable adhesive inner liner.
 3. Color: Black.
 4. Manufacturers
 - a. Raychem.
 - b. 3M.
- D. Wraparound Duct Band
 1. Material: Heat-shrinkable, cross-linked polyolefin, precoated with hot-melt adhesive.
 2. Width: 50 mm minimum.
 3. Manufacturer and Product: Raychem; Type TWDB.

PART 3 - EXECUTION

3.01 GENERAL

- A. Conduit and tubing sizes shown are based on use of copper conductors. Reference SECTION 26 05 53 – WIRES AND CABLES, concerning conduit sizing for aluminum conductors.
- B. Comply with NECA Installation Standards.
- C. Crushed or deformed raceways not permitted.
- D. Maintain raceway entirely free of obstructions and moisture.
- E. Immediately after installation, plug or cap raceway ends with watertight and dust-tight seals until time for pulling in conductors.
- F. Aluminum Conduit: Do not install in direct contact with concrete. Install in PVC sleeve or cored hole through concrete walls and slabs.
- G. Sealing Fittings: Provide drain seal in vertical raceways where condensate may collect above sealing fitting.

- H. Avoid moisture traps where possible. When unavoidable in exposed conduit runs, provide junction box and drain fitting at conduit low point.
- I. Group raceways installed in same area.
- J. Proximity to Heated Piping: Install raceways minimum 12 inches from parallel runs.
- K. Follow structural surface contours when installing exposed raceways. Avoid obstruction of passageways.
- L. Run exposed raceways parallel or perpendicular to walls, structural members, or intersections of vertical planes.
- M. Block Walls: Do not install raceways in same horizontal course or vertical cell with reinforcing steel.
- N. Install watertight fittings in outdoor, underground, or wet locations.
- O. Paint threads and cut ends, before assembly of fittings, galvanized conduit, PVC-coated galvanized conduit, or IMC installed in exposed or damp locations with zinc-rich paint or liquid galvanizing compound.
- P. Metal conduit shall be reamed, burrs removed, and cleaned before installation of conductors, wires, or cables.
- Q. Do not install raceways in concrete equipment pads, foundations, or beams without Engineer approval.
- R. Horizontal raceways installed under floor slabs shall lie completely under slab, with no part embedded within slab.
- S. Install concealed, embedded, and buried raceways so that they emerge at right angles to surface and have no curved portion exposed.
- T. Install conduits for fiber optic cables, telephone cables, and Category 6 data cables in strict conformance with the requirements of TIA 569B.

3.02 REUSE OF EXISTING CONDUITS

- A. Where Drawings indicate existing conduits may be reused, they may be reused only where they meet the following criteria.
 - 1. Conduit is in useable condition with no deformation, corrosion, or damage to exterior surface.
 - 2. Conduit is sized per the NEC.
 - 3. Conduit is of the type specified in Contract Documents.
 - 4. Conduit is supported as specified in Contract Documents.
- B. Conduit shall be reamed with wire brush, then with a mandrel approximately 1/4 inch smaller than raceway inside diameter then cleaned prior to pulling new conductors.

3.03 INSTALLATION IN CAST-IN-PLACE STRUCTURAL CONCRETE

- A. Minimum Cover: 2 inches, including fittings.
- B. Conduit placement shall not require changes in reinforcing steel location or configuration.
- C. Provide nonmetallic support during placement of concrete to ensure raceways remain in position.
- D. Conduit larger than 1 inch shall not be embedded in concrete slabs, walls, foundations, columns, or beams unless approved by Engineer.
- E. Slabs and Walls (Requires Engineer Approval)
 - 1. Trade size of conduit not to exceed one-fourth of slab or wall thickness.
 - 2. Install within middle two-fourths of slab or wall.
 - 3. Separate conduit less than 2-inch trade size by a minimum ten times conduit trade size, center-to-center, unless otherwise shown.
 - 4. Separate conduit 2-inch and greater trade size by a minimum eight times conduit trade size, center-to-center, unless otherwise shown.
 - 5. Cross conduit at an angle greater than 45 degrees, with minimum separation of 1 inch.
 - 6. Separate conduit by a minimum six times the outside dimension of expansion/deflection fittings at expansion joints.
 - 7. Conduit shall not be installed below the maximum water surface elevation in walls of water holding structures.
- F. Columns and Beams (Requires Engineer Approval)
 - 1. Trade size of conduit not to exceed one-fourth of beam thickness.
 - 2. Conduit cross-sectional area not to exceed 4 percent of beam or column cross section.

3.04 CONDUIT APPLICATION

- A. Diameter: Minimum 3/4 inch.
- B. Exterior, Exposed
 - 1. Rigid Aluminum.
 - 2. PVC-coated rigid galvanized steel.
- C. Interior, Exposed
 - 1. Rigid galvanized steel.
 - 2. PVC-coated rigid galvanized steel (corrosive locations with chemicals).

- D. Interior, Concealed (Not Embedded in Concrete)
 - 1. Rigid galvanized steel.
 - 2. Electric metallic tubing (in office/laboratory locations).
 - E. Aboveground, Embedded in Concrete Walls, Ceilings, or Floors
 - 1. Rigid galvanized steel.
 - F. Direct Earth Burial
 - 1. PVC Schedule 40 for power and control circuits.
 - 2. PVC-coated rigid galvanized steel (for analog signal circuits)
 - G. Concrete-Encased Ductbank
 - 1. PVC Schedule 40 for power and control circuits.
 - 2. PVC-coated rigid galvanized steel (for analog signal circuits)
 - H. Under Slabs-On-Grade
 - 1. PVC Schedule 40 for power and control circuits.
 - 2. PVC-coated rigid galvanized steel (for analog signal circuits)
 - I. Transition from Underground or Concrete Embedded to Exposed
 - 1. PVC-coated rigid steel conduit.
 - J. Under Equipment Mounting Pads: PVC-coated rigid steel conduit.
 - K. Exterior Light Pole Foundations: PVC-coated rigid steel conduit.
 - L. Corrosive Areas
 - 1. PVC-coated rigid galvanized steel.
 - 2. PVC Schedule 40.
 - M. Hazardous Gas Areas
 - 1. Rigid galvanized steel.
- 3.05 FLEXIBLE CONNECTIONS
- A. For motors, wall or ceiling mounted fans and unit heaters, dry type transformers, electrically operated valves, instrumentation, and other locations approved by Engineer where flexible connection is required to minimize vibration:
 - 1. Conduit Size 4 Inches or Less: Flexible, liquid-tight conduit.

2. Conduit Size Over 4 Inches: Nonflexible.
 3. Wet or Corrosive Areas: Flexible, nonmetallic or flexible metal liquid-tight.
 4. Dry Areas: Flexible, metallic liquid-tight.
 5. Hazardous Areas: Flexible coupling suitable for Class I, Division 1 and 2 areas.
- B. Suspended Lighting Fixtures in Dry Areas: Flexible steel, nonliquid-tight conduit.
 - C. Outdoor Areas, Process Areas Exposed to Moisture, and Areas Required to be Oiltight and Dust-Tight: Flexible metal, liquid-tight conduit.
 - D. Flexible Conduit Length: 18 inches minimum, 60 inches maximum; sufficient to allow movement or adjustment of equipment.
- 3.06 PENETRATIONS
- A. Make at right angles, unless otherwise shown.
 - B. Notching or penetration of structural members, including footings and beams, not permitted.
 - C. Fire-Rated Walls, Floors, or Ceilings: Firestop openings around penetrations to maintain fire-resistance rating using fire penetration seal as shown on the drawings.
 - D. Apply heat shrinkable tubing or single layer of wraparound duct band to metallic conduit protruding through concrete floor slabs to a point 2 inches above and 2 inches below concrete surface.
 - E. Concrete Walls, Floors, or Ceilings (Aboveground): Provide non-shrink grout dry-pack or use watertight seal device.
 - F. Entering Structures
 1. General: Seal raceway at first box or outlet with oakum or expandable plastic compound to prevent entrance of gases or liquids from one area to another.
 2. Concrete Roof or Membrane Waterproofed Wall or Floor
 - a. Provide a watertight seal.
 - b. Without Concrete Encasement: Install watertight entrance seal device on each side.
 - c. With Concrete Encasement: Install watertight entrance seal device on accessible side.
 - d. Securely anchor malleable iron body of watertight entrance seal device into construction with one or more integral flanges.
 - e. Secure membrane waterproofing to watertight entrance seal device in a permanent, watertight manner.

3. Heating, Ventilating, and Air Conditioning Equipment
 - a. Penetrate equipment in area established by manufacturer.
 - b. Terminate conduit with flexible metal conduit at junction box or conduit attached to exterior surface of equipment prior to penetrating equipment.
 - c. Seal penetration with Type 5 sealant
4. Corrosive-Sensitive Areas
 - a. Seal conduit passing through chlorine and ammonia room walls.
 - b. Seal conduit entering equipment panel boards and field panels containing electronic equipment.
 - c. Seal penetration with Type 5 sealant
5. Existing or Precast Wall (Underground): Core drill wall and install watertight entrance seal device.
6. Nonwaterproofed Wall or Floor (Underground, without Concrete Encasement)
 - a. Provide Schedule 40 galvanized pipe sleeve, or watertight entrance seal device.
 - b. Fill space between raceway and sleeve with expandable plastic compound or oakum and lead joint, on each side.
7. Manholes and Handholes
 - a. Metallic Raceways: Provide insulated grounding bushings.
 - b. Nonmetallic Raceways: Provide bell ends flush with wall.
 - c. Install such that raceways enter as near as possible to one end of wall, unless otherwise shown.

3.07 SUPPORT

- A. Support from structural members only, at intervals not exceeding NFPA 70 requirements. Do not exceed 10 feet in any application. Do not support from piping, pipe supports, or other raceways.
- B. Multiple Adjacent Raceways: Provide ceiling trapeze. For trapeze-supported conduit, allow 20 percent extra space for future conduit.
- C. Application/Type of Conduit Strap
 1. Aluminum Conduit: Aluminum or stainless steel.
 2. Rigid Steel or EMT Conduit: Zinc coated steel, pregalvanized steel or malleable iron.
 3. PVC-Coated Rigid Steel Conduit: PVC-coated metal.

4. Nonmetallic Conduit: Nonmetallic or PVC-coated metal.
- D. Provide and attach wall brackets, strap hangers, or ceiling trapeze as follows:
1. Wood: Wood screws.
 2. Hollow Masonry Units: Toggle bolts.
 3. Concrete or Brick: Expansion shields, or threaded studs driven in by powder charge, with lock washers and nuts.
 4. Steelwork: Machine screws.
 5. Location/Type of Hardware
 - a. Dry, Noncorrosive Areas: Galvanized.
 - b. Wet, Noncorrosive Areas: Stainless steel.
 - c. Corrosive Areas: Stainless steel.
- E. Nails or wooden plugs inserted in concrete or masonry for attaching raceway not permitted. Do not weld raceways or pipe straps to steel structures. Do not use wire in lieu of straps or hangers.
- F. Support aluminum conduit on concrete surfaces with stainless steel or nonmetallic spacers, or aluminum or nonmetallic framing channel.
- 3.08 BENDS
- A. Install concealed raceways with a minimum of bends in the shortest practical distance.
 - B. Make bends and offsets of longest practical radius. Bends in conduits and ducts being installed for fiber optic cables shall be not less than 20 times cable diameter, 15 inches minimum.
 - C. Install with symmetrical bends or cast metal fittings.
 - D. Avoid field-made bends and offsets, but where necessary, make with acceptable hickey or bending machine. Do not heat metal raceways to facilitate bending.
 - E. Make bends in parallel or banked runs from same center or centerline with same radius so that bends are parallel.
 - F. Factory elbows may be installed in parallel or banked raceways if there is change in plane of run, and raceways are same size.
 - G. PVC Conduit
 1. Bends 30 Degrees and Larger: Provide factory-made elbows.
 2. 90-Degree Bends: Provide rigid steel elbows.

- 3. Use manufacturer's recommended method for forming smaller bends.
 - H. Flexible Conduit: Do not make bends that exceed allowable conductor bending radius of cable to be installed or that significantly restricts conduit flexibility.
- 3.09 EXPANSION/DEFLECTION FITTINGS
- A. Provide on raceways at structural expansion joints and in long tangential runs.
 - B. Provide expansion/deflection joints for 35 degrees F maximum temperature variation.
 - C. Install in accordance with manufacturer's instructions.
- 3.10 PVC CONDUIT
- A. Solvent Welding
 - 1. Apply manufacturer recommended solvent to joints.
 - 2. Install in order that joint is watertight.
 - B. Adapters
 - 1. PVC to Metallic Fittings: PVC terminal type.
 - 2. PVC to Rigid Metal Conduit or IMC: PVC female adapter.
 - C. Belled-End Conduit: Bevel unbelled end of joint prior to joining.
- 3.11 PVC-COATED RIGID STEEL AND RIGID ALUMINUM CONDUIT
- A. Install in accordance with manufacturer's instructions.
 - B. Tools and equipment used in cutting, bending, threading and installation of PVC-coated rigid conduit shall be designed to limit damage to PVC coating.
 - C. Provide PVC boot to cover exposed threading.
- 3.12 WIREWAYS
- A. Install in accordance with manufacturer's instructions.
 - B. Locate with cover on accessible vertical face of wireway, unless otherwise shown.
 - C. Applications
 - 1. Metal wireway in indoor dry locations.
 - 2. Nonmetallic wireway in indoor wet, outdoor, and corrosive locations.
- 3.13 CABLE TRAYS
- A. Install in accordance with NEMA VE 1, section Application Information.

- B. Install accessories as necessary for complete system.
- C. Install in order that joints are not made at support brackets.
- D. Install horizontal section support brackets between support point and quarter point of tray span.
- E. Provide ceiling trapeze for horizontal cable tray.
- F. Install support within 2 feet on each side of expansion joints and within 2 feet of fitting extremity.
- G. Provide expansion joints in accordance with NEMA VE 1 for 35 degrees F maximum temperature variation.
- H. Install horizontal tray level, plumb, straight, and true to line or grade within a tolerance of 1/8 inch in 10 feet and within a cumulative maximum of 1/2 inch.
- I. Install vertical tray plumb within a tolerance of 1/8 inch in 10 feet.
- J. Install without exposed raw edges.
- K. Maintain 24 inch vertical separation between multi-tiered trays having a common support, and at crossover locations.
- L. Provide bonding jumper at each expansion joint and adjustable connection.
- M. Ground Conductor: Provide properly sized clamps for each section, elbow, tee, cross, and reducer.

3.14 TERMINATION AT ENCLOSURES

- A. Cast Metal Enclosure: Install manufacturer's premolded insulating sleeve inside metallic conduit terminating in threaded hubs.
- B. Nonmetallic, Cabinets, and Enclosures
 - 1. Terminate conduit in threaded conduit hubs, maintaining enclosure integrity.
 - 2. Metallic Conduit: Provide ground terminal for connection to maintain continuity of ground system.
- C. Sheet Metal Boxes, Cabinets, and Enclosures
 - 1. General
 - a. Install insulated bushing on ends of conduit where grounding is not required.
 - b. Provide insulated throat when conduit terminates in sheet metal boxes having threaded hubs.
 - c. Utilize sealing locknuts or threaded hubs on sides and bottom of NEMA 3R and NEMA 12 enclosures.

- d. Terminate conduits at threaded hubs at the tops of NEMA 3R and NEMA 12 boxes and enclosures.
 - e. Terminate conduits at threaded conduit hubs at NEMA 4 and NEMA 4X boxes and enclosures.
- 2. Rigid Galvanized Conduit
 - a. Provide one lock nut each on inside and outside of enclosure.
 - b. Install grounding bushing at source enclosure.
 - c. Provide bonding jumper from grounding bushing to equipment ground bus or ground pad.
- 3. Electric Metallic Tubing: Provide gland compression, insulated connectors.
- 4. Flexible Metal Conduit: Provide two screw type, insulated, malleable iron connectors.
- 5. Flexible, Nonmetallic Conduit: Provide nonmetallic, liquid-tight strain relief connectors.
- 6. PVC-Coated Rigid Galvanized Steel Conduit: Provide PVC-coated, liquid-tight, metallic connector.
- 7. PVC Schedule 40 Conduit: Provide PVC terminal adapter with lock nut, except where threaded hubs required above.
- D. Motor Control Center, Switchboard, Switchgear, and Free-Standing Enclosures
 - 1. Terminate metal conduit entering bottom with grounding bushing; provide grounding jumper extending to equipment ground bus or grounding pad.
 - 2. Terminate PVC conduit entering bottom with bell end fittings.

3.15 UNDERGROUND RACEWAYS

- A. Grade: Maintain minimum grade of 4 inches in 100 feet, either from one manhole, handhole, or pull box to the next, or from a high point between them, depending on surface contour.
- B. Cover: Maintain minimum 2-foot cover above conduit and concrete encasement, unless otherwise shown.
- C. Make routing changes as necessary to avoid obstructions or conflicts.
- D. Couplings: In multiple conduit runs, stagger so couplings in adjacent runs are not in same transverse line.
- E. Union type fittings not permitted.
- F. Spacers

1. Provide preformed, nonmetallic spacers designed for such purpose, to secure and separate parallel conduit runs in a trench or concrete encasement.
 2. Install at intervals not greater than that specified in NFPA 70 for support of the type conduit used, but in no case greater than 10 feet.
- G. Support conduit so as to prevent bending or displacement during backfilling or concrete placement.
- H. Transition from Underground to Exposed: PVC-coated rigid steel conduit.
- I. Installation with Other Piping Systems
1. Crossings: Maintain minimum 12-inch vertical separation.
 2. Parallel Runs: Maintain minimum 12-inch separation.
 3. Installation over valves or couplings not permitted.
- J. Metallic Raceway Coating: At couplings and joints, clean and paint in accordance with SECTION 09915 – PROTECTIVE COATING, apply wraparound duct band with one-half tape width overlap to obtain two complete layers, apply heat shrinkable tubing.
- K. Provide expansion fittings that allow minimum of 4 inches of movement in vertical conduit runs from underground where exposed conduit will be fastened to or will enter building or structure.
- L. Provide expansion/deflection fittings in conduit runs that exit building or structure below grade. Conduit from building wall to fitting shall be PVC-coated rigid steel.
- M. Backfill
1. As specified in SECTION 02300 - EARTHWORK. Controlled low strength fill is an acceptable bedding and pipe zone material, Backfill material to within 12 inches of surface.
 2. Do not backfill until inspected by Engineer.
- 3.16 UNDER SLAB RACEWAYS
- A. Make routing changes as necessary to avoid obstructions or conflicts.
- B. Support raceways so as to prevent bending or displacement during backfilling or concrete placement.
- C. Install raceways with no part embedded within slab and with no interference with slab on grade construction.
- D. Raceway spacing, in a single layer or multiple layers:
1. 3 inches clear between adjacent 2-inch or larger raceway.
 2. 2 inches clear between adjacent 1-1/2-inch or smaller raceway.

- E. Individual Raceways and Single Layer Multiple Raceways: Install at lowest elevation of backfill zone with spacing as specified herein. Where conduits cross at perpendicular orientation, installation of conduits shall not interfere with placement of under slab fill that meets compaction and void limitations of earthwork specifications.
- F. Under slab raceways that emerge from below slab to top of slab as exposed, shall be located to avoid conflicts with structural slab rebar. Coordinate raceway stub ups with location of structural rebar.
- G. Fittings
 - 1. Union type fittings are not permitted.
 - 2. Provide expansion/deflection fittings in raceway runs that exit building or structure below slab. Locate fittings 18 inches, maximum, beyond exterior wall. Raceway type between building exterior wall to fitting shall be PVC-coated rigid steel.
 - 3. Couplings: In multiple raceway runs, stagger so couplings in adjacent runs are not in same traverse line.

3.17 OUTLET AND DEVICE BOXES

A. General

- 1. Install plumb and level.
- 2. Install suitable for conditions encountered at each outlet or device in wiring or raceway system, sized to meet NFPA 70 requirements.
- 3. Open no more knockouts in sheet steel device boxes than are required; seal unused openings.
- 4. Install galvanized mounting hardware in industrial areas.

B. Size

- 1. Depth: Minimum 2 inches, unless otherwise required by structural conditions. Box extensions not permitted.
 - a. Hollow Masonry Construction: Install with sufficient depth such that conduit knockouts or hubs are in masonry void space.
- 2. Ceiling Outlet: Minimum 4-inch octagonal device box, unless otherwise required for installed fixture.
- 3. Switch and Receptacle: Minimum 2-inch by 4-inch device box.

C. Locations

- 1. Drawing locations are approximate.

2. To avoid interference with mechanical equipment or structural features, relocate outlets as directed by Engineer.
3. Light Fixture: Install in symmetrical pattern according to room layout, unless otherwise shown.

D. Mounting Height

1. General
 - a. Dimensions given to centerline of box.
 - b. Where specified heights do not suit building construction or finish, adjust up or down to avoid interference.
 - c. Do not straddle CMU block or other construction joints.
2. Light Switch
 - a. 48 inches above floor.
 - b. When located next to door, install on lock side of door.
3. Thermostat: 54 inches above floor.
4. Telephone Outlet
 - a. 15 inches above floor.
 - b. 6 inches above counter tops.
 - c. Wall Mounted: 52 inches above floor.
5. Convenience Receptacle
 - a. General Interior Areas: 15 inches above floor.
 - b. General Interior Areas (Counter Tops): Install device plate bottom or side flush with top of backsplash, or 6 inches above counter tops without backsplash.
 - c. Industrial Areas, Workshops: 48 inches above floor.
 - d. Outdoor Areas: 24 inches above finished grade.
6. Special-Purpose Receptacle: In accordance to manufacturer or as shown.
7. Switch, Motor Starting: 48 inches above floor, unless otherwise indicated on Drawings.

E. Flush Mounted

1. Install with concealed conduit.

2. Install proper type extension rings or plaster covers to make edges of boxes flush with finished surface.
3. Holes in surrounding surface shall be no larger than required to receive box.

F. Supports

1. Support boxes independently of conduit by attachment to building structure or structural member.
2. Install bar hangers in frame construction or fasten boxes directly as follows:
 - a. Wood: Wood screws.
 - b. Concrete or Brick: Bolts and expansion shields.
 - c. Hollow Masonry Units: Toggle bolts.
 - d. Steelwork: Machine screws.
3. Threaded studs driven in by powder charge and provided with lock washers and nuts are acceptable in lieu of expansion shields.
4. Provide plaster rings where necessary.
5. Boxes embedded in concrete or masonry need not be additionally supported.

G. Install separate junction boxes for flush or recessed lighting fixtures where required by fixture terminal temperature.

H. Boxes Supporting Fixtures: Provide means of attachment with adequate strength to support fixture.

3.18 JUNCTION AND PULL BOXES

A. General

1. Install plumb and level.
2. Installed boxes shall be accessible.
3. Do not install on finished surfaces.
4. Use outlet boxes as junction and pull boxes wherever possible and allowed by applicable codes.
5. Use conduit bodies as junction and pull boxes where no splices are required and allowed by applicable codes.
6. Install pull boxes where necessary in raceway system to facilitate conductor installation.

7. Install where shown and where necessary to terminate, tap-off, or redirect multiple conduit runs.
 8. Install in conduit runs at least every 150 feet or after the equivalent of three right-angle bends.
- B. Flush Mounted
1. Install with concealed conduit.
 2. Holes in surrounding surface shall be no larger than required to receive box.
 3. Make edges of boxes flush with final surface.
- C. Mounting Hardware
1. Noncorrosive Dry Areas: Galvanized.
 2. Noncorrosive Wet Areas: Stainless steel.
 3. Corrosive Areas: Stainless steel.
- D. Supports
1. Support boxes independently of conduit by attachment to building structure or structural member.
 2. Install bar hangers in frame construction or fasten boxes directly as follows:
 - a. Wood: Wood screws.
 - b. Concrete or Brick: Bolts and expansion shields.
 - c. Hollow Masonry Units: Toggle bolts.
 - d. Steelwork: Machine screws.
 3. Threaded studs driven in by powder charge and provided with lock washers and nuts are acceptable in lieu of expansion shields.
 4. Boxes embedded in concrete or masonry need not be additionally supported.
- E. At or Below Grade
1. Install boxes for below grade conduit flush with finished grade in locations outside of paved areas, roadways, or walkways.
 2. If adjacent structure is available, box may be mounted on structure surface just above finished grade in accessible but unobtrusive location.
 3. Obtain Engineer's written acceptance prior to installation in paved areas, roadways, or walkways.

- 4. Use boxes and covers suitable to support anticipated weights.
- F. Install Drain/breather fittings in NEMA 250 Type 4 and Type 4X enclosures.
- 3.19 TELEPHONE TERMINAL CABINET
 - A. Install with top of cabinet 6 feet above floor.
 - B. Door Opening: 120 degrees, minimum.
- 3.20 TELEPHONE AND DATA OUTLET
 - A. Provide empty 4-11/16-inch square, deep outlet box.
 - B. Provide blank single gang raised device cover if cables are not installed.
- 3.21 MANHOLES, PULL BOXES AND HANDHOLES
 - A. Excavate, shore, brace, backfill, and final grade.
 - B. Do not install until final raceway grading has been determined.
 - C. Install such that raceway enters at nearly right angle and as near as possible to end of wall, unless otherwise shown.
 - D. Grounding: As specified in SECTION 26 05 26 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
 - E. Identification: Field stamp covers with manhole or handhole number as shown. Stamped numbers to be 1-inch minimum height.
- 3.22 EMPTY RACEWAYS
 - A. Provide permanent, removable cap over each end.
 - B. Provide PVC plug with pull tab for underground raceways with end bells.
 - C. Provide nylon pull cord.
 - D. Identify, as specified in Article Identification Devices, with waterproof tags attached to pull cord at each end, and at intermediate pull point.
- 3.23 IDENTIFICATION DEVICES
 - A. Raceway Tags
 - 1. Identify Raceway Schedule designation.
 - 2. For exposed raceways, install tags at each terminus, near midpoint, and at minimum intervals of every 50 feet, whether in ceiling space or surface mounted.
 - 3. Install tags at each terminus for concealed raceways.

- 4. Provide: nylon strap for attachment.
 - B. Warning Tape: Install approximately 18 inches above underground or concrete-encased raceways. Align parallel to, and within 12 inches of, centerline of run.
 - C. Buried Raceway Marker
 - 1. Install at grade to indicate direction of underground raceway.
 - 2. Install at bends and at intervals not exceeding 100 feet in straight runs.
 - 3. Embed and secure to top of concrete base, sized 14 inches long, 6 inches wide, and 8 inches deep; top set flush with finished grade.
- 3.24 PROTECTION OF INSTALLED WORK
- A. Protect products from effects of moisture, corrosion, and physical damage during construction.
 - B. Provide and maintain manufactured watertight and dust-tight seals over conduit openings during construction.
 - C. Touch up painted conduit threads after assembly to cover nicks or scars.
 - D. Touch up coating damage to PVC-coated conduit with patching compound approved by manufacturer. Compound shall be kept refrigerated according to manufacturers' instructions until time of use.

END OF SECTION

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SECTION 26 05 53
WIRES AND CABLES

PART 1 - GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Association of Edison Illuminating Companies (AEIC): CS 8, Specification for Extruded Dielectric Shielded Power Cables Rated 5 kV through 46 kV.
2. ASTM International (ASTM)
 - a. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - b. B3, Standard Specification for Soft or Annealed Copper Wire.
 - c. B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
 - d. B496, Standard Specification for Compact Round Concentric-Lay-Stranded Copper Conductors.
3. Institute of Electrical and Electronics Engineers, Inc. (IEEE)
 - a. 48, Standard 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 Above 600V.
 - c. 404, Standard for Extruded and Laminated Dielectric Shielded Cable Joints Rated 2500 V to 500000 V.
4. Insulated Cable Engineer's Association, Inc. (ICEA)
 - a. S-58-679, Standard for Control Cable Conductor Identification.
 - b. S-73-532, Standard for Control Thermocouple Extensions and Instrumentation Cables.
 - c. T-29-520, Conducting Vertical Cable Tray Flame Tests with Theoretical Heat Input of 210,000 Btu/hour.
5. National Electrical Manufacturers' Association (NEMA)
 - a. CC 1, Electric Power Connectors for Substations.

- b. WC 57, Standard for Control, Thermocouple Extension, and Instrumentation Cables.
 - c. WC 70, Standard for Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy.
 - d. WC 71, Standard for Nonshielded Cables Rated 2001-5000 Volts for Use in the Distribution of Electric Energy.
 - e. WC 74, 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy.
- 6. 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.
- 7. Telecommunications Industry Association (TIA): TIA-568-C, Commercial Building Telecommunications Cabling Standard.
- 8. Underwriters Laboratories Inc. (UL)
 - a. 13, Standard for Safety for Power-Limited Circuit Cables.
 - b. 44, Standard for Safety for Thermoset-Insulated Wires and Cables.
 - c. 62, Standard for Safety for Flexible Cord and Cables.
 - d. 486A-486B, Standard for Safety for Wire Connectors.
 - e. 486C, Standard for Safety for Splicing Wire Connectors.
 - f. 510, Standard for Safety for Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape.
 - g. 854, Standard for Safety for Service-Entrance Cables.
 - h. 1072, Standard for Safety for Medium-Voltage Power Cables.
 - i. 1277, Standard for Safety for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.
 - j. 1569, Standard for Safety for Metal-Clad Cables.
 - k. 1581, Standard for Safety for Reference Standard for Electrical Wires, Cables, and Flexible Cords.

1.02 SUBMITTALS

A. Action Submittals

1. Product Data
 - a. Wire and cable.
 - b. Wire and cable accessories.
 - c. Cable fault detection system.
 2. Manufactured Wire Systems
 - a. Product data.
 - b. Rating information.
 - c. Dimensional drawings.
 - d. Special fittings.
 3. Busway
 - a. Product data.
 - b. Rating information.
 - c. Dimensional drawings.
 - d. Special fitting.
 - e. Equipment interface information for equipment to be connected to busways.
 4. Cable Pulling Calculations
 - a. Ensure submitted and reviewed before cable installation.
 - b. Provide for the following cable installations:
 - 1) Medium voltage cable runs that cannot be hand pulled.
 - 2) Multiconductor 600-volt cable sizes larger than 2 AWG that cannot be hand pulled.
 - 3) Power and control conductor, and control and instrumentation cable installations in ductbanks.
 - 4) Feeder circuits; single conductors #4/0 and larger.
- B. Informational Submittals
1. Journeyman lineman or electrician splicing credentials.
 2. Factory Test Report per AEIC CS 8, including AEIC qualification report for conductors above 600 volts.

1.03 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ)

1. Provide the Work in accordance with NFPA 70. Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
2. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories Inc. shall conform to those standards and shall have an applied UL listing mark.

B. Terminations and Splices for Conductors above 600 Volts: Work shall be done by journeyman lineman with splicing credentials or electrician certified to use materials approved for cable splices and terminations.

PART 2 - PRODUCTS

2.01 CONDUCTORS 600 VOLTS AND BELOW

A. Conform to applicable requirements of NEMA WC 70.

B. Conductor Type

1. 120-Volt and 277-Volt Lighting, 10 AWG and Smaller: Solid copper.
2. 120-Volt Receptacle Circuits, 10 AWG and Smaller: Solid copper.
3. All Other Circuits: Stranded copper.

C. Insulation: Type THHN/THWN-2 for sizes No. 8 and smaller, except for sizes No. 6 and larger, with XHHW-2 insulation.

D. Flexible Cords and Cables

1. Type SOW-A/50 with ethylene propylene rubber insulation in accordance with UL 62.
2. Conform to physical and minimum thickness requirements of NEMA WC 70.

2.02 CONDUCTORS ABOVE 600 VOLTS

A. EPR Insulated Cable

1. Extrusion: Single-pass, triple-tandem, of conductor screen, insulation, and insulation screen.
2. Type: 5 kV or 15 kV, shielded, UL 1072, Type MV-105.
3. Conductors: Copper concentric lay Class B round stranded in accordance with ASTM B3, ASTM B8, and ASTM B496.
4. Strand Fill: Waterproof strand compound enclosing conductors.

5. Conductor Screen: Extruded, semiconducting ethylene-propylene rubber in accordance with NEMA WC 71 and AEIC CS 8.
6. Insulation: 133 percent insulation level, ethylene-propylene rubber (EPR) containing no polyethylene, in accordance with NEMA WC 71, and AEIC CS 8.
7. Insulation Thickness: 115-mil (5 kV), 220-mil (15 kV) nominal.
8. Insulation Screen: Thermosetting, semiconducting ethylene-propylene rubber (EPR), extruded directly over insulation in accordance with NEMA WC 74 and AEIC CS 8.
9. Metallic Shield: Uncoated, 5-mil, copper shielding tape, helically applied with 17-1/2 percent minimum overlap.
10. Jacket: Extruded polyvinyl chloride (PVC) compound applied in accordance with NEMA WC 71 or NEMA WC 74.
11. Operating Temperature: 105 degrees C continuous normal operations, 130 degrees C emergency operating conditions, and 250 degrees C short-circuit conditions.
12. Manufacturers
 - a. Okonite Co.
 - b. Pirelli Wire and Cable.
 - c. General Cable.
 - d. Southwire Co.

B. TR-XLP Insulated Cable

1. Extrusion: Single-pass, triple-tandem, of conductor screen, insulation, and insulation screen.
2. Type: 5 kV or 15 kV, shielded, UL 1072, Type MV 105.
3. Conductors: Copper concentric lay Class B round stranded in accordance with ASTM B3, ASTM B8, and ASTM B496.
4. Strand Fill: Waterproof strand compound enclosing conductors.
5. Conductor Screen: Extruded, semiconducting thermosetting compound in accordance with NEMA WC 71 and AEIC CS 8.
6. Insulation: 133 percent insulation level, thermosetting, tree-resistant, cross-link polyethylene (TR-XLP), in accordance with NEMA WC 71 and AEIC CS 8.
7. Insulation Thickness: 115-mil (5 kV), 220-mil (15 kV) nominal.
8. Insulation Screen: Thermosetting, semiconducting cross-link polyethylene, extruded directly over insulation.

9. Metallic Shield: Coated, 5-mil, copper shielding tape, helically applied with 17-1/2 percent minimum overlap.
10. Jacket: Extruded polyvinyl chloride (PVC) compound applied in accordance with NEMA WC 71 or NEMA WC 74 and AEIC CS 8.
11. Operating Temperature: 105 degrees C continuous normal operations, 130 degrees C emergency operating conditions, and 250 degrees C short-circuit conditions.
12. Manufacturers
 - a. Okonite Co.
 - b. Pirelli Wire and Cable.
 - c. General Cable.
 - d. Southwire Co.

2.03 600-VOLT RATED CABLE

A. General

1. Type TC, meeting requirements of UL 1277, including Vertical Tray Flame Test at 70,000 Btu per hour, and NFPA 70, Article 340, or UL 13 meeting requirements of NFPA 70, Article 725.
2. Permanently and legibly marked with manufacturer's name, maximum working voltage for which cable was tested, type of cable, and UL listing mark.
3. Suitable for installation in open air, in cable trays, or conduit.
4. Minimum Temperature Rating: 90 degrees C dry locations, 75 degrees C wet locations.
5. Overall Outer Jacket: PVC, flame-retardant, sunlight- and oil-resistant.

B. Type 1, Multiconductor Control Cable

1. Conductors
2. 14 AWG, seven-strand copper.
3. Insulation: 15-mil PVC with 4-mil nylon.
4. UL 1581 listed as Type THHN/THWN rated VW-1.
5. Conductor group bound with spiral wrap of barrier tape.
6. Color Code: In accordance with ICEA S-58-679, Method 1, Table 2.
7. Cable: Passes the ICEA T-29-520, 210,000 Btu per hour Vertical Tray Flame Test.
8. Cable Sizes

No. of Conductors	Max. Outside Diameter (Inches)	Jacket Thickness (Mils)
3	0.41	45
5	0.48	45
7	0.52	45
12	0.72	60
19	0.83	60
25	1.00	60
37	1.15	80

9. Manufacturers

- a. Okonite Co.
- b. Southwire.

C. Type 2, Multiconductor Power Cable

1. General

- a. Meet or exceed UL 1581 for cable tray use.
- b. Meet or exceed UL 1277 for direct burial and sunlight-resistance.
- c. Overall Jacket: PVC.

2. Conductors

- a. Class B stranded, coated copper.
- b. Insulation: Chemically cross-linked ethylene-propylene or cross-linked polyethylene.
- c. UL rated VW-1 or listed Type XHHW-2.
- d. Color Code
 - 1) Conductors, size 8 AWG and smaller, colored conductors, ICEA S-58-679, Method 1, Table 1.
 - 2) Conductors, size 6 AWG and larger, ICEA S-73-532, Method 4.

3. Cable shall pass ICEA T-29-520, 210,000 Btu per hour Vertical Tray Flame Test.

4. Cable Sizes

Conductor Size	Minimum Ground Wire Size	No. of Current Carrying Conductors	Max. Outside Diameter (Inches)	Nominal Jacket Thickness (Mils)
12	12	2 3 4	0.42 0.45 0.49	45
10	10	2 3 4	0.54 0.58 0.63	60
8	10	3 4	0.66 0.75	60
6	8	3 4	0.74 0.88	60
4	6	3 4	0.88 1.04	60 80
2	6	3 4	1.01 1.16	80
1	6	3 4	1.10 1.25	80
1/0	6	3 4	1.22 1.35	80
2/0	4	3 4	1.32 1.53	80
3/0	4	3 4	1.40 1.60	80
4/0	4	3 4	1.56 1.78	80 110

5. Manufacturers

- a. Okonite Co.
- b. Southwire.

D. Type 3, 16 AWG, Twisted, Shielded Pair, Instrumentation Cable: Single pair, designed for noise rejection for process control, computer, or data log applications meeting NEMA WC 57 requirements.

- 1. Outer Jacket: 45-mil nominal thickness.
- 2. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer overlapped to provide 100 percent coverage.
- 3. Dimension: 0.31-inch nominal OD.
- 4. Conductors
 - a. Bare soft annealed copper, Class B, seven-strand concentric, meeting requirements of ASTM B8.
 - b. 20 AWG, seven-strand tinned copper drain wire.

- c. Insulation: 15-mil nominal PVC.
 - d. Jacket: 4-mil nominal nylon.
 - e. Color Code: Pair conductors, black and red.
 - 5. Manufacturers
 - a. Okonite Co.
 - b. Alpha Wire Corp.
 - c. Belden.
- E. Type 4, 16 AWG, Twisted, Shielded Triad Instrumentation Cable: Single triad, designed for noise rejection for process control, computer, or data log applications meeting NEMA WC 57 requirements.
- 1. Outer Jacket: 45-mil nominal.
 - 2. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer, overlapped to provide 100 percent coverage.
 - 3. Dimension: 0.32-inch nominal OD.
 - 4. Conductors
 - a. Bare soft annealed copper, Class B, seven-strand concentric, meeting requirements of ASTM B8.
 - b. 20 AWG, seven-strand, tinned copper drain wire.
 - c. Insulation: 15-mil nominal PVC.
 - d. Jacket: 4-mil nylon.
 - e. Color Code: Triad conductors black, red, and blue.
 - 5. Manufacturers
 - a. Okonite Co.
 - b. Alpha Wire Corp.
 - c. Belden.
- F. Type 5, 18 AWG, Multitwisted Shielded Pairs, with a Common Overall Shield, Instrumentation Cable: Designed for use as instrumentation, process control, and computer cable, meeting NEMA WC 57 requirements.
- 1. Conductors

- a. Bare soft annealed copper, Class B, seven-strand concentric, in accordance with ASTM B8.
 - b. Tinned copper drain wires.
 - c. Pair drain wire size AWG 20, group drain wire size AWG 18.
 - d. Insulation: 15-mil PVC.
 - e. Jacket: 4-mil nylon.
 - f. Color Code: Pair conductors, black and red with red conductor numerically printed for group identification.
 - g. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer.
2. Cable Shield: 2.35-mil, double-faced aluminum/synthetic polymer, overlapped for 100 percent coverage.
3. Cable Sizes

Number of Pairs	Maximum Outside Diameter (Inches)	Nominal Jacket Thickness (Mils)
4	0.50	45
8	0.68	60
12	0.82	60
16	0.95	80
24	1.16	80
36	1.33	80
50	1.56	80

4. Manufacturers:
- a. Okonite Co.
 - b. Alpha Wire Corp.
 - c. Belden.
- G. Type 6, 18 AWG, Multitwisted Pairs with Common Overall Shield Instrumentation Cable: Designed for use as instrumentation, process control, and computer cable meeting NEMA WC 57.
1. Conductors
- a. Bare soft annealed copper, Class B, seven-strand concentric, in accordance with ASTM B8.
 - b. Tinned copper drain wire size AWG 18.
 - c. Insulation: 15-mil nominal PVC.

- d. Jacket: 4-mil nylon.
 - e. Color Code: Pair conductors, black and red with red conductor numerically printed for group identification.
2. Cable Shield: 2.35-mil, double-faced aluminum/synthetic polymer, overlapped for 100 percent coverage.

Cable Sizes: Number of Pairs	Maximum Outside Diameter (Inches)	Nominal Jacket Thickness (Mils)
4	0.48	45
8	0.63	60
12	0.75	60
16	0.83	60
24	1.10	80
36	1.21	80
50	1.50	80

3. Manufacturers
- a. Okonite Co.
 - b. Alpha Wire Corp.
 - c. Belden.
- H. Type 7, Multiconductor Metal-Clad (UL Type MC) Power Cable:
- 1. Meeting requirements of UL 44 and UL 1569.
 - 2. Conductors
 - a. Class B stranded, coated copper.
 - b. Insulation: 600-volt cross-linked polyethylene, UL Type XHHW or EPR.
 - c. Grounding Conductors: Bare, stranded copper.
 - 3. Sheath
 - a. UL listed Type MC.
 - b. Continuous welded, corrugated aluminum sheath.
 - c. Suitable for use as grounding conductor.
 - 4. Outer Jacket: PVC per UL 1569.
 - 5. Cable shall pass ICEA T-29-520, 210,000 Btu per hour Vertical Tray Flame Test.

6. Cable Sizes

Conductor Size	Minimum Ground Wire Size (AWG)	No. of Insulated Conductors	Max. Outside Diameter (Inches)	Jacket Thickness (Mils)
12 AWG	12 or 3x16	3 4	0.79 0.85	50
10 AWG	10 or 3x14	3 4	0.82 0.90	50
8 AWG	10 or 3x14	3 4	0.85 1.00	50
6 AWG	8 or 3x12	3 4	0.99 1.10	50
4 AWG	8 or 3x12	3 4	1.08 1.20	50
2 AWG	6 or 3x10	3 4	1.24 1.45	50
1 AWG	6 or 3x10	3 4	1.40 1.55	50
1/0 KCM	6 or 3x10	3 4	1.52 1.60	50
2/0 AWG	4 or 3x8	3 4	1.67 1.75	50
4/0 AWG	4 or 3x8	3 4	1.93 2.10	60
250 KCM	4 or 3x8	3 4	2.11 2.20	60
350 KCM	3 or 3x8	3 4	2.39 2.50	60
500 KCM	2 or 3x8	3 4	2.80 2.90	75

7. Manufacturers and Products

- a. Okonite Co.; Type CLX.
- b. Southwire Type MC.
- c. General Cable, CCW Armored Power.

I. Type 8, Multiconductor Adjustable Frequency Drive Power Cable:

1. Conductors

- a. Class B, stranded coated copper.
- b. Insulation: 600-volt cross-linked polyethylene, UL Type XHHW-2.
- c. Grounding Conductors: Insulated stranded copper.

2. Sheath
 - a. UL 1277 Type TC, 90 degrees C.
 - b. Continuous shield, A1/polyester foil, drain wires, overall copper braid.
3. Outer Jacket: Polyvinyl chloride (PVC) per UL 1569.
4. Cable Sizes

Conductor Size	Minimum Ground Wire Size (AWG)	No. of Insulated Conductors	Max. Outside Diameter (Inches)	Minimum Jacket Thickness (Mils)
12 AWG	12	4	0.655	50
10 AWG	10	4	0.769	50
8 AWG	8	4	0.940	50
6 AWG	6	4	1.038	50
4 AWG	4	4	1.180	50
2 AWG	2	4	1.351	50

5. Manufacturers and Products
 - a. Alpha Wire; Series V.
 - b. Belden; Series 29500.
 - c. LAPP USA; OLFLEX VFD Slim.
- J. Type 9, Multiconductor Metal-Clad (UL Type MC) Power Cable for Adjustable Frequency Drive Applications:
1. Meeting requirements of UL 44 and UL 1569.
 2. Conductors
 - a. Class B, stranded coated copper.
 - b. Insulation: 600-volt cross-linked polyethylene, UL Type XHHW or EPR.
 - c. Grounding Conductors: Bare, stranded copper. Provide three symmetrical grounding conductors.
 3. Sheath
 - a. UL listed Type MC.
 - b. Continuous welded, corrugated aluminum sheath.
 - c. Suitable for use as grounding conductor.
 4. Outer Jacket: PVC per UL 1569.

5. Cable shall pass ICEA T-29-520, 210,000 Btu per hour Vertical Tray Flame Test.
6. Cable Sizes

Conductor Size	Minimum Ground Wire Size (AWG)	No. of Insulated Conductors	Max. Outside Diameter (Inches)	Jacket Thickness (Mils)
12 AWG	3x16	3 4	0.79 0.85	50
10 AWG	3x14	3 4	0.82 0.90	50
8 AWG	3x14	3 4	0.85 1.00	50
6 AWG	3x12	3 4	0.99 1.10	50
4 AWG	3x12	3 4	1.08 1.20	50
2 AWG	3x10	3 4	1.24 1.45	50
1 AWG	3x10	3 4	1.40 1.55	50
1/0 KCM	3x10	3 4	1.52 1.60	50
2/0 AWG	3x8	3 4	1.67 1.75	50
4/0 AWG	3x8	3 4	1.93 2.10	60
250 KCM	3x8	3 4	2.11 2.20	60
350 KCM	3x8	3 4	2.39 2.50	60
500 KCM	3x8	3 4	2.80 2.90	75

7. Manufacturer and Product: Okonite Co.; Type CLX MC-HL.

2.04 300-VOLT RATED CABLE

A. General

1. Type PLTC, meeting requirements of UL 13 and NFPA 70, Article 725.
2. Permanently and legibly marked with manufacturer's name, maximum working voltage for which cable was tested, type of cable, and UL listing mark.
3. Suitable for installation in open air, in cable trays, or conduit.
4. Minimum Temperature Rating: 105 degrees C.
5. Passes Vertical Tray Flame Test.

6. Outer Jacket: PVC, flame-retardant, sunlight- and oil-resistant.
- B. Type 20, 16 AWG, Twisted, Shielded Pair Instrumentation Cable: Single pair, designed for noise rejection for process control, computer, or data log applications meeting NEMA WC 57.
1. Outer Jacket: 35-mil nominal.
 2. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer, overlapped to provide 100 percent coverage.
 3. Dimension: 0.26-inch nominal OD.
 4. Conductors
 - a. Bare soft annealed copper, Class B, seven-strand concentric, ASTM B8.
 - b. 20 AWG, seven-strand tinned copper drain wire.
 - c. Insulation: 15-mil PVC.
 - d. Color Code: Pair conductors black and white.
 5. Manufacturers
 - a. Okonite Co.
 - b. Alpha Wire Corp.
- C. Type 21, 16 AWG, Twisted, Shielded Triad Instrumentation Cable: Single triad, designed for noise rejection for process control, computer, or data log applications meeting requirements of NEMA WC 57.
1. Outer Jacket: 35-mil nominal thickness.
 2. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer, overlapped to provide 100 percent coverage.
 3. Dimension: 0.28-inch nominal OD.
 4. Conductors
 - a. Bare soft annealed copper, Class B, seven-strand concentric, ASTM B8.
 - b. 20 AWG, seven-strand tinned copper drain wire.
 - c. Insulation: 15-mil PVC.
 - d. Color Code: Triad conductors; black, red, and white.
 5. Manufacturers
 - a. Okonite Co.

- b. Alpha Wire Corp.
- D. Type 22, 18 AWG, Multitwisted, Shielded Pairs with a Common Overall Shield Instrumentation Cable: Designed for use as instrumentation, process control, and computer cable meeting NEMA WC 57.
 - 1. Conductors
 - a. Bare soft annealed copper, Class B, seven-strand concentric, ASTM B8.
 - b. Tinned copper drain wires.
 - c. Pair drain wire size AWG 20, group drain wire size AWG 18.
 - d. Insulation: 15-mil PVC.
 - e. Color Code: Pair conductors black and white; white conductor numerically printed for group identification.
 - f. Individual Pair Shield: 1.35-mil aluminum/mylar.
 - g. Cable Shield: 2.35-mil, double-faced aluminum/synthetic polymer, overlapped for 100 percent coverage.
 - 2. Cable Sizes

Number of Pairs	Maximum Outside Diameter (Inches)	Nominal Jacket Thickness (Mils)
4	0.50	50
8	0.66	60
12	0.79	60
16	0.91	60
24	1.13	70
36	1.31	70
50	1.55	80

- 3. Manufacturers
 - a. Okonite Co.
 - b. Alpha Wire Corp.
 - c. Belden.
- E. Type 23, 18 AWG, Multitwisted Pairs with Common Overall Shield Instrumentation Cable: Designed for use as instrumentation, process control, and computer cable meeting NEMA WC 57.
 - 1. Conductors

- a. Bare soft annealed copper, Class B, seven-strand concentric, ASTM B8.
- b. Tinned copper.
- c. Group drain wire size AWG 20, minimum.
- d. Insulation: 15-mil PVC.
- e. Color Code: Pair conductors black and white; white conductor numerically printed for group identification.
- f. Cable Shield: 2.35-mil, double-faced aluminum/synthetic polymer, overlapped for 100 percent coverage.

2. Cable Sizes

Number of Pairs	Maximum Outside Diameter (Inches)	Nominal Jacket Thickness (Mils)
4	0.48	50
8	0.63	60
12	0.73	60
16	0.77	60
24	0.96	70
36	1.09	70
50	1.45	50

3. Manufacturers

- a. Okonite Co.
- b. Alpha Wire Corp.
- c. Belden.

F. Type 24, Twisted Pair Fire Alarm Cable Shielded: Power limited fire protective signaling circuit cable meeting requirements of NFPA 70, Article 760.

1. Cable: Pass NFPA 262, 70,000 Btu flame test and listed by Texas State Fire Marshall.
2. Outer Jacket: Red in color, identified along its entire length as fire protective signaling circuit cable.
3. Conductors
 - a. Solid, tinned, or bare copper shielded, with stranded tinned copper drain wire.
 - b. Insulation: 15-mil PVC.
 - c. Shield: Aluminum/mylar spiral wound along entire length.

4. Cable Size

Wire Size	Maximum Outside Diameter (Inches)	Nominal Jacket Thickness (Inches)
12	0.36	0.042
14	0.32	0.042
16	0.26	0.037
18	0.23	0.037

5. Manufacturers

- a. West Penn Wire.
- b. Coleman Cable, Inc.

2.05 SPECIAL CABLES

A. Type 30, Unshielded Twisted Pair (UTP) Telephone and Data Cable, 300V

1. Category 6 UTP, UL listed, and third party verified to comply with TIA/EIA 568-C Category 6 requirements.
2. Suitable for high speed network applications including gigabit ethernet and video. Cable shall be interoperable with other standards compliant products and shall be backward compatible with Category 5 and Category 5e.
3. Provide four each individually twisted pair, 23 AWG conductors, with FEP insulation and blue PVC jacket.
4. NFPA 70 Plenum (CMP) rated; comply with flammability plenum requirements of NFPA 70 and NFPA 262.
5. Cable shall withstand a bend radius of 1-inch minimum at a temperature of minus 20 degrees C maximum without jacket or insulation cracking.
6. Manufacturer and Product: Belden; 7852A.

B. Type 31, Data Highway Cable Allen-Bradley "Blue Hose"

1. Meet or exceed electrical characteristics of Allen-Bradley Catalog No. 1770-CD.
2. Approved by Allen-Bradley for use with A-B programmable logic controller systems.
3. Outer Jacket: Blue PVC
4. Shield: 1.35-mil, double-faced aluminum/synthetic polymer, overlapped to provide 100 percent coverage.
5. Drain: 55 percent tinned copper braid and drain wire.

6. Dimension: 0.243-inch nominal OD.
 7. Conductors
 - a. One pair 20 AWG, seven-strand tinned copper.
 - b. Insulation: Polyethylene.
 - c. Color Code: Blue and clear.
 8. Manufacturers
 - a. Allen-Bradley.
 - b. Belden.
- C. Type 32, DeviceNet Round Cable, 600V, Class 1, Two Twisted, Shielded Pairs with Common Overall Shield:
1. Outer Jacket: PVC.
 2. Overall Shield: Tinned copper braid, 18 AWG tinned copper drain wire.
 3. Individual Pair Shield: Aluminum foil-polyester tape.
 4. Dimension: 0.460-inch nominal OD.
 5. Conductors
 - a. 15 AWG stranded tinned copper.
 - b. Insulation: FEP.
 6. Manufacturer and Product: Belden; 7897A.
- D. Type 33, DeviceNet Flat Cable, 600V, Class 1, Four Conductor Unshielded Network Trunk Cable
1. Outer Jacket: Thermoplastic Elastomer (TPE).
 2. Conductors: Four conductor, unshielded, flat configuration.
 3. Manufacturer and Product: Allen-Bradley; 1485C-P1E.
- E. Type 34, Profibus PA Cable, 300V
1. Outer Jacket: PVC.
 2. Shield: Aluminum foil-polyester tape, 20 AWG tinned copper drain wire.
 3. Dimension: 0.253-inch nominal OD.
 4. Conductors

- a. 18 AWG stranded tinned copper.
- b. Insulation: polyolefin.

5. Manufacturer and Product: Belden; 3076F.

2.06 GROUNDING CONDUCTORS

- A. Equipment: Stranded copper with green, Type USE/RHH/RHW-XLPE or THHN/THWN, insulation.
- B. Direct Buried: Bare stranded copper.

2.07 ACCESSORIES FOR CONDUCTORS 600 VOLTS AND BELOW

A. Tape

- 1. General Purpose, Flame Retardant: 7-mil, vinyl plastic, Scotch Brand 33+, rated for 90 degrees C minimum, meeting requirements of UL 510.
- 2. Flame Retardant, Cold and Weather Resistant: 8.5-mil, vinyl plastic, Scotch Brand 88.
- 3. Arc and Fireproofing
 - a. 30-mil, elastomer.
 - b. Manufacturers and Products:
 - 1) 3M; Scotch Brand 77, with Scotch Brand 69 glass cloth tapebinder.
 - 2) Plymouth; 53 Plyarc, with 77 Plyglas glass cloth tapebinder.

B. Identification Devices

- 1. Sleeve
 - a. Permanent, PVC, yellow or white, with legible machine-printed black markings.
 - b. Manufacturers and Products
 - 1) Raychem; Type D-SCE or ZH-SCE.
 - 2) Brady, Type 3PS.
- 2. Heat Bond Marker
 - a. Transparent thermoplastic heat bonding film with acrylic pressure sensitive adhesive.
 - b. Self-laminating protective shield over text.
 - c. Machine printed black text.

- d. Manufacturer and Product: 3M Co.; Type SCS-HB.
- 3. Marker Plate: Nylon, with legible designations permanently hot stamped on plate.
- 4. Tie-On Cable Marker Tags
 - a. Chemical-resistant white tag.
 - b. Size: 1/2 inch by 2 inches.
 - c. Manufacturer and Product: Raychem; Type CM-SCE.
- 5. Grounding Conductor: Permanent green heat-shrink sleeve, 2-inch minimum.
- C. Connectors and Terminations
 - 1. Nylon, Self-Insulated Crimp Connectors
 - a. Manufacturers and Products
 - 1) Thomas & Betts; Sta-Kon.
 - 2) Burndy; Insulug.
 - 3) ILSCO.
 - 2. Nylon, Self-Insulated, Crimp Locking-Fork, Torque-Type Terminator
 - a. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
 - b. Seamless.
 - c. Manufacturers and Products
 - 1) Thomas & Betts; Sta-Kon.
 - 2) Burndy; Insulink.
 - 3) ILSCO; ILSCONS.
 - 3. Self-Insulated, Freespring Wire Connector (Wire Nuts)
 - a. UL 486C.
 - b. Plated steel, square wire springs.
 - c. Manufacturers and Products
 - 1) Thomas & Betts.
 - 2) Ideal; Twister.
 - 4. Self-Insulated, Set Screw Wire Connector

- a. Two piece compression type with set screw in brass barrel.
- b. Insulated by insulator cap screwed over brass barrel.
- c. Manufacturers
 - 1) 3M Co.
 - 2) Thomas & Betts.
 - 3) Marrette.

D. Cable Lugs

- 1. In accordance with NEMA CC 1.
- 2. Rated 600 volts of same material as conductor metal.
- 3. Uninsulated Crimp Connectors and Terminators
 - a. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
 - b. Manufacturers and Products
 - 1) Thomas & Betts; Color-Keyed.
 - 2) Burndy; Hydent.
 - 3) ILSCO.
- 4. Uninsulated, Bolted, Two-Way Connectors and Terminators
 - a. Manufacturers and Products
 - 1) Thomas & Betts; Locketite.
 - 2) Burndy; Quiklug.
 - 3) ILSCO.

E. Cable Ties

- 1. Nylon, adjustable, self-locking, and reusable.
- 2. Manufacturer and Product: Thomas & Betts; TY-RAP.

F. Heat Shrinkable Insulation

- 1. Thermally stabilized cross-linked polyolefin.
- 2. Single wall for insulation and strain relief.
- 3. Dual Wall, adhesive sealant lined, for sealing and corrosion resistance.

4. Manufacturers and Products
 - a. Thomas & Betts; SHRINK-KON.
 - b. Raychem; RNF-100 and ES-2000.
 - c. Or equal.

2.08 ACCESSORIES FOR CONDUCTORS ABOVE 600 VOLTS

A. Molded Splice Kits

1. Components necessary to provide insulation, metallic shielding and grounding systems, and overall jacket.
2. Capable of making splices with a current rating equal to, or greater than cable ampacity, conforming to IEEE 404.
3. Class 5 and 15 kV, with compression connector, EPDM molded semiconductive insert, peroxide-cured EPDM insulation, and EPDM molded semiconductive outer shield.
4. Premolded splice shall be rejaacketed with a heat shrinkable adhesive-lined sleeve to provide a waterproof seal.
5. Manufacturers
 - a. Elastimold.
 - b. Cooper Industries.

B. Heat Shrinkable Splice Kits

1. Components necessary to provide insulation, metallic shielding and grounding systems, and overall jacket.
2. Capable of making splices with a current rating equal to, or greater than, cable ampacity, conforming to IEEE 404.
3. Class 5 and 15 kV, with compression connector, splice insulating and conducting sleeves, stress-relief materials, shielding braid and mesh, and abrasion-resistant heat shrinkable adhesive-lined rejaacketing sleeve to provide a waterproof seal.
4. Manufacturers
 - a. Raychem.
 - b. 3M Co.

C. Termination Kits

1. Capable of terminating 5 and 15 kV, single-conductor, polymeric-insulated shielded cables plus a shield ground clamp.

2. Capable of producing a termination with a current rating equal to, or greater than, cable ampacity meeting Class 1 requirements of IEEE 48.
3. Capable of accommodating cable shielding or construction without need for special adapters or accessories.
4. Manufacturers
 - a. Raychem.
 - b. 3M Co.

D. Bus Connection Insulation

1. Heat shrinkable tubing, tape, and sheets of flexible cross-linked polymeric material formulated for high dielectric strength.
2. Tape and sheet products to have coating to prevent adhesion to metal surfaces.
3. Insulating materials to be removable and reusable.
4. Manufacturer: Raychem.

E. Elbow Connector Systems

1. Molded, peroxide-cured, EPDM-insulated, Class 15 kV, 95 kV BIL, 600A, 40,000 rms nonload-break elbows having copper current-carrying parts in accordance with IEEE 386.
2. Protective Caps: Class 15 kV, 95 kV BIL, 600 amperes, with molded EPDM insulated body.
3. Insulated Standoff Bushings: Class 15 kV, 95 kV BIL, 600 amperes, complete with EPDM rubber body, stainless steel eyebolt with brass pressure foot, and stainless steel base bracket.
4. Bushing Inserts: Class 15 kV, 95 kV BIL, 600A, nonload-break with EPDM rubber body and all-copper, current-carrying parts.
5. Junctions: Class 15 kV, 95 kV, three-way, 600A, nonload-break, having EPDM rubber body mounted on adjustable bracket.
6. Mounting Plates: Three way, ASTM A167 stainless steel, complete with universal mounting brackets, grounding lugs and two parking stands.
7. Manufacturers
 - a. Cooper Industries.
 - b. Elastimold.
 - c. Or equal.

F. Cable Lugs

1. In accordance with NEMA CC1.
2. Rated 5 and 15 kV of same material as conductor metal.
3. Manufacturers and Products, Uninsulated Compression Connectors and Terminators:
 - a. Burndy; Hydent.
 - b. Thomas & Betts; Color-Keyed.
 - c. ILSCO.
4. Manufacturers and Products, Uninsulated, Bolted, Two-Way Connectors and Terminators:
 - a. Thomas & Betts; Locktite.
 - b. ILSCO.

2.09 CABLE FAULT DETECTION SYSTEM

- A. One fault sensor for each phase conductor prewired with lead cable extending to remote indicator target.
- B. Magnetically operated, automatic indicator target.
- C. Nonresettable, unless all three phases are fault free.
- D. Sensor/indicator target sealed for submersible operation.
- E. Trip Rating: 600 amperes.
- F. Fault powered with a normal current flow rating in excess of 5 amperes.
- G. Portable, Handheld Cable Fault Tester: One.
- H. Equip each sensor with auxiliary relay contacts for remote monitoring and future use.
- I. Manufacturers and Products
 1. Cooper Industries; Type CR3.
 2. AB Chance.

2.10 PULLING COMPOUND

- A. Nontoxic, noncorrosive, noncombustible, nonflammable, water-based lubricant; UL listed.
- B. Suitable for rubber, neoprene, PVC, polyethylene, hypalon, CPE, and lead-covered wire and cable.
- C. Approved for intended use by cable manufacturer.
- D. Suitable for zinc-coated steel, aluminum, PVC, bituminized fiber, and fiberglass raceways.

E. Manufacturers

1. Ideal Co.
2. Polywater, Inc.
3. Cable Grip Co.

2.11 BUSWAY

- A. Low impedance, copper bus bar, indoor type with internal ground bus.
- B. UL listed for support and spacing provided, meeting NFPA 70 requirements, and totally enclosed throughout its length.
- C. Suitable for mounting in vertical (edgewise) or horizontal position without derating, and capable of withstanding short-circuit of 100,000 amperes.

2.12 MANUFACTURED WIRING SYSTEMS

A. System Rating

1. 20 amperes load-carrying capacity each phase with final assemblies consisting of maximum of three-phase conductors.
2. Composition: Type MC cable with 90 degrees C insulation and stranded copper conductors.

B. Cable Configuration: Three, single-phase, five-wire circuit with standard color wire coding:

1. 208/120 Volt: Black, red, blue, white, green.
2. 480/277 Volt: Brown, orange, yellow, white, green.

C. Locking Mechanism: Latch/strike with voltage clearly marked on latch.

D. NFPA 262 listed for use in air handling plenums, listed to connect or disconnect under load, and manufactured in accordance with NFPA 70, Article No. 604.

2.13 WARNING TAPE

A. As specified in SECTION 26 05 53 – RACEWAYS AND BOXES.

2.14 SOURCE QUALITY CONTROL

1. Conductors 600 Volts and Below: Test in accordance with UL 44 and UL 854.
2. Conductors Above 600 Volts: Test in accordance with NEMA WC 71 and AEIC CS 8 partial discharge level test for EPR insulated cable.

PART 3 - EXECUTION

3.01 GENERAL

- A. Conductor installation shall be in accordance with manufacturer's recommendations.
- B. Conductor and cable sizing shown is based on copper conductors, unless noted otherwise.
- C. Do not exceed cable manufacturer's recommendations for maximum pulling tensions and minimum bending radii.
- D. Terminate conductors and cables, unless otherwise indicated.
- E. Tighten screws and terminal bolts in accordance with UL 486A-486B for copper conductors.
- F. Cable Lugs: Provide with correct number of holes, bolt size, and center-to-center spacing as required by equipment terminals.
- G. Bundling: Where single conductors and cables in manholes, handholes, vaults, cable trays, and other indicated locations are not wrapped together by some other means, bundle conductors from each conduit throughout their exposed length with cable ties placed at intervals not exceeding 12 inches on center.
- H. Ream, remove burrs, and clear interior of installed conduit before pulling wires or cables.
- I. Concrete-Encased Raceway Installation: Prior to installation of conductors, pull through each raceway a mandrel approximately 1/4 inch smaller than raceway inside diameter.
- J. Cable Tray Installation
 - 1. Install wire and cable parallel and straight in tray.
 - 2. Bundle, in groups, wire and cable of same voltage having a common routing and destination; use cable ties, at maximum intervals of 8 feet.
 - 3. Clamp cable bundles prior to making end termination connections.
 - 4. Separate cables of different voltage rating in same cable tray with barriers.
 - 5. Fasten wires, cables, and bundles to tray with nylon cable straps at the following maximum intervals:
 - a. Horizontal Runs: 20 feet.
 - b. Vertical Runs: 5 feet.

3.02 POWER CONDUCTOR COLOR CODING

- A. Conductors 600 Volts and below:
 - 1. 6 AWG and Larger: Apply general purpose, flame retardant tape at each end, and at accessible locations wrapped at least six full overlapping turns, covering area 1-1/2 inches to 2 inches wide.

2. 8 AWG and Smaller: Provide colored conductors.
3. Colors

System	Conductor	Color
All Systems	Equipment Grounding	Green
240/120 Volts, Single-Phase, Three-Wire	Grounded Neutral One Hot Leg Other Hot Leg	White Black Red
208Y/120 Volts, Three-Phase, Four-Wire	Grounded Neutral Phase A Phase B Phase C	White Black Red Blue
240/120 Volts, Three-Phase, Four-Wire, Delta, Center Tap, Ground on Single-Phase	Grounded Neutral Phase A High (wild) Leg Phase C	White Black Orange Blue
480Y/277 Volts, Three-Phase, Four-Wire	Grounded Neutral Phase A Phase B Phase C	White Brown Orange Yellow
Note: Phase A, B, C implies direction of positive phase rotation.		

4. Tracer: Outer covering of white with identifiable colored strip, other than green, in accordance with NFPA 70.

B. Conductors Above 600 Volts

1. Apply general purpose, flame retardant tape at each end, and at accessible locations wrapped at least six full overlapping turns, covering area 1-1/2 inches to 2 inches wide.
2. Colors
 - a. Grounded Neutral: White.
 - b. Phase A: Brown
 - c. Phase B: Orange
 - d. Phase C: Yellow

3.03 CIRCUIT IDENTIFICATION

- A. Identify power, instrumentation, and control conductor circuits at each termination, and in accessible locations such as manholes, handholes, panels, switchboards, motor control centers, pull boxes, and terminal boxes.
- B. Circuits Appearing in Circuit Schedules: Identify using circuit schedule designations.
- C. Circuits Not Appearing in Circuit Schedules

1. Assign circuit name based on device or equipment at load end of circuit.
2. Where this would result in same name being assigned to more than one circuit, add number or letter to each otherwise identical circuit name to make it unique.

D. Method

1. Conductors 3 AWG and Smaller: Identify with sleeves or heat bond markers.
2. Cables and Conductors 2 AWG and Larger
 - a. Identify with marker plates or tie-on cable marker tags.
 - b. Attach with nylon tie cord.
3. Taped-on markers or tags relying on adhesives not permitted.

3.04 CONDUCTORS 600 VOLTS AND BELOW

- A. Install 10 AWG or 12 AWG conductors for branch circuit power wiring in lighting and receptacle circuits.
- B. Conductors shall be continuous from end to end unless otherwise noted on the Drawings. Do not splice conductors unless specifically indicated or approved by Engineer.
- C. Connections and Terminations
 1. Install wire nuts only on solid conductors. Wire nuts are not allowed on stranded conductors.
 2. Install nylon self-insulated crimp connectors and terminators for instrumentation and control, circuit conductors.
 3. Install self-insulated, set screw wire connectors for two-way connection of power circuit conductors 12 AWG and smaller.
 4. Install uninsulated crimp connectors and terminators for instrumentation, control, and power circuit conductors 4 AWG through 2/0 AWG.
 5. Install uninsulated, bolted, two-way connectors and terminators for power circuit conductors 3/0 AWG and larger.
 6. Install uninsulated terminators bolted together on motor circuit conductors 10 AWG and larger.
 7. Place no more than one conductor in any single-barrel pressure connection.
 8. Install crimp connectors with tools approved by connector manufacturer.
 9. Install terminals and connectors acceptable for type of material used.
 10. Compression Lugs

- a. Attach with a tool specifically designed for purpose. Tool shall provide complete, controlled crimp and shall not release until crimp is complete.
 - b. Do not use plier type crimpers.
- D. Do not use soldered mechanical joints.
- E. Splices and Terminations
 - 1. Insulate uninsulated connections.
 - 2. Indoors: Use general purpose, flame retardant tape or single wall heat shrink.
 - 3. Outdoors, Dry Locations: Use flame retardant, cold- and weather-resistant tape or single wall heat shrink.
 - 4. Below Grade and Wet or Damp Locations: Use dual wall heat shrink.
- F. Cap spare conductors with UL listed end caps.
- G. Cabinets, Panels, and Motor Control Centers
 - 1. Remove surplus wire, bridle and secure.
 - 2. Where conductors pass through openings or over edges in sheet metal, remove burrs, chamfer edges, and install bushings and protective strips of insulating material to protect the conductors.
- H. Control and Instrumentation Wiring
 - 1. Where terminals provided will accept such lugs, terminate control and instrumentation wiring, except solid thermocouple leads, with insulated, locking-fork compression lugs.
 - 2. Terminate with methods consistent with terminals provided, and in accordance with terminal manufacturer's instructions.
 - 3. Conductors shall be continuous from end to end unless otherwise noted on the Drawings. Do not splice conductors unless specifically indicated or approved by Engineer.
 - 4. Where indicated or approved by the Engineer, locate splices in readily accessible cabinets or junction boxes using terminal strips.
 - 5. Cable Protection
 - a. Under Infinite Access Floors: May install without bundling.
 - b. All Other Areas: Install individual wires, pairs, or triads in flex conduit under floor or grouped into bundles at least 1/2 inch in diameter.
 - c. Maintain integrity of shielding of instrumentation cables.
 - d. Ensure grounds do not occur because of damage to jacket over shield.

6. Extra Conductor Length: For conductors to be connected by others, install minimum 6 feet of extra conductor in freestanding panels and minimum 2 feet in other assemblies.

3.05 CONDUCTORS ABOVE 600 VOLTS

- A. Do not splice unless specifically indicated or approved by Engineer.
- B. Make joints and terminations with splice and termination kits, in accordance with kit manufacturer's instructions.
- C. Install splices or terminations as continuous operation in accessible locations under clean, dry conditions.
- D. Single Conductor Cable Terminations: Provide heat shrinkable stress control and outer non-tracking insulation tubings, high relative permittivity stress relief mastic for insulation shield cutback treatment, and a heat-activated sealant for environmental sealing plus a ground braid and clamp.
- E. Install terminals or connectors acceptable for type of conductor material used.
- F. Provide outdoor rain skirts for riser pole and outdoor switchgear terminations.
- G. Provide shield termination and grounding for terminations.
- H. Provide necessary mounting hardware, covers, and connectors.
- I. Where elbow connectors are specified, install in accordance with manufacturer's instructions.
- J. Connections and Terminations
 1. Install uninsulated crimp connectors and terminators for power circuit conductors 4 AWG and larger.
 2. Install uninsulated, bolted, two-way connectors for motor circuit conductors No. 12 and larger.
 3. Insulate bus connections with heat shrinking tubing, tape, and sheets.
 4. Make bus connections removable and reusable in accordance with manufacturer's instructions.
- K. Give 2 working days notice to Engineer prior to making splices or terminations.

3.06 CONDUCTOR ARC AND FIREPROOFING

- A. Install arc and fireproofing tape on 600-volt single conductors and cables, except those rated Type TC throughout entire exposed length at splices in manholes, handholes, vaults, cable trays, and other indicated locations.
- B. Install arc and fireproofing tape on 5 kV and 15 kV cables throughout entire exposed length at splices in manholes, handholes, vaults, cable trays, and other indicated locations.
- C. Wrap conductors of same circuit entering from separate conduit together as single cable.

- D. Follow tape manufacturer's installation instructions.
- E. Secure tape at intervals of 5 feet with bands of tapebinder. Each band to consist of a minimum of two wraps directly over each other.

3.07 BUSWAY

- A. Install in strict accordance with manufacturer's recommendations and NFPA 70.
- B. Maximum Support Spacing: 10 feet.

3.08 UNDERGROUND DIRECT BURIAL CABLE

- A. Warning Tape: Install approximately 6 inches above cable, aligned parallel to, and within 12 inches of centerline of the run.

END OF SECTION

SECTION 26 05 70
WIRING DEVICES

PART 1 - GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM): A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
2. Federal Specifications (FS)
 - a. W-C-596G, General Specification for Connector, Electrical, Power.
 - b. W-S-896F, Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification).
3. Institute of Electrical and Electronic Engineers, Inc. (IEEE):
 - a. C62.41.2, Recommended Practice on Characterization of Surges in Low-Voltage (1000V and less) AC Power Circuits.
 - b. C62.45, Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000V and less) AC Power Circuits.
4. National Electrical Contractors Association (NECA): 1, Standard Practice of Good Workmanship in Electrical Contracting.
5. National Electrical Manufacturers Association (NEMA)
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - b. FB 11, Plugs, Receptacles, and Connectors of the Pin and Sleeve Type for Hazardous Locations.
 - c. WD 1, General Color Requirements for Wiring Devices.
 - d. WD 6, Wiring Devices – Dimensional Specifications.
6. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
7. Underwriters Laboratories Inc. (UL)
 - a. 498, Standard for Safety for Attachment Plugs and Receptacles.
 - b. 508, Standard for Safety for Industrial Control Equipment.
 - c. 943, Standard for Safety for Ground-Fault Circuit-Interrupters.

- d. 1010, Standard for Safety for Receptacle-Plug Combinations for Use in Hazardous (Classified) Locations.
- e. 1436, Standard for Safety for Outlet Circuit Testers and Similar Indicating Devices.
- f. 1449, Standard for Safety for Surge Protective Devices (SPD).

1.02 SUBMITTALS

- A. Action Submittals: Manufacturer's product data for wiring devices.

PART 2 - PRODUCTS

2.01 SWITCHES

- A. Switch, General Purpose
 - 1. NEMA WD 1 and FS W-S-896F.
 - 2. Totally enclosed, ac type, with quiet tumbler switch and screw terminal.
 - 3. Rivetless one-piece brass or copper alloy contact arm with silver alloy contact.
 - 4. Capable of controlling 100 percent tungsten filament and fluorescent lamp loads.
 - 5. Rating: 20 amps, 120/277 volts.
 - 6. Automatic grounding clip and integral grounding terminal on mounting strap.
 - 7. Special Features: Provide the following features in comparable devices where indicated:
 - a. Three-way and four-way.
 - b. Tamper resistant.
 - c. Key operated with key.
 - d. Locator, illuminated operator.
 - e. Pilot, red illuminated operator.
 - f. Rectangular (decorator) face.
 - g. Three-position, maintained contact, center off.
 - 8. Manufacturers and Products, Industrial Grade
 - a. Cooper Arrow Hart.
 - b. Bryant.
 - c. Hubbell.

- d. Leviton.
- 9. Manufacturers and Products, Commercial Grade
 - a. Cooper Arrow Hart.
 - b. Bryant.
 - c. Hubbell.
 - d. Leviton.

B. Switch, Motor Rated

- 1. Type: Two-pole or three-pole, manual motor starting/disconnect switch without overload protection.
- 2. UL 508 listed.
- 3. Totally enclosed snap-action switch. Quick-make, slow-break design with silver alloy contacts.
- 4. Minimum General Purpose Rating: 30 amperes, 600V ac.
- 5. Minimum Motor Ratings
 - a. 2 horsepower for 120V ac, single-phase, two-pole.
 - b. 3 horsepower for 240V ac, single-phase, two-pole.
 - c. 15 horsepower for 480V ac, three-phase, three-pole.
- 6. Screw-type terminal.
- 7. Manufacturers and Products
 - a. Cooper Arrow Hart.
 - b. Hubbell Bryant: HBL78 Series.
 - c. Leviton.

2.02 RECEPTACLES

A. Receptacle, General Purpose

- 1. NEMA WD 1 and FS W-C-596G.
- 2. Duplex, two-pole, three-wire grounding type with screw type wire terminals.
- 3. Impact resistant nylon cover and body, with finger grooves in face, unless otherwise indicated.

4. One-piece mounting strap with integral ground contact (rivetless construction).
 5. Contact Arrangement: Contact to be made on two sides of each inserted blade without detent.
 6. Rating: 125 volts, NEMA WD 1, Configuration 5-20R, 20 amps, unless otherwise indicated.
 7. Size: For 2-inch by 4-inch outlet box.
 8. Special Features: Provide the following features in comparable devices where indicated:
 - a. Listed weather-resistant per NEC 406.8.
 - b. Listed tamper-resistant per NEC 406.11.
 - c. Isolated ground.
 - d. Illuminated.
 - e. Smooth face.
 - f. Rectangular (decorator) smooth face.
 9. Industrial Grade Manufacturers and Products
 - a. Cooper Arrow Hart; 5262/5362 Series.
 - b. Hubbell Bryant; HBL5262/HBL5362 Series.
 - c. Leviton; 5262/5362 Series.
- B. Receptacle, Surge Protective Device (SPD)
1. Meet requirements of general-purpose receptacle, except as otherwise indicated.
 2. Configuration: 20 amps, NEMA WD 6, 5-20R, smooth rectangular face.
 3. Minimum Surge Suppression: 240 joules/15 kA per mode (line to ground, line to neutral, and neutral to ground), according to IEEE C62.41.2 and IEEE C62.45.
 4. Listed UL 498 receptacle and UL 1449 SPD.
 5. Alarm Indicators: LED and audible with nylon muting screw in face.
 6. Minimum Noise Rejection: 30 dB at 500 kHz to 30 MHz.
 7. Manufacturers and Products
 - a. Cooper Arrow Hart; 5262S Series.
 - b. Hubbell Bryant; HBL 5362SA Series.

- c. Leviton; 7380 Series.

C. Receptacle, Ground Fault Circuit Interrupter

1. Meet requirements of general-purpose receptacle.
2. Listed Class A to UL 943, tripping at 5 mA.
3. Rectangular smooth face with push-to-test and reset buttons.
4. Listed weather-resistant per NEC 406.8.
5. Feed-through Capability: 20 amps.
6. Manufacturers and Products
 - a. Hubbell Bryant.
 - b. Cooper Arrow Hart.
 - c. Leviton.
 - d. Or equal.

D. Receptacle, Corrosion-Resistant

1. Meet requirements of general-purpose receptacle.
2. Nickel coated metal parts.
3. Manufacturers and Products
 - a. Hubbell Bryant.
 - b. Leviton.
 - c. Cooper Arrow Hart.

E. Receptacle, Special-Purpose

1. Rating and number of poles as indicated or required for anticipated purpose.

2.03 DEVICE PLATES

A. Sectional type plate not permitted.

B. Nylon

1. Material: Specification grade, 0.10-inch minimum thickness, noncombustible, thermosetting.
2. Color: To match associated wiring device.

3. Mounting Screw: Oval-head metal, color matched to plate.
- C. Metal
1. Material: Specification grade, one-piece, 0.040-inch nominal thickness stainless steel.
 2. Finish: ASTM A167, Type 302/304, satin.
 3. Mounting Screw: Oval-head, finish matched to plate.
- D. Cast Metal
1. Material: Malleable ferrous metal or Copper-free aluminum.
 2. Screw: Oval-head stainless steel.
- E. Sheet Steel
1. Finish: Zinc electroplate.
 2. Screws: Oval-head stainless steel.
 3. Manufacturers
 - a. Appleton.
 - b. Crouse-Hinds.
- F. Engraved
1. Character Height: 1/8 inch.
 2. Filler: Black
- G. Weatherproof
1. Receptacle, Weatherproof Type 1
 - a. Gasketed, cast-aluminum, with individual cap over each receptacle opening.
 - b. Mounting Screw and Cap Spring: Stainless steel.
 - c. Manufacturers and Products
 - 1) Crouse-Hinds; Type WLRD-1.
 - 2) Appleton; Type FSK-WRD.
 2. Receptacle, Weatherproof Type 2
 - a. UL listed for wet location while in use.
 - b. Die cast metal cover.

- c. Locking type.
 - d. Manufacturer and Product: TayMac; Type Multi-Mac.
- 3. Switch
 - a. Gasketed, cast-metal or cast-aluminum, incorporating external operator for internal switch.
 - b. Mounting Screw: Stainless steel.
 - c. Manufacturers and Products
 - 1) Crouse-Hinds; DS-181 or DS-185.
 - 2) Appleton; FSK-1VTS or FSK-1VS.
- H. Raised Sheet Metal: 1/2-inch high zinc- or cadmium-plated steel designed for one-piece drawn type sheet steel box.
- I. Sheet Steel: Formed sheet steel or Ferroalloy designed for installation on cast-metal box.
- 2.04 OCCUPANCY SENSOR, WALL SWITCH
 - A. Description
 - 1. Passive-infrared type, 120/277-volt, adjustable time delay up to 30 minutes, 180-degree field of view, with a minimum coverage area of 900 square feet (84 square meters).
 - 2. Provide dual switch unit where indicated.
 - 3. Color: Manufacturer's standard white.
 - B. Manufacturers and Products
 - 1. Hubbell; WS1277.
 - 2. Leviton; ODS 10-ID.
 - 3. Pass & Seymour; WS3000.
 - 4. Watt Stopper (The); WS-200.
- 2.05 FINISHES
 - A. Wiring device catalog numbers specified in this section do not designate device color. Unless otherwise indicated, or required by code, provide colors as specified below.
 - B. Wiring Device Connected to Normal Power System
 - 1. Office Areas: Gray
 - 2. Other Areas: Gray

- C. Wiring Device Connected to Emergency: Red
- D. Special purpose and hazardous location devices may be manufacturer's standard color (black).
- E. Corrosion-resistant receptacle may be manufacturer's standard color (yellow).

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Comply with NECA 1.
- B. Coordination with Other Trades
 - 1. Ensure device and its box are protected. Do not place wall finish materials over device box and do not cut holes for box with router that is guided by riding against outside of box.
 - 2. Keep outlet box free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate raceway system, conductors, and cables.
 - 3. Install device box in brick or block wall such that cover plate does not cross a joint, unless otherwise indicated. Where indicated or directed to cross joint, trowel joint flush with face of wall.
 - 4. Install wiring device after wall preparation, including painting, is complete.
- C. Conductors
 - 1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
 - 2. Strip insulation evenly around conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 - 3. Length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
 - 4. Existing Conductors
 - a. Cut back and pigtail, or replace damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtailing existing conductors is permitted provided outlet box is large enough.
- D. Device Installation
 - 1. Replace devices that have been in temporary use during construction or that show signs they were installed before building finishing operations were complete.
 - 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.

3. Do not remove surface protection, such as plastic film and smudge covers, until last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (150 mm) in length.
5. Use torque screwdriver when a torque is recommended or required by manufacturer.
6. When conductors larger than 12 AWG are installed on 15-amp or 20-amp circuits, splice 12 AWG pigtails for device connections.
7. Tighten unused terminal screws on device.
8. Device Plates
 - a. Do not use oversized or extra deep plate.
 - b. Repair wall finishes and remount outlet box when standard device plate does not fit flush or does not cover rough wall opening.

3.02 SWITCH INSTALLATION

A. Switch, General Purpose

1. Mounting Height: See SECTION 26 05 33 – RACEWAYS AND BOXES.
2. Install with switch operation in vertical position.
3. Install single-pole, two-way switch such that toggle is in up position when switch is on.

B. Switch, Motor Rated

1. Mounting Height: See SECTION 26 05 33 – RACEWAYS AND BOXES.
2. Install with switch operation in vertical position such that toggle is in up position when ON.
3. Install within sight of motor when used as disconnect switch.

C. Occupancy Sensor, Wall Switch: Install in accordance with manufacturer's instructions.

3.03 RECEPTACLE INSTALLATION

A. Duplex Receptacle

1. Install with grounding slot up, except where horizontal mounting is shown, in which case install with neutral slot up.
2. Ground receptacle to box with grounding wire only.
3. Weatherproof Receptacle
 - a. Install in cast metal box.

- b. Install such that hinge for protective cover is above receptacle opening.
- 4. Ground Fault Interrupter: Install feed-through model at locations where ground fault protection is specified for “downstream” conventional receptacles.
- 5. Special-Purpose Receptacle: Install in accordance with manufacturer’s instructions.
- B. Multioutlet Surface Raceway System
 - 1. Install in accordance with manufacturer’s instructions.
 - 2. Wire alternate outlets to each circuit where two-circuit, three-wire supply is shown.
- 3.04 DEVICE PLATE INSTALLATION
 - A. Securely fasten to wiring device; ensure tight fit to box.
 - B. Flush Mounted: Install with all four edges in continuous contact with finished wall surface without use of mat or similar material. Plaster fillings will not be acceptable.
 - C. Surface Mounted: Plate shall not extend beyond sides of box, unless plate has no sharp corners or edges.
 - D. Install with alignment tolerance to box of 1/16 inch.
 - E. Engrave with designated title.
 - F. Type (Unless Otherwise Shown)
 - 1. Office Areas: Metal.
 - 2. Other Areas: Metal.
 - 3. Exterior
 - a. Switch: Weatherproof.
 - b. Receptacle in Damp Location: Weatherproof Type 1.
 - c. Receptacle in Wet Location: Weatherproof Type 2.
 - G. Interior
 - 1. Flush Mounted Box: Metal.
 - 2. Surface Mounted, Metal Box
 - a. General Purpose Areas: Sheet Steel.
 - b. Other Areas: Cast.
 - 3. Surface Mounted, Aluminum Box

- a. General Purpose Areas: Stamped.
- b. Other Areas: Cast.
- 4. Surface Mounted, Sheet Steel Box: Raised sheet steel.
- 5. Surface Mounted, Nonmetallic Box: Manufacturer's standard.
- 6. Receptacle Shown as Weatherproof on Drawings: Weatherproof Type 1.

3.05 IDENTIFICATION

- A. Use tape labels for identification of individual wall switches and receptacles in dry indoor locations.
 - 1. Degrease and clean device plate surface to receive tape labels.
 - 2. Use 3/16-inch Kroy black letters on white background, unless otherwise indicated.
 - 3. Identify panelboard and circuit number from which item is served on face of plate.
- B. Identify conductors with durable wire markers or tags inside outlet boxes where more than one circuit is present.

3.06 FIELD QUALITY CONTROL

- A. Perform tests and inspections, and prepare test reports.
- B. Test Instrument for 125-Volt 20-Amp Receptacle: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.
- C. Using test plug, verify device and its outlet box are securely mounted.
- D. Line Voltage Range: 105 volts to 132 volts.
- E. Percent Voltage Drop under 15-Amp Load: Less than 6 percent; 6 percent or higher is not acceptable.
- F. Ground Impedance: 2 ohms, maximum.
- G. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
- H. Tests shall be diagnostic, indicating damaged conductors, high resistance at circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION

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SECTION 26 24 16
PANELBOARDS

PART 1 - GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. National Electrical Contractor's Association (NECA): 407, Recommended Practice for Installing and Maintaining Panelboards.
2. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - b. 289, Application Guide for Ground Fault Circuit Interrupters.
 - c. KS 1, Enclosed Switches.
 - d. PB 1, Panelboards.
 - e. PB 1.1, General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
3. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
4. Underwriters Laboratories, Inc. (UL)
 - a. 67, Standard for Panelboards.
 - b. 98, Standard for Enclosed and Dead-Front Switches.
 - c. 486E, Standard for Equipment Wiring Terminals for use with Aluminum and/or Copper Conductors.
 - d. 489, Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures.
 - e. 508, Standard for Industrial Control Equipment.
 - f. 870, Wireways, Auxiliary Gutters and Associated Fittings.
 - g. 943, Ground-Fault Circuit-Interrupters.
 - h. 1699, Standard for Arc-Fault Circuit-Interrupters.

1.02 SUBMITTALS

A. Action Submittals

1. Manufacturer's data sheets for each type of panelboard, protective device, accessory item, and component.
2. Manufacturer's shop drawings including dimensioned plan, section, and elevation for each panelboard type, enclosure, and general arrangement.
3. Tabulation of features for each panelboard to include the following:
 - a. Protective devices with factory settings.
 - b. Provisions for future protective devices.
 - c. Space for future protective devices.
 - d. Voltage, frequency, and phase ratings.
 - e. Enclosure type.
 - f. Bus and terminal bar configurations and current ratings.
 - g. Provisions for circuit terminations with wire range.
 - h. Short circuit current rating of assembled panelboard at system voltage.
 - i. Features, characteristics, ratings, and factory settings of auxiliary components.
 - j. Wiring and schematic diagrams detailing control wiring, and differentiating between manufacturer-installed and field-installed wiring.

1.03 QUALITY ASSURANCE

- A. Listing and Labeling: Provide products specified in this section that are listed and labeled as defined in NEC Article 100.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Materials, equipment, and accessories specified in this section shall be products of:
 1. Eaton/Cutler-Hammer.
 2. General Electric Co.
 3. Square D Co.
 4. Siemens.

2.02 GENERAL

- A. Provide low voltage panelboards for application at 600V or less in accordance with this section.
- B. Provide equipment in accordance with NEMA PB 1, NFPA 70, and UL 67.

C. Wire Terminations

1. Provide panelboard assemblies, including protective devices, suitable for use with 75 degrees C or greater wire insulation systems at NFPA 70, 75 degrees C conductor ampacity, and in accordance with UL 486E.
2. Lugs for termination of conductors shall comply with SECTION 26 05 53 – WIRES AND CABLES.

D. Load Current Ratings

1. Unless otherwise indicated, load current ratings for panelboard assemblies, including bus and circuit breakers, are noncontinuous as defined by NEC. Continuous ratings shall be 80 percent of noncontinuous rating.
2. Where indicated “continuous” or “100 percent”, selected components and protective devices shall be rated for continuous load current at value shown.

E. Short Circuit Current Rating (SCCR): Integrated equipment short circuit rating for each panelboard assembly shall be no less than the fault current available as shown at point of application in distribution system.

F. Series-Connected Short Circuit Current Ratings: Panelboards shall be fully rated; application of series-connected device ratings is unacceptable.

2.03 OVERCURRENT PROTECTIVE DEVICES

A. Overcurrent Device Mounting and Arrangement: Design panelboards to accommodate device installation and replacement without disturbing adjacent devices and without removing main bus.

B. Overcurrent Protective Devices: In accordance with NEMA KS 1, UL 98, and UL 489. Protective devices shall be adapted to panelboard installation.

C. Provisions for Future Overcurrent Device

1. Provide space, mountings and bus connections such that like device may be installed without additional hardware.
2. Panel openings shall be closed with individual removable cover for each provision for future device.
3. Unless otherwise indicated, “spaces” in panelboards shall be fully equipped provision for future like devices.
4. Provisions for future devices shall be suitable devices rated no less than 60 amperes.

D. Protective Device Locking: Furnish provisions for handle padlocking for main, subfeed, and branch devices where indicated.

E. Branch Protective Devices

1. Provide Wire Lug Load Connections: Mechanical or crimp compression type removable/replaceable, and suitable for 75 degrees C rated conductors without derating switch nor conductor ampacity.
2. Provide a nameplate for each circuit, blanks for spares.

2.04 CIRCUIT BREAKERS

- A. General: Thermal-magnetic unless otherwise indicated, quick-make, quick-break, molded case, of indicating type showing ON/OFF and TRIPPED positions of operating handle. Circuit breakers shall comply with SECTION 26 05 04 – BASIC ELECTRICAL MATERIALS AND METHODS.
- B. Bus Connection: Bolt-on circuit breakers in 480Y/277-volt, and plug-in circuit breakers in 208Y/120 and 240/120-volt panelboards.
- C. Trip Mechanism
 1. Individual permanent thermal and magnetic trip elements in each pole.
 2. Variable magnetic trip elements with a single continuous adjustment 3X to 10X for frames greater than 100 amps.
 3. Two and three pole, common trip.
 4. Automatically opens all poles when overcurrent occurs on one pole.
 5. Test button on cover.
 6. Calibrated for 40 degrees C ambient, unless shown otherwise.
- D. Unacceptable Substitution
 1. Do not substitute single-pole circuit breakers with handle ties for multi-pole breakers.
 2. Do not use tandem or dual circuit breakers in normal single-pole spaces.
- E. Specialty Breakers: Where indicated, provide breakers with the following features:
 1. Ground Fault Circuit Interrupter (GFCI): Rated to trip on 5-mA ground fault within 0.025 second (UL 943, Class A sensitivity, for protection of personnel). Ground fault sensor shall be rated same as circuit breaker. Breaker shall include push-to-test and reset buttons.
 2. Heating and Air Conditioning Rated (HACR): Where indicated, provide breaker UL listed for the protection of such equipment.
- F. Solid State Trip Units
 1. Long (Time) Short (Time) Instantaneous (LSI): Electronic trip unit with fixed long-time trip, adjustable short-time trip and delay, and adjustable instantaneous trip settings.
 2. Long (Time) Short (Time) Instantaneous Ground (Fault) (LSIG): Electronic trip unit as above and also with adjustable ground fault trip and delay settings.

G. Fused Switch

1. Quick-make, quick-break, motor rated, load-break, heavy-duty (HD) type with external markings clearly indicating ON/OFF positions.
2. UL 98 listed for use and location of installation and comply with NEMA KS 1.
3. Fuse Provisions
 - a. 30-amp to 600-amp rated shall incorporate rejection feature to reject all fuses except Class R.
 - b. 601-amp rated and greater shall accept Class L fuses, unless otherwise shown.
4. Interlock fuse cover and switch to prevent opening cover with switch in ON position. Provide bypass feature for use by qualified personnel.
5. Fuses: Provide for each ungrounded circuit conductor as specified in SECTION 26 05 04 – BASIC ELECTRICAL MATERIALS AND METHODS.

2.05 ENCLOSURES

A. General

1. Provide as specified in SECTION 26 05 04 – BASIC ELECTRICAL MATERIALS AND METHODS.
2. Type 1, Type 3R, and Type 3S material code-gauge, hot-dip galvanized sheet steel with reinforced steel frame.
3. Provide surface-mount panelboard from trim with same dimensions as box front.

B. Finish: Rust inhibitor prime followed by manufacturer's standard gray baked enamel or lacquer. NEMA Type 1 enclosure box may be unfinished galvanized sheet steel

C. NEMA 250 Type 1 Branch Panelboard Enclosure

1. Secure front trim to box with concealed trim clamps.
2. Overlap flush panelboards front trims with box nominal 3/4 inch on all sides.
3. Provide door in panelboard front trim, with concealed hinges, to access protective device operating handles.
4. Provide multi-point latching for doors over 30 inches in height.
5. Door Lock: Secure with flush catch and tumbler lock; all panelboards keyed alike, with two milled keys each lock.
6. Circuit Directory: Metal frame with transparent plastic face and enclosed card, mounted inside each panel door.

- D. Multi-Section Panelboards: Where more than one section is required, provide multiple panelboard sections with separate fronts.
1. Sections shall be suitable for individual mounting to be field interconnected to form a single electrical unit.
 2. Recessed-mount sections of the same panel shall all have the same size tubs and flush covers.
 3. Surface-mount multi-section panelboards may be comprised of sections of unequal heights.
 4. Provide feed-through and main lugs in individual sections as required for field assembly of a complete multi-section panelboard. Unless otherwise indicated, provide feed-through lugs on each section but last.
 5. Provide neutral and ground terminal bars in each section.

2.06 BUSSING AND TERMINAL BARS

- A. Bus
1. Material: Tin-plated copper full sized throughout length.
 2. Provide for mounting of future protective devices along full length of bus regardless of number of units and spaces shown. Machine, drill, and tap as required for current and future positions.
- B. Equipment Ground Terminal Bus: Copper with suitably sized provisions for termination of ground conductors, and bonded to box.
1. Provide individual mechanical termination points no less than the quantity of breaker pole positions.
 2. Provide individual termination points for all other grounding conductors such as feeder, grounding electrode, etc.
 3. Termination points shall be bolted crimp compression lugs for conductors 6 AWG and larger.
- C. Neutral Terminal Bus: Copper with suitably sized provisions for termination of neutral conductors, and isolated from box.
1. Provide individual mechanical termination points no less than the quantity of breaker pole positions.
 2. Provide individual termination points for all other neutral conductors.
 3. Termination Points: Bolted crimp compression lugs for conductors 6 AWG and larger.
- D. Provision for Future Devices: Equip with mounting brackets, bus connections, and necessary appurtenances for future protective device ampere ratings indicated.

2.07 SPECIAL FEATURES

- A. General: Where indicated on Drawings or schedules, provide special features as specified.
- B. Service Equipment Approval: Listed for use as service equipment for panelboards having service disconnecting means.
- C. Isolated Equipment Ground Terminal Bar
 - 1. Provide in addition to equipment ground terminal bar specified above.
 - 2. Insulated from box.
 - 3. Provide individual conductor termination points equal to quantity of breaker pole positions plus all feeder, subfeed, and feed-through isolated ground conductors.
- D. Controls
 - 1. Provide controls in accordance with UL 508.
 - 2. Controls: Class I, 120V ac.
 - 3. Control circuits shall be protected by fuse or circuit breaker.
- E. Magnetic Contactor
 - 1. Comply with SECTION 26 05 04 – BASIC ELECTRICAL MATERIALS AND METHODS.
 - 2. Provide with current rating, poles, and connections (mains or between split bussing) indicated.
 - 3. Electrically held with 120V ac coil.
 - 4. Include at least one convertible (NO or NC) auxiliary contact and coil clearing auxiliary contacts for mechanically held contactors
- F. Control Transformer
 - 1. Provide for contactor, shunt trip, or other devices as required.
 - 2. Capacity: 125 percent of maximum burden plus 100VA.
 - 3. Mount in cabinet of panelboard.
 - 4. Provide primary and secondary fused protection.
- G. Extra Gutter Space: Dimensions and arrangement indicated.
- H. Gutter Barrier: Arranged to isolate section of gutter as shown.
- I. Subfeed: Protective device or lugs indicated, with additional terminals on neutral and ground bus to accommodate feeder.

- J. Feed-Through Lugs: At opposite end of phase bus from mains, with additional terminals on neutral and ground buses, sized to accommodate feeders indicated.
- K. Double Main Lugs: Furnish additional terminals on neutral and ground buses, sized to accommodate feeders indicated.
- L. Surge Arresters
 - 1. Provide protective device within panelboard as disconnecting means and short circuit protection per manufacturer's recommendation.
 - 2. Provide factory mounting within panelboard utilizing UL-recognized mounting device.
- M. Fire Alarm Circuits: Identify all branch circuits feeding fire detection and alarm panels and equipment with a red, engraved to white core, plastic nameplate attached to the individual branch circuit breakers. Engrave nameplates with "FIRE ALARM CIRCUIT".

PART 3 - EXECUTION

3.01 GENERAL

- A. Install in accordance with NECA 407, NEMA PB 1.1, and manufacturers' written installation instructions.
- B. Install securely, plumb, in-line and square with walls.
- C. Install top of cabinet trim 78 inches above floor, unless otherwise shown. Install cabinet so tops of protective device operating handles are no more than 78 inches above the floor.
- D. Ground Fault Protection: Install panelboard ground fault circuit interrupter devices in accordance with installation guidelines of NEMA 289.
- E. Install filler plates in unused spaces.
- F. Wiring in Panel Gutters: Train conductors neatly in groups; bundle and wrap with nylon wire ties.
- G. Mount flush panels uniformly flush with wall finish.
- H. Provide typewritten circuit directory for each panelboard.
- I. Provide engraved identification for each protective device.

END OF SECTION

SECTION 26 56 29

LIGHTING

PART 1 - GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. 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. A572/A572A, Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
 - d. A588/A588M, Standard Specification for High-Strength Low-Alloy Structural Steel, with 50 ksi [345 MPa] Minimum Yield Point to 4-in. [100-mm] Thick.
 - e. A595/A595M, Standard Specification for Steel Tubes, Low-Carbon or High-Strength Low-Alloy, Tapered for Structural Use.
 - f. A615/A615M, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - g. A1011/A1011M, 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.
 - h. D6576, Standard Specification for Flexible Cellular Rubber Chemically Blown.
 - i. G154, Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials.
2. American Wood Protection Association (AWPA): M6, Brands Used on Forest Products.
3. Certified Ballast Manufacturer (CBM).
4. Federal Communications Commission (FCC).
5. Illuminating Engineering Society of North America (IESNA).
 - a. HB-9, Lighting Handbook.
 - b. LM-79, IES Electrical and Photometric Measurements of Solid-State Lighting Products.

- c. LM-80, IESNA Approved Method for Measuring Lumen Maintenance of LED Light Sources.
- d. RP (Recommended Practices) Series.
- e. TM-21, Projecting Long Term Lumen Maintenance of LED Light Sources.
- 6. Institute of Electrical and Electronics Engineers (IEEE): C62.41, Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
- 7. National Electrical Manufacturers Association (NEMA):
- 8. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
- 9. ICS 6, Industrial Control and Systems: Enclosures.
- 10. National Energy Policy Act.
- 11. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC) – Softbound Version.
- 12. Rural Utilities Service (RUS): 1728F-700, Specification for Wood Poles, Stubs and Anchor Logs.
- 13. Underwriters Laboratories, Inc. (UL)
 - a. 773, UL Standard for Safety Plug-In Locking Type Photocontrols for Use with Area Lighting - Fourth Edition; Reprint with Revisions Through and Including March 08, 2002.
 - b. 844, Electric Lighting Fixtures for Use in Hazardous (Classified) Locations.
 - c. 924, Emergency Lighting and Power Equipment.
 - d. 1598, UL Standard for Safety Luminaires.
 - e. 2108, UL Standard for Safety Low Voltage Lighting Systems - First Edition; Reprint with Revisions through and Including February 24, 2014.
 - f. 8750, UL Standard for Safety Light Emitting Diode (LED) Equipment for Use in Lighting Products - First Edition; Reprint with Revisions Through and Including April 1, 2015.
- 14. U.S. Environmental Protection Agency and U.S. Department of Energy: Energy Star.

1.02 SUBMITTALS

A. Action Submittals

- 1. Shop Drawings
 - a. General

- 1) Provide catalog data sheets and pictures for all products listed below.
 - 2) Proposed Luminaire Substitutions (Interior and Exterior): Provide an electronic photometric file in standard '.ies' file format per the Illumination Engineering Society of North America (IESNA) for any proposed luminaire substitution not identified on the project Luminaire Schedule. Obtain file from the luminaire manufacturer or approved independent photometric testing laboratory. Include the proposed substitute luminaire with all options identified on the project Luminaire Schedule.
- b. Interior Luminaires
- 1) Catalog data sheets with pictures.
 - 2) Luminaire material, finish, dimensions, and metal gauge.
 - 3) Lens material, pattern, and thickness.
 - 4) Candle power distribution curves in two or more planes.
 - 5) Candle power chart 0 degree to 90 degrees.
 - 6) Lumen output chart.
 - 7) Average maximum brightness data in foot lamberts.
 - 8) Coefficients of utilization for zonal cavity calculations.
 - 9) Mounting or suspension details.
- c. Exterior Luminaires
- 1) Catalog data sheets with pictures. Luminaire material, finish, dimensions, and metal gauge.
 - 2) Lens material, pattern, and thickness. Filters.
 - 3) IESNA lighting classification (BUG rating).
 - 4) Isolux diagram.
 - 5) Lighting distribution data and lighting distribution classification type as defined in IESNA HB 9.
 - 6) Fastening details to wall, pendant, or pole.
 - 7) Ballast type, location, and method of fastening.
 - 8) For light poles, submit catalog sheet, wind loading, pole deflection with fixture attached, total weight, all accessories, complete dimensions, and finish.

- 9) For concrete poles, include section and details to indicate quantities and position of prestressing steel, spiral steel, inserts, and through holes, initial prestressing steel tension, and concrete strengths at release and at 28 days.
- 10) Documentation for Energy Star qualifications for equipment provided under this section.
- 11) Brackets and supports.
- 12) Pole foundations.

d. Lamps

- 1) Voltages.
- 2) Watts.
- 3) Correlated Color Temperature (CCT).
- 4) Color Rendering Index (CRI).
- 5) Published rated life (in hours). Provide number of hours per start and operating temperature for published rated life hours indicated.
- 6) Published rated initial and mean lumens.
- 7) Lumen maintenance curve.
- 8) Lamp type (ANSI designation, dimensions, shape, and base).

e. Ballasts

- 1) Type.
- 2) Wiring diagram.
- 3) Ballast factor.
- 4) Nominal watts and input watts.
- 5) Input voltage and power factor.
- 6) Starting current, line current, and restrike current values.
- 7) Sound rating.
- 8) Temperature rating.
- 9) Efficiency ratings.
- 10) Low temperature characteristics.
- 11) Emergency Ballasts

- a) Electrical ratings.
 - b) Lamp type compatibility.
 - c) Battery capacity.
- 12) Dimming Ballasts: Operating principle (0V to 10V, etc.), dimming range, manufacturer certification for operation with proposed dimmers.
- f. LED Source Systems
 - 1) General
 - a) IESNA LM-80 test reports.
 - b) IESNA TM-21 ratings.
 - c) Operating temperature range. Data sheet (chart/graph) describing life as a function of temperature.
 - d) Warranty: Light engine and driver.
 - e) Rated life.
 - f) Surge protection.
 - g) Thermal control device, heat sink.
 - h) Enclosure and wiring information.
 - i) Operating voltage range.
 - 2) Electronic Module/Light Engine
 - a) Correlated Color Temperature (CCT).
 - b) Color Rendering Index (CRI).
 - 3) Drivers
 - a) Input Current Total Harmonic Distortion.
 - b) Power factor.
 - c) Sound rating.
 - d) Dimming system information.
- g. Time Switches
 - 1) Wiring diagram.
 - 2) Contact ratings.

- 3) Functional features.
- 4) Programmable capabilities.
- 5) Enclosure type, dimensions.
- h. Lighting Contactor
 - 1) Type (mechanically or electrically held).
 - 2) Enclosure.
 - 3) Contact ratings and configuration.
 - 4) Coil operating voltage.
- i. Photoelectric Switches (Photocells)
 - 1) Voltage.
 - 2) Power consumption.
 - 3) Load capacity (watts).
 - 4) Contact ratings and configuration.
 - 5) Time delay.
 - 6) Light operating level controls.
 - 7) Enclosure type and dimensions.
 - 8) Mounting type.
 - 9) Temperature range.
 - 10) Features and options.
- j. Photo Sensors/Controls for Daylight Harvesting Control
 - 1) System description, overall functionality.
 - 2) Each component.
 - 3) Electrical ratings (voltage, amperage, watts).
 - 4) Wiring diagrams.
 - 5) Programming.
 - 6) Testing.
- k. Wall box dimmers.

- l. Dimming systems.
- m. Occupancy Sensors
 - 1) Type.
 - 2) Switching capacity.
 - 3) Coverage.
 - 4) Time delay AUTO/OFF adjustment.
- n. Low Voltage Remote Control Wiring System
 - 1) Type.
 - 2) Switching capacity.
 - 3) Voltage rating.
 - 4) Wiring diagrams.
- o. Outdoor Motion Sensors.
- p. Emergency Shunt Relay.
- q. High mast lighting.
- r. Standby lighting panel.
- s. Luminaire lowering device.
- t. Landscape Lighting
 - 1) Luminaires.
 - 2) Controls.
 - 3) Transformers.
 - 4) Wiring

B. Informational Submittals

- 1. Manufacturer's printed installation instructions.

1.03 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ)

- 1. Provide Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, provide material and equipment labeled or listed by a nationally

recognized testing laboratory or other organization acceptable to the AHJ to provide a basis for approval under NEC.

2. Provide materials and equipment manufactured within the scope of standards published by Underwriters Laboratories, Inc. in conformance with those standards and with an applied UL listing mark.

B. Standard Products

1. Provide materials and equipment of manufacturers regularly engaged in the production of products specified in this section and that are of equal material, design, and workmanship.
2. Provide products that have been in satisfactory commercial or industrial use for 2 years prior to Bid opening in similar applications under similar circumstances and of similar size. Provide products that have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period.
3. Material and Equipment Manufacturing Date: Do not use products manufactured more than 3 years prior to date of delivery to Site.

C. Preinstallation Meeting

1. Occupancy Sensors: Arrange preinstallation meeting with manufacturer's factory authorized representative at Owner's facility, to verify placement of sensors and installation criteria.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Wood Poles

1. Stack poles if stored for more than 2 weeks on decay-resisting skids arranged to support poles without producing noticeable distortion.
2. Store poles to permit free circulation of air; support so that bottom poles in stack are at least 1 foot above ground level and growing vegetation.
3. Do not permit decayed or decaying wood to remain underneath stored poles.
4. Do not drag treated poles along the ground.
5. Do not use pole tongs, cant hooks, and other pointed tools capable of producing indentation more than 1 inch in depth in handling the poles.
6. Do not apply tools to the ground-line section of pole.

B. Concrete Poles

1. Do not store poles on ground.
2. Support poles so they are at least 1 foot above ground level and growing vegetation.
3. Ship poles with bolt circle template, base cover, handhold cover, and shaft cap or tenon.

C. Aluminum and Steel Poles

1. Provide manufacturer's standard protection for the finish during shipment and installation. At minimum, spirally wrap each pole shaft with protective paper secured with tape, and ship small parts in boxes.
2. Do not store poles on ground.
3. Support poles so they are at least 1 foot above ground level and growing vegetation.
4. Do not remove factory-applied pole wrappings until just before installing pole.
5. Ship poles with bolt circle template, base cover, handhold cover, and shaft cap or tenon.

D. Fiberglass Poles

1. Do not store poles on ground.
2. Support poles so they are at least 1 foot above ground level and growing vegetation.
3. Do not remove factory-applied pole wrappings until just before installing pole.
4. Ship poles with bolt circle template, base cover, handhold cover, and shaft cap or tenon.

PART 2 - PRODUCTS

2.01 LUMINAIRES

- A. Specific requirements relative to execution of the Work of this section are located in Luminaire Schedule: on Drawings.
- B. Provide luminaires and components tested, listed, and labeled by UL, or other approved testing agency.
- C. Provide luminaires with Illumination Engineering Society of North America (IESNA) formatted photometric files, ".ies" format, certified by the luminaire manufacturer for use with lighting software.
- D. Luminaire Labels
 1. External label per ANSI C136.15.
 2. Internal label per ANSI C136.22.
- E. Provide luminaires rated by the manufacturer to start and operate to their full lumen capacity for rated life of the luminaire at the minimum low and maximum high ambient temperatures as defined in the Contract Documents at their installation location.
- F. Feed-through type, or separate junction box.
- G. Fluorescent Ballasts: Two-lamp when possible, unless noted otherwise.
- H. Wire Leads: Minimum 18 AWG.

- I. Component Access: Accessible and replaceable without removing luminaire from ceiling.
- J. Soffit Installations (Interior or Exterior Damp Locations)
 - 1. UL Labeled: SUITABLE FOR DAMP LOCATIONS.
 - 2. Ballast: Removable, prewired.
- K. Exterior Installations
 - 1. UL Labeled: SUITABLE FOR WET LOCATIONS.
 - 2. Ballast: Removable, prewired.
 - 3. When factory-installed photocells are provided, entire assembly shall have UL label.
- L. Marine Environments
 - 1. UL Labeled: MARINE, OUTSIDE TYPE.
 - 2. Housing: Copper-free, aluminum in accordance with UL 595.
- M. Illuminated Exit Signs
 - 1. Body: As scheduled.
 - 2. Face: Translucent.
 - a. Letters
 - 1) 6-inch high by 3/4-inch stroke.
 - 2) Color: Green.
 - 3. Mounting: Universal.
 - 4. Directional Arrows: As indicated on Drawings.

2.02 LED SOURCE SYSTEMS

A. General

- 1. Provide IESNA LM-80 test reports.
- 2. Provide Energy Star compliance for solid state luminaires.
- 3. Listed To: UL 8750 Standard for Safety for Light Emitting Diode (LED) Equipment for use in Lighting Products.
- 4. Provide RoHS compliant LED light source(s) and driver(s).
- 5. Rated operating temperature range as indicated on the Luminaire Schedule.

6. Warranty: 5 years minimum.

B. Electronic Module/Light Engine

1. Mount all components to a single plate and factory prewired with quick-disconnect plugs.
2. Include a driver, thermal control device, thermal protector device, and surge protector device.
 - a. Provide surge protector tested in accordance with IEEE/ANSI C62.41.2 to Category C Low.
3. Provide LEDs mounted to a metal-core circuit board and aluminum heat sink for optimal thermal management and long life.

C. Drivers

1. Expected life of 100,000 hours at 25 degrees C
2. Provide drivers mounted in an all metal can.
3. Operating Voltage Range: 50/60-Hz input source 120V to 277V with sustained variations of plus or minus 10 percent voltage with no damage to the driver.
4. Input Current Total Harmonic Distortion: Less than 20 percent up to 50 percent of full load rating.
5. Power Factor: Greater than 0.90 for primary application up to 50 percent of full load rating.
6. Sound rating: Class A.
7. Comply with NEMA 410 for inrush current limits.
8. Dimming
 - a. Continuously dimmable from 0 percent to 100 percent.
 - b. Dimming Control: 0V to 10V.
 - c. Provide driver compatible with standalone dimming controls and/or dimming systems used.

2.03 LIGHTING CONTROL

A. Photoelectric Switch (Photocell)

1. Automatic Solid State ON/OFF Switching Photo Control
 - a. Dry Contacts
 - 1) Configuration: SPST.
 - 2) Rating: 1,000VA inductive.

- 3) Compatible with connected load device indicated on Drawings.
2. Housing: Self-contained, die-cast aluminum, unaffected by moisture, vibration, or temperature changes.
3. Mounting Type: 1/2-inch conduit entry.
4. Setting: ON at dusk and OFF at dawn.
5. Time delay feature to prevent false switching.
6. Field adjustable to control operating light levels.
7. Integral surge protection.
8. Manufacturers
 - a. Tork.
 - b. Intermatic.
 - c. Paragon Electric Company.

2.04 POLES

A. General

1. Design for wind load as required for the project site, while supporting luminaires and other appurtenances. Use effective projected areas (EPA) of luminaires and appurtenances in calculations specific to the actual products proposed on each pole.
2. Poles 40 feet and Shorter: One-piece construction.
3. Pole Height: As indicated on Luminaire Schedule.
4. Handhole
 - a. Except for wood poles, Provide oval-shaped handhole having a minimum clear opening of 2.5 inches by 5 inches.
 - b. Secure cover with stainless steel captive screws.
 - c. Metal Poles: Provide an internal grounding connection accessible from handhole near bottom of each pole.
5. Do not install scratched, stained, chipped, or dented poles.

B. Steel Poles

1. Minimum 11-gauge steel with minimum yield/strength of 48,000 psi and hot-dipped galvanized factory finish.

2. Provide pole grounding connection designed to prevent electrolysis when used with copper ground wire.
3. Square poles shall be hinged.
4. Tapered tubular members, either round in cross section or polygonal.
5. Provide one-piece pole shafts of welded construction with no bolts, rivets, or other means of fastening except as specifically approved.
6. Pole Markings: Approximately 3 feet to 4 feet above grade and include manufacturer, year of manufacture, top and bottom diameters, and length.
7. Base Covers: Structural quality hot-rolled carbon steel plate having a minimum yield of 36,000 psi.

2.05 BRACKETS AND SUPPORTS

A. Features

1. Not less than 1-1/4-inch galvanized steel pipe secured to pole.
2. Slip-fitter or pipe-threaded brackets may be used, but coordinate brackets to luminaires provided. Provide identical brackets for use with one type of luminaire unless otherwise approved by Engineer.
3. Select brackets for pole-mounted street lights to correctly position luminaire no lower than mounting height indicated.
4. Mount brackets not less than 24 feet above street.
5. Provide special mountings or brackets as indicated on Drawings fabricated of metal which will not promote galvanic reaction with luminaire head.

2.06 POLE FOUNDATIONS

- A. Anchor Bolts: Steel rod having a minimum yield strength of 50,000 psi; at minimum, galvanize the top 12 inches of the rod.
- B. Concrete: As specified in Section 03300, Cast-in-Place Concrete.

2.07 LANDSCAPE LIGHTING

- A. Not used.

2.08 EQUIPMENT IDENTIFICATION

- A. Manufacturer's Nameplate: Provide each item of equipment with a nameplate bearing manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; nameplate of distributing agent will not be acceptable.
- B. Provide clear markings located to be readily visible to service personnel.

2.09 FACTORY FINISH

- A. Provide electrical equipment with factory-applied painting systems that, at minimum, meet the requirements of NEMA 250 corrosion-resistance test.

PART 3 - EXECUTION

3.01 LUMINAIRES

A. General

1. Install in accordance with manufacturer's recommendations.
2. Provide additional ceiling bracing, hanger supports, and other structural reinforcements to building and to concrete pole bases required to safely mount.
3. Install plumb and level.
4. Install each luminaire outlet box with galvanized stud.

B. Mounting

1. General

- a. Coordinate mounting, fastening, and environmental conditions with Section 26 05 04, Basic Electrical Materials and Methods Requirements.

2. Wall Mounted: Measure mounting heights from center of mounting plate to finished floor or finished grade, whichever is applicable.

3. Pendant Mounted

- a. Provide swivel type hangers and canopies to match luminaires, unless otherwise noted.
- b. Space single-stem hangers on continuous-row fluorescent luminaires nominally 48 inches apart.
- c. Provide twin-stem hangers on single luminaires.
- d. Measure mounting heights from bottom of luminaire to finished floor or finished grade, whichever is applicable.

4. Pole Mounted

- a. Provide precast concrete base.
- b. Provide branch circuit in-line fuses in pole base handhole.

- C. Swinging Type: Provide, at each support, safety cable capable of supporting four times vertical load from structure to luminaire.

D. Finished Areas

1. Install symmetrically with tile pattern.
 2. Locate with centerlines either on centerline of tile or on joint between adjacent tile runs.
 3. Install recessed luminaires tight to finished surface such that no spill light will show between ceilings and sealing rings.
 4. Combustible Low Density Cellulose Fiberboard: Provide spacers and mount luminaires 1-1/2 inches from ceiling surface, or use fixtures suitable for mounting on low density ceilings.
 5. Junction Boxes
 - a. Flush and Recessed Luminaires: Locate minimum 1-foot from luminaire.
 - b. In concealed locations, install junction boxes to be accessible by removing luminaire.
 6. Wiring and Conduit
 - a. Provide wiring of temperature rating required by luminaire.
 - b. Provide flexible steel conduit.
 7. Provide plaster frames when required by ceiling construction.
 8. Independent Supports
 - a. Provide each recessed fluorescent luminaire with two safety chains or two No. 12 soft-annealed galvanized steel wires of length needed to secure luminaire to building structure independent of ceiling structure.
 - b. Select chain or wire with tensile strength and method of fastening to structure adequate to support luminaire weight.
 - c. Fasten chain or wire to each end of luminaire.
 - E. Unfinished Areas: Locate luminaires to avoid conflict with other building systems or blockage of luminaire light output.
 1. Fixture Suspension: Provide 1/4 inch threaded steel hanger rods. Scissor type hangers not permitted.
 2. Attachment to Steel Beams: Provide flanged beam clips and straight or angled hangers.
 - F. Building Exterior: Flush-mounted back box and concealed conduit, unless otherwise indicated.
- 3.02 LAMPS
- A. Provide in each fixture, number and type for which fixture is designed, unless otherwise noted.

3.03 BALLASTS

- A. Install in accordance with manufacturer's recommendations.
- B. Utilize all ballast mounting holes to fasten securely within luminaire.
- C. Replace noisy or defective ballasts.

3.04 LIGHTING CONTROL

- A. Outdoor Luminaires: Photocells switch lights ON at dusk and OFF at dawn.

3.05 POLES

- A. Electrical Installations: Conform to IEEE C2 and requirements specified herein.
- B. Pole Setting
 - 1. Depth: As indicated on Drawings or footing detail.
 - 2. Install poles in straight runs in a straight line.
- C. Wood Poles: Provide pole holes at least as large at the top as at the bottom and large enough to provide 4 inches of clearance between pole and side of hole.
 - 1. Setting Depth

Length of Pole (feet)	Setting in Soil (feet)
20	5.0
25	5.5
30	5.5
35	6.0
40	6.0
45	6.5
50	7.0
55	7.5
60	8.0

- 2. Soil Setting: Depths shall apply where pole holes are in soil, sand, or gravel or any combination of these.
- 3. Setting on Sloping Ground: On sloping ground, measure depth of hole from low side of hole.
- 4. Backfill: Tamp pole backfill for the full depth of hole and mound excess fill around pole.
- 5. Dig holes large enough to permit the proper use of tampers to the full depth of the hole.
- 6. Place backfill in the hole in 6-inch maximum layers and thoroughly tamp.

7. Place surplus earth around the pole in a conical shape and pack tightly to drain water away.
- D. Steel Poles: Install according to pole manufacturer's instructions.
 1. Provide precast concrete base.
- E. High Mast Lighting: Install according to manufacturer's instructions.
- F. Photocell Switch Aiming: Mount and aim switch according to manufacturer's recommendations.
- G. Grounding: Ground noncurrent-carrying parts of equipment including metal poles, luminaires, mounting arms, brackets, and metallic enclosures as specified in Section 26 05 26, Grounding and Bonding. Where copper grounding conductor is connected to a metal other than copper, provide specially treated or lined connectors suitable for this purpose.

3.06 LANDSCAPE LIGHTING

- A. General: Electrical work and installation shall be in accordance with Article 411 of the NEC.
- B. Installation
 1. Aboveground
 - a. Locate wire, hardware, and fixtures so as to allow for “normal” unobstructed plant growth with attention paid to the following:
 - 1) Hardware or fixtures should not be mounted in such a way that wire needs to be routed through a tree branch or trunk union.
 - 2) Branches or trunks should not be encircled with wire or other hardware.
 - 3) Maintain 10 inches minimum between new and existing installations of tree hardware.
 - b. Protect wire by PVC conduit or water-resistant flexible conduit to a minimum of 8 feet abovegrade.
 - c. Make connections in approved junction boxes.
 - d. Secure conduit to tree with appropriate approved clips and hardware.
 - 1) Wire is to be fastened only with galvanized wire staples which have standoff nubs.
 - 2) Do not drive staples into tree past the standoff nubs to avoid pinching wire. Leave wire loose to allow for tree sway, tree growth, and wire expansion and contraction.
 - e. Leave 10-inch slack or service loop at each end junction or fixture to allow:
 - 1) Wire contraction.
 - 2) Servicing.

3) Relocation.

2. Belowgrade Wiring

a. Excavating and Backfill

- 1) Excavate trenches for electrical conduit and wiring of sufficient width to permit proper handling and installation of pipe and fittings.
- 2) Trenches containing conduit for line voltage wiring must have a minimum cover of at least 15 inches wherever possible and 18 inches minimum in vehicle areas.
- 3) Trenches containing conduit for low voltage wiring must have a minimum cover of at least 6 inches wherever possible.
- 4) Compact backfill up to original grade level to 90 percent of the modified Proctor density.

b. Pulling

- 1) Size pull boxes in accordance with Section 26 05 33 Raceways and Boxes.
- 2) Keep interior of conduit free from dirt and debris.

c. Underground Conduit: Install per Section 26 05 33, Raceways and Boxes

d. Pull Boxes and Junction Boxes

- 1) Install in accordance with Section 26 05 33, Raceways and Boxes.
- 2) Boxes shall remain accessible at all times.

3.07 FIELD FINISHES

- A. Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Paint as specified in Section 09915a, Protective Coating.

3.08 FIELD QUALITY CONTROL

- A. Upon completion of installation, verify equipment is properly installed, connected, and adjusted. Conduct an operating test to show equipment operates in accordance with the requirements of this section.
- B. Coordinate lighting and controls installation and testing with commissioning as specified in Section 01400, Quality Control.

3.09 CLEANING

- A. Remove labels and markings, except UL listing mark.
- B. Wipe luminaires inside and out to remove construction dust.

- C. Clean luminaire plastic lenses with antistatic cleaners only.
- D. Touch up painted surfaces of luminaires and poles with matching paint ordered from manufacturer.
- E. Replace defective lamps at time of Substantial Completion.

END OF SECTION

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SECTION 31 00 00

EARTHWORK

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Drawings and general provisions of the Contract, including General Terms and Conditions section, apply to this Section.
- B. Requirements of the Geotechnical reports, project drawings and other specifications shall govern over the requirements in this specification.

1.02 RELATED WORK

- A. This Section includes the following:
 - 1. Preparing subgrades for slabs-on-grade, walks, and pavements.
 - 2. Excavating and backfilling for buildings and structures.
 - 3. Subbase course for concrete walks and pavements.
 - 4. Subsurface drainage backfill for walls and trenches.
 - 5. Excavating and backfilling for utility trenches.
 - 6. Excavating and backfilling trenches for buried mechanical and electrical utilities and pits for buried utility structures.
- B. Related Sections include the following:
 - 1. SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS for temporary controls, utilities, and support facilities.
 - 2. SECTION 31 10 00 - SITE CLEARING for temporary erosion and sedimentation control measures, site stripping, grubbing, stripping, and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.

1.03 DEFINITIONS

- A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
- B. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
- C. Final Backfill: Backfill placed over initial backfill to fill a trench.
- D. Base Course: Course placed between the subbase course and hot-mix asphalt paving.
- E. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.
- F. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

- G. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
- H. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by ENGINEER. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
- I. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by ENGINEER. Unauthorized excavation, as well as remedial work directed by ENGINEER, shall be without additional compensation.
- J. Fill: Soil materials used to raise existing grades.
- K. Spoil Material: Satisfactory excavated material in excess of the amount required for backfill or site grading.
- L. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- M. Subbase Course: Course placed between the subgrade and base course for hot-mix asphalt pavement, or course placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
- N. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.
- O. Topsoil: On-site material, 4 in. in depth (unless otherwise described in drawings or other specification sections) stripped from designated borrow areas as shown by ENGINEER. If no approved material is available, CONTRACTOR shall import material approved by ENGINEER.
- P. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.04 SUBMITTALS

- A. Product Data: For the following:
 - 1. Each type of plastic warning tape.
 - 2. Geotextile.
 - 3. Controlled low-strength material, including design mixture.
- B. One (1) electronic copy in Portable Document Format (PDF) of all submittals and re-submittals shall be submitted suitable for distribution over electronic mail or File Transfer Protocol (FTP). For final approved submittals provide PDF and two (2) hard copies.

1.05 QUALITY ASSURANCE

- A. Geotechnical Testing Agency Qualifications: An independent testing agency qualified according to ASTM E 329 to conduct soil materials and rock-definition testing, as documented according to ASTM D 3740 and ASTM E 548.

1.06 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by OWNER or others unless permitted in writing by ENGINEER and then only after arranging to provide temporary utility services according to requirements indicated.
 - 1. Notify ENGINEER not less than four (4) days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without ENGINEER'S written permission.
 - 3. Contact utility-locator service for area where Project is located before excavating.
- B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies or OWNER to shut off services if lines are active.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

- A. General: Provide all borrow soil materials from on-site borrow areas if available and approved by ENGINEER. Off-site material, if necessary, shall be imported by the CONTRACTOR, as approved by ENGINEER.
- B. Satisfactory Soils: ASTM D 2487 Soil Classification Groups SC, GW, GP, GM, SW, SP, and SM, or a combination of these groups; free of rock or gravel larger than 3 in. dimension in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- C. Unsatisfactory Soils: Soil Classification Groups GC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487 or a combination of these groups.
 - 1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. Reconditioned Fill: Reference the Geotechnical Reports.
- E. General Fill: Reference the Geotechnical Reports.
- F. Pipe Bedding Course: #57 crushed stone per ASTM C-33, unless shown otherwise on the drawings. This material shall be used in the entirety of the pipe bedding envelope and where shown on the plans.
- G. Select Fill: Reference the Geotechnical Reports.
- H. Drainage Course: ASTM C-33 #57 crushed stone completely wrapped in Mirifi 140N or 160N filter fabric. The drainage course shall be installed where shown on the plans and accordance with the details provided.
- I. Sand: ASTM C 33; fine aggregate, natural, or manufactured sand.

2.02 CONTROLLED LOW-STRENGTH MATERIAL (FLOWABLE FILL)

- A. Controlled Low-Strength Material: Low-density, self-compacting, flowable concrete material as follows:
1. Portland Cement: ASTM C 150, Type [II].
 2. Fly Ash: ASTM C 618, Class C or F.
 3. Fine Aggregate: All fine aggregate shall conform to the grading and quality requirements of ASTM C33.
 4. Coarse Aggregate: Coarse aggregate shall conform to the grading and quality requirements of ASTM C33 for size No. 476, No. 57, or No. 67.
 5. Water: The batch mixing water and mixer washout water shall conform to the requirements of ASTM C94.
 6. Chemical admixtures that do not contain calcium chloride and conform to ASTM C494/C494M for concrete may be used in the CLSM mix.
 7. All chemical admixtures shall be compatible with the cement and all other admixtures in the batch.
- B. Produce low-density, controlled low-strength material with the following physical properties:
1. Strength: CLSM shall have a minimum twenty-eight (28) day compressive strength of three hundred (300) psi when molded and cured as in conformance with ASTM D4832.
 2. The CLSM shall have a minimum cement content of eighty (80) pounds per cubic yard. The water-cementitious materials ratio of the mix shall not exceed three and one-half to one (3.5:1).
 3. Air-Entrainment: All CLSM shall be air entrained to a total air content of approximately five percent (5%).
 4. Slump: The minimum slump shall be seven (7) inches and the maximum slump shall be nine (9) inches when tested in accordance with ASTM D6103.
 5. Aggregate: Fine aggregate shall be between fifty percent (50%) and sixty percent (60%) by volume of the total aggregates in the CLSM mix.
 6. The consistency of the CLSM slurry shall be such that the material flows easily into all openings between the pipe and the lower portion of the trench.
 - a. When trenches are on a steep slope, a stiffer mix of slurry may be required to prevent CLSM from flowing down the trench.
 - b. When a stiffer mix is used, vibration shall be performed to ensure that the CLSM slurry completely fills all spaces between the pipe and the lower portion of the trench.

2.03 ACCESSORIES

- A. Detectable Warning Tape: Acid and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 in. wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 in. deep; colored as follows:
1. Red: Electric.
 2. Yellow: Gas, oil, steam, and dangerous materials.
 3. Orange: Telephone and other communications.
 4. Blue: Water systems.
 5. Green: Sewer systems.
 6. Purple: Non-potable water systems

PART 3 - EXECUTION

3.01 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface is specified in SECTION 31 10 00 - SITE CLEARING.
- C. Protect and maintain erosion and sedimentation controls, which are specified in SECTION 31 10 00 - SITE CLEARING, during earthwork operations.
- D. Provide protective insulating materials to protect subgrades and foundation soils against freezing temperatures or frost.
- E. Dust Control
1. Use all means necessary to control dust on the Work area or if resulting from the condition in which the CONTRACTOR leaves the site.
 2. Thoroughly moisten all surfaces as required to prevent dust being a nuisance to the neighbors.

3.02 DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
 2. Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.
- C. Seepage waters may be encountered in portions of the work area. The CONTRACTOR shall design and construct temporary dewatering systems to such extent that the required construction can be accomplished.
- D. The CONTRACTOR shall not be allowed to dam the existing drainage ditch or alter the movement of water within the drainage ditch.
- E. Impacted water, as deemed by the OWNER or ENGINEER, shall be collected, and contained. The CONTRACTOR shall remove impacted water offsite in accordance with local, state, and federal requirements.

3.03 EXPLOSIVES

- A. Explosives: Do not use explosives.

3.04 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
 2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:
 - a. 24 in. outside of concrete forms other than at footings.
 - b. 12 in. outside of concrete forms at footings.
 - c. 6 in. outside of minimum required dimensions of concrete cast against grade.
 - d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
 - e. 6 in. beneath bottom of concrete slabs on grade.
 - f. 6 in. beneath pipe in trenches, and the greater of 24 in. wider than pipe or 42 in. wide.

3.05 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 in. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
2. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 in. Do not disturb bottom of excavations intended as bearing surfaces.

3.06 EXCAVATION FOR WALKS AND PAVEMENTS

1. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.07 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
 1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line. CONTRACTOR shall confirm frost line with ENGINEER prior to excavation.
- B. Excavate trenches to uniform widths to provide the clearance indicated on Drawings.
- C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

3.08 SUBGRADE INSPECTION

- A. Notify ENGINEER when excavations have reached required subgrade.
- B. If ENGINEER determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
- C. Proof-roll subgrade below the building slabs and pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
 1. Completely proof-roll subgrade in one direction repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
 2. Proof-roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
 3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by ENGINEER, and replace with compacted backfill or fill as directed.
- D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
- E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by ENGINEER, without additional compensation.

1. Remove damaged subgrade material to depth specified by ENGINEER. Backfill with select fill (as described in the Geotechnical report) and compacted in maximum 8 in. lifts as specified in Section 3.15.

3.09 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by ENGINEER.
 1. Fill unauthorized excavations under other construction or utility pipe as directed by ENGINEER.

3.10 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
- B. Stockpile soil materials away from edges of excavations. Do not store within drip line of remaining trees.
- C. CONTRACTOR shall dispose off-site all stockpile soil materials that are not required for fill, grading, etc., in accordance with local and state regulations, unless otherwise directed by ENGINEER.

3.11 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 1. Construction below finish grade including, where applicable, subsurface drainage, dampproofing, and waterproofing.
 2. Surveying locations of underground utilities for Record Documents.
 3. Testing and inspecting underground utilities.
 4. Removing concrete formwork.
 5. Removing trash and debris.
 6. Removing temporary shoring and bracing, and sheeting.
 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.12 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.
- B. Install bedding and backfill according to the dimensions shown in the Drawings.

- C. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- D. Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in SECTION 03 30 00 - CAST-IN-PLACE CONCRETE.
- E. Place and compact initial backfill of #57 crushed stone meeting ASTM C-33 to a height of 12 in. over the utility pipe or conduit, unless otherwise indicated in Drawings.
 - 1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
- F. Backfill voids with satisfactory soil while installing and removing shoring and bracing.
- G. Place and compact final backfill of satisfactory soil to final subgrade elevation.
- H. Controlled Low-Strength Material: Place final backfill of controlled low-strength material to final subgrade elevation.
- I. Install warning tape directly above utilities, 12 in. below finished grade, except 6 in. below subgrade under pavements and slabs.
- J. Reference drawings for requirements to concrete encase piping under structures.

3.13 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than one (1) vertical to four (4) horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:
 - 1. Under grass and planted areas, use satisfactory soil material.
 - 2. Under walks and pavements, use satisfactory soil material.
 - 3. Under steps and ramps, use select fill.
 - 4. Under building slabs, use select fill.
 - 5. Under footings and foundations, use select fill.
- C. Place soil fill on subgrades free of mud, frost, snow, or ice.
- D. For landscape berms
 - 1. From on-site borrow area.
 - 2. Topsoil from on-site stripping.

3.14 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
 - 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
 - 2. Remove and replace or scarify and air dry otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.15 COMPACTION OF SOIL BACKFILL AND FILL

- A. Place backfill and fill soil materials in layers not more than 8 in. in loose depth for material compacted by heavy compaction equipment, and not more than 4 in. in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:
 - 1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 in. of existing subgrade and each layer of backfill or fill soil material at 95 percent.
 - 2. Under walkways, scarify and recompact top 6 in. below subgrade and compact each layer of backfill or fill soil material at 95 percent.
 - 3. Under unpaved areas, scarify and recompact top 4 in. below subgrade and compact each layer of backfill or fill soil material at 95 percent.
 - 4. For utility trenches, compact each layer of initial and final backfill soil material at 95 percent.

3.16 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 - 1. Provide a smooth transition between adjacent existing grades and new grades.
 - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
 - 1. Unpaved Areas: Plus or minus 1 in.
 - 2. Walks: Plus or minus 1 in.

3. Pavements: Plus or minus 1/2 in.
 4. Sidewalks and buildings entrance requiring ADA/Accessibility shall meet TDLR requirements.
- C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 in. when tested with a 10 ft. straightedge.

3.17 SUBBASE AND BASE COURSES

- A. Place subbase and base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place subbase and base course under pavements and walks as follows:
1. Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
 2. Place base course material over subbase course under hot-mix asphalt pavement.
 3. Shape subbase and base course to required crown elevations and cross-slope grades.
 4. Place subbase and base course 6 in. or less in compacted thickness in a single layer.
 5. Place subbase and base course that exceeds 6 in. in compacted thickness in layers of equal thickness, with no compacted layer more than 6 in. thick or less than 3 in. thick.
 6. Compact subbase and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.
- C. Pavement Shoulders: Place shoulders along edges of subbase and base course to prevent lateral movement. Construct shoulders, at least 12 in. wide, of satisfactory soil materials and compact simultaneously with each subbase and base layer to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.18 DRAINAGE COURSE

- A. Place drainage course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place, and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
1. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
 2. Place drainage course 6 in. or less in compacted thickness in a single layer.
 3. Place drainage course that exceeds 6 in. in compacted thickness in layers of equal thickness, with no compacted layer more than 6 in. thick or less than 3 in. thick.
 4. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.19 FIELD QUALITY CONTROL

- A. Testing Agency: CONTRACTOR will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing, as approved by ENGINEER.
- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.
- C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by ENGINEER.
- D. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:
 - 1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one (1) test for every 2,000 sq. ft. or less of paved area or building slab, but in no case fewer than three (3) tests.
 - 2. Foundation Wall Backfill: At each compacted backfill layer, at least one (1) test for each 100 ft. or less of wall length, but no fewer than three (3) tests.
 - 3. Trench Backfill: At each compacted initial and final backfill layer, at least one (1) test for each 100 ft. or less of trench length, but no fewer than two (2) tests.
- E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify, and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.20 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to the specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
 - 1. Scarify or remove and replace soil material to depth as directed by ENGINEER; reshape and recompact.
 - 2. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 - 3. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.21 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove waste material and spoil material from the OWNER'S property.

1. Remove waste material, including but not limited to unsatisfactory soil, trash, equipment, pipe, concrete, electrical components, and pavement material, and legally dispose of it at a registered landfill per regulatory requirements.
2. CONTRACTOR shall remove all surplus material and dispose of off-site in accordance with local and state regulations. This cost shall be included in the CONTRACTOR'S bid price including but not limited to:
 - a. Any and all permitting costs.
 - b. Transporting the spoil material and installing the material at the disposal site.
 - c. Negotiations and communications with the owner of the disposal site.
 - d. Payment to landowner for disposal.
 - e. Maintenance of access roads at the disposal site as directed by the landowner.
 - f. Repair of any damage to landowner's property.
 - g. Providing any insurance required by the landowner.
 - h. Any other requirements of the landowner.
3. The location and placement of spoil material shall comply with the requirements of all regulatory agencies, including but not limited to TCEQ, EPA, FEMA, and TxDOT, as applicable. No material shall be placed in a FEMA designated floodway or floodplain.
4. The OWNER will not be held responsible for any liability associated with the CONTRACTOR'S transportation of the spoil material or his performance at the disposal site(s) or spoil disposal means.

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SECTION 31 10 00
SITE CLEARING

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. This section includes the following:
 - 1. Protecting existing trees and grass to remain.
 - 2. Removing existing trees, plants, and grass.
 - 3. Clearing and grubbing.
 - 4. Stripping and stockpiling topsoil.
 - 5. Removing above- and below-grade site improvements.
 - 6. Disconnecting, capping, or sealing, and removing or abandoning site utilities.
 - 7. Temporary erosion and sedimentation control measures.

1.02 RELATED SECTIONS

- A. Drawings and general provisions of the Contract, including General and Special Conditions and DIVISION 1 - GENERAL REQUIREMENTS sections, apply to this Section.
- B. SECTION 01 50 00 – TEMPORARY FACILITIES AND CONTROLS for temporary utilities, temporary construction and support facilities, temporary security, and protection facilities,
- C. SECTION 01 57 23 – STORMWATER POLLUTION PREVENTION PLAN for temporary erosion and sedimentation control procedures.
- D. SECTION 31 00 00 – EARTHWORK for soil materials, excavating, backfilling, and site grading.

1.03 DEFINITIONS

- A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 in. diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.
- B. Tree Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

1.04 MATERIAL OWNERSHIP

- A. Except for stripped topsoil or other materials indicated to remain OWNER'S property, cleared materials shall become CONTRACTOR'S property and shall be removed from Project site.

1.05 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from OWNER and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- B. Improvements on Adjoining Property: Authority for performing site clearing indicated on property adjoining OWNER'S property will be obtained by OWNER before award of Contract.
 - 1. Do not proceed with work on adjoining property until directed by ENGINEER.
- C. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on OWNER'S premises where indicated.
- D. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.
- E. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

- A. Satisfactory Soil Materials: Requirements for satisfactory soil materials are specified in SECTION 31 00 00 – EARTHWORK.
 - 1. Obtain approved borrow soil materials on-site, when satisfactory soil materials are not available in designated borrow areas request borrow area expansion.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Locate and clearly flag trees and vegetation to remain or to be relocated.
- C. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to OWNER.

3.02 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion and sedimentation control measures in accordance with SECTION 01 57 23 – STORMWATER POLLUTION PREVENTION PLAN to prevent soil erosion and

discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.

- B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.03 TREE PROTECTION

- A. Erect and maintain temporary fencing around tree protection zones before starting site clearing. Remove fence when construction is complete.
 - 1. Do not store construction materials, debris, or excavated material within fenced area.
 - 2. Do not permit vehicles, equipment, or foot traffic within fenced area.
 - 3. Maintain fenced area free of weeds and trash.
- B. Do not excavate within tree protection zones, unless otherwise indicated.
- C. Where excavation for new construction is required within tree protection zones, hand clear and excavate to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.
 - 1. Cover exposed roots with burlap and water regularly.
 - 2. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
 - 3. Coat cut faces of roots more than 1-1/2 in. diameter with an emulsified asphalt or other approved coating formulated for use on damaged plant tissues.
 - 4. Backfill with soil as soon as possible.
- D. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by ENGINEER.
 - 1. Employ an arborist, licensed in jurisdiction where Project is located, to submit details of proposed repairs and to repair damage to trees and shrubs.
 - 2. Replace trees that cannot be repaired and restored to full-growth status, as determined by ENGINEER.

3.04 UTILITIES

- A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.
 - 1. Arrange with utility companies to shut off indicated utilities.
 - 2. OWNER will arrange to shut off indicated OWNER utilities when requested by CONTRACTOR.

- B. Existing Utilities: Do not interrupt utilities serving facilities occupied by OWNER or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify ENGINEER not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without ENGINEER'S written permission.

- C. Excavate for and remove underground utilities indicated to be removed.

3.05 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
3. Grind stumps and remove roots, obstructions, and debris extending to a depth of 18 in. below exposed subgrade, unless noted otherwise.
4. Use only hand methods for grubbing within tree protection zone.
5. Chip removed tree branches and stockpile in areas approved by ENGINEER.

- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 in. and compact each layer to a density equal to adjacent original ground.

3.06 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.

- B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and nonsoil materials from topsoil, including trash, debris, weeds, roots, and other waste materials.

- C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Limit height of topsoil stockpiles to 72 in.
2. Do not stockpile topsoil within tree protection zones.
3. Dispose of excess topsoil as specified for waste material disposal.
4. Stockpile surplus topsoil to allow for re-spreading deeper topsoil.

3.07 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
 - 1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.
 - 2. Paint cut ends of steel reinforcement in concrete to remain to prevent corrosion.

3.08 DISPOSAL

- A. Disposal: Remove surplus soil material and unsuitable topsoil and dispose of on site as directed by the ENGINEER. Obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off OWNER'S property.
 - 1. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities.

END OF SECTION

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SECTION 31 23 35

STRUCTURAL EXCAVATION, BACKFILL, AND COMPACTION

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish all work, materials, equipment, and related items required to remove all earth, rock, water, and other materials to the extent required for the construction of the facilities shown on the Drawings; to prepare the subgrade or subbase for the foundation of the facilities to the lines and grades established on the Drawings.
- B. Requirements of the Geotechnical reports, project drawings and other specifications shall govern over the requirements in this specification.

1.02 QUALITY ASSURANCE

- A. The specifications of the American Society for Testing and Materials (ASTM) referred to in this Section listed below shall apply to this Section to the extent applicable in each reference:
 - 1. C 136 Sieve or Screen Analysis of Fine and Coarse Aggregates.
 - 2. D 423 Test for Liquid Limit of Soils.
 - 3. D 424 Test for Plastic Limit and Plasticity Index of Soils.
 - 4. D 1557 Test for Moisture-Density Relations of Soils.
 - 5. D 2922 Test for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Concrete: All concrete shall comply with the requirements of SECTION 03 30 00 – CAST-IN-PLACE CONCRETE, with the Class as specified or indicated on the Drawings.
- B. Backfill Material
 - 1. Select Fill: As defined in the Geotechnical Reports.
 - 2. General Fill: As defined in the Geotechnical Reports.

PART 3 - EXECUTION

3.01 EXCAVATION

- A. General
 - 1. Excavations shall be of such dimensions as to permit the construction of the work in the manner, shape and size shown on the Drawings. Excavation shall extend a sufficient

distance from walls to allow for placing and removal of forms, installation of piping and inspection.

2. Structures having 6 in. or more of select subbase may be excavated by plowing, scraping or machine digging to obtain the finished subgrade elevation.
3. Authorized Additional Excavation: Where the proposed subgrade material on which the foundation, footing or slab is to be placed is deemed unsatisfactory by the ENGINEER, carry the excavation to an additional depth specified by the ENGINEER and fill the excavated space with select subbase material, as directed by the ENGINEER.
4. Unauthorized Excavation: Whenever the excavation is carried beyond or below the lines or grades shown on the Drawings, refill all such excavated space below the structure foundation with Class "C" concrete. This work shall be done at no additional cost to the OWNER.
5. Material Storage: Stockpile excavated materials classified as satisfactory soil material where directed by the OWNER until required for backfill or fill. Place, grade, and shape stockpiles for proper drainage. CONTRACTOR shall sample.
6. Shoring, Sheet piling and Bracing. Excavations shall be properly shored, sheeted and braced as the nature of the ground may require, to prevent shifting of material with possible damage to existing or uncompleted structures.

3.02 DEWATERING

- A. Commencing sufficiently in advance of excavation, during the excavation period and as long thereafter as the condition of the work may require, provide, and maintain in good operation such equipment as may be required to prevent all water from entering any excavation. This shall include, but is not limited to: surface water which would drain into the excavation; seepage water which would enter as a result of the excavation and a high ground water table; and the water which could penetrate the excavation due to the anticipated piezometric head coupled with the removal of overburden, should the CONTRACTOR not lower the water table in advance of the excavation. Complete backfilling operations before dewatering operations are suspended. Water removed from the excavation shall be disposed of in such a manner as to prevent damage to adjacent property or to other work under construction. Damage of whatever nature caused by dewatering the work or failure to dewater the work satisfactorily shall be promptly repaired or remedied by the CONTRACTOR at his own expense. Provision shall be made for the satisfactory disposal of water pumped from excavations so as to prevent damage to public or private property. In all cases, accumulated water in the trench shall be removed before placing embedment, laying pipe, placing any concrete, or backfilling.

3.03 BACKFILLING

- A. Materials. Materials for backfilling around structures shall be select fill, as described in the geotechnical report, unless otherwise described in these specifications or shown in the drawings.
- B. Placement of Backfill
 1. Concrete in walls shall have attained the required twenty-eight (28) day compressive strength before any backfill is placed.

2. If a floor or structural system frames into a floor, no backfill shall be placed against walls until floors at the top and bottom have been in place fourteen (14) days unless authorization has been received from the OWNER in writing.
3. Engineered Fill: Reference the Structural drawings.
4. Select Fill: As defined in the Geotechnical Reports.

3.04 EXISTING UTILITIES

- A. Locate existing underground utilities in the areas of work. Provide adequate means of protection during excavation operations.
- B. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult the utility OWNER immediately for directions. Cooperate with the OWNER and public and private utility companies in keeping their respective services and facilities in operation. Repair damaged utilities to the satisfaction of the utility OWNER.
- C. Do not interrupt existing utilities serving facilities occupied and used by the OWNER or others, except when permitted in writing by the OWNER, and then only after acceptable temporary utility services have been provided.

END OF SECTION

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SECTION 31 41 35
SHORING, SHEETING, AND BRACING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Work required for protection of an excavation or structure through shoring, sheeting, and bracing.
- B. Related Work Specified in other Sections Includes:
 - 1. SECTION 31 23 35 – STRUCTURAL EXCAVATION, BACKFILL, AND COMPACTION
 - 2. SECTION 31 50 00 – EXCAVATION SUPPORT AND PROTECTION
 - 3. SECTION 31 00 00 – EARTHWORK

1.02 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 1.
- B. CONTRACTOR's Submittals: All sheeting and bracing shall be the responsibility of the CONTRACTOR. CONTRACTOR shall retain qualified design services for these systems, and to be completed with strict adherence to OSHA Regulations. Submit complete design calculations and working drawings of proposed shoring, sheeting, and bracing which have been prepared, signed, and sealed by a Licensed Professional Engineer experienced in Structural Engineering and registered in the State of Texas, before starting excavation for trenches and structures. Use the geotechnical report recommendations shown for shoring, sheeting, and bracing design. ENGINEER's review of calculations and working drawings will be limited to confirming that the design was prepared by a licensed professional engineer and that the geotechnical report recommendations shown was used.
- C. One (1) electronic copy in Portable Document Format (PDF) of all submittals and re-submittals shall be submitted suitable for distribution over electronic mail or File Transfer Protocol (FTP). For final approved submittals provide PDF and two (2) hard copies.

1.03 REFERENCES

- A. Design: Comply with all Federal and State laws and regulations applying to the design and construction of shoring, sheeting, and bracing.
- B. N.B.S. Building Science Series 127 “Recommended Technical Provisions for Construction Practice in Shoring and Sloping Trenches and Excavations.”

1.04 QUALITY ASSURANCE

- A. Regulatory Requirements: Do work in accordance with the U.S. Department of Labor Safety and Health Regulations for construction promulgated under the Occupational Safety Act of 1970 (PL 91-596) and under Section 107 of the Contract Work Hours and Safety Standards Act (PL 91-54), and the Texas Health and Safety Code. The CONTRACTOR shall also observe 29 CFR 1910.46 OSHA's regulation for ConfinedSpace Entry.

PART 2 - PRODUCTS

2.01 MANUFACTURERS AND MATERIALS

- A. Material Recommendations: Use manufacturers and materials for shoring, sheeting, and bracing as recommended by the Licensed Professional Engineer who designed the shoring, sheeting, and bracing.
 - 1. Wood Materials: Oak, or treated fir or pine for wood lagging.

PART 3 - EXECUTION

3.01 SHORING, SHEETING AND BRACING INSTALLATION

- A. General: Provide safe working conditions, to prevent shifting of material, to prevent damage to structures or other work, to avoid delay to the work, all in accordance with applicable safety and health regulations. Properly shore, sheet, and brace all excavations which are not cut back to the proper slope and where shown. Meet the general trenching requirements of the applicable safety and health regulations for the minimum shoring, sheeting, and bracing for trench excavations.
 - 1. CONTRACTOR's Responsibility: Sole responsibility for the design, methods of installation, and adequacy of the shoring, sheeting, and bracing.
- B. Arrange shoring, sheeting, and bracing so as not to place any strain on portions of completed work until the general construction has proceeded far enough to provide ample strength.
- C. If ENGINEER is of the opinion that at any point the shoring, sheeting, or bracing are inadequate or unsuited for the purpose, resubmission of design calculations and working drawings for that point may be ordered, taking into consideration the observed field conditions. If the new calculations show the need for additional shoring, sheeting, and bracing, it should be installed immediately.
- D. Monitoring: Periodically monitor horizontal and vertical deflections of sheeting. Submit these measurements for review.
- E. Accurately locate all underground utilities and take the required measures necessary to protect them from damage. All underground utilities shall be kept in service at all times as specified in Division 1.
- F. Driven Sheeting: Drive tight sheet piling in that portion of any excavation in paved or surface streets City collector and arterial streets and in State and County highways below the intersection of a one-on-one slope line from the nearest face of the excavation to the edge of the existing pavement or surface.
- G. Sheeting Depth: In general drive or place sheeting for pipelines to a depth at elevation equal to the top of the pipe as approved.
 - 1. If it is necessary to drive sheeting below that elevation in order to obtain a dry trench or satisfactory working conditions, cut the sheeting off at the top of the pipe and leave in place sheeting below the top of the pipe.
 - 2. Cut off sheeting not designated as "Sheeting Left in Place". The cut ends of sheeting left adjacent to the pipe will be paid for as "Sheeting Left in Place".

3. Do not cut the sheeting until backfill has been placed and compacted to the top of the pipe.
- H. Sheeting Removal: In general, remove sheeting and bracing above the top of the pipe as the excavation is refilled in a manner to avoid the caving in of the bank or disturbance to adjacent areas or structures. Sheeting shall be removed as backfilling progresses so that the sides are always supported or when removal would not endanger the construction of adjacent structures. When required to eliminate excessive trench width or other damages, shoring or bracing shall be left in place and the top cut off at an elevation 2.5 feet below finished grade, unless otherwise directed.
1. Carefully fill voids left by the withdrawal of the sheeting by jetting, ramming or otherwise.
 2. No separate payment will be made for filling of such voids.
- I. Permission for Removal: Obtain permission before the removal of any shoring, sheeting, or bracing. Retain the responsibility for injury to structures or to other property or persons from failure to leave such shoring, sheeting, and bracing in place even though permission for removal has been obtained.
- J. Preload internal braces to 50 percent of the design loads.
- K. Proof test tie backs to 133 percent of the design loads and lock off tie backs at 75 percent of the design loads.
- 3.02 SHEETING LEFT IN PLACE FOR PROTECTION
- A. Ordered Left in Place: In addition to sheeting specified or shown to be left in place, the ENGINEER may order, in writing, any or all other shoring, sheeting, or bracing to be left in place for the purpose of preventing injury to the structures, pipelines or to other property or to persons.
1. Cutoff sheeting left in place at the elevation shown or ordered, but, in general, at least 2.5 feet below the final ground surface.
 2. Drive up tight any bracing remaining in place.
- B. Right to Order: Do not construe the right to order shoring, sheeting, and bracing left in place as creating any obligation to issue such orders.
- C. Payment: Shoring, sheeting, and bracing left in place, by written order, will be paid for under the appropriate Contract Items or where no such items exist, as changes in the work.

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SECTION 31 50 00
EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.01 SUMMARY

- A. This section includes the requirements for trench excavation support and protection.
- B. It is the sole duty, responsibility, and prerogative of the CONTRACTOR, not the OWNER or ENGINEER, to determine the specific applicability of a trench safety system to each field condition encountered on the project. It will be the CONTRACTOR'S responsibility to identify the soil type and to accurately adjust his trench safety methods according to the OSHA requirements.
- C. Section Includes:
 - 1. Trench safety system for the construction of trench excavations.
 - 2. Trench safety system for structural excavations which fall under provisions of State and Federal trench safety laws.

1.02 MEASUREMENT AND PAYMENT

- A. Unit Prices
 - 1. Measurement for trench safety systems used on trench excavations is on a linear foot basis measured along the centerline of the trench, including manholes and other line structures.
 - 2. No payment will be made under this section for trench safety systems for structural excavations, tunnel shafts, auger pits, or excavation for trenchless installations, and also for any necessary non trenchless installations included in the aforementioned methods of construction unless included as a bid item. Include payment for trench safety systems in applicable structural or utility installation sections.
- B. THE BID ITEM FOR "OSHA TRENCH SAFETY" SHALL INCLUDE PAYMENT FOR THE ACTUAL TRENCH WALL SUPPORT. DAMAGES TO ADJACENT EXISTING UTILITIES AND IMPROVEMENTS OF ANY KIND THAT OCCUR WHEN THE TRENCH WALLS MOVE SHALL BE REPAIRED AT THE CONTRACTOR'S EXPENSE.

1.03 DEFINITIONS

- A. A trench shall be defined as a narrow excavation (in relation to its depth) made below the surface of the ground.
- B. The trench safety system requirements will apply to larger open excavations if the erection of structures or other installations limits the space between the excavation slope and these installation to dimensions equivalent of a trench as defined.

- C. Trench Safety Systems include but are not limited to sloping, sheeting, trench boxes or trench shields, sheet piling, cribbing, bracing, shoring, dewatering, or diversion of water to provide adequate drainage.
- D. Trench Safety Program is the safety procedures governing the presence and activities of individuals working in and around trench excavations.

1.04 SUBMITTALS

- A. Submit in accordance with SECTION 01 33 00 – SUBMITTAL PROCEDURES.
- B. Submit a safety program specifically for the construction of trench excavation. Design the trench safety program to be in accordance with OSHA 29CFR standards governing the presence and activities of individuals working in and around trench excavations.
- C. Construction and shop drawings containing deviations from OSHA standards or special designs shall be sealed by a licensed Engineer retained and paid by CONTRACTOR.
- D. Review of the safety program by the ENGINEER will only be in regard to compliance with this specification and will not constitute approval by the ENGINEER nor relieve CONTRACTOR of obligations under State and Federal trench safety laws.
- E. Submit certification that trench safety system will not be subjected to loads exceeding those which the system was designed to withstand according to the available construction and geotechnical information.

1.05 REGULATORY REQUIREMENTS

- A. Install and maintain trench safety systems in accordance with the detail specifications set out in the provision of Excavations, Trenching, and Shoring, Federal Occupation Safety and Health Administration (OSHA) Standards, 29CFR, Part 1926, Subpart P, as amended, including Final Rule, published in the Federal Register Vol. 54, No. 209 on Tuesday, October 31, 1989. The sections that are incorporated into these specifications by reference include Sections 1926-650 through 1926-652.
- B. A reproduction of the OSHA standards included in "Subpart P - Excavations" from the Federal Register Vol. 54, No. 209 is available upon request to CONTRACTOR'S bidding on OWNER projects. The OWNER assumes no responsibility for the accuracy of the reproduction. The CONTRACTOR is responsible for obtaining a copy of this section of the Federal Register.
- C. Legislation that has been enacted by the Texas Legislature with regard to Trench Safety systems, is hereby incorporated, by reference, into these specifications. Refer to Texas Health and Safety Code Ann., §756.021 (Vernon 1991).
- D. Reference materials, if developed for a specific project, will be issued with the Bid Documents, including the following:
 - 1. SECTION 02 06 10 – GEOTECHNICAL DATA for use in design of the trench safety system.

1.06 INDEMNIFICATION

- A. CONTRACTOR shall indemnify and hold harmless the OWNER, his employees, and agents, from any and all damages, costs (including, without limitation, legal fees, court costs, and the cost of investigation), judgements or claims by anyone for injury or death of persons resulting from the collapse or failure of trenches constructed under this Contract.
- B. CONTRACTOR acknowledges and agrees that this indemnity provision provides indemnity for the OWNER in case the OWNER is negligent either by act or omission in providing for trench safety, including, but not limited to safety program and design reviews, inspections, failures to issue stop work orders, and the hiring of the CONTRACTOR.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install and maintain trench safety systems in accordance with provisions of OSHA 29CFR.
- B. Install specially designed trench safety systems in accordance with the CONTRACTOR'S trench excavation safety program for the locations and conditions identified in the program.
- C. A competent person, as identified in the CONTRACTOR'S Trench Safety Program, shall verify that trench boxes and other premanufactured systems are certified for the actual installation conditions.

3.02 INSPECTION

- A. CONTRACTOR, or CONTRACTOR'S independently retained consultant, shall make daily inspections of the trench safety systems to ensure that the installed systems and operations meet OSHA 29CFR and other personnel protection regulations requirements.
- B. If evidence of possible cave-ins or slides is apparent, CONTRACTOR shall immediately stop work in the trench and move personnel to safe locations until the necessary precautions have been taken by CONTRACTOR to safeguard personnel entering the trench.
- C. Maintain a permanent record of daily inspections.

3.03 FIELD QUALITY CONTROL

- A. CONTRACTOR shall verify specific applicability of the selected or specially designed trench safety systems to each field condition encountered on the project.

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SECTION 31 92 28
LOAMING AND HYDROSEEDING

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required, provide erosion control and place topsoil, finish grade, apply fertilizer, hydraulically apply seed and mulch and maintain all seeded areas as shown on the Drawings and as specified herein, including all areas disturbed by the CONTRACTOR.
- B. All disturbed, unpaved areas shall be hydroseeded as specified herein.

1.02 SUBMITTALS

- A. Samples of all materials shall be submitted for inspection and acceptance upon ENGINEER'S request.
- B. Number of Copies: Submit six (6) copies of each submittal, unless otherwise indicated. ENGINEER will return two (2) copies.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Topsoil shall be fertile, friable, natural topsoil typical of topsoil of the locality and shall be obtained from a well drained site that is free of flooding. It shall be without admixture of subsoil or slag and free of stones, lumps, plants or their roots, sticks, clay, peat and other extraneous matter and shall not be delivered to the site or used while in a frozen or muddy condition. Topsoil as delivered to the site or stockpiled shall have pH between 6.0 and 7.0 and shall contain not less than 3 percent organic matter as determined by loss of ignition of moisture-free samples dried at 100°C. The topsoil shall meet the following mechanical analysis:

	Percentage Finer
1 in. screen opening	100
No. 10 mesh	95-100
No. 270 mesh	35-75
0.002 mm*	5-25

* Clay size fraction determined by pipette or hydrometer analysis.

- B. Fertilizer shall be commercial mixed free flowing granules or pelleted fertilizer, 10-20-10 (N-P2O5-K2O) grade for lawn and naturalized areas. Fertilizer shall be delivered to the site in original unopened containers each showing the manufacturer's guaranteed analysis conforming to applicable state fertilizer laws. At least 40 percent of the nitrogen in the fertilizer used shall be in slowly available (organic) form.
- C. Seed shall be labeled in accordance with USDA Rules and Regulations under the Federal Seed Act and applicable State seed laws. Seed shall be furnished in sealed bags or containers bearing the date of the last germination, which date shall be within a period of six (6) months prior to

commencement of planting operations. Seed shall be from same or previous year's crop; each variety of seed shall have a purity of not less than 85 percent, a percentage of germination not less than 90 percent, shall have a weed content of not more than 1 percent and contain no noxious weeds. The seed mixtures shall consist of seed proportioned by weight as follows:

Mixture for Use in Clay or Tight Soils		Mixture for Use in Sand or Sandy Soils	
Green Sprangletop	0.6	Green Sprangletop	0.9
Sideoats Grama	1.8	Bermudagrass	1.2
(Haskell or Premier)		K-R Bluestem	1.0
Buffalograss	5.3	Sand Dropseed	0.3
Little Bluestem	1.1		
K-R Bluestem	0.7		
Switchgear	1.2		

1. All seeding/planting shall be done between the dates specified except as specifically authorized in writing. If planting is authorized to be done outside the dates specified the seed shall be planted with the addition of winter fescue (Kentucky 31) at a rate of 100 lbs. per acre.
 2. The seed shall be furnished and delivered premixed in the proportions specified above. A manufacturer's certificate of compliance to the specified mixes shall be submitted by the manufacturers for each seed type. These certificates shall include the guaranteed percentages of purity, weed content and germination of the seed and also the net weight and date of shipment. No seed may be sown until the CONTRACTOR has submitted the certificates.
 3. Seed shall be delivered in sealed containers bearing the dealer's guaranteed analysis.
- D. Fiber Mulch shall be a specially processed cellulose fiber containing no growth or germination-inhibiting factors. It shall be manufactured in such a manner that after addition and agitation in slurry tanks with water, the fibers in the material become uniformly suspended to form a homogeneous slurry. When sprayed on the ground, the material shall allow absorption and percolation of moisture. Each package of the cellulose fiber shall be marked by the manufacturer to show the air dry weight content and not contain in excess of 10 percent moisture.

PART 3 - EXECUTION

3.01 APPLICATION

- A. Unless otherwise shown on the Drawings, topsoil shall be placed to a minimum compacted depth of 6 in. and seed applied on all disturbed areas of the site not covered with structures, pavement, or existing woodland.
- B. For all areas to be seeded:
 1. Fertilizer (10-20-10) shall be applied at the rate of ten pounds per 1,000 sq. ft. or as determined by the soil test.

2. Seed shall be applied at the rates described in Paragraph 2.01C.
 3. Fiber mulch shall be applied at the rate of 40 lbs. per 1,000 sq. ft.
- C. The application of fertilizer may be performed hydraulically in one operation with hydroseeding and fiber mulching. The CONTRACTOR is responsible for cleaning all structures and paved areas of unwanted deposits of the hydroseeded mixture.

3.02 INSTALLATION

- A. Previously established grades, as shown on Drawings shall be maintained in a true and even condition.
- B. Subgrade shall be prepared by tilling prior to placement of topsoil to obtain a more satisfactory bond between the two (2) layers. Tillage operations shall be across the slope. Tillage shall not take place on slopes steeper than two (2) horizontal to one (1) vertical or where tillage equipment cannot be operated. Tillage shall be accomplished by discing or harrowing to a depth of 9 in. parallel to contours. Tillage shall not be performed when the subgrade is frozen, excessively wet, extremely dry or in other conditions which would not permit tillage. The subgrade shall be raked and all rubbish, sticks, roots and stones larger than 2 in. shall be removed. Subgrade surfaces shall be raked or otherwise loosened immediately prior to being covered with topsoil.
- C. Topsoil shall be placed over approved areas to a depth sufficiently greater than required so that after natural settlement and light rolling, the complete work will conform to the lines, grades and elevations indicated. No topsoil shall be spread in water or while frozen or muddy.
- D. After topsoil has been spread, it shall be carefully prepared by scarifying or harrowing and hand raking. All stiff clods, lumps, roots, litter and other foreign material shall be removed from the topsoiled area and disposed of by the CONTRACTOR. The areas shall also be free of smaller stones, in excessive quantities, as determine by the ENGINEER. The whole surface shall then be rolled with a hand roller weighing not more than 100 lbs. per foot of width. During the rolling, all depressions caused by settlement of rolling shall be filled with additional topsoil and the surface shall be regraded and rolled until a smooth and even finished grade is created.
- E. Seeding, mulching and conditioning shall only be performed during those periods within the seasons which are normal for such work as determined by the weather and locally accepted practice, as approved by the ENGINEER. The CONTRACTOR shall hydroseed only on a calm day.
- F. Schedules for seeding and fertilizing must be submitted to the ENGINEER for approval prior to the work. Seeding as specified herein shall be accomplished between the period of March 1st to June 1st. Seeding during the period from October 1st to March 1st shall only be undertaken upon approval of the ENGINEER. Seeding during the period from June 1st to October 1st shall only be performed if irrigation is provided.
- G. Seeding shall be done within ten days following soil preparation. Seed shall be applied hydraulically at the rates and percentages indicated. The spraying equipment and mixture shall be so designed that when the mixture is sprayed over an area, the grass seed and mulch shall be equal in quantity to the specified rates. Prior to the start of work, the CONTRACTOR shall furnish the ENGINEER with a certified statement as to the number of pounds of materials to be used per 100 gallons of water. This statement shall also specify the number of square feet of

seeding that can be covered with the quantity of solution in the CONTRACTOR'S hydroseeder. Upon completion of seeding operations, the CONTRACTOR shall furnish the ENGINEER with a certified statement on the actual quantity of solution applied.

- H. In order to prevent unnecessary erosion of newly topsoiled and graded slopes and unnecessary siltation of drainageways, the CONTRACTOR shall conduct seeding and mulching as soon as he/she has satisfactorily completed a unit or portion of the project. For the purpose of this project a unit is defined as 10,000 sq. ft. When protection of newly topsoiled and graded areas is necessary at a time which is outside of the normal seeding season, the CONTRACTOR shall protect those areas by whatever means necessary as approved by the ENGINEER and shall be responsible for prevention of siltation in the areas beyond the limit of work.
- I. When newly graded subgrade areas cannot be topsoiled and seeded because of season or weather conditions and will remain exposed for more than thirty (30) days, the CONTRACTOR shall protect those areas against erosion and washouts by whatever means necessary such as straw applied with a tar tack, wood chips or by other measures as approved by the ENGINEER. Prior to application of topsoil, any such materials applied for erosion control shall be thoroughly incorporated into the subgrade by discing. Fertilizer shall be applied prior to spreading of topsoil.
- J. On slopes, the CONTRACTOR shall provide against washouts by an approved method. Any washout which occurs shall be regraded and reseeded at the CONTRACTOR'S expense until a good sod is established.

3.03 MAINTENANCE, AND PROVISIONAL ACCEPTANCE

- A. The CONTRACTOR shall keep all seeded areas watered, lawn areas mowed and in good condition, reseeding all seeded areas if and when necessary until a good, healthy, uniform growth is established over the entire area seeded and shall maintain all seeded areas in an approved condition until provisional acceptance.
- B. The ENGINEER will inspect all work for provisional acceptance at the end of the ten week maintenance period, upon the written request of the CONTRACTOR received at least ten days before the anticipated date of inspection. The maintenance period must occur during the growing season between March 15th and October 1st and shall include a minimum of three mowings.
- C. A satisfactory stand will be defined as a section of turf of 10,000 sq. ft. or larger that has:
 - 1. No bare spots larger than 3 sq. ft.
 - 2. No more than 10 percent of total area with bare spots larger than 1 sq. ft.
 - 3. Not more than 15 percent of total area with bare spots larger than 6 in. square.
- D. After the inspection has occurred but prior to provisional acceptance, a soil test shall be performed to determine if additional soil fertilization should occur. If necessary, additional fertilizer not to exceed 30 lbs. per 1,000 sq. ft. of 20-10-10 shall be applied as directed by the ENGINEER.
- E. The inspection by the ENGINEER will determine whether maintenance shall continue in any area or manner.

- F. After all necessary corrective work and clean-up has been completed, the ENGINEER will certify in writing the provisional acceptance of the lawn areas. The CONTRACTOR'S responsibility for maintenance of lawns, or parts of lawns shall cease on receipt of provisional acceptance.

3.04 GUARANTEE PERIOD AND FINAL ACCEPTANCE

- A. All seeded areas shall be guaranteed by the CONTRACTOR for not less than two (2) full years from the time of provisional acceptance.
- B. At the end of the guarantee period, inspection will be made by the ENGINEER upon written request submitted by the CONTRACTOR at least ten (10) days before the anticipated date. Seeded areas not demonstrating satisfactory stands as outlined above, as determined by the ENGINEER, shall be renovated, reseeded and maintained meeting all requirements as specified herein.
- C. After all necessary corrective work has been completed, the ENGINEER shall certify in writing the final acceptance of the seeded areas.

END OF SECTION

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SECTION 32 31 13
GALVANIZED CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.01 RELATED SECTIONS

- A. Drawings and general provisions of the contract, including General and Special conditions and DIVISION 1 - GENERAL REQUIREMENTS sections, apply to this section.

1.02 SUBMITTALS

- A. Shop drawings: Layout of fences and gates with dimensions, details, and finishes of components, accessories, and post foundations.
- B. Product data: Manufacturer's catalog cuts indicating material compliance and specified options.
- C. One (1) electronic copy in Portable Document Format (PDF) of all submittals and re-submittals shall be submitted suitable for distribution over electronic mail or File Transfer Protocol (FTP).

PART 2 - PRODUCTS

2.01 MANUFACTURER

- A. Products from qualified manufacturers having a minimum of five (5) years' experience manufacturing galvanized coated chain link fencing will be acceptable by the Engineer.
- B. Obtain chain link fences and gates, including accessories, fittings, and fastenings, from a single source.
- C. Approved Manufacturer: Master- Halco / Anchor Fence, Baltimore, MD Phone (800) 229-5615 Fax (410) 676-7098, or ENGINEER approved equal.

2.02 CHAIN LINK FENCE FABRIC

- A. Galvanized wire: Zinc coated Wire, ASTM A 392 - Class 1 (1.2oz/sf), Wire Spec-A817-83.
- B. Size: Helically wound and woven to height of 6 ft. with 2 in. diamond mesh, 9 gauge, with a wire diameter of 0.148 in. and a breakload of 1,290 lbs.
- C. Selvage of fabric twisted at top and knuckled at bottom.

2.03 STEEL FENCE FRAMING

- A. Steel pipe - Type I: ASTM F 1083, standard weight schedule 40; minimum yield strength of 25,000 psi; sizes as indicated. Hot-dipped galvanized with minimum average 1.8 oz./ft² of coated surface area.
- B. Formed steel ("C") sections: Roll formed steel shapes complying with ASTM F 1043, Group II, produced from 45,000 psi yield strength steel; sizes as indicated. External coating per ASTM F 1043, Type A, minimum average 2.0 oz./ft² of zinc per ASTM A 123, or 4.0 oz./ft² per ASTM A 525.

- C. Steel square sections: ASTM A 500, Grade B steel having minimum yield strength of 40,000 psi; sizes as indicated. Hot-dipped galvanized with minimum 1.8 oz/ft² of coated surface area.
- D. End and Corner Post: 2-1/2 in. od, 3.65 lbs./ft.
- E. Line (intermediate) Post: 2 in. od, 2.72 lbs./ft.
- F. Rail and Braces: 1-5/8 in. od, 2.27 lbs./ft.

2.04 SWING GATES

- A. Gate frames: Fabricate chain link swing gates in accordance with ASTM F 900 using galvanized steel tubular members, 2 in. square, weighing 2.60 lb./ft. Fusion or stainless steel welded connections forming rigid one-piece unit. For gates over 8 ft. high or 15 ft. wide, provide minimum 1-1/2 in. square additional horizontal and vertical interior members to ensure proper strength.
- B. Chain link fence fabric: Gate fabric to be same as fence fabric.
- C. Hardware materials: Hot dipped galvanized steel or malleable iron shapes to suit gate size.
- D. Hinges: Structurally capable of supporting gate leaf and allow opening and closing without binding. Non-lift-off type hinge design shall permit gate to swing 180° inward or outward.
- E. Latch: Forked type capable of retaining gate in closed position and have provision for padlock. Latch shall permit operation from either side of gate.
- F. Keeper: Provide keeper for each gate leaf over 5 ft. wide. Gate keeper shall consist of mechanical device for securing free end of gate when in full open position.
- G. Double gates: Provide drop rod to hold inactive leaf. Provide gate stop pipe to engage center drop rod. Provide locking device and padlock eyes as an integral part of latch, requiring one padlock for locking both gate leaves. Gate drop rods shall be installed in minimum 12" square x 12" deep, 3000 psi concrete blocks for open and closed gate positions.
- H. Barbed wire top: Incorporate barbed extensions by extending vertical members 13 in. to accommodate three strands of barbed wire.
- I. Gate posts: Steel pipe ASTM F 1083 standard weight schedule 40; minimum yield strength of 25,000 psi. Hot-dipped galvanized with minimum 1.8 oz./ft² of zinc.

Gate leaf single width	Post Size (Round)	Weight
6 ft. or less	2.5 in.	5.79 lb./ft.
6 ft. to 12 ft.	3.5 in.	9.11 lb./ft.
12 ft. to 18 ft.	6.0 in.	18.97 lb./ft.
Over 18 ft.	8.0 in	24.70 lb./ft.

- J. Setting Materials: Concrete - Minimum twenty-eight (28) days compressive strength of 3,000 psi.
- K. Chain Link Swing Gate Post Installation

1. Install gate posts in accordance with manufacturer's instructions.
 - a. Gate posts and hardware: Set posts, keepers, stops, sleeves into concrete. Check each post for vertical and top alignment and maintain in position during placement and finishing operations.
2. Concrete set gate posts: Drill holes in firm, undisturbed or compacted soil. Holes shall have diameter of four (4) times greater than outside dimension of post, and depths approximately 6 in. (152 mm) deeper than post bottom. Excavate deeper as required for adequate support in soft and loose soils, and for posts with heavy lateral loads. Set post bottom 36 in. (914 mm) below surface when in firm, undisturbed soil. Place concrete around posts in a continuous pour. Trowel finish around post and slope to direct water away from posts.

L. Gate Installation

1. Install gates plumb, level, and secure for full opening without interference.
2. Attach hardware by means which will prevent unauthorized removal.
3. Adjust hardware for smooth operation.
4. Touch up hardware.
5. The bottom of gate frames shall be no more than 3 in. above finished grade.

2.05 ACCESSORIES

- A. Chain link fence accessories: Provide items required to complete fence system. Galvanize each ferrous metal item and finish to match framing.
- B. Post caps: Formed steel, cast malleable iron, or aluminum alloy weathertight closure cap for tubular posts. Provide one cap for each post. Cap to have provision for barbed wire when necessary. "C" shaped line post without top rail or barbed wire supporting arms do not require post caps. (Where top rail is used, provide tops to permit passage of top rail.)
- C. Top rail and brace rail ends: Pressed steel per ASTM F626, for connection of rail and brace to terminal posts. Top rail shall be continuous along entire fence length.
- D. Top rail sleeves: 7 in. expansion sleeve with spring, allowing for expansion and contraction of top rail.
- E. Wire ties: 9 gauge (0.148 in.) galvanized steel wire for attachment of fabric to line posts. Double wrap 13 gauge (0.092 in.) for rails and braces. Hog ring ties of 12-1/2 gauge (0.0985 in.) for attachment of fabric to tension wire.
- F. Brace and tension (stretcher bar) bands: Pressed steel. At square post provide tension bar clips.
- G. Tension (stretcher) bars: One piece lengths equal to 2 in. less than full height of fabric with a minimum cross-section of 3/16 in. x 3/4 in. or equivalent fiber glass rod. Provide tension (stretcher) bars where chain link fabric meets terminal posts.

- H. Tension wire: Galvanized coated steel wire, 7 gauge, (0.177 in.) diameter wire with tensile strength of 75,000 psi.
- I. Truss rods & tightener: Steel rods with minimum diameter of 5/16 in. Capable of withstanding a tension of minimum 2,000 lbs.
- J. Nuts and bolts shall be galvanized.
- K. Tension wire: Galvanized coated steel wire, 7 gauge, (0.177 in.) diameter wire with tensile strength of 75,000 psi.
- L. Barbed wire: ASTM A 121 Class 3, zinc coated steel wire double-strand, 12-1/2 gauge (0.099 in.) twisted line wire with galvanized steel, four (4) point barbs spaced approximately 5 in. on center.
- M. Barbed wire supporting arms: Pressed steel arms for attaching three (3) rows of barbed wire. Arms shall withstand 250 lbs. downward pull at the outermost end of arm without failure.
 - 1. Provide 450, 3 strands, single arm
 - 2. Provide intermediate arms with hole for passage of top rail.
 - 3. Arms shall be angled at 45 degrees, angled outward from fence.

2.06 SETTING MATERIALS

- A. Concrete: Minimum twenty-eight (28) days compressive strength of 3,000 psi.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify areas to receive fencing are completed to final grades and elevations.
- B. Ensure property lines and legal boundaries of work are clearly established.

3.02 CHAIN LINK FENCE FRAMING INSTALLATION

- A. Install chain link fence in accordance with ASTM F 567 and manufacturer's instructions.
- B. Locate terminal post at each fence termination and change in horizontal or vertical direction of 30 degrees or more.
- C. Space line posts uniformly at 10 ft. on center (maximum spacing).
- D. Concrete set terminal and gate posts: Drill holes in firm, undisturbed or compacted soil. Holes shall have diameter four (4) times greater than outside dimension of post, and depths approximately 6 in. deeper than post bottom. Excavate deeper as required for adequate support in soft and loose soils, and for posts with heavy lateral loads. Set post bottom 36 in. below surface when in firm, undisturbed soil. Place concrete around posts in a continuous pour. Trowel finish around post. Slope to direct water away from posts.

- E. Drive Anchor (line) posts: With protective cap, drive post 36 in. into ground. Slightly below ground level install drive anchor shoe fitting. Install two (2) diagonal drive anchors and tighten in the shoe.
- F. Check each post for vertical and top alignment and maintain in position during placement and finishing operations.
- G. Bracing: Install horizontal pipe brace at mid-height for fences 6 ft. and over, on each side of terminal posts. Firmly attach with fittings. Install diagonal truss rods at these points. Adjust truss rod, ensuring posts remain plumb.
- H. Tension wire: Provide tension wire at bottom of fabric. Install tension wire before stretching fabric and attach to each post with ties. Secure tension wire to fabric with 12-1/2 gauge (0.0985 in.) hog rings 24 in. oc.
- I. Install concrete strip/runner at base of fence for its entire length, as show on drawings.

3.03 CHAIN LINK FABRIC INSTALLATION

- A. Fabric: Install fabric on security side and attach so that fabric remains in tension after pulling force is released. The bottom of fence fabric shall be no more than 3 in above finished grade. Attach fabric with wire ties to line posts at 15 in. on center and to rails, braces, and tension wire at 24 in. on center.
- B. Tension (stretcher) bars: Pull fabric taut; thread tension bar through fabric and attach to terminal posts with bands or clips spaced maximum of 15 in. on center.

3.04 ACCESSORIES

- A. Tie wires: Bend ends of wire to minimize hazard to persons and clothing.
- B. Fasteners: Install nuts on side of fence opposite fabric side for added security.
- C. Barbed wire: Uniformly space parallel rows of barbed wire on security side of fence. Pull wire taut and attach in clips or slots of each extension.

3.05 CLEANING

- A. Clean up debris and unused material and remove from the site.

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SECTION 32 31 13
GALVANIZED CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

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1. Install gates plumb, level, and secure for full opening without interference.
2. Attach hardware by means which will prevent unauthorized removal.
3. Adjust hardware for smooth operation.
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5. The bottom of gate frames shall be no more than 3 in. above finished grade.

2.05 ACCESSORIES

- A. Chain link fence accessories: Provide items required to complete fence system. Galvanize each ferrous metal item and finish to match framing.
- B. Post caps: Formed steel, cast malleable iron, or aluminum alloy weathertight closure cap for tubular posts. Provide one cap for each post. Cap to have provision for barbed wire when necessary. "C" shaped line post without top rail or barbed wire supporting arms do not require post caps. (Where top rail is used, provide tops to permit passage of top rail.)
- C. Top rail and brace rail ends: Pressed steel per ASTM F626, for connection of rail and brace to terminal posts. Top rail shall be continuous along entire fence length.
- D. Top rail sleeves: 7 in. expansion sleeve with spring, allowing for expansion and contraction of top rail.
- E. Wire ties: 9 gauge (0.148 in.) galvanized steel wire for attachment of fabric to line posts. Double wrap 13 gauge (0.092 in.) for rails and braces. Hog ring ties of 12-1/2 gauge (0.0985 in.) for attachment of fabric to tension wire.
- F. Brace and tension (stretcher bar) bands: Pressed steel. At square post provide tension bar clips.
- G. Tension (stretcher) bars: One piece lengths equal to 2 in. less than full height of fabric with a minimum cross-section of 3/16 in. x 3/4 in. or equivalent fiber glass rod. Provide tension (stretcher) bars where chain link fabric meets terminal posts.

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 - 1. Provide 450, 3 strands, single arm
 - 2. Provide intermediate arms with hole for passage of top rail.
 - 3. Arms shall be angled at 45 degrees, angled outward from fence.

2.06 SETTING MATERIALS

- A. Concrete: Minimum twenty-eight (28) days compressive strength of 3,000 psi.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify areas to receive fencing are completed to final grades and elevations.
- B. Ensure property lines and legal boundaries of work are clearly established.

3.02 CHAIN LINK FENCE FRAMING INSTALLATION

- A. Install chain link fence in accordance with ASTM F 567 and manufacturer's instructions.
- B. Locate terminal post at each fence termination and change in horizontal or vertical direction of 30 degrees or more.
- C. Space line posts uniformly at 10 ft. on center (maximum spacing).
- D. Concrete set terminal and gate posts: Drill holes in firm, undisturbed or compacted soil. Holes shall have diameter four (4) times greater than outside dimension of post, and depths approximately 6 in. deeper than post bottom. Excavate deeper as required for adequate support in soft and loose soils, and for posts with heavy lateral loads. Set post bottom 36 in. below surface when in firm, undisturbed soil. Place concrete around posts in a continuous pour. Trowel finish around post. Slope to direct water away from posts.

- E. Drive Anchor (line) posts: With protective cap, drive post 36 in. into ground. Slightly below ground level install drive anchor shoe fitting. Install two (2) diagonal drive anchors and tighten in the shoe.
- F. Check each post for vertical and top alignment and maintain in position during placement and finishing operations.
- G. Bracing: Install horizontal pipe brace at mid-height for fences 6 ft. and over, on each side of terminal posts. Firmly attach with fittings. Install diagonal truss rods at these points. Adjust truss rod, ensuring posts remain plumb.
- H. Tension wire: Provide tension wire at bottom of fabric. Install tension wire before stretching fabric and attach to each post with ties. Secure tension wire to fabric with 12-1/2 gauge (0.0985 in.) hog rings 24 in. oc.
- I. Install concrete strip/runner at base of fence for its entire length, as show on drawings.

3.03 CHAIN LINK FABRIC INSTALLATION

- A. Fabric: Install fabric on security side and attach so that fabric remains in tension after pulling force is released. The bottom of fence fabric shall be no more than 3 in above finished grade. Attach fabric with wire ties to line posts at 15 in. on center and to rails, braces, and tension wire at 24 in. on center.
- B. Tension (stretcher) bars: Pull fabric taut; thread tension bar through fabric and attach to terminal posts with bands or clips spaced maximum of 15 in. on center.

3.04 ACCESSORIES

- A. Tie wires: Bend ends of wire to minimize hazard to persons and clothing.
- B. Fasteners: Install nuts on side of fence opposite fabric side for added security.
- C. Barbed wire: Uniformly space parallel rows of barbed wire on security side of fence. Pull wire taut and attach in clips or slots of each extension.

3.05 CLEANING

- A. Clean up debris and unused material and remove from the site.

END OF SECTION

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SECTION 33 01 10

DISINFECTION

PART 1 - GENERAL

1.01 SCOPE

- A. This Section includes the clean-up and disinfection of the storage tanks and water mains, complete with all required disinfecting and neutralizing chemicals, and all equipment, labor and superintendence.
- B. All disinfection procedures shall meet requirements of TCEQ and AWWA.

1.02 REFERENCES

- A. AWWA B 300 – Standard for Hypochlorites.
- B. AWWA C 651 – Standard for Disinfecting Water Mains.
- C. AWWA C 652 – Standard for Disinfection of Water Storage Facilities.

1.03 SUBMITTALS

- A. Prior to starting disinfection work, furnish to ENGINEER a detailed outline of proposed sequence of work, manners of filling and flushing units, source and quality of water to be used, and disposal of wastewater.
- B. Submit material data sheets on all disinfectants and neutralization chemicals to be used.

1.04 QUALITY ASSURANCE

- A. Bacteriological Sampling and Testing
 - 1. Bacteriological sampling and water quality testing of disinfected tank to be conducted by a certified laboratory acceptable to the OWNER.
 - 2. Results to be acceptable to City of Seguin.
 - 3. Tank to be verified free of coliform bacteria contamination. Work to be in accordance with AWWA C652, Disinfection of Water Storage Facilities, as applicable.
 - 4. Methods of bacteriological analysis are as specified in the Standard.
- B. Methods for Examination of Water and Wastewater by the American Public Health Association, latest edition.

1.05 DISINFECTANT

- A. Disinfectant to be calcium hypochlorite meeting the requirements of the AWWA B300 “Standard for Hypochlorites”.

1.06 WATER

- A. Water for the first tank washdown, disinfection, fill and testing of piping to meet the TCEQ Standards for potable water will be provided by the City.
- B. The CONTRACTOR may be required to pay for water required for refill or retesting due to failures in workmanship caused by the CONTRACTOR discovered during initial testing.

1.07 CLEAN-UP

- A. Remove all construction equipment, scaffolding, planks, tools, rags, paint containers, erection lugs, brackets weld burrs, weld spatter, or other materials not part of the tank structure.
- B. Clean tank of dirt, blast products, and debris by sweeping, scrubbing, vacuuming or equally effective measures.
- C. Hose down tank interior (walls, roof and floor) with potable water to remove remaining foreign materials.
- D. Collect and properly dispose of all accumulated rinse water and associated solids.

1.08 DISINFECTION

- A. General: All inside surfaces of the tank including roof, rafters and other structural members above the high water level but excluding the tank overflow piping are to be disinfected. Thoroughly rinse chlorinated water from roof and rafters prior to the filling of the tank.
- B. Initial Disinfection Procedure
 - 1. Spray and/or brush interior of tank with chlorine solution of one pound of 65 percent calcium hypochlorite to 100 gallons of water.
 - 2. Thoroughly coat all surfaces including inlet and outlet piping up to and including first block valve.
 - 3. Surfaces to be disinfected to remain in contact with disinfectant solution for a minimum of 30 minutes.
 - 4. After minimum contact time has elapsed, disinfected surfaces to be flushed by hosing down with potable water.
- C. Secondary Disinfection Procedure
 - 1. Fill tank with water, furnished by OWNER, to approximately eight feet above the tank floor.
 - 2. Add 65% calcium hypochlorite in solution to obtain a 5 ppm residual in the eight feet of water in the tank as follows:
 - a. Use the following formula to calculate weight of 65% Calcium Hypochlorite to use to obtain 5 ppm:

$\frac{(\text{Total weight of water}) \times (5 \text{ ppm})}{(1,000,000) \times (.65)}$

3. Fill the tank with water to top of overflow.
4. Let stand for a minimum of 24 hours or until the chlorine residual is less than or equal to 4 ppm.
5. Tests for leakage shall be made at this time.
6. In the event leaks occur, water shall be lowered to two feet below the point the leaks occur.
7. After repairs, the process shall be repeated.

D. Water Sampling

1. Water samples are to be taken from the tank by the OWNER for bacteriological and quality analyses.
2. The CONTRACTOR shall notify the ENGINEER when the tank is ready to be sampled.
3. All sampling to be done during normal business working hours.

E. Additional Testing Requirements

1. Repeat disinfection procedure, if necessary, at CONTRACTOR's expense until acceptable water samples are obtained.
2. CONTRACTOR responsible for disposing of chlorinated water.
3. Responsibility to include the obtaining of any necessary permits and all required neutralizing chemicals.
4. After the bacteriological criteria have been satisfied, the water in the tank must have a chlorine residual of less than 2.0 ppm before the tank is placed in service.

1.09 DISINFECTION OF PLANT PIPING

A. General

1. Furnish pump, pipe connections and necessary apparatus, gauges and meters.
2. Furnish necessary labor, assistance and chlorination agent for disinfection.

B. Contamination Control

1. Prevent admission of contaminated water to previously disinfected units.
2. If contaminated water is admitted to previously disinfected units, disinfect these units at no additional cost to OWNER.

C. Disinfect: In accordance with applicable sections of AWWA C651, Disinfecting Water Mains and as follows:

1. Chlorine dose, 50 mg/l minimum.
2. Retain chlorine water in system until completion of hydrostatic tests. Minimum retention period to be 24 hours.
3. Following chlorination, flush treated water from piping until replacement water has chlorine content not more than 0.1 mg/l in excess of residual in water from supply line, and in any event not more than 0.2 mg/l total.
4. If initial treatment results in an unsatisfactory bacterial test, repeat disinfection procedures at no additional cost to OWNER until satisfactory results are obtained.

SECTION 33 01 12
TESTING OF PIPELINES

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, tools, equipment, and related items required to perform exfiltration testing and deflection testing of facility piping systems and to perform pressure and leakage testing of pressure pipelines.
- B. All testing shall meet minimum TCEQ requirements. TCEQ requirements shall govern and supersede requirements herein.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 GENERAL

- A. Hydrostatic pressure and leakage tests shall be made on all pressure pipelines carrying water or wastewater.
- B. All labor and equipment, including test pump with regulated by-pass meters and gauges required for conducting pipeline tests, temporary pipe connections or fittings, plugs, etc. shall be furnished by the CONTRACTOR. The CONTRACTOR shall furnish equipment and necessary piping as required to transport water used in testing from source to test location.
- C. Time and sequence of testing shall be scheduled by the CONTRACTOR, subject to observation and approval by the OWNER. The CONTRACTOR shall provide adequate labor, tools, and equipment to operate valves and to locate and repair any leaks discovered during the initial filling of the pipeline prior to actual testing or during the course of the tests.
- D. Testing shall meet all TCEQ requirements.

3.02 CLEANING

- A. At the conclusion of the work, thoroughly clean all pipelines by flushing with water or other means to remove all dirt, stones, pieces of wood, or other material that may have entered the pipes during the construction period. Debris cleaned from the lines shall be removed from the low end of the pipeline. If after this cleaning, obstructions remain, they shall be removed. After the pipelines are cleaned and if the groundwater level is above the pipe or following a heavy rain, the ENGINEER will examine the pipes for leaks. If any defective pipes or joints are discovered, they shall be repaired.

3.03 TEST PROCEDURES FOR GRAVITY PIPELINES

- A. Gravity pipelines shall be installed and backfilled and then tested using either Exfiltration Water Testing or Low-Pressure Air Testing. In addition, flexible pipes shall be tested using an Allowable Deflection Test.
 - 1. Exfiltration Water Testing

- a. The section of pipe to be tested shall be filled with water and allowed to stand for such time as is required for the pipeline to adsorb such water as it will and for the escape of all air from the line. The sections undergoing test shall be carefully examined for leakage. All known leaks shall be repaired, regardless of these test requirements.
- b. The line shall then be filled to a reference level in manhole or in a reservoir of sufficient capacity to allow for a reference level to be established. The reservoir must be of sufficient capacity as to not allow the water level to drop below the crown of the pipe during the 24-hour test period. If the water level drops below the crown of the pipe, the test shall be voided and run again or until such time the water level is maintained above the crown throughout the duration of the test.
- c. At the end of a 24-hour period, water, if needed, shall be added to the line to bring the water level back to the referenced line. All water added shall be accurately measured by an approved water meter so that an exfiltration rate can be established.
- d. Leakage during the above test shall not exceed a rate equal to 25 gallons per inch of internal diameter per mile per twenty-four hours.
- e. All observed leaks shall be repaired regardless of the measured leakage rate.

2. Low Pressure Air Testing

- a. This test shall conform to the procedure described in ASTM C828, ASTM C924 or other appropriate procedures. For safety reasons, air testing of sections of pipe shall be limited to lines less than 36 in. average inside diameter. Lines 36 in. average inside diameter and larger may be air tested at each joint. The minimum time allowable for the pressure to drop from 3.5 pounds per square inch gauge to 2.5 pounds per square inch gauge during a joint test, regardless of pipe size, shall be 20 seconds. For sections of pipe less than 36 in. average inside diameter, the maximum time allowable for the pressure to drop from 3.5 pounds per square inch gauge to 2.5 pounds per square inch gauge shall be computed by the following equation:

$$T = 0.085 (D) (K) / (Q)$$

where T = time for pressure to drop 1.0 pounds per square inch gauge in seconds

K = 0.00049DL, but not less than 1.0

D = average inside diameter in inches

L = length of line of same pipe size being tested in feet

Q = rate of loss, assume 0.0015 ft³/min/sq. ft. internal surface

- b. All observed leaks shall be repaired regardless of the air test results.

3. Allowable Deflection Test

- a. Pipe deflection testing shall be conducted on all gravity pipes constructed of flexible materials (PVC or other plastic materials).
- b. Pipe deflection measured not less than ninety (90) days after the backfill has been completed as specified shall not exceed five (5.0) percent. Deflection shall be computed by multiplying the amount of deflection (nominal diameter less minimum diameter when measured) by 100 and dividing by the nominal diameter of the pipe.
- c. Deflection shall be measured with a rigid mandrel device cylindrical in shape and constructed with a minimum of nine evenly spaced legs. The outer diameter of the legs shall be 95 percent of the pipe's actual internal diameter. Drawings of the mandrel with complete dimensions shall be submitted to the ENGINEER for each diameter of pipe to be tested. The mandrel shall be hand pulled by the CONTRACTOR through all sewer lines.
- d. Any section of sewer not passing the mandrel shall be uncovered at the CONTRACTOR'S expense and the bedding and backfill replaced to prevent excessive deflection. Repaired pipe shall be retested.

3.04 MANHOLE TESTING

- A. The contractor shall perform the testing for all sanitary sewer manholes in accordance with the following:
 - 1. All manholes must pass a leakage test.
 - 2. The contractor shall test each manhole for leakage, separate and independent of all other sanitary sewer piping, by means of vacuum test, as follows:
 - a. The lines entering the manhole shall be temporarily plugged with the plugs braced to prevent them from being drawn into the manhole.
 - b. The plugs shall be installed in the lines beyond drop connections, gas sealing connections, etc.
 - c. Prior to performing the test, the Contractor shall plug all lift holes and exterior joints with a non-shrink grout and plug all pipes entering the manhole.
 - d. Contractor shall use a minimum 60 inch-lb. torque wrench to tighten the external clamps that secure the test cover to the top of the manhole.
 - e. The test head shall be inflated in accordance with the manufacturer's recommendations.
 - f. A vacuum of 10 inches of mercury shall be drawn, and the vacuum pump will be turned off.
 - g. With the valve closed, the level vacuum shall be read after the required test time.
 - h. If the drop in the level is less than 1 inch of mercury (final vacuum greater than 9 inches of mercury), the manhole will have passed the vacuum test.

- i. The required test time is 2 minutes.
3. Acceptance: Any manhole which fails the initial test must be repaired with a non-shrink grout or other suitable material based on the material of which the manhole is constructed.
4. The manhole shall be retested as described above until a successful test is attained.
5. After a successful test, the temporary plugs will be removed.

3.05 TEST PROCEDURES FOR PRESSURE PIPELINES

A. General

1. After the pipe has been laid and backfilled and the backfill has been otherwise consolidated, all newly laid pipe, or any valved section thereof, shall be subjected to the hydrostatic pressure and leakage tests specified below for that particular type of pipe. The duration of each hydrostatic pressure test shall be at least one hour and each leakage test at least four hours, unless otherwise specified or noted on the Drawings. All meters, fixtures, devices or appliances which are connected to the pipeline system, and which might be damaged if subjected to the specified test pressure shall be disconnected and the ends of the branch lines plugged or capped during the testing procedures.
2. Each valved (capped or plugged) section of pipe shall be filled slowly with water and all air shall be expelled. If permanent air vents are not located at all high points, the CONTRACTOR shall install corporation or blow-off cocks at such points so that air can be expelled as filling takes place. After verification that all air has been expelled, the cocks shall be closed, and the pipe kept filled until tested. All exposed pipe, fittings, valves, hydrants, and joints shall be examined while under test pressure and all visible leaks shall be stopped. Any cracked or defective pipe, fittings, valves, or hydrants discovered during testing shall be removed and replaced by the CONTRACTOR. Replacement shall be with sound material and the test shall be repeated until satisfactory to the OWNER.

- B. Special Requirements. Where any section of pipeline is provided with concrete thrust blocking, the hydrostatic pressure test shall not be made until at least five (5) days have elapsed after installation of the blocking. However, if high-early-strength cement is used in the concrete, two (2) days shall have elapsed prior to testing.

C. Hydrostatic Pressure Tests

1. After compliance with all applicable procedures described above, pressure of 150 percent of the pipe's normal operating pressure shall be applied, unless another test pressure is specified for the type of pipe being tested or as shown in the Table below. This pressure, based on the lowest point of the line or section under test, shall be corrected to the relative elevation of the test gauge and the pressure maintained for a period of not less than one (1) hour. CONTRACTOR shall coordinate all test pressures with ENGINEER.
2. Pipe Test Pressure Summary Schedule

Pipe ID	Test Pressure, psi
All Flanged Ductile Iron Piping	150
All restrained mechanical joint ductile iron piping	150
All bell and spigot, gravity	25
All PVC solid wall piping	100

D. Leakage Tests

1. Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe, or any valved section thereof, to maintain the specified leakage test pressure after the air in the pipeline has been expelled and the pipe has been filled with water.
2. Leakage shall be determined by recording the quantity of water pumped into the pipeline through a standard water meter of a size appropriate to secure an accuracy of ± 2 percent at the average rate of flow pumped. Leakage rate shall be calculated by extrapolation of the total leakage during the testing period to a 24-hour period. Leakage test pressure shall be coordinated with ENGINEER and test pressure shall be maintained for a period of four (4) hours.
3. Allowable leakage for the types of pipe used shall be as follows:
 - a. Cast Iron and Ductile Iron. Allowable as permitted by AWWA Standard C-600-82, "Installation of Gray and Ductile Cast-Iron Water Mains and Appurtenances", which is not to exceed that determined by the formula:

$$L = (SD\sqrt{P}) / 133,200$$

- 1) Where L is the allowable leakage in gallons per hour, S is the length of pipeline tested in feet, D is the nominal diameter of the pipe in inches, and P is the average test pressure during the leakage tests in pounds per square inch gauge.
- b. PVC and HDPE – No leakage allowed.
- c. Stainless steel Air Piping – No leakage allowed.
4. In the event any section of the line tested fails to meet the above specified requirements for water tightness, the cause of the excessive leakage shall be determined and remedied at the expense of the CONTRACTOR, including retesting if required.

3.06 SUBMITTALS TO ENGINEER

- A. Provide test report for each pipe segment tested. Each test report shall be submitted to the ENGINEER for approval and shall include the following minimum information: date of test, location of test, manholes related to test, pipe section ID number, manhole number, pipe diameter, pipe material, pipe length, and whether the test passed or failed. Additionally, any explanatory comments related to the testing shall be noted. A representative from the OWNER shall be onsite to witness testing procedures and provide a signature of acceptance for each test report.

3.07 FINAL ACCEPTANCE

- A. No pipe installation will be accepted until all known leaks have been repaired whether or not leakage is within allowable limits. Locating and repairing of leaks shall be performed by the CONTRACTOR at no additional cost to the OWNER.
- B. The OWNER will certify that all required pressure and leakage tests have been successfully completed before the pipeline is accepted.

3.08 WATER SOURCE

- A. Water shall be available on this project as specified in other sections. The CONTRACTOR shall install temporary connections to the supply pipe, including supply/installation of RPZ backflow preventer and meter. Any additional water, if necessary, shall be provided at CONTRACTOR'S expense.

END OF SECTION

SECTION 33 05 09
PIPING SPECIALTIES

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. This section specifies piping appurtenances which are not specifically covered in other sections.
- B. Specific piping materials, systems and related installation and testing requirements are included in other sections.
- C. The items shall include the following:
 - 1. Unions
 - 2. Plugs and Caps
 - 3. Vents and Drains
 - 4. Line Strainers
 - 5. Self-Backwashing Filter
 - 6. Service Clamps
 - 7. Floor Drains
 - 8. Quick Connect Couplings
 - 9. Flexible Connectors
 - a. Sleeve Couplings
 - b. Split or Grooved Couplings
 - c. Flange Adapters
 - d. Pump and Equipment Flexible Connectors
 - e. Flexible Connectors
 - 10. Harnessing and Restraints
 - 11. Pressure Gauges
 - 12. Diaphragm Seals for Gauges
 - 13. Rotameters and Flow Indicators
 - 14. Spray Nozzle

- 15. Prefabricated Pipe Trough
- 16. Appurtenances and Miscellaneous Items

1.02 RELATED WORK

- A. Piping materials and systems are included in other sections.

1.03 SUBMITTALS

- A. General submittals for piping, piping systems and pipeline appurtenances are listed below. Submittals shall be in accordance with SECTION 01 33 00 – SUBMITTAL PROCEDURES. It is not intended that all submittals listed below be provided for all piping materials and systems. Refer to individual System or Piping Sections for specific submittals.
- B. Shop Drawings and Product Data
 - 1. Piping layouts in full detail.
 - 2. Location of pipe hangers and supports.
 - 3. Location and type of backup block or device to prevent joint separation.
 - 4. Large scale details of wall penetrations and fabricated fittings.
 - 5. Schedules of all pipe, fittings, special castings, couplings, expansion joints and other appurtenances.
 - 6. Catalog cuts of joints, couplings, harnesses, expansion joints, gaskets, fasteners, and other accessories.
 - 7. Catalog cuts of all pipeline appurtenances specified herein.
 - 8. Brochures and technical data on coatings and linings and proposed method for application and repair.
- C. Samples
- D. Design Data
- E. Test Reports
 - 1. Certified shop tests showing compliance with appropriate standard.
 - 2. Field test reports, signed by CONTRACTOR and ENGINEER.
- F. Certificates
 - 1. Copies of certification for all welders performing work in accordance with ANSI B31.1.
- G. Manufacturer's Installation (or application) instructions.
- H. Statement of Qualifications

- I. Manufacturers Field Report
- J. Project Record Document
- K. Operation and Maintenance Data in accordance with SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA.
- L. Warranties
- M. One (1) electronic copy in Portable Document Format (PDF) of all submittals and re-submittals shall be submitted suitable for distribution over electronic mail or File Transfer Protocol (FTP). For final approved submittals provide PDF and two (2) hard copies.

1.04 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM A36 - Standard Specification for Structural Steel.
 - 2. ASTM A126 - Gray Iron Casting for Valves, Flanges and Pipe Fittings.
 - 3. ASTM A183 - Carbon Steel Track Bolts and Nuts.
 - 4. ASTM A278 - Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 50°F.
 - 5. ASTM A307 - Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
 - 6. ASTM A325 - Standard Specification for High-Strength Bolts for Structural Steel Joints.
 - 7. ASTM A536 - Ductile Iron Castings
 - 8. ASTM A575 - Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grade.
 - 9. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.
 - 10. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
- B. American National Standards Institute (ANSI)
 - 1. ANSI A13.1 - Scheme for the Identification of Piping Systems.
 - 2. ANSI B1.1 - Unified Inch Screw Threads (UN and UNR Thread Form)
 - 3. ANSI B2.1 - Specifications, Dimensions, Gauging for Taper and Straight Pipe Threads (except dry seals).
 - 4. ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800.
 - 5. ANSI B16.5 - Pipe Flanges and Flange Fittings

6. ANSI B18.2 - Square and Hex Bolts and Screws Inch Series Including Hex Cap Screws and Lag Screws.
 7. ANSI B31 - Code for Pressure Piping, B31 Interpretation.
 8. ANSI B31.1 - Power Piping
- C. American Welding Society (AWS)
1. AWS B3.0 - Welding Procedure and Performance Qualifications
- D. American Water Works Association (AWWA)
1. AWWA C-110 - Ductile-Iron and Gray-Iron Fittings 3 in. Through 48 in., for Water and Other Liquids.
 2. AWWA C-111 - Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings.
 3. AWWA C-201
 4. AWWA C-206 - Grooved and Shouldered Type Joints.
 5. AWWA Manual M11 - Steel Pipe - A Guide for Design and Installation.
- E. Plumbing and Drainage Institute (PDI)
1. WH 201 - Water Hammer Arrestors
- F. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.
- 1.05 QUALITY ASSURANCE
- A. All materials shall be new and unused.
 - B. Install piping to meet requirements of local codes.
 - C. Provide manufacturer's certification that materials meet or exceed minimum requirements as specified. Reference to standards such as ASTM and ANSI shall apply to those versions in effect at the time of bid opening.
 - D. Coordinate dimensions and drilling of flanges with flanges for valves, pumps, and other equipment to be installed in piping systems. Bolt holes in flanges to straddle vertical centerline.
 - E. Reject materials contaminated with gasoline, lubricating oil, liquid or gaseous fuel, aromatic compounds, paint solvent, paint thinner and acid solder.
 - F. Pipe-joint compound, for pipe carrying flammable or toxic gas, must bear approval of Underwriters' Laboratories or Factory Mutual Engineering Division.

- G. Unless otherwise specified, pressures referred to in all Piping Sections are expressed in pounds per square in gauge above atmospheric pressure, psig and all temperatures are expressed in degrees Fahrenheit.

1.06 DELIVERY, STORAGE AND HANDLING

- A. During loading, transportation and unloading take care to prevent damage to pipes and coating.
- B. Carefully load and unload each pipe under control at all times. Place skids or blocks under each pipe in the shop and securely wedge pipe during transportation to ensure no injury to pipe and lining.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. Specific piping materials and appurtenances are specified in the respective Piping or System Sections. The use of a manufacturer's name and/or model number is for the purpose of establishing the standard of quality and general configuration desired.
- B. Equipment shall be of the size shown on the Drawings or as noted and as far as possible equipment of the same type shall be identical and from one manufacturer.
- C. Equipment shall have the name of the maker, nominal size, flow directional arrows (if applicable), working pressure for which they are designed, and standard referenced specifications cast in raised letters or indelibly marked upon some appropriate part of the body.
- D. Unless otherwise noted, items shall have a minimum working pressure of 150 psi or be of the same working pressure as the pipe they connect to, whichever is higher and suitable for the pressures noted where they are installed.

2.02 UNIONS

- A. Unions shall be brass or bronze unions for joining nonferrous pipe; malleable brass or bronze-seated iron or steel unions for joining ferrous pipe; PVC unions for joining PVC pipe; CPVC unions for joining CPVC pipe.

2.03 PLUGS AND CAPS

- A. Provide standard plug or cap as required for testing, plugs, caps suitable for permanent service.
- B. Plug or cap or otherwise cover all piping work in progress.

2.04 VENTS AND DRAINS

- A. 1/2 in. vents shall be provided at the high point in each system. Vent connections may be tapped, provided the tap will accept three full threads on the bronze nipple.
- B. 1-1/2 in. drains shall be provided to permit drainage of each system; provide hose-end valve.

2.05 LINE STRAINERS

- A. "Y" Type Strainers

1. Manual strainers furnished for pipe diameters smaller than 2 in. shall be "Y" type, capable of removing solids 0.01 in. diameter and larger. The strainer body shall be of semi-steel construction for steel pipe and brass or bronze for copper pipe and shall conform to the latest revision of ASTM A278, Class 30. Strainer elements, including woven wire mesh, shall be constructed of stainless steel.
2. The design of the strainer body shall be such that the cleanout plug, and screen may be easily removed to permit inspection and cleaning without disassembly of the inlet and outlet piping. End connections shall be ANSI screwed pipe threads.
3. Sufficient spare screen shall be furnished for replacement of all "Y" type units at least once.
4. The strainers shall be designed for a maximum operating pressure of 150 psig. They shall be as manufactured by GA Industries Inc., Pittsburgh, PA or equal.

2.06 SERVICE CLAMPS

- A. Service clamps for outlet sizes up to 2 in. shall have malleable or ductile iron bodies which extend at least 160 degrees around the circumference of the pipe and shall have neoprene gaskets cemented to the saddle body. Bodies shall be tapped for IPS. Clamps shall be of the double strap design. Service clamps shall be Style 91 as manufactured by Dresser Industries, Inc. or equal as manufactured by Smith Blair, Mueller or equal.
- B. Service clamps for outlet sizes 4 in. through 12 in. where the outlet size is not greater than half the size of the main pipe shall have ductile iron bodies and a neoprene circular cross section O-ring gasket confined within the body. Outlet shall be AWWA C-110 flange or AWWA C-111 mechanical joint as required for the application. Straps shall be alloy steel, minimum 1/4 in. by 12 in. in cross section and fabricated with 3/4 in. threaded ends. Service clamps shall be Fig. A-10920 or A-30920 as manufactured by American Cast Iron Pipe Company or equal.

2.07 QUICK CONNECT COUPLINGS

- A. Couplings shall be of the cam and groove type consisting of a male adapter conforming to Specification MIL-C-27487. Male adapters shall be designed to receive a female coupler without requiring threading, bolting, or tools. Connections shall remain tight and leak-proof under pressures up to 100 psig. Each adapter shall be furnished with a dust cap complete with an 18 in. long security chain of corrosion resistant material. Couplings shall be as manufactured by Dover Corporation; Ever-tite, or equal. Units shall be "drip proof", providing totally dry connections and disconnections.
- B. Adapters shall be furnished in accordance with the Drawings, or as required by the installation.

2.08 FLEXIBLE CONNECTORS

- A. Sleeve Couplings
 1. Provide plain end type ends to be joined by sleeve couplings as stipulated in AWWA C201.
 - a. Join welds on ends by couplings without pipe stops. Grind flush to permit slipping coupling in at least one direction to clear pipe joint.

- b. Outside diameter and out-of-round tolerances shall be within limits specified by coupling manufacturer.
 - c. Provide lugs in accordance with ASTM A36.
 - d. Provide hardened steel washers in accordance with ASTM A325.
 - e. Plastic plugs shall be fitted in coupling to protect bolt holes.
 - f. Nuts and bolts:
 - 1) Provide bolts and bolt-studs in accordance with ASTM A307 and ANSI B1.1 with hexagonal or square heads, coarse thread fit, threaded full length with ends chamfered or rounded.
 - 2) Project ends 1/4 in. beyond surface of nuts.
 - 3) Hexagonal nuts with dimensions in accordance with ANSI B18.2 and coarse threads in accordance with ANSI B1.1.
2. For AWWA C200 Welded Steel Pipe, middle ring of each mechanical coupling shall have a thickness at least equal to that specified for size of pipe on which coupling is to be used and shall not be less than 10 in. long for pipe 30 in. and larger and not less than 7 in. long for pipe under 30 in. diameter.
- a. Omit pipe stop from inner surface of middle rings of couplings whenever necessary to permit removal of valves, flowmeters, and other installed equipment.
 - b. Provide pipe stops in other couplings.
3. Clean and shop prime with manufacturer's standard rust inhibitive primer.
4. Furnish gaskets of a composition suitable for exposure to the fluid service.
5. Where shown on the Drawings, anchor sleeve-coupled joints with harness bolts. Weld harness lugs to steel pipe.
- a. Joint harness bolts shall be of sufficient length, with harness lugs placed so that coupling can be slipped at least in one direction to clear joint. Provide harnesses of sufficient number and strength to withstand test pressure.
 - b. Each harness shall have a minimum of two 5/8 in. diameter bolts.
6. Unless otherwise specified with the individual type of pipe, sleeve couplings (mechanical couplings) shall be ITT (formerly Smith Blair) Style 411; Dresser Style 38, similar models by Baker or equal, with the pipe stop removed.
7. Similar insulation type couplings shall be provided at the face of buildings, between different type metals or where otherwise noted.
8. In addition to those locations noted on the Drawings, sleeve coupling shall be provided on all piping where it connects with a structure or buried directly under a structure at the structure's expansion joints. Special treatment will be required where

pipe is encased in concrete, utilizing minimum 3 in. thick Styrofoam placed perpendicular to the horizontal centerline of the coupling.

B. Split or Grooved Couplings

1. Split couplings shall be cast in two or more parts. When secured together with ASTM F583, Type 316 stainless steel bolts and nuts, couplings shall engage grooved or shouldered pipe ends and encase an elastomeric gasket to create a pipe seal. Gasket material shall be as recommended by the manufacturer for the service required.
2. Split couplings shall be as manufactured by Victaulic Company of America; Gustin-Bacon or equal. Numbers below refer to Victaulic Co. items, for reference only.
3. Unless otherwise specified with the individual type of pipe:
 - a. Flexible split ring couplings shall be:
 - 1) grooved ends- Style 77
 - 2) shouldered ends - Style 44
 - b. Rigid split ring couplings shall be:
 - 1) Grooved ends - rigid groove with Style HP-70 couplings on ductile iron less than 18 in. diameter with sufficient wall thickness per AWWA C606, on standard groove with Style 77 coupling on manufactured steel or other pipe.
 - 2) Shouldered ends - Style 44 coupling on ductile iron over 16 in. diameter or without sufficient wall thickness per AWWA C606 or on manufactured steel pipe or thin wall stainless steel pipe.
4. Ductile iron pipe for use with split-type coupling joints shall have radius grooved ends conforming to AWWA C606. Pipe shall have grooved ends to provide either a rigid joint or flexible joint as shown on the Drawings and as specified herein. Flexible joint grooving shall permit expansion and contraction, and angular deflection. Rigid joint grooving shall allow no angular or linear movement. Minimum pipe wall thickness for grooved pipe shall be the following class:

Size	Class
4 thru 16	53
18	54
20	55
24	56

5. Grooved couplings for steel and stainless-steel piping shall have roll grooving, machine-grooving, or ring collars fully welded to the pipe or fitting.
6. Rigid split couplings may be substituted for flanges as noted on the Drawings and in the individual pipe specifications.
7. Certain minimum thickness of pipe walls are required by AWWA C606 and coupling manufacturers for use of various type split couplings with certain pipes. The

CONTRACTOR shall be responsible for utilizing at least those minimum wall thicknesses required (unless a greater thickness is specified or required in the individual pipe specifications) with split couplings.

8. If minimum thicknesses are not utilized with grooving, then a shouldered end treatment with couplings as noted shall be utilized.

C. Flanged Adaptors

1. Flanged adaptor connections for grooved or shouldered end pipe compatible with split couplings at fittings, valves and equipment shall be VIC-Flange Style 341 as manufactured by the Victaulic Company of America, or equal product as manufactured by Gustin-Bacon.
2. Flanged adaptor connections for plain end pipe at fittings, valves and equipment shall be Dresser Style 127 or 128, similar models by ITT (formerly Smith-Blair), Baker or equal.

D. Pump and Equipment Flexible Connectors

1. The flexible connectors shall be expansion/vibration joints of the single arch type of butyl rubber construction with carcass of high-grade woven cotton or suitable synthetic fiber and individual solid steel ring reinforcement. Soft rubber fillers shall be integrally cured into the arches to provide a smooth flow path to prevent settling of material into the arch. Joints shall be constructed to pipeline size and to meet working pressures and corrosive conditions similar to the line where installed. Joints shall have full faced fabric reinforced butyl flanges integral with the body.
2. Split steel or ductile iron back-up rings shall be provided to ensure a good joint. Rings shall be designed for mating with ANSI Standard minimum 150 lbs. flanges. All joints shall be finish coated with Hypalon, or equal paint.
3. Expansion/vibration joints shall be furnished with control (harness) units. Harness units shall consist of minimum two drilled plates, stretcher bolts, and rubber washers backed by metal washers. The stretcher bolts shall prevent over-elongation of the joint. Extra nuts shall be provided on the stretcher bolts on the inside of the plate to prevent over compression. All nuts, bolts and plates shall be galvanized.
4. The manufacturer of the expansion joints shall be a member of the Rubber Expansion Joint Division of the Fluid Sealing Association. Expansion joints shall be Style 1025 filled arch as manufactured by General Rubber Corp., South Hackensack, NJ, or similar products of Mercer Rubber; Goodall Rubber; Garlock; Proco Products Inc., Stockton, CA or equal.
5. In addition to other locations shown on the Drawings, expansion joints shall be utilized in all exposed piping, within one foot of a building expansion joint, and on the suction and discharge side of all positive displacement pumps, compressors, and rotating machinery, as close to the unit as possible.

E. Flexible Connectors

1. Provide one flexible connector for the seal water connection to each pump stuffing box. Connectors shall be of hose of Buna-N or similar resilient material, with fiber

reinforcement, rated minimum 150 psi with bronze or Type 304 stainless steel NPT end fittings and shall be 12 in. in length. Connectors shall be for the purpose of isolating pump vibration from the seal water piping.

2.09 HARNESSING AND RESTRAINT

- A. Where harnessed couplings or adapters are noted, they shall conform to AWWA Manual M11 except as modified by the Drawings or this Specification.
- B. Unless otherwise noted, size and material for tie rods, clamps, plates, and hex nuts shall be as shown on the Drawings, or, if not shown on the Drawings, shall be as required in AWWA Manual Mil. Manufactured restraining clamp assemblies shall be as manufactured by Stellar Corporation, Columbus, OH, or fabricated equal.
- C. Restrained joints (such as welded, locking mechanical joints) shall be of the type specified with the individual type of pipe. If not specified, restrained (locking) mechanical joint pipe shall be of the manufacturer's standard design utilizing a locking device (ring or ears) integrally cast with the pipe.
- D. The CONTRACTOR shall be responsible for anchorage including restraint as noted elsewhere in DIVISION 15 - MECHANICAL.

2.10 PRESSURE GAUGES

- A. Bosses, connections, or nipples for gauges shall be provided as acceptable to the ENGINEER.
- B. Unbossed tappings shall not be acceptable. Where gauge tappings are not available in the suction or discharge nozzle, the necessary tapping in the adjacent piping shall be made.
- C. In addition to the locations shown on the Drawings, pressure gauges shall be furnished and installed on the upstream and downstream sides of pressure reducing stations and, in the suction, and discharge nozzle of all pumps, compressors and similar equipment. Additional pressure gauges shall be furnished and installed as specified with individual equipment.
- D. Gauges shall be furnished as part of a complete factory assembly, including gauge, snubber, liquid fill, bar stock ball valve isolation valve and threaded red brass connecting piping.
- E. Unless otherwise noted, gauge rating shall be from 0 to at least 2.5 percent higher than the rating of the pipe it is connected to.
- F. For Liquid Service
 - 1. Pressure gauges shall have an aluminum case and shall be 4-1/2 in. nominal diameter with a full-sized Type 316 stainless steel Bourdon tube and a 300 series stainless steel movement. The gauges shall be liquid filled with glycerin and shall be provided with a filler/breather cap. The socket shall be 1/4 in. NPT Type 316 stainless steel with a bottom connection and the dial shall be a white background with black markings. Gauges shall be ANSI Grade A plus or minus 1 percent of scale and shall have a blow-out back design.
 - 2. Gauges for the above services shall be liquid filled as manufactured by U.S. Gage; Ashcroft or Trerice or equal. CONTRACTOR shall ensure that one gauge manufacturer is used throughout the project.

- G. Gauges shall be furnished from standard ranges of the manufacturer, with dual range (ft. and psi) scales, and with scales as approved during submittals.

2.11 DIAPHRAGM SEALS FOR GAUGES

- A. Diaphragm seals shall be installed for all pressure gauges and pressure switches not on clean water lines, to protect pressure gauges and pressure switches from contact with the fluid in the pipeline. Gauges shall be furnished as part of a complete factory assembly, including gauge, snubber, diaphragm seal, liquid fill, bar stock isolation valve and threaded red brass interconnecting piping. Furnish also a 1/4 in. backflushing connection and ball valve.
- B. Diaphragm seals shall be minimum 2-1/2 in. diameter, or as required for the connected pressure gauges. The diaphragm shall be "thread attached" to both piping and pressure switches or gauges. Furnish mineral oil fill between the diaphragm seal and the gauge.
 - 1. Diaphragm seals shall have an upper housing of cadmium plated carbon steel, with the lower housing of material specifically chosen according to the fluid type and pressure being monitored with Type 304 stainless steel bolts. Diaphragms shall be Teflon.
 - 2. Each diaphragm seal shall be connected to its respective piping or equipment with threaded red brass pipe and fittings. Pipe size and diaphragm tap size shall match the size of the gauge tap on the equipment, but shall not be less than 3/4 in., except for connections to plant water piping which shall be minimum 1/2 in. Furnish a ball valve shut-off valve between the pipeline or equipment and the diaphragm seal.
 - 3. Each diaphragm seal shall have a minimum 1/4 in. NPT flush connection with ball valve and gauge tap to match the size of the gauge.
 - 4. Furnish pulsation dampeners adequate to prevent pulsation and/or vibration of the gauge indicator under all system operating conditions.
 - 5. Pump gauges shall connect to the diaphragm seal by a flexible Type 304 stainless steel capillary tube. Gauges shall be mounted on a support stand independent of the pump and piping, to minimize vibration of the gauges caused by vibration of the equipment or piping. Mount both the suction and discharge gauges at the same elevation.
 - 6. Diaphragm seals shall be Type SG by Mansfield and Green, Ashcroft, or equal.

2.12 ROTAMETERS AND FLOW INDICATORS

- A. Rotameters for the systems listed below shall be of the glass tube type with Borosilicate glass tubes, Type 302 stainless steel frames with slip-on covers, 10 in. detached type aluminum scales graduated in gallons per minute, 10:1 flow range, accuracy of 2 percent of full scale and vertical screwed end connections. Capacity, size, and materials of construction shall be in accordance with the following table. Tube size shall be the same size as the end connections. Pressure drop at rated capacity shall not exceed 32 in. of water.
- B. Number and size of rotameters shall be as specified in individual Sections.
- C. Flow indicators for shaft seal/flushing water systems shall be brass body, glass or plastic tube, stainless steel float, 125 psi pressure rating. Accuracy shall be at least 5 percent of full scale.

2.13 SPRAY NOZZLES

- A. Nozzles shall be of the size, with feed rates as noted on the Drawings. Nozzles shall be attached to the distribution header, as indicated on the Drawings, via split-eyelet connections. Unless otherwise noted nozzles shall be Type 316 stainless steel.
- B. Each nozzle shall be furnished with a stainless-steel adjustable ball fitting.
- C. The distribution piping to the nozzles shall be sloped for drainage and shall be adequately supported to prevent sagging, while facilitating access for nozzle replacement. The CONTRACTOR shall test the system to demonstrate to the ENGINEER that it is entirely self-draining prior to acceptance.
- D. All nozzles shall be the appropriate model, as manufactured by Spraying Systems Incorporated or equal.

2.14 APPURTENANCES AND MISCELLANEOUS ITEMS

- A. All gaskets, glands, bolts, nuts, and other required hardware shall be provided for connection of piping and appurtenances. Bolts and nuts shall be high strength, Type 316 stainless steel if submerged, buried, or subject to splashing and cadmium plated otherwise, with tee-head and hexagon nut. All other hardware shall be of the size, type and number as required and recommended by the piping or appurtenance manufacturer and as specified herein.
- B. All gaskets for flanges shall be full face and suitable for 200°F operating temperature unless higher temperature required on individual systems and the fluids carried. See also DIVISION 1 - GENERAL REQUIREMENTS.
- C. Plugs, caps, and similar accessories shall be of the same material as the pipe and of the locking type, unless otherwise noted.
- D. Unions shall be of the same material as the pipe, except for dielectric connections.

PART 3 - EXECUTION

3.01 GENERAL

- A. All dirt, scale, weld splatter, water and other foreign matter shall be removed from the inside and outside of all pipe and sub-assemblies prior to installing.
- B. All pipe joints and connections to equipment shall be made in such a manner as to produce a minimum of strain at the joint.
- C. Install piping in a neat manner with lines straight and parallel or at right angles to walls or column lines and with risers plumb. Run piping so as to avoid passing through ductwork or directly under electric light outlets and/or interference with other lines. All work shall be accomplished using recognized methods and procedures of pipe fabrication and in accordance with the latest revision of applicable ANSI Standards, ASME Codes and Pipe Fabrication Institute Standards.
 - 1. Use full length of pipe except where cut lengths are necessary. Do not spring or deform piping to make up joints.

2. Pipe shall be cut square, not upset, undersize or out of round. Ends shall be carefully reamed and cleaned before being installed. Bending of pipe is not permitted. Use fittings for all changes in direction.
3. Do not use bushings except where specifically approved by the ENGINEER. Reducers shall be eccentric to provide for drainage from all liquid-bearing lines and facilitate air removal from water lines.
4. Verify the locations and elevations of any existing piping and manholes before proceeding with work on any system. Any discrepancies between the information shown on the Drawings and the actual conditions found in the field shall be reported at once to the ENGINEER. No claim for extra payment will be considered if the above provision has not been complied with.
5. Where lines of lower service rating tie into services or equipment of higher service rating the isolation valve between the two shall conform to the higher rating.
6. Mitering of pipe to form elbow is not permitted.
7. All piping interiors shall be thoroughly cleaned after installation and kept clean by approved temporary closures on all openings until the system is put in service. Closures should be suitable to withstand the hydrostatic test.
8. End caps on pre-cleaned pipe shall not be removed until immediately before assembly. All open ends shall be capped immediately after completion of installation.

D. Test Connections

1. Provide 1/2 in. female NPT test connection equipped with 1/2 in. brass plug on all pump suction and discharge lines. Where indicated on the Drawings, test connections should be equipped with bar stock valve and gauge. Provide test connections at all steam traps. The connection shall be located on the discharge side of the trap between the trap and the first valve. It shall consist of a 1/2 in. branch connection terminated with a gate valve.

E. Unions

1. Unions screwed or flanged shall be provided where indicated and in the following locations even if not indicated.
 - a. In long runs of piping to permit convenient disassembly for alterations or repairs.
 - b. In by-passes around equipment.
 - c. In connections to tanks, pumps and other equipment between the shut-off valve and the equipment.
 - d. In connections on both sides of traps, controls, and automatic control valves.

F. Vents and Drains

1. Provide vents and drains in the following places:
 - a. Water Lines- Vents at high points and drains at low points.

- b. Air Lines - Drains at low points.

3.02 UNIONS

- A. Use unions to allow dismantling of pipe, valves, and equipment.

3.03 WELDING

- A. Welding in accordance with ANSI Standard B31 and AWS B3.0.
- B. Install welding fittings on all welded lines. Make changes in direction and intersection of lines with welding fittings. Do not miter pipes to form elbows or notching of straight runs to form tees, or any similar construction. Do not employ welder who has not been fully qualified in above specified procedure and so certified by approved welding bureau or similar locally recognized testing authority.

3.04 FLANGED JOINTS

- A. Make flanged joints with bolts; bolt studs with nut on each end; or studs with nuts where one flange is tapped. Use number and size of bolts conforming to same ANSI Standard as flanges. Before flange pieces are assembled, remove rust resistant coating from machined surfaces, clean gaskets and smooth all burrs and other defects. Make up flanged joints tight, care being taken to prevent undue strain upon valves or other pieces of equipment.

3.05 SLEEVE COUPLINGS

- A. Install tie rods, pipe clamps or bridles when sleeve type couplings or fittings are used in piping systems where indicated, and at changes in direction or other places as necessary, to prevent joints from pulling apart under pressure. Use bridles and tie rods at least 3/4 in. diameter, except where tie rods replace flange bolts of smaller size; in which case, fit with nut on each side of pair of flanges. Joint harnessing shall conform, as a minimum, to the requirements for the bolts and tie bolt lugs as set forth in AWWA Manual Mil.

3.06 WALL SLEEVE SEALS

- A. Use expandable rubber segmented sealing device with corrosion-resistant fasteners to make watertight the annular space between pipe and sleeve. Determine the required inside diameter of each individual wall opening or sleeve to fit the pipe and seal to assure a watertight joint as recommended by the manufacturer, before ordering, fabricating, or installing. Install pipe concentrically through wall sleeve. Install and tighten seal per manufacturer's instructions.

3.07 TESTING

- A. Test all pipelines for water/gas tightness as specified in the Piping or System sections. Furnish all labor, testing plugs or caps, pressure pumps, pipe connections, gauges and all other equipment required. Testing shall be performed in accordance with procedures specified or set forth by the ENGINEER. All testing shall be performed in the presence of the ENGINEER.
- B. Repair faulty joints or remove defective pipe and fittings and replace as approved by the ENGINEER. Retest.

3.08 DISINFECTION

- A. Water being flushed from pipelines after disinfection with a chlorine residue of 2 mg/L or greater, shall be treated with a dichlorination solution, in a method approved by the ENGINEER, prior to discharge to natural streams or upon the ground.

END OF SECTION

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SECTION 33 05 19
DUCTILE IRON PIPE AND FITTINGS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The work to be performed under this section of the specifications shall comprise the furnishing of all labor, equipment, and materials, and in performing all operations necessary in connection with the installation of ductile iron pipe and fittings as shown in the plans, and as specified herein.
- B. The CONTRACTOR shall submit for approval, complete and dimensional working drawings of all ductile iron pipeline layouts. Such drawings shall indicate the size, class, and laying dimensions of all pipes, valve fittings, expansion couplings, and specials and the location of all hangers and supports needed for the installation and not specifically indicated for on the plans.
- C. All buried ductile iron piping shall be mechanical joint with meg-a-lug glands. Above ground piping shall be US pipe, or Engineer approved equal.
- D. All piping, fittings, valves, and appurtenances shall be rated for 150 psi working pressure.

1.02 RELATED DOCUMENTS

- A. SECTION 33 05 32 – WATER MAIN CONSTRUCTION
- B. SECTION 40 05 67 – GATE VALVES

1.03 SUBMITTALS

- A. The CONTRACTOR shall submit for approval, complete and dimensional working drawings of all ductile iron pipeline layouts. Such drawings shall indicate the size, class, and laying dimensions of all pipe, valve fittings, expansion couplings, and specials and the location of all hangers and supports needed for the installation and not specifically indicated for on the plans. The number, size, and length of all bolts required for flanged pipe installations shall be given on the pipe schedule of the working drawings.
- B. One (1) electronic copy in Portable Document Format (PDF) of all submittals and re-submittals shall be submitted suitable for distribution over electronic mail or File Transfer Protocol (FTP). For final approved submittals provide PDF and two (2) hard copies.

1.04 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs 60,000 psi Tensile Strength.
- B. American Water Works Association (AWWA)
 - 1. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pressure Pipe and Fittings.

2. AWWA C105 - Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids.
 3. AWWA C110 - Ductile-Iron and Gray-Iron Fittings, 3 in. through 48 in. for Water and Other Liquids.
 4. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 5. AWWA C115 - Standard for Flanged Ductile-Iron Pipe with Threaded Flanges.
 6. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds for Water or Other Liquids.
 7. AWWA C153 - Ductile-Iron Compact Fittings, 3 in. through 12 in. for Water and Other Liquids.
 8. AWWA C600 - Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances.
 9. AWWA C651 - Disinfection Water Mains
- C. American National Standards Institute (ANSI)
1. ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
- D. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

PART 2 - PRODUCTS

2.01 DUCTILE IRON PIPE AND FITTINGS

- A. Ductile Iron Pipe of size, class, and joint type shown on the plans will be furnished by the CONTRACTOR. All pipe furnished shall meet USA Standard A21.50, ANSI A 21.50, AWWA C150 (thickness design), or current revision. All Ductile Iron Pipe furnished shall also meet the requirements of federal specification ANSI A 21.51, AWWA C151, or current revision, unless otherwise noted on the plans. Flanged Ductile Iron Pipe shall be furnished with Ductile Iron Flanges and shall conform to ANSI A21.15 and AWWA C115. The ductile iron pipe shall meet thickness class 150. Certain fittings and connections shall be restrained equal to US Pipe HDSS, as shown on the drawings.
- B. Fittings shall be ductile iron of compact design and shall meet the requirements of ANSI A21.10, AWWA C153, or current revision. All fittings for above ground service shall be short body flanged fittings with Class 150 flanges. All flanges shall be faced and drilled.
- C. Joints for buried pipe shall be mechanical joints conforming to AWWA C111, except when flange joints are shown on the Drawings.
- D. All joints shall be made in strict accordance with the manufacturer's specifications.

2.02 LININGS AND COATINGS

- A. All pipe and fittings shall have a bituminous outside coating in accordance with AWWA C151 and C110, respectively. All pipe and fittings shall be cement-mortar lined and seal coated in accordance with AWWA C104, unless otherwise noted. The type and brand of interior lining shall be clearly marked on the outside of the pipe and fittings. Except as authorized by the OWNER'S Representative, only one type and brand of pipe lining shall be used on a given project.

2.03 POLYETHYLENE ENCASEMENT

- A. All buried ductile iron or cast-iron pipe, fittings, and valves will be protected with polyethylene encasement in accordance with the latest revision of AWWA C 105 specification and/or ANSI A 21.5. Encasement for non-potable water will be purple in color.
- B. In general, the following items will summarize that specification, however, the CONTRACTOR will follow the entire specification as if written herein:
 - 1. The pipe encasement material will be a polyethylene film with a thickness of 8 mils. Either tube or sheet material may be used.
 - 2. The tube will completely encase each section of pipe with at least a 1 ft. overlap at each joint. Overlaps will be secured by the use of adhesive tape, plastic string, or any other material capable of holding the encasement in place until backfilling operations are completed. The encasement shall prevent contact between the pipe and the surrounding bedding and backfill material but is not intended to be a complete air and watertight enclosure.
 - 3. Bell holes must be made at the joints to facilitate installation at the joints. Loose material will be overlapped to make a snug fit and secured with tape or string. Slack material along the barrel of the pipe shall be taken up to make a snug, but not tight, fit and secured at the quarter points of the pipe length.
 - 4. Repairs to any rip, puncture, or other damage to the polyethylene will be made with adhesive tape or with short lengths of tubing cut, wrapped and secured in place prior to backfilling procedure.
 - 5. Backfill of the pipe shall be performed as described in other specification sections described herein or as shown on the plans. The material of backfilling shall be free from cinders, refuse, boulders, rocks, stones, or other material that could damage the polyethylene.”

2.04 EXPANSION COUPLINGS

- A. Where the use of expansion couplings is indicated on the plans, they shall be Style 38 Dresser couplings, or approved equal, unless otherwise required.
- B. As may be necessary to conform to the dimensions of the couplings, the outside diameter of the plain ends of the ductile iron pipe sections which are to be jointed by a coupling, shall be gauged to proper size for use with the couplings.

2.05 SUPPORTS AND HANGERS

- A. The CONTRACTOR shall furnish and install all necessary supports and hangers, indicated on the plans, or required for the proper installation of the ductile iron pipelines in a workmanlike manner.

2.06 FLANGED JOINTS

- A. Flanged joints shall be made with bolts, or bolt-studs, with a nut on each end. Bolts, stud-bolts, and nuts shall conform to American Standard Heavy dimensions, semi-finished, with square or hexagonal heads and cold punched hexagonal nuts meeting the requirements of ASA B18.2. Bolt sizes shall be American Standard for the flanges specified. Bolt and nut threads shall conform to ASA B1.1, coarse thread series, Class 2 fit.
- B. Gaskets shall be full face with bolt holes punched. Gasket material shall be nylon-reinforced rubber, 1/8 in. minimum thickness.

2.07 GASKET MATERIALS

- A. Gaskets furnished for Flanged, Mechanical Joint, or Bell and Spigot Piping for Water, Wastewater, shall be of the materials specified below:

Temperature Minimum				
<u>Service</u>	<u>Joint Type</u>	<u>Rating</u>	<u>Thickness</u>	<u>Material</u>
Water or Wastewater	Flanged	150°F	1/8 in.	Nylon Reinforced Rubber
Water or Wastewater	M.J. or B&S	150°F	-	Styrene- Butadiene

2.08 WALL CASTINGS

- A. Mechanical Joint Wall Pipes will be utilized when possible, or as shown on the drawings. They shall be made of Ductile Iron, as specified. Fabricated Wall Castings shall have Ductile Iron wall collars and shall be welded on both sides. Screwed-on bells will not be acceptable.

PART 3 - EXECUTION

3.01 HANDLING

- A. During loading, transportation, and unloading, care shall be taken to prevent injury to the pipe or fittings. Loading or unloading shall be so handled that the piece being moved is under perfect control at all times. Under no circumstances shall a pipe or large fitting be dropped.

3.02 LAYING DUCTILE IRON PIPE AND FITTINGS

- A. Care shall be taken in loading, transporting, and unloading to prevent injury to the pipe, lining, or coatings. Pipe or fittings shall not be dropped. All pipe or fittings shall be examined before laying and no piece shall be installed which is found to be defective. Any damage to the pipe linings or coatings shall be repaired as directed by the OWNER'S Representative. Handling and laying of pipe and fittings shall be in accordance with the manufacturer's instruction and as specified herein.

- B. All pipe and fittings shall be thoroughly cleaned before laying, shall be kept clean until they are used in the work, and when laid, shall conform to the lines and grades required. Ductile iron pipe and fittings shall be installed in accordance with requirements of AWWA C600, except as otherwise provided herein. A firm, even bearing throughout the length of the pipe shall be constructed by tamping pipe bedding material conforming Drawings. Blocking will not be permitted. If any defective pipe is discovered after it has been laid, it shall be removed and replaced with a sound pipe in a satisfactory manner by the CONTRACTOR, at his own expense.
- C. All pipes shall be sound and clean before laying. When laying is not in progress, including lunchtime, the open ends of the pipe shall be closed by watertight plugs or other approved means. Good alignment shall be preserved in laying. The deflection at joints shall not exceed 75 percent of that recommended by manufacturer. Fittings, in addition to those shown on the Drawings, shall be provided, if required, for crossing utilities which may be encountered upon opening the trench or other conditions requiring alignment changes. Solid sleeves shall be used only where approved by the OWNER'S Representative.
- D. When cutting pipe is required, the cutting shall be done by machine, leaving a smooth cut at right angles to the axis of the pipe. Cut ends of pipe to be jointed with a bell shall be beveled to conform to the manufactured spigot end. Cement lining shall be undamaged.
- E. The CONTRACTOR shall have on hand at the start of the job, one 1/16 bend and one 1/8 bend for each size of pipe. These shall be used as job conditions require.

3.03 MECHANICAL JOINTS

- A. Mechanical joints shall be made in accordance with Appendix A of AWWA C111 and the manufacturer's instructions. Thoroughly clean and lubricate the joint surfaces and rubber gasket with soapy water before assembly. Bolts shall be tightened to the specified torques. Under no conditions shall extension wrenches or pipe over handle of ordinary ratchet wrench be used to secure greater leverage.

3.04 POLYETHYLENE ENCASEMENT

- A. The polyethylene encasement shall be installed in accordance with either method specified in AWWA C105.

3.05 TESTING

- A. Pipelines shall be subjected to water test pressure of 150 psi, in accordance with specification SECTION 33 01 12.16 – TESTING OF PIPELINES.

3.06 CLEANING

- A. At the conclusion of the work thoroughly clean all of the new pipelines by flushing with water or other means to remove all dirt, stones, pieces of wood or other material which may have entered during the construction period. If, after this cleaning, obstructions remain, they shall be removed.

END OF SECTION

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SECTION 33 05 32
WATER MAIN CONSTRUCTION

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. These specifications for construction of water mains are intended to be so written that only first-class workmanship and finish of the best grade and quality will result. The fact that the following specifications may fail to be so complete as to cover all details will not relieve the CONTRACTOR of full responsibility for providing a complete project of high-quality, first-class finish and appearance and satisfactory for operation.
- B. The CONTRACTOR shall furnish all materials, labor, and equipment for constructing the work included in these specifications and as detailed on the plans.

1.02 REFERENCES

- A. SECTION 33 14 19 – VALVES.
- B. SECTION 33 05 32 – PLASTIC PIPE AND FITTINGS.
- C. SECTION 31 71 20 – TUNNELING, BORING AND JACKING.

PART 2 - PRODUCTS

2.01 MATERIALS FOR WATER MAIN CONSTRUCTION

- A. All pipe, fittings, and valves shall be new. All water pipe shall be approved by the Underwriters laboratories for fire protection, approved by the National Sanitation Foundation and installed according to manufacturer's specifications.
- B. All fittings and valves for WATER MAIN CONSTRUCTION shall be mechanical joint or as specified on the plans.

2.02 WATER MAIN – RESTRAINED JOINTS

- A. All fittings for the proposed water main projects shall include meg-a-lug restrained joints. This shall include valves and fire hydrants.
- B. WATER LINE DISINFECTION
- C. The CONTRACTOR's unit price bid costs shall include the services of a certified laboratory to perform the "Bac-T" tests for the newly installed water mains/services. The sample shall be acquired by a direct employee of the lab. Samples acquired by the CONTRACTOR will not be acceptable. Sampling and testing shall meet all requirements of TCEQ. The OWNER's representative will be notified of when the sample will be acquired. The CONTRACTOR shall submit the name of the laboratory to the ENGINEER for approval. There will be no separate pay for these services.

2.03 ABANDONMENT OF EXISTING WATER LINES

- A. The project will parallel several existing water lines. It will be the CONTRACTOR's responsibility to take these existing water lines out of service, whether or not the lines to be abandoned are indicated on the plans. The CONTRACTOR shall plug the existing lines to be abandoned with an approved fitting. This work shall be deemed incidental to the project. No separate payment will be made.

PART 3 - EXECUTION

3.01 PROTECTION OF WORK

- A. When construction is stopped temporarily and at the end of the day's work, tight fitting stoppers or bulkheads shall be securely placed in or across the ends of all pipes.
- B. The CONTRACTOR will be held responsible for the care of all work until final completion and acceptance, and he will be required to make good, at his own expense, any damage or injury it may sustain for any cause. He shall assume all risks from floods and casualties of every description and make no charge for damages from such cause.

3.02 MATERIALS

- A. The CONTRACTOR shall furnish and place materials meeting the requirements of these specifications, of the dimensions and types at the locations and elevations shown on the plans or established by the ENGINEER. All materials shall be approved by the ENGINEER before being installed and any of these materials placed before they are so approved shall be removed and replaced with approved materials.

3.03 STORAGE OF MATERIALS

- A. Materials delivered to the site of the work prior to their use shall be stored to cause the least inconvenience to the public, and in a manner satisfactory to the ENGINEER.
- B. Materials that will deteriorate such as cement and mortar shall be stored in weather-tight buildings.

3.04 DESIGN PRESSURES

- A. Pipe and fittings for water lines shall be designed to withstand minimum internal working pressures of 150 pounds per square inch unless otherwise noted on the plans or in the bid proposal.

3.05 TRENCHING AND BACKFILL FOR WATER MAIN CONSTRUCTION

- A. This item consists of excavating all necessary trenches for the water main and system construction and backfilling after the pipe has been properly laid, inspected, and tested.
- B. This work shall include the furnishing of all labor, materials, tools, equipment, and machinery necessary for clearing and removing from the site of the work, wherever located, all obstructions, trees, stumps, brush, vegetation and debris, and all earth, rock, and other materials to be excavated; the removal of existing structures except where specifically paid for as separate contract pay items; the stripping or removal of top soil or sod to be piled separately from other excavated materials and later to be restored to its original place after backfilling is completed; the furnishing, placing, and maintaining of all sheeting, shoring and bracing necessary to protect the

work and adjacent properties, all pumping, bailing, and draining necessary to keep the excavation free from seepage water, water from sewers, drains, ditches, creeks, and other sources; provision for the uninterrupted flow of sewers and surface waters during progress of the construction; the removal, after completion of the work, of all sheeting, shoring, and bracing not necessary to support the sides of the excavation; the satisfactory disposal of excess and unsuitable materials not required or which cannot be used for backfilling, tamping, compacting, and refilling after settlement of all excavated areas; the restoring of all streets, alleys, fences, rights-of-way, and other lands or structures, private or public, damaged or occupied by the CONTRACTOR in the performance of the contract, to as good a condition as they were prior to the beginning of the work.

3.06 CLASSIFICATION

- A. Excavation in trenches for water line construction will be **unclassified** and will not be paid for separately but shall be included in the lump sum bid.

3.07 CONSTRUCTION METHODS

- A. Trenches shall be excavated by trenching machine, backhoe, or dragline, except in locations where hand trenching is required. The banks of trenches shall be vertical, to a point 1 foot above the top of the pipe.
- B. Trenches will be excavated to the lines and grades laid out by the ENGINEER or as shown on the plans. No change in locations of the lines is contemplated, but should any changes be made in the lines not materially altering the amount of character of the trenching to be done, the CONTRACTOR shall proceed with the changed alignment at the unit bid price. In case any change involves greater construction difficulties than the original alignment, the OWNER and the ENGINEER will agree with the CONTRACTOR for extra compensation therefor, prior to the construction of the changed line or lines.
- C. The width of the trench shall be as shown on the drawings.
- D. Trenches for water pipe shall be of such depth as to provide a minimum of 42" of cover unless otherwise shown on the plans.
- E. The excavation shall not advance more than 300 feet ahead of the completed and backfilled pipeline. Pipe shall be laid in all trenches that has been opened at the end of each day's work unless the CONTRACTOR secures written permission to do otherwise from the ENGINEER.
- F. If the bottom of the trench becomes an unstable foundation for the pipe through the neglect of the CONTRACTOR to adequately shore or dewater, the CONTRACTOR will be required to remove the unstable material and backfill the trench to the proper grade with approved compacted gravel, and no extra compensation will be granted for this material or work.
- G. If the trench is inadvertently excavated deeper than necessary it shall be backfilled to the proper grade with approved compacted gravel at the CONTRACTOR's expense.
- H. If the undisturbed material encountered at the grade depth constitutes, in the opinion of the ENGINEER, an unstable foundation for the pipe, the CONTRACTOR will be required to remove such unstable material and backfill the trench to the proper grade with approved compacted material.

- I. The CONTRACTOR shall excavate all trenches, including work necessary in working around existing pipelines or other obstructions. The CONTRACTOR shall give notice to the Owners of any such lines or obstructions in order that they may have time to take the necessary precautions for protecting their property. The CONTRACTOR shall be responsible for protecting the OWNER from any damage from his operations in such work.
- J. In rock, excavation shall be carried 3" below the bottom of the pipe, and loose earth or gravel, thoroughly tamped, shall be used for backfilling to the grade of the bottom of the pipeline.
- K. After inspection of pipelines has been finished on any completed portion of the work the trench may be backfilled. Backfilling shall be accomplished in compliance with the applicable portions of these specifications.

3.08 PUMPING, BAILING AND DRAINING

- A. The CONTRACTOR shall immediately remove all surface or seepage water from sewers, drains, ditches, and other sources which may accumulate during the excavation and construction work by providing the necessary underdrains or otherwise and by doing the necessary pumping, bailing, or draining. The CONTRACTOR shall always have available sufficient equipment in proper working order for doing the work herein required. All water removed from excavations shall be disposed of in an approved manner so as not to create unsanitary conditions nor to interfere unduly with the use of streets, private driveways, or entrances. Pumping, bailing, draining, underdrains, ditches, etc., shall be considered as incidental work and will not be bid for as separate items but their cost shall be included in the contract prices bid in the Proposal for the various units of measure.

3.09 SUPPORT OF EXISTING PIPES ACROSS TRENCH

- A. It shall be the responsibility of the CONTRACTOR to protect and support all water, sewer, gas, and other conduits crossed by the excavation or work to be performed by him or to arrange for their temporary removal and subsequent replacement. All expense incidental to this phase of the work shall be borne by the CONTRACTOR.

3.10 DISPOSAL OF EXCAVATED MATERIALS

- A. Excavated materials, so far as needed and of a suitable character, shall be piled adjacent to the work to be used for backfilling as required. Excavated materials unsuitable for the backfilling or in excess of that required for backfilling shall be disposed of in an approved manner at locations designated on the plans or approved by the ENGINEER. Desirable topsoil, sod, etc. shall be carefully piled separately and replaced in its original position when required. Excavated materials shall be always handled in such a manner as to cause a minimum of inconvenience to public travel and to permit safe and convenient access to private and public property adjacent to or along the line of the work. In parkways and easements where it is necessary to deposit excavated materials on lawns during the work, burlap or canvas shall be placed on the lawn to prevent contact between excavated materials and the lawn.

3.11 USE OF EXPLOSIVES

- A. Explosives or blasting shall not be allowed on this project.

3.12 CROSSINGS TO BE KEPT OPEN

- A. At such street, railroad, and all other crossings as may be designated by the ENGINEER, the trenches are to be filled in such a manner as to prevent any serious interruption of traffic upon the roadway or sidewalks. The cost thereof shall be borne by the CONTRACTOR.

3.13 PROTECTION OF UNFINISHED WORK

- A. Before leaving work for the night, during a storm, or at other times, care must be taken to protect and securely close the unfinished end of the pipe. Any earth or other materials that may find entrance into the pipe through any such open or unplugged end of the pipe must be removed at the CONTRACTOR's expense.

3.14 BACKFILL

- A. Excavation shall be backfilled only with approved materials. The placing of backfill material shall not begin until approval has been given by the ENGINEER and shall be done immediately when so ordered by the ENGINEER.
- B. Backfilling shall be brought up to an elevation slightly above the original ground level to allow for subsequent settlement. The top surface or slopes of all backfill shall be neatly graded off in a workmanlike manner, and where select topsoil, sod, or other material is removed and piled separately, such material shall be carefully replaced in a manner satisfactory to the ENGINEER.

3.15 BACKFILL MATERIAL

- A. Backfill material shall be as shown on the drawings. Broken concrete, rock, bituminous pavement, or other lumpy material shall not be used in the backfill except as the lumps are small and their dispersal in the backfill is made in the upper section in a manner satisfactory to the ENGINEER. Materials of a perishable, spongy, or otherwise improper nature shall not be used in backfilling. Gravel cushion and/or granular backfill material will not be required when concrete encasement is specified or used around the pipe. No backfill shall be made until it is authorized by the ENGINEER. All debris shall be removed. Sheet piling, shoring and bracing shall be pulled and removed during the progress of the backfilling in a manner satisfactory to the ENGINEER.

3.16 CONCRETE ENCASEMENT

- A. Concrete encasement, when required, shall be composed of a free-flowing material consisting of small stone, pea gravel, limestone chat, or pit run sand and gravel and shall always consist of at least 60% sand. The material shall all pass a three-quarter 3/4" screen and be free from sticks, lumps, stones, and organic matter. The material shall be mixed with Portland Cement in the proportions of one (1) part cement to ten (10) parts of the above-described granular material, by volume measurement. Concrete encasement shall be poured either wet or dry as may be directed by the ENGINEER.
- B. When concrete encasement backfill material is specified or ordered by the ENGINEER to be poured UDRYU, the CONTRACTOR shall place this material on each side of the pipe for the full width of the trench using shovels to cut the material back under the pipe and shall be tamped to a height of 6" above the pipe to receive final backfill. Care must be exercised not to dislocate or disturb the grade and alignment of the pipe. If ordered by the ENGINEER to be poured UWETU, caution and care must be used not to float the pipe out of place. In the event pipes are

floated out of proper position they shall be removed and re-laid at the expense of the CONTRACTOR.

3.17 GRAVEL CUSHION OR BACKFILL

- A. On water line construction when, in the opinion of the ENGINEER, the subgrade material encountered at grade is soft, spongy, and unsuitable, it shall be removed to such a depth that the replacement thereof with firmly tamped gravel or crushed stone will provide an unyielding, stable foundation. The gravel used in cushion or backfill shall be pit run gravel or crushed stone and shall be free from silt, loam, or vegetable matter and shall be of a gradation suitable to the ENGINEER.
- B. Gravel cushion or backfill, when required by the plans or the ENGINEER, will be paid for at the contract unit price and shall be the total compensation for furnishing all labor materials, tools, and equipment for performing this phase of work.
- C. Subgrades that have been allowed to become unstable by neglect of the CONTRACTOR, by improper drainage or lack of drainage, and when in the opinion of the ENGINEER, the condition was caused by the neglect or fault of the CONTRACTOR, the ENGINEER shall order the CONTRACTOR to remove the unstable subgrade and replace the same with gravel at the expense of the CONTRACTOR, and no extra compensation will be allowed.

3.18 CEMENT STABILIZED BACKFILL

- A. Where backfill material shown or called for on the plans to be used in the pipe zone is cement stabilized sand, the material shall extend from a point 6" below the pipe to a point 6" above the top of the pipe. The backfill material shall be deposited simultaneously on both sides of the pipe and worked carefully around and under the pipe with the point of a shovel. Payment for this bedding material shall be included in the unit price bid per linear foot of cement stabilized backfill material. Cement stabilized backfill shall contain a minimum of one (1) sack mix (per yard of pit run sand).

3.19 INSPECTION

- A. During the process of unloading, all pipe and accessories shall be inspected by the CONTRACTOR for loss or damage in transit. No shipment shall be accepted by the CONTRACTOR until notation of any lost or damaged material shall have been placed on the bill of lading by the agent of the carrier.
- B. All pipe and accessories shall be laid, jointed, tested for defects and for leakage with pressure, and chlorinated in the manner herein specified in the presence of the ENGINEER or his authorized Inspector and subject to their approval.
- C. All material found during the progress of the work to have cracks, flaws, or other defects will be rejected by the ENGINEER, and the CONTRACTOR shall promptly remove from the site of the work such defective material.
- D. The CONTRACTOR shall be responsible for all material furnished to him or by him and shall replace at his own expense all such material that is found to be defective in manufacturing or that has become damaged in handling after delivery by the manufacturer. The CONTRACTOR shall be responsible for the safe storage of material furnished by or to him until it has been incorporated in the completed project.

- E. Pipe fittings, valves and other accessories shall be unloaded at the point of delivery, hauled to, and distributed at the site of the project by the CONTRACTOR. They shall, always, be handled with care to avoid damage. In loading and unloading they shall be lifted by hoists, slid, or rolled on skidways in such a manner as to avoid shock. Under no circumstances shall they be dropped. Pipe handled on skidways must not be skidded or rolled against pipe already on the ground.
- F. In distributing the material at the site of the work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench. Pipe shall be handled in such a manner that a minimum amount of damage to the coating will result. Damaged coating shall be replaced in a manner satisfactory to the ENGINEER.
- G. Pipe shall be placed on the site of the work parallel with the trench alignment and with bell ends facing the direction on which the work will proceed unless otherwise directed. The interior of all pipe, fittings, and other accessories shall be always kept free from dirt and foreign matter.

3.20 PIPE HANDLING

- A. Proper implements, tools, and facilities shall be provided and used by the CONTRACTOR for the safe and convenient prosecution of the work. All pipe, fittings, and valves shall be carefully lowered into the trench piece by piece by means of derrick ropes or other suitable tools or equipment in such a manner as to prevent damage to pipe or pipe coating. Under no circumstances shall pipe or accessories be dropped into the trench.
- B. At all times when pipe laying is not in progress, the open ends of the pipe shall be closed by approved means. No trench water shall be permitted to enter the pipe. All foreign matter or dirt shall be removed from the pipe, and it shall be kept clean by approved means during and after laying. No pipe shall be laid in water or when trench conditions are unsuitable for such work.
- C. Cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat workmanlike manner without damage to the pipe. Concrete pressure pipe shall not be cut on the job without the approval of the ENGINEER.

3.21 JOINTING PIPE

- A. Materials: All component parts are to be furnished with and included in the price bid for pipe. The materials consist of a circular rubber gasket of modified bulb shape in cross section.
- B. Procedure: Remove any foreign matter in the gasket seat of the socket, wipe gasket clean, flex gasket and place in socket with the large round end or bulb end entering first. Seat gasket evenly around inside of the socket with the groove fitted over the bead. Remove any bulges. Apply a thin film of lubricant furnished by the pipe manufacturer to the inside surface of gasket. No lubricant other than that furnished with the pipe by the pipe manufacturer will be allowed to be used. Wipe plain end of pipe to be entered, clean and place in approximate alignment with the bell of the pipe to which it is to be joined. Apply a thin film of the lubricant to the outside of the plain end for about 1" back from the end. Align the pipe and carefully enter the plain end into the socket until it just makes contact with the gasket. Complete joint assembly by forcing the plain end of the entering pipe past the gasket until it contacts the bottom of the socket. For pipe in sizes 10" and larger, a jack-type tool will be used to make up the joint and complete the assembly of the joint in forcing the plain end of the pipe past the gasket.
- C. Deflection of Joints: The maximum deflection at each joint will not exceed 5 degrees for sizes through 12", 4 degrees for 14" and 16", and 3 degrees for 18", 20" and 24" pipe sizes. If a profile

is shown on the plans, the CONTRACTOR will be required to lay the line to conform to the grades shown. If it is necessary that water line shall have over 42" of cover in order not to exceed the manufacturer's recommendations for deflection of the pipe, the CONTRACTOR shall excavate the ditch with no extra compensation. Regardless of the depth of ditch necessary, the CONTRACTOR shall, under no condition, exceed the manufacturer's recommendations for deflection of the pipe at joints. The CONTRACTOR will receive no extra compensation for extra depth necessary to cross existing utility lines.

3.22 CLEARANCE FROM OTHER PIPES

- A. Water lines and sanitary sewers shall be installed no closer to each other than 9 feet. Where this cannot be achieved, the sanitary sewer shall be constructed of pressure type cast iron pipe or the equivalent of 150 psi pressure pipe with watertight joints used in water main construction for the 9 feet clearance. No physical connection shall be made between a drinking water supply, public or private, and the sewer or any appurtenances.
- B. Any facilities for permitting discharge of drinking water into the sewer or any appurtenance thereof shall be constructed to prevent any possibility of sewage entering the drinking water system.
- C. All portions of non-potable water pipe within 4 feet of a potable water pipe must be embedded in cement stabilized sand that has a minimum content of 10% cement, based on loose dry weight volume and is installed a minimum of 6 inches above and one quarter of the pipe diameter on either side and below the non-potable water pipe.

3.23 CONNECTION TO EXISTING WATER MAINS

- A. Where indicated on the plans and/or hereinafter specified, the CONTRACTOR shall connect the new main with existing mains or lines. The CONTRACTOR shall furnish all labor, materials, equipment, or services required for the locating and uncovering of the existing line, the making of cuts in the existing line, the removal, relocation, and lowering of existing lines as required, dewatering of the trench, connecting of the existing line into the new main and all appurtenant work required for a complete connection. Relocated mains or lines shall be laid so that all valves so relocated or installed shall be set vertically.
- B. Connections to existing water mains shall be made at the locations shown, as specified, and/or as directed by the ENGINEER. All such connections shall be made in a most expeditious and workmanlike manner to cause the least inconvenience to water customers and to traffic and shall be made at night unless otherwise approved by the ENGINEER. The detailed schedule of operations for making each connection shall be approved by the ENGINEER or his inspector before any work thereupon is commenced.

3.24 STERILIZATION OF WATER MAINS

- A. During the construction operations workmen shall be required to use utmost care to see those parts of the structures, inside of pipes, fittings, jointing materials, valves, etc., the surface of which come in contact with City water are maintained in a sanitary condition.
- B. Every effort must be made to keep the inside of the pipe, fittings, and valves free of all foreign matter, sticks, dirt, rocks, etc. As each joint of pipe is being laid it must be effectively swabbed so that all foreign matter is removed. All fittings and exposed open ends of pipe must be blocked or capped until the line is completed.

- C. When the entire pipeline or certain selected sections thereof have been completed, tested, and made ready for turning over to the OWNER ready for use, the line or section of line shall be thoroughly sterilized according to AWWA C-651 and the following procedure:
1. The line shall be flushed out, completely replacing its entire volume with water from the OWNER's mains.
 2. Chlorine will be injected into the section of line being sterilized so that its entire capacity will be filled with water containing chlorine in the amount of 50 p.p.m. or in such other quantity as determined by the ENGINEER. The sterilizing agent shall be introduced at one end of the section and the water released from the opposite end until the sterilizing agent is present at the discharge end in such quantity as to indicate a residual-chlorine of 50 p.p.m. or as otherwise determined by the ENGINEER. All valves shall be opened and closed several times and the sterilizing solution permitted to remain in the pipeline section for not less than 24 hours.
 3. At the end of the sterilizing period the sterilizing solution shall be discharged from the pipe and replaced with water direct from a main of the OWNER.
 4. A sample of water from the sterilized main shall be taken (not through a fire hydrant) from a suitable tap under the supervision of the ENGINEER or his Inspector and submitted to an approved testing laboratory or the State Health Department for analysis. If the test shows a satisfactory quality of water, the line so sterilized shall then be placed in service by the CONTRACTOR who shall notify and assist the Water Superintendent in location and operation of all valves installed by the CONTRACTOR. If the sample shows unsatisfactory quality of water, the process of sterilization shall be repeated until a satisfactory water is obtained.
- D. Sterilization of the line or any section thereof shall not be commenced until the ENGINEER's approval of the method, apparatus, sterilizing agent, and the section of the line has been obtained.

3.25 CONCRETE BACKING

- A. Concrete having compressive strength of not less than 2,000 pounds per square inch shall be used as a cradle or backing where shown on the plans or where directed by the ENGINEER. All materials including aggregates, cement, and water, as well as the mixing and placing of the concrete, shall be approved by the ENGINEER. Bends of 22-1/2 degrees and greater, plugs, and all tees, crosses, etc. shall be placed between solid ground and the fitting to be anchored; the area of bearing on pipe and on ground in each instance shall be that required by the ENGINEER. The backing shall, unless otherwise directed, be placed so that the pipe and fitting joints will be accessible for repair.
- B. Concrete shall be composed of normal Portland Cement, coarse aggregate, fine aggregate, and water proportioned and mixed properly in a concrete mixer. Transit mix concrete will be allowed. Portland Cement shall be Type 1 and shall be fully protected until incorporated in this work. Gravel to be used for coarse aggregate shall consist of clean hard, durable grains, and shall be free from an excess of salt or alkali and foreign materials. Concrete shall have a compressive strength of not less than 2,000 pounds per square inch at 28-days and shall not have less than three (3) sacks of cement nor more than 6 and 6-3/4 gallons of water per cubic yard of concrete.

3.26 CLEAN-UP

- A. During construction, the CONTRACTOR shall maintain the premises in an orderly, neat, and presentable manner. Scraps and debris shall not be left scattered but shall be assembled and such as are unusable shall be moved from the premises or disposed of to the satisfaction of the ENGINEER. When construction of the contract has been otherwise completed, the CONTRACTOR shall remove all left-over construction materials, equipment, scraps, debris, and rubbish. Earthwork shall be smoothed and graded to the lines shown on the plans. Backfill over all trenches shall be left in a uniform and neat condition.

3.27 MEASUREMENT AND PAYMENT

- A. The bid items include the work of every nature required for the completion of the job in every respect except as may be otherwise provided for in these specifications. The CONTRACTOR shall include the furnishing of all materials and labor, including any incidental labor, in his lump sum bid.

3.28 SANITARY SEWER AND WATER MAIN SEPARATION DISTANCES

- A. The following separation distances shall be maintained between potable water and wastewater treatment plants, and waterlines and sanitary sewers.
 - 1. Water line/new sewer line separation. When new sanitary sewers are installed, they shall be installed no closer to waterlines than 9 feet in all directions. All separation distances shall be measured from the outside surface of each of the respective pieces. Sewers that parallel waterlines must be installed in separate trenches. Any appurtenance shall be designed and constructed to prevent any possibility of sewage entering the drinking water system. Where the 9 feet separation distance cannot be achieved, the following guidelines will apply:
 - a. Where a sanitary sewer parallels a waterline, the sewer shall be constructed of cast iron, ductile iron, or PVC meeting ASTM specifications with a pressure rating for both the pipe and joints of 150 psi. The waterline shall be located at least a minimum of 2 feet above the wastewater main or lateral, measured vertically, and at least a minimum of 4 feet away, measured horizontally, from the wastewater main or lateral. The sewer shall be located below the waterline.
 - b. Where a sanitary sewer crosses a waterline, and the sewer is constructed of cast iron, ductile iron, or PVC with a minimum pressure rating of 150 psi. The potable waterline shall be at least a minimum of 6" above the wastewater main or lateral. Whenever possible, the crossing shall be centered between the joints of the wastewater main or lateral.
 - c. Where a sewer crosses under a waterline and the sewer is constructed of ABS truss pipe, similar semi-rigid plastic composite pipe, clay pipe or concrete pipe with gasketed joints, the potable waterline shall be at least a minimum two (2') feet above the wastewater main or lateral. The initial backfill shall be from one quarter diameter below the centerline of the pipe to one (1) pipe diameter (but not less than 12") above the top of the pipe.
 - d. Where a sewer crosses over a waterline all portions of the sewer within 9 feet of the waterline shall be constructed of cast iron, ductile iron, or PVC pipe with a pressure

rating of at least 150 psi using appropriate adapters. In lieu of this procedure the new conveyance may be encased in a joint of 150 psi pressure class pipe at least 18 feet (or longer) and two (2) nominal sizes larger than the new conveyance. The space around the carrier pipe shall be supported at 5 feet intervals with spacers or be filled to the springline with washed sand. The encasement pipe should be centered on the crossing, and both ends sealed with cement grout or manufactured seal.

2. Waterline/manhole separation. Unless sanitary sewer manholes and the connecting sewer can be made watertight and tested for no leakage, they must be installed to provide a minimum of 9 feet of horizontal clearance from an existing or proposed waterline. Where the nine (9') foot separation distance cannot be achieved, a carrier pipe as described in subsection A (1) of this section may be used where appropriate.

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SECTION 33 16 16

MULTI-COLUMN ELEVATED WATER STORAGE TANK

PART 1 - GENERAL

1.01 SCOPE OF PROJECT

- A. The work to be performed under this specification consists of constructing a new Multi-Column Elevated Water Storage Tank including water main connection, foundations and site work. The tank foundation will be designed in accordance with the governing Standard Specifications. The tank and foundation shall be designed for loads and subsurface conditions as described in these specifications.
- B. Bids shall be submitted for two tank sizes: 250,000 gallon (Proposal I) and 400,000 gallon (Proposal II).
- C. Tank design and construction shall meet all requirements of TCEQ, EPA and AWWA.

1.02 GENERAL DESCRIPTION

- A. The tank shall be of an all-welded, water-tight construction including that portion of the tank above the high water level. The net capacity of the tank proper (250,000 or 400,000 gallon) shall be as measured from the point of overflow to the low water level. The total range in head between these limits shall be as shown on the plans. The height to the high water level from the top of the foundation shall be as shown on the plans. The tank shall be coated using TNEMEC products, without exception.

1.03 REFERENCES

- A. The latest version of the following Specifications, Codes and Standards are referenced in this section.

ACI 117	Standard Tolerances for Concrete Construction and Materials
ACI 301	Specification for structural Concrete
ACI 304	Guide for Measuring, Mixing, Transporting and Placing Concrete
ACI 305	Hot Weather Concreting
ACI 306	Cold Weather Concreting
ACI 318	Building Code Requirements for Structural Concrete
ACI 347	Guide to Formwork for Concrete
AISC S335	Specification for Structural Steel Buildings
ANSI B16.5	Pipe Flanges and Flanged Fittings
ANSI ASCE 7	Minimum Design Loads for Buildings and Other Structures
API 650	Welded Steel Tanks for Oil Storage
ASTM A 123	Zinc Coatings on Iron and Steel Products
ASTM A 240	Stainless Steel Plate, Sheet and Strip for Pressure Vessels
ASTM A 285	Pressure Vessel Plates, Carbon Steel
ASTM A 774	Welded Stainless Steel Fittings
ASTM A 778	Welded Stainless Steel Tubular Products
AWS D1.1	American Welding Society
AWWA D100	Welded Steel Tanks for Water Storage

AWWA D102	Coating Steel Water Storage Tanks
AWWS D107	Composite Elevated Tanks for Water Storage
AWWA C652	Disinfection of Water Storage Facilities
FAA 70/7460-1H	Obstruction Marking and Lighting
NACE RP0178	Fabrication Details, Surface Finish Requirements, and Proper Design Considerations for Tanks and Vessels
NFPA NEC	National Electric Code
NFPA 780	Standard for the Installation of Lightning Protection Systems
NSF 61	Standard for Drinking Water System Components
OSHA 29 CFR	Part 1926 Safety and Health Regulations for Construction
SSPC VIS-89	Visual Standard for Abrasive Blast Cleaned Steel
STEEL STRUCTURES PAINTING COUNCIL	Manual – Volume 1 – Good Painting Practice
STEEL STRUCTURES PAINTING COUNCIL	Manual – Volume 2 – Systems and Specifications

1.04 QUALIFICATIONS OF MANUFACTURER

- A. The design and construction of the “Multi-Column” elevated water storage tank shall only be undertaken by a CONTRACTOR with a minimum of ten (10) years’ experience with elevated tank construction. The CONTRACTOR must be able to demonstrate experience through the design and construction of at least twenty (20) “Multi-Column” elevated water tanks of the same or greater capacity. The CONTRACTOR shall not subcontract the design or erection of the steel tank and supporting tower. Bid submittals shall include project lists/references substantiating this requirement.
- B. Bids will be considered only from CONTRACTOR’s who have their own design, fabricating and erecting facilities. Divided responsibility for the adequacy of the design and safety of the completed structure will not be acceptable.

1.05 SUBMITTALS

- A. No bid will be considered unless this information is provided with the proposal:
 1. A list of five “Multi-Column” elevated tanks constructed within the last five (5) years, including the name of the OWNER, tank capacity, and the Consulting ENGINEER.
 2. A preliminary drawing of the tank showing major dimensions and plate thickness upon which the bid is based, the high and low water levels and the dimensions of the supporting tower.
 3. A foundation design drawing showing preliminary dimensions and approximate quantities of concrete and reinforcing steel.
- B. Construction Drawings
 1. Provide elevation, plan and sectional view drawings of the foundation, support structure, tank and all appurtenant equipment and accessories. Show the location, dimensions,

material specifications and finish requirements. The submission shall be sealed by a Professional Engineer currently licensed in the State of Texas. This information will be reviewed for conformance with the Specifications and Plans and retained for information only. The design coefficients and resultant loads for snow, wind, water, and seismic forces, and the methods of analysis shall be documented.

2. Foundation details shall include foundation design, installation, and testing requirements. Excavation, soil protection, and backfill/compaction details shall be included in accordance with the recommendations of the CONTRACTOR's foundation designer and the Geotechnical report provided within the Contract Documents. Foundation load calculations shall be documented.
3. Reinforced concrete details shall be clearly indicated on the structural drawings and identified by mark numbers that are used on the fabrication schedule. Location, spacing and splice dimensions shall be shown. Placement and fabrication details shall conform to ACI 318.
4. Steel tank details shall include weld joints and a layout showing all primary and secondary shop and field welds.
5. Piping details shall include schedules and layouts for above and below ground piping and valves.

C. Construction Procedures

1. Provide procedures for the support structure forming system.
2. Provide shop and field weld procedures for all structural joints on the steel tank.

D. Design Data

1. Provide a table showing capacity of the tank in gallons at all levels in one-foot increments.
2. Provide a calculation report of the design for the foundation, support structure, tank and all other structural components. Include the design basis, loads and load combinations and results.

E. Product Data

1. Provide technical data and color samples of all coating products (shall be Tnemec without exception).
2. Provide manufacturers descriptive information for appurtenant equipment and accessories that are not detailed on the construction drawings.

F. Reports/Certification

1. Provide documentation of all tests, inspections and certifications required by this section.
2. Provide qualifications of all welders. Prequalification shall be performed for this specific project on welds he will specifically be performing. Certification shall be in accordance with ASME Section IX.

3. Certify that the CONTRACTOR is not associated with the independent testing laboratory, nor does the CONTRACTOR or its officers have a beneficial interest in the laboratory.
4. Provide proof of insurance for Professional Liability with a minimum limit of each \$1,000,000 occurrence and \$2,000,000 aggregate.

G. Operation/Maintenance

1. Provide operating instructions and maintenance procedures for the elevated tank and applicable appurtenant equipment, mechanical components and accessories.

1.06 QUALITY ASSURANCE

A. Experience Requirements of Tank CONTRACTOR

1. The work described in this section shall be performed by a company that specializes in the design and construction of multi-column elevated tanks. The tank CONTRACTOR shall have the following qualifications:
 - a. A minimum of ten (10) years' experience in multi-column tank design and construction with minimum of twenty (20) installations of the same or greater capacity.

B. The ENGINEER and/or OWNER shall be the sole and final judge as to the acceptability of a tank CONTRACTOR's qualifications. Bids will be considered only from CONTRACTOR's who have their own design, fabricating, and erecting facilities. Divided responsibility for the adequacy of the design and safety of the completed structure will not be acceptable.

C. Quality Assurance

1. Elevated tank design, support structure construction and steel tank construction shall not be subcontracted. These items shall be self-performed by the CONTRACTOR.
2. The CONTRACTOR shall directly employ a full time professional engineer with a minimum five (5) years cumulative experience in the design and construction of multi-column elevated tanks. The engineer shall be registered in the State of Texas and shall be in responsible engineering charge of the work.
3. A qualified supervisor directly employed by the manufacturer shall be on site at all times during construction of the foundation, support structure and steel tank.

D. Regulatory Requirements

1. The specifications, codes and standards referenced in paragraph 1.03 shall govern the work with regard to materials, design, construction, inspection and testing to the extent specified.
2. Personnel safety equipment shall be provided in accordance with OSHA requirements and manufacturer's documentation.

1.07 DELIVERY, STORAGE & HANDLING

- A. Handling and Shipping: The CONTRACTOR shall handle materials and fabricated components in a manner that will protect them from damage. Allow painted materials adequate cure time prior to stacking or shipping.
- B. Storage and Protection: Protect delivered materials and equipment from damage. Store in well drained areas and provide blocking to minimize contact with the ground.

1.08 PROJECT CONDITIONS

- A. Permits and Easements: Permits, licenses, and easements required for permanent structures, changes in existing facilities or advancement of the construction as specified shall be secured and paid for by the OWNER prior to the start of construction. These include building permits, airspace authority approval, site access easements, highway crossing permits, etc.
- B. Licenses or permits of a temporary nature required by specific trades shall be the responsibility of the CONTRACTOR.
- C. Existing Conditions: A geotechnical investigation has been carried out at the site and a report has been incorporated within these specifications. The net allowable bearing pressure of shallow foundations and/or the allowable capacity of deep foundation elements have been defined in this report. The CONTRACTOR shall be responsible for securing any further geotechnical information required beyond that provided in this report.
- D. Access: The CONTRACTOR shall provide access from public roads to the tank site unless otherwise specified.
- E. Working Conditions: Safety and Health - The CONTRACTOR shall comply with safe working practices and all health and safety regulations of OSHA, state and local health regulatory agencies and Material Safety Data Sheets (MSDS). Provide protective and lifesaving equipment for persons working at the site. Personnel safety equipment shall be provided in accordance with OSHA requirements and the manufacturers' documentation. A certified health and safety technician (CHST) will perform spot inspections of the field activities. The safety supervisor is to be a full time employee of the tank manufacturer.

1.09 SEQUENCING AND SCHEDULING

- A. Schedule: The CONTRACTOR shall provide a schedule indicating the design, submittals, site work and the major components of construction including foundation, support structure and steel tank. In addition, show tank painting, electrical installation and other significant activities. Update the schedule as required.
- B. Certifications: Provide certification from the ENGINEER of record that the elevated tank has been designed in accordance with the requirements of the specification. Provide certification that testing and inspection requirements have been performed and the results comply with the requirements of the specification.

1.10 WORKING DRAWINGS

- A. After contract award and prior to construction, the CONTRACTOR shall provide engineering drawings and design calculations for the elevated steel tank and the foundation as noted in paragraph 1.05. Drawings shall show the size and location of all structural components and the

foundations along with reinforcement details, the required strength and grade of all materials, and the size and arrangement of principle piping and equipment. The drawings and calculations shall bear the certification of a Professional Engineer licensed in the State of Texas. The design coefficients and resultant loads for snow, wind and seismic forces, and the methods of analysis shall be documented.

1.11 DESIGN

A. General

1. The structural design of the elevated storage tank shall conform to the following design standards (latest edition) except as modified or clarified as follows:
 - a. Foundations – AWWA D100 and ACI 318 – Building Code Requirements for reinforced concrete.
 - b. Steel Tank – AWWA D100
 - c. Steel Tank Painting – AWWA D102

B. Foundation: A Geotechnical investigation has been carried out at the site and a copy of the report is included with the Contract Documents. Recommendations for the foundation and allowable bearing capacities are defined in this report. The concrete foundation shall be designed by the CONTRACTOR based upon the recommendations in the Geotechnical report.

1. Additional geotechnical Bores, reports, etc., required by the Tank Manufacturer shall be paid for by the Manufacturer.

C. Steel Tank

1. General

- a. The materials, design, fabrication, erection, welding, testing and inspection of the steel tank shall be in accordance with the applicable sections of AWWA D100 except as modified in this document.

D. Minimum Plate Thickness: The minimum thickness for any part of the structure shall be 3/16 in. for parts not in contact with water and 1/4 in. for parts in contact with water. All portions of the tank including the roof shall be of watertight construction.

E. Design Loads

1. Design loads shall be in accordance with ASCE 7 for Category IV (essential facility) structure.
 - a. Dead load shall be the estimated weight of all permanent construction.
 - b. Water load shall be the weight of water when the tank is filled to overflow.
 - c. Roof live load in addition to snow load: none.
 - d. Roof snow load shall be the larger of 15 psf. or the snow load determined in accordance with ASCE 7.

- e. Wind loads shall be in accordance with ASCE 7 for wind exposure category C, and basic wind speed of 120 mph. (see Figure 26.5-1D in ASCE 7)
 - f. Horizontal and vertical seismic loads shall be in accordance with ASCE 7 and the Site Class as determined in the soil investigation report.
 - 1) Importance factor $I = 1.50$.
 - 2) Response Modification Coefficient $R = 3.0$ in accordance with ASCE 7
2. Combination of Loads: The effects of load combinations shall be considered according to the requirements of ASCE 7 and AWWA standards, and the following as the minimum.

$1.4D + 1.4F$
$1.2D + 1.2F + 1.6L + 0.5S$
$1.2D + 1.2F + 1.6S + L$
$1.2D + 1.2F + 1.6S + 0.5W$
$1.2D + 1.2F + W + L + 0.5S$
$0.9D + 0.9F + W$
$1.2D + 1.2F + E + L + 0.2S$
$0.9D + 0.9F + E$
$1.4D$
$1.2D + 1.6L + 0.5S$
$1.2D + 1.6S + L$
$1.2D + 1.6S + 0.5W$
$1.2D + W + L + 0.5S$
$0.9D + W$
$1.2D + E + L + 0.2S$
$0.9D + E$

D	=	Effect of dead load.
F	=	Effect of water load.
E	=	Effect of horizontal and vertical seismic load.
L	=	Effect of interior or roof live load.
S	=	Effect of roof snow load.
W	=	Effect of wind load.

1.12 CONSTRUCTION

- A. Concrete Foundation: The foundation shall be designed and constructed to safely and permanently support the structure. The basis of the foundation construction shall be consistent with the soils investigation data included herein at the end of these specifications.
- B. Steel Tank Construction
 1. General: The erection of the steel tank shall comply with the requirements of Section 10 of AWWA D100 except as modified by these documents.
 2. Welding: All shop and field welding shall conform to AWS and AWWA D100, Section 10. The CONTRACTOR shall ensure welders or welding operators are qualified in accordance with ASME Section IX or ANSI/AWS B2.1.

3. Fabrication: All fabrication and shop assembly shall conform to the requirements of AWWA D100, Section 9, Shop Fabrication.
- C. Erection: Plates subjected to stress by the weight or pressure of the contained liquid shall be assembled and welded in such a manner that the proper curvature of the plates in both directions is maintained. Plates shall be assembled and welded together by a procedure that will result in a minimum of distortion from weld shrinkage.
- D. Roof Lap Joints: All interior lap joints shall be sealed by means of continuous seal welding. This shall include penetrations of roof accessories.
- 1.13 APPURTENANCES FOR MULTI-COLUMN TANK
- A. Ladders: Furnish ladders on the exterior of the tank and on the interior of the bowl. Ladder rungs shall be minimum 3/4 in. diameter smooth bars, on 12 in. centers, mounted between minimum 1/2 in. x 2 in. flat bar side rails spaced at 16 in. Mounting distance from walls shall be a minimum of 7 in. All material shall be steel and shall be painted.
- B. Safe Climbing Device
1. High strength aluminum, rigid rail safe climbing devices shall be provided on all ladders. Rails shall be center mounted and extend from 3 ft. above the ladder bottom to the top of the ladder section. Mounting brackets, fasteners and splice bars shall be provided as required for a rigid installation.
 2. Three trolleys with snap hooks shall be provided that are designed to be operated with the aluminum rail. A full safety body harness with front and side rings shall be supplied for each trolley.
 3. A caution sign shall be provided at the lowest point of access to the ladder requiring safe climbing devices. The sign shall read "CAUTION – Safety Equipment Required When Climbing Ladder ". The sign shall be secured to the wall.
- C. Access Hatches: Provide one (1) 30-inch square steel access hatch on the roof of the tank. The hatch shall be provided with suitable hinges and a hasp to permit locking. The hatch opening shall have a curb at least 4 in. high, and the cover shall have a downward overlap of at least 2 in.
- D. Manhole: Provide a 30 in. diameter manhole at the base of the wet riser to provide access into the wet riser.
- E. Roof Vent: Provide a minimum 36 in. diameter 316 stainless steel flanged frost-proof vent in the tank roof to permit passage of air when the tank is being filled or emptied. It shall have a capacity sufficient to pass air at the rate which will prevent dangerous pressures or vacuum. It shall also be so constructed that an exhaust fan may be bolted to the vent, if required for ventilation during painting. The vent shall be screened with 16 mesh stainless steel screen.
- F. Painter Access: Provide a removable, 30 in. diameter (min.) manway at the walkway elevation, adjacent to the interior bowl ladder, for access to the interior of the tank bowl.
- G. Overflow Pipe: Provide a 12 in. diameter steel overflow pipe, fitted with an appropriately sized weir box. The overflow pipe shall extend down a leg to a point 1 ft.-6 in. above grade, and terminate with a flap valve.

- H. Sample Cock and Pressure Gauges: Sample cocks and pressure gauges shall be provided as shown on the drawings.

1.14 LIGHTNING GROUNDING

- A. Lightning Protection

- 1. Provide a lightning protection system for the elevated tank structure and any roof mounted equipment that may be damaged by lightning.

1.15 ELECTRICAL

- A. Electrical work shall be in accordance with Electrical specifications.

- B. Obstruction lighting shall be provided in accordance with FAA standards. The obstruction light shall be centrally located on the roof of the tank above all permanent installations. It shall be a steady burning, dual fixture type with a lamp-out relay switch. The fixture shall be weather sealed, corrosion resistant, with aluminum base and housing. Red globes with 116-watt clear traffic signal lamps rated at 8,000 hour life shall be provided. A pilot light located near the electrical panel shall be provided to indicate when the primary bulb has failed.

1.16 IDENTIFICATION PLATE

- A. A tank identification plate shall be mounted on the tank riser pipe above the access manhole. The identification plate shall be corrosion resistant and contain the following information:

- 1. Tank CONTRACTOR.
 - 2. CONTRACTOR's project or file number.
 - 3. Tank capacity.
 - 4. Height to High Water Level.
 - 5. Date erected.

1.17 PLAQUE

- A. A bronze plaque shall be properly attached to the tank exterior to include the following:

- 1. Tank Name: Elevated Tank
 - 2. Current City Council Names
 - 3. Previous City Council Names
 - 4. Engineer: TRC Engineers, Inc.
 - 5. CONTRACTOR's Name

1.18 WELDING & INSPECTIONS

- A. All joints, whether butt or lap, must be continuously welded on the interior, as well as the exterior.

- B. All joints must be smoothed by mechanically grinding to remove slag, spatters, and all rough edges.
- C. Weld inspection shall be radiographed in accordance with AWWA Specifications, Section 11 (or latest revision). The radiographs will be initiated, developed, and paid for by the CONTRACTOR at the job site and submitted to the ENGINEER for approval.
- D. All rafters, interior braces and lap joints must be seal welded on both sides to the tank shell or roof.

1.19 TESTING & DISINFECTION

- A. Upon completion of erection and painting of the tank, the tank and associated piping shall be filled with potable water. Water shall be provided in accordance with SECTION 33 05 32 – WATER MAIN CONSTRUCTION. Any leaks or other defects which are disclosed in the test shall be repaired by the CONTRACTOR. The CONTRACTOR shall be responsible for repairing not only leaks but also any damage to the paint at the point(s) of repair.
- B. Before placing into service, the tank and associated piping shall be disinfected in accordance with AWWA C652. The CONTRACTOR shall furnish the chlorine and perform the disinfection, all of which shall be done in the presence of the OWNER. The CONTRACTOR shall perform all sampling for bacteriological tests. Sampling for bacteriological analysis shall be done in accordance with the latest edition of “Standard Methods for the Examination of Water and Wastewater”. Should the samples fail to be acceptable, the CONTRACTOR shall be obligated to again disinfect the tank completely, and have additional samples taken for analysis. The CONTRACTOR shall submit a testing and disinfection plan to the ENGINEER and OWNER for review and approval a minimum of fifteen (15) days prior to starting testing and disinfection activities.

1.20 GUARANTEE

- A. The CONTRACTOR must guarantee for a period of two (2) year the structure he furnishes under these specifications, to the extent that he will repair any defects due to faulty design, workmanship or materials which may appear in the structure during that period.

1.21 CLEAN-UP

- A. Upon completion of the erection, the CONTRACTOR will remove or dispose of all rubbish or other unsightly material caused by his operations and will leave premises graded.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION – NOT USED

END OF SECTION

APPENDIX A

GEOTECHNICAL REPORT

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Geotechnical Engineering Report

**Wastewater Treatment and Lift
Station Expansion Project
Lytle Wastewater Treatment Plant
Lytle, Texas**

June 17, 2024 (Revised August 3, 2024)

TRC Project No. 536680

Prepared For:

CITY OF LYTLE
14916 Main St.
Lytle, Texas 78052

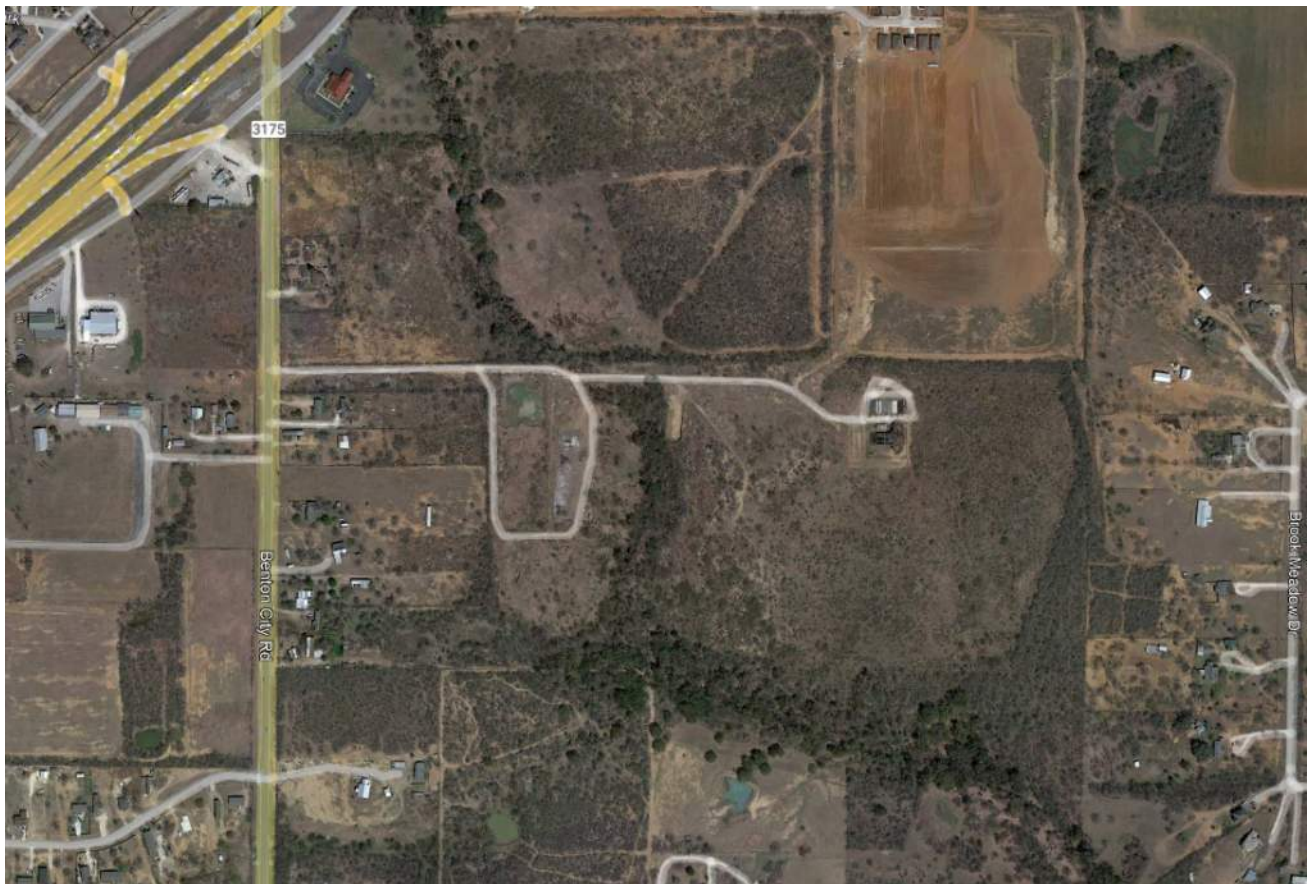


Prepared By:

TRC Engineers, Inc.
505 E. Huntland Drive, Suite 250
Austin, Texas 78752

Texas Registered Engineering Firm:

Firm # 8632





505 East Huntland Dr.
Suite 250
Austin, TX 78752

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June 17, 2024 (Revised August 3, 2024)

Mr. Matthew Dear, CPM – City Administrator
City of Lytle
14916 Main St.
Lytle, Texas 78052

Re: GEOTECHNICAL ENGINEERING REPORT
Wastewater Treatment Plant and Lift Station Expansion Project
Lytle, Atascosa County, Texas
TRC Project No. 536680

Dear Mr. Dear:

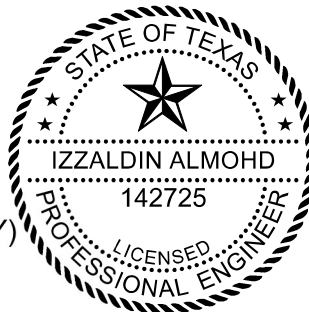
TRC Engineers, Inc. (TRC) is pleased to present this Geotechnical Engineering Report for the above-referenced improvements project. The attached report describes our exploration procedures, summarizes existing subsurface conditions, presents results of our laboratory testing, and provides our geotechnical findings and recommendations as relates to the referenced project.

TRC appreciates this opportunity to provide engineering services and looks forward to working with City of Lytle on future projects. Please contact us if you have questions regarding the contents of this report or if you require additional information.

Sincerely,

TRC Engineers, Inc.

Izzaldin Almohd, PE (TX, OH, IL, NY)
Chief Geotechnical Engineer



Shawn D. McGee, PE*
Senior Geotechnical Engineer
* (AR, IN, KY, MI, OH, PA, TN, VA & WV)

cc: Mr. Luis Tonche, PE, TRC

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Appendix A	Site/Boring Location Map
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1.0 Introduction

1.1 Project Description

City of Lytle (hereafter referred to as Client) retained TRC to provide geotechnical services for the development of engineering recommendations for the expansion of the existing wastewater treatment plant (WWTP) and lift station project (herein referred to as the "Project") in Lytle, Atascosa County, Texas. The existing WWTP treatment facility is located about 2,400 feet east of FM 3175, and approximately 1,300 feet south of the intersection of I-35 and FM 3175 in Lytle, Texas.

The proposed WWTP project consists of several upgrades associated with the expansion of the existing wastewater plant facility. The proposed upgrades include, but are not limited to, an aeration basin, two (2) clarifiers, two (2) chlorine contact basins, sludge holding area, sludge processing area, and additional ancillary equipment/structures. Most of the upgrades are planned just east of the existing facility, in a wooded area that generally slopes downwards towards the east.

The planned lift station expansion project consists of the construction of a new wet well adjacent to the existing lift station. The planned depth of the new wet well was not available at the time of this report.

Details regarding to structural loads, anticipated foundation types, or site grading is not known at this time. However, it is understood the site is fairly flat and will require minimal grading (less than 1 foot of fills/cuts) to achieve final site grade elevation. Also, we anticipate maximum foundation loading on the order of 2,000 pounds per square foot (psf).

If the details of the proposed construction and/or improvements differ from that described herein, TRC should be contacted to evaluate the potential impact on the recommendations provided in this report.

1.2 Purpose and Scope

The scope of services presented in this report has been based upon the information provided by the Client and our experience with similar projects. To accomplish its intended purpose, this work has been conducted in the following phases:

1. Drilling of test borings to determine the general subsurface conditions to the depths of the test borings and to obtain samples for laboratory testing;
2. Performing laboratory tests on selected samples to determine pertinent engineering properties of the subsurface materials; and,
3. Performing engineering analyses, using the field and laboratory data to develop geotechnical-related information to be used by TRC's Design Team for the design and construction of the proposed WWTP and lift station expansion project.

Exploration for underlying geologic conditions or evaluation of potential geologic hazards, such as salt contamination, karst conditions, sinkholes, solution cavities, surface or underground mines, seismic activity, faulting, growth faulting, ground heaving/subsidence associated with hydrocarbon production, and/or ground subsidence/cracking potential due to groundwater withdrawal/injection well activities, were beyond the scope of this report.

2.0 Field Exploration and Testing

2.1 Field Exploration

The field exploration for this project was conducted at the Site on September 11 and 15, 2023. TRC retained the services of an independent drilling contractor, Envirocore of Corpus Christi, Texas, to drill the test borings and collect samples for laboratory testing. Subsurface conditions beneath the WWTP expansion site were explored by advancing five (5) test borings (labeled B-1 through B-5) to depths ranging from approximately 30 to 40 feet below existing ground surface (bgs). In addition, the subsurface conditions for the lift station expansion site were explored by advancing one (1) test boring (labeled B-6) to a depth of about 38.5 feet bgs.

The test boring locations and depths were established by TRC based on the proposed site development layout. TRC personnel located the test borings in the field by reference from existing site features and by using conventional hand measuring methods. The accuracy of the test boring locations should only be considered to the level implied by the method used to determine them. Ground surface elevations at the test boring locations were neither surveyed nor furnished by the Client. The approximate test boring locations are shown on the Site/Boring Location Plan included in Appendix A.

A truck-mounted rotary drilling rig, using solid flight augers, was used to advance the test borings. Soil sampling was conducted in general accordance with the American Society for Testing and Materials (ASTM) D1586, entitled "Standard Test Method for Standard Penetration Test and Split-Barrel Sampling of Soils". The soils encountered in the borings were sampled continuously using the Standard Penetration Test (SPT) split-barrel sampler to a depth of 10 feet bgs and at 5-foot intervals below 10 feet to the depth of the boring. The samples were obtained by driving the split spoon sampler 18 inches into the soil with a 140-pound automatic hammer free-falling 30 inches. The number of blows required for each 6 inches of penetration was recorded separately. The blow count ("N-value") of the soil was calculated as the number of blows required for the final 12 inches (6-18 inch interval) of penetration. The SPT N-value serves as an indicator of relative consistency for cohesive soils and relative density of granular soils. The blow counts are shown on the boring logs in Appendix B at the respective sample depths. Soil samples were sealed in plastic bags to minimize loss of moisture. The samples were transported to the laboratory for visual observations and assignment of laboratory testing.

Test borings were logged by a representative of the subcontract driller. The Field Boring Logs were reviewed, and the samples visually-manually examined by a geotechnical engineer from TRC's geotechnical team. TRC edited the driller's logs as needed using the results of the sample observations and tests performed on selected soil samples from the test borings that represent foundation and slabs subgrade materials. The Boring Logs are included in Appendix B and represent the geotechnical engineer's interpretations of the subsurface conditions based on the driller's field observations, visual-manual observation of samples and laboratory test results. Lines designating the interface between various strata on the Boring Logs represent the approximate positions of the interface. The in-situ transition between strata may be gradual.

Groundwater conditions recorded on the Boring Logs are based on the field observations at the time the field exploration was conducted. Upon completion of the drilling operations, boreholes were generally backfilled with the auger cuttings. In borings drilled through pavement, a cold asphalt patch was placed to cap the boring backfill.

2.2 Laboratory Testing

The soil samples were delivered to TRC's AASHTO/ASTM accredited soils laboratory where a limited number of soil samples representative of foundation soils were assigned for geotechnical laboratory testing. Select samples were subjected to grain-size analyses (ASTM D422), plasticity (Atterbergs) characteristics (ASTM D4318), and moisture content determinations (ASTM D2216). Portions of composite soil samples encountered near the surface in test boring B-1 (0-2 ft bgs) was submitted to an accredited laboratory for corrosivity testing (including electrical resistivity, pH, chlorides, redox potential, sulfides, and sulfates). All phases of the laboratory testing program were conducted in general accordance with applicable American Society for Testing and Materials (ASTM) specifications. Soil descriptions recorded on the Boring Logs in Attachment B result from field observations as well as from laboratory test data.

Copies of the laboratory testing reports are provided in Appendix C.

Samples will be retained for 30 days from the date of this report, after which time they will be discarded unless Client requests otherwise.

3.0 Subsurface Conditions

3.1 Subsurface Conditions

The subsurface materials encountered in the borings generally consist of native cohesive soils from the ground surface to a depth of 40 ft bgs, the maximum depth explored. The encountered native cohesive soils are generally low to moderate plasticity clays and sandy clays. The results of Standard Penetration Testing (SPT) yielded "N" values ranging from 11 to 65 blows per foot (bpf), excluding the blow counts at zero depths, indicating "stiff" to "hard" consistencies. Grain-size distribution testing yielded percentage of fines (material finer than a No. 200 Sieve) values ranging from 51 to 86 percent. The existing clayey (cohesive) soils exhibited plasticity indices ranging from 3% to 18%, averaging between 11% and 12%.

A 5- to 10-foot-thick clayey sand layer was observed at depths of 18.5 to 23.5 feet in Borings B-1, B-2, B-3, and B-5. SPT "N" values of 25 to 40 bpf were recorded within the sands, indicating "medium dense" to "dense" relative densities. Grain-size distribution testing yielded percentage of fines value of 42 percent for the observed sands.

SPT refusal (SPT blow counts exceeding 50 blows with less than 1 inch penetration) was reported in Boring B-6 between the depths from 33.5 to 40.0 indicating possible bedrock of highly weathered sandstone below 33.5 ft bgs.

Uncontrolled fill soils were not identified in the borings drilled during our field activities. However, it is possible that loose fill, buried debris, or other deleterious materials could be encountered intermediate of the test boring locations. Based on this, it is recommended that any existing fill encountered prior to or during construction be evaluated and any soft/loose or otherwise unsuitable areas be remediated at the direction of the Geotechnical Engineer.

3.2 Groundwater Observations

During drilling operations, free water was first encountered at a depth of 36 feet in Boring B-6. The water level was measured at 27.5 ft bgs at the end of drilling. Groundwater was not observed in

Borings B-1 through B-5. It should be noted the presence, depth, and quantity of hydrostatic groundwater levels and upper (perched) saturation zones should be expected to fluctuate seasonally based on variations in rainfall, climatic conditions, site surface runoff characteristics, evapotranspiration, permeability of on-site soils, continuity of pervious materials, irrigation practices, and other factors. Consequently, any measured groundwater levels shown on the boring logs only represent conditions at the time the readings were collected and may thus be different at the time of construction, which can include levels encountered at shallower depths during periods of heavy precipitation. Static daily and seasonal groundwater levels and upper (perched) saturation zones would need to be determined through the installation and long-term monitoring of piezometers, especially in fine-grained soil strata. This was outside of TRC's scope of work. Any changes noted in groundwater levels during the construction process may require a review of the recommendations presented in this report.

3.3 Expansive Soil Movements

To estimate the potential vertical soil movement for this Site, we used the Texas Department of Transportation Potential Vertical Rise (PVR) method (TEX-124-E). Also, the results of the laboratory tests performed on samples obtained from the Site, engineering judgment, and experience have been considered. For a full seasonal cycle, ***the estimated soil PVR is on the order of less than 1 inch at the ground surface within the proposed project areas.***

The aforementioned estimated soil movement is based on the observed subsurface conditions, laboratory testing results and anticipated seasonal moisture fluctuations. Actual soil movements will depend on the subsurface moisture fluctuations over the life of the structure and the overlying structural loading conditions. Soil movements may be less than those estimated if moisture variations are minimized after construction or if the structural loading conditions assumed in this report are different. However, soil movements, significantly larger than estimated, could occur due to inadequate site grading, poor drainage, ponding of rainfall, leaky water or sprinkler lines, or other increases in moisture conditions.

The estimated PVR is based on the existing grades (at time of our field exploration) and conditions observed in the test borings drilled for this project. PVR calculations may differ at other locations or times. Site grading will alter the estimated PVR movements. **Proper construction practices, such as those outlined in this report, will tend to reduce potential movements.**

4.0 Analysis and Recommendations

4.1 Seismic Considerations

Part of the International Building Code (IBC) procedure to evaluate seismic forces requires the evaluation of the Seismic Site Class, which categorizes the site based upon the characteristics of the subsurface profile within the upper 100 feet of the ground surface. To define the Seismic Site Class for this project, we have interpreted the results of our soil test borings drilled within the project site and estimated appropriate soil properties below the base of the test borings to a depth of 100 feet, as permitted by the IBC. Based on the soil profiles observed at the test boring locations and the understanding that the proposed structure for this project is considered a Risk Category I, it is our opinion that the subsurface conditions within the site are generally consistent with the characteristics of Site Class D (Stiff Soil) as listed in Chapter 16, Section 1613.2.2 of the 2018 edition of the IBC and as defined in Table 20.3-1, Chapter 20 of ASCE 7. The maximum considered earthquake ground motion response accelerations in this area for 0.2 second and 1.0 spectral response acceleration are approximately 5.5% g (S_s) and 1.7% g (S_1),

respectively. The corresponding 5% dampened design spectral response acceleration parameters for short periods (S_{DS}) and 1-second periods (S_{D1}) are 5% g and 2.4% g, respectively.

4.2 Shallow Foundations

Based on the subsurface conditions encountered, our understanding of the proposed construction, and our experience with similar projects, we believe that the proposed structures and equipment may be supported by a shallow spread footing foundation bearing on the stiff clay or on newly placed, compacted fill material. Additionally, the existing native clays are generally suitable for re-use in compacted backfills, however, they contain significant fine-grained portions and will be moisture sensitive. The following paragraphs present our recommendation for the design and construction of shallow foundations.

Following site preparation as recommended, the anticipated structure/equipment loads may be supported on a shallow foundation system. Shallow foundations may consist of spread footings, strip footings, or mat foundations bearing on the encountered native stiff to hard cohesive soils. The following table presents our recommended design parameters for shallow foundations bearing on native clays.

Table 1: Shallow Foundations Design Parameters

Design Parameter	Recommendation
Maximum Allowable Bearing Capacity @ Wastewater Treatment Plant	3,500 psf (includes F.S.=3)
Maximum Allowable Bearing Capacity @ Lift Station (Boring B-6)	2,000 psf (includes F.S.=3)
Minimum Embedment Depth	2 feet below exterior grade
Bearing Material	Stiff to hard native clays
Minimum Footing Width	Columns: 30 inches Continuous: 18 inches
Coefficient of Sliding Friction	Native Cohesive Soils: 0.30 Select Fill: 0.35
Total Estimated Settlement	Less than 1 inch
Differential Settlement	Typically, about 1/2 of total settlement

The Geotechnical Engineer should evaluate each footing excavation prior to steel reinforcement or concrete placement. Conditions that are observed should be compared to the test boring data and design requirements. If unsuitable bearing material is encountered, it should be excavated and replaced or otherwise treated as recommended by the Geotechnical Engineer.

Final site grading plans were not provided to TRC; however, for purposes of this project we anticipate that minimal (less than 1-foot) grading will be required to achieve final grades. The general arrangement of the proposed development is shown on the Site/Boring Location Plan included in the Appendix.

TRC has developed geotechnical-related information to be used by others in the proposed foundations on the basis of the previously described project characteristics and subsurface conditions observed in the test borings drilled during the field exploration and as previously discussed in this report. After final design plans and specifications are available, a general review by TRC is recommended as a means to check that the evaluations made in preparation of this report are correct, and that earthwork, foundation, and subgrade preparation recommendations are properly interpreted and implemented.

4.3 Grade-Supported Concrete Pads and Slabs on Grade with

The recommendations provided in this section apply for grade supported concrete pad or slabs on grad with perimeter beams. For grade-supported concrete pads, the existing native clay soils shall be undercut as necessary to facilitate the placement and compaction of a minimum of 16-inches of select fill (two 8-inch thich compacted select fill) directly under the concrete pads. The reached grade beneath the pads should be at least 6 inches above adjacent grade to promote positive drainage. Note that grade-supported concrete pads are only recommended for lightly loaded, settlement insensitive equipment/structures.

Allowable Bearing Pressure. Grade-supported concrete pads should be proportioned so that the maximum contact pressure under dead loads, sustained live loads, and transient loads does not exceed the allowable bearing pressure for the foundation soils. We recommend an allowable sustained net bearing pressure of 2,500 psf for grade-supported concrete pads bearing on proofrolled existing subgrade or properly placed and compacted Select Fill. The pad foundations should have width and lengths of at least 5 ft. This allowable bearing pressure includes a factor of safety of at least 2 with respect to ultimate values.

Perimeter Grade Beams. Exterior grade beams may be used in conjunction with grade-supported concrete pads to reduce moisture fluctuation beneath the concrete pads and to stiffen the edges. These grade beams will not eliminate movements due to shrink/swell, however they should reduce total movements and potential damage to the concrete slabs.

Grade-Supported Pad Movements. Typically, movements of grade-supported pads are associated to shrink/swell soil behavior rather than soil settlement. We estimate that grade-supported foundations may experience shrink/swell movements of approximately one inch related to moisture changes in the foundation soils. The soil moisture and weather conditions at the time of construction will determine the soil's potential for future shrinking and/or swelling. Special care should be taken during construction of grade-supported pads to not allow the subgrade soils to dry out. Moisture variations in the subgrade soils will increase the potential for soil volume changes (shrink/swell) and subsequent damage to the concrete pad.

Modulus of Subgrade Reaction. Provided that site preparation is conducted as indicated in Section 4.5, a modulus of subgrade reaction (k_1) value of 170 pounds per cubic inch (pci) is recommended for concrete pads bearing on native clays. These values are based upon empirical equations that estimate the results of a plate load test.

Climatic Rating and soil-climate index (1-C). Given the project location and Figure 14 of the 2003 Wire Reinforcement Institute (WRI) "Design of Slab-On-Ground Foundations", the site has a climatic rating of 17. Using Figure 15 of the WRI design reference and the plasticity index of the existing soils ($PI = 12\%$, less than 15%), the soil-climate support index (1-C) is estimated to be 0.0.

Utilities Through Concrete Pads. Utilities which project through grade-supported concrete pads should be designed with either some degree of flexibility or with sleeves. Such design features will help reduce damage to utility lines if vertical movements occur.

4.4 Lift Station Wet Well Uplift

The new lift station wet well may be designed to resist uplift pressures if there is a possibility of water level build up behind the well walls. Uplift pressures can be resisted by one or more of the following options:

- Total dead weight from the weight of the reinforced concrete walls, the reinforced mat base, and any equipment.
- Extending a perimeter "lip" of sufficient size around the base of the proposed wet well to use the deadweight of the backfill soil directly above the lip.

The most critical case would be when the water level is at the ground surface and the wet well is empty. If the wet well is designed with a lip to extend out beyond the vertical concrete walls, the weight of the soil on the base may be included to resist the uplift force. We recommend that the base be designed for the most critical case, as described above, using a uniform distribution of uplift pressures resisted by the weight of the concrete and soil. For the assessment of uplift, we recommend assuming a vertical failure plane through the soil.

The maximum allowable uplift capacity should be taken as a sum of the effective weight of soil plus the dead weight of the foundation, divided by an appropriate factor of safety. A maximum total unit weight of 110 pcf should be used for the backfill. This unit weight should be reduced to 50 pcf for portions of the backfill or natural soils below the groundwater elevation. We recommend a factor of safety of 1.2 or higher to be adequate for this condition.

4.5 Piled Foundations

It is our understanding that reinforced concrete pile are also considered for this project to support axial (compression and uplift) as well as lateral loads. The drilled borings showed general similarity between of all borings, excluding boring B-6 which revealed clayey soils with SPT blow counts averaging 14 bpf with possible highly weathered rock (granular IGM) at 33.5 ft bgs. Accordingly, the recommended parameters for design of the piles are provided for two areas; with Area-1 represented by Borings B-1 through B-5 and Area-2 represented by Boring B-6. The soil parameters for design under axial loading are provided in Table 2, whereas the soil parameters for lateral load (L-Pile) analyses are provided in Table 3. The upper 3.0 ft pile length shall be not be considered when running the LPile analyses.

Table 2: Recommended Soil Parameters for Piles under Axial Loading

Area	Borings	Depth, ft	Ultimate Resistance, Kips		
			Compression Loading		Uplift
			Skin Resistance	Eng Bearing	
Area-1	B-1 to B-5	0-20	1.1	20	0.35
		>20	1.8	23	0.60
Area-2	B-6	0-18.5	0.75	14	0.25
		18.5-33.5	0.90	18	0.3
		>33.5	6.0	50	2.0

Table 3: Recommended Soil Parameters for Piles under Lateral Loading

Area	Borings	Depth, ft	Soil Model	Unit Weight, pcf	Cu, psf	E50	ϕ' , deg	K, lb/in ³
Area-1	B-1 to B-5	0-20	Clay	120	2500	0.005	--	--
		>20	Clay	120	3500	0.005	--	--
Area-2	B-6	0-18.5	Clay	120	1500	0.007	--	--
		18.5-33.5	Clay	120	2000	0.007	--	--
		>33.5	Sand*	130	---	---	38	225

* Possible highly weathered rock, to be modeled as very dense sand.

4.5 Site Preparation

Before proceeding with construction, any old foundations, existing pavements, base materials, buried structures, construction debris, vegetation, root systems, topsoil, refuse, sediment in low-lying areas and other deleterious non-soil materials should be stripped/removed from proposed construction areas. The actual stripping depth should be based on field observations with particular attention given to old drainage areas, uneven topography, unexpected fill material areas, and excessively wet soils (if present). The stripped areas should be observed to determine if additional excavation is required to remove weak or otherwise objectionable materials that would adversely affect foundation installations or fill placement. The stripping should extend at least 5 feet beyond the limits of construction areas.

The on-site soils are moisture sensitive and will likely become unstable when saturated (wet). Generally, more undercutting and delays due to the need for extended drying times can be expected if the grading is performed in the seasonally wet period of the year.

After site stripping/removal, the exposed subgrade should be proofrolled to detect soft spots, which, if they exist should be reworked. Proofrolling should be performed using a heavy pneumatic tired roller, loaded dump truck, or similar piece of equipment weighing approximately 25 tons. The proofrolling operations shall be observed by a geotechnical engineer or his/her representative. The subgrade shall be firm and able to support the construction equipment without displacement. Soft or yielding subgrade shall be corrected and made stable before construction proceeds. The depth and extent of the undercut operations at the site should be established by a qualified geotechnical engineer during earthwork construction activities based on the results of the proofroll.

4.6 Fill Types and Compaction

The project will include the placement and compaction of a variety of materials. Typical material requirements and compaction specifications for various materials are provided below.

- **On-site native clayey soils (below foundations and slabs).** Compact to at least 98 percent of maximum laboratory dry density at a -1 to +3 percent of the optimum moisture content as determined by Modified Proctor method (ASTM D 1557).
- **On-site native clayey soils (areas subject to surface loads, but not below structure, or used as backfill) -** Compact to at least 95 percent of maximum laboratory dry density at -1 to +3 percentage points of the optimum moisture content as determined by ASTM D 1557.

- **Select Fill** - Non-expansive select fill should consist of a soil having a plasticity index up to 11, maximum particle size of 3 inches, a maximum of 35 percent passing #200 sieve and be free of roots or any other organic debris. Organic content should be less than 2 percent. The select fill material used at this site should be compacted to at least 98 percent of maximum laboratory dry density within plus or minus 2 percentage points of optimum moisture content (-2 to +2) as determined by the Modified Proctor method (ASTM D 1557). TRC recommends that any grade-raise fill placed beneath proposed structures meet the requirements of non-expansive select fill.

The moisture content of the subgrade must be maintained until placement of the first fill lift. Fill material, whether non-expansive select fill or moisture conditioned on site soils, should be placed in horizontal loose lifts not exceeding 8 inches in uncompacted thickness. The fill material should be uniform with respect to material type and moisture content. Clods and chunks of material greater than 3 inches should be broken and the fill material mixed as necessary, so that a material of uniform moisture and density is obtained for each lift. Water required to bring the fill material to the proper moisture content should be applied evenly through each layer.

Each lift should be compacted, tested, and approved before another lift is added. As a guide, one field density test per lift for each 5,000 square feet of compacted area is recommended. For small areas or critical areas, the frequency of testing may need to be increased to one test per 2,500 square feet. A minimum of two tests per lift should be required. The purpose of the field density tests is to provide some indication that uniform and adequate compaction and moisture control are being achieved. The actual quality of the fill, as compacted, should be the responsibility of the contractor and satisfactory results from the tests should not be considered as a guarantee of the quality of the contractor's work.

Backfill placed within utility trenches that project areas should be properly compacted. Numerous parking, drive, sidewalk, and landscape areas for other projects typically experience settlement due to soft backfill within utility trenches. Backfill placed in utility trenches or other excavated areas within the project areas should be placed in lifts, compacted, and tested in accordance with these earthwork recommendations. Trenches should be opened a sufficient width to safely allow compaction equipment access to the backfill and to safely allow for confirmation testing to occur. Backfill should be placed in horizontal lifts, and if the trench is over 5 feet deep, a trench box should be used or the side slopes benched prior to placing the backfill.

4.7 Construction Adjacent to Existing Structures

For new structures placed in close proximity of existing facilities, differential settlement between new and existing structures is expected to approach the magnitude of the total settlement discussed herein for the new structures. Expansion joints should be provided between the new and existing structures to accommodate differential movements between the two structures. Underground piping between the two structures should be designed with flexible couplings and utility knockouts in foundation walls should be oversized, so minor deflections in alignment do not result in breakage or distress. Care should be taken during excavation adjacent to existing foundations, to avoid disturbing existing foundation bearing soils.

New footings should bear at or near the bearing elevation of immediately adjacent existing foundations. Depending upon their locations and current loads on the existing footings, footings for the new structures could cause settlement of adjacent foundations. To reduce this concern and risk, clear distances at least equal to the new footing widths should be maintained between the new and existing foundations.

4.8 Lateral Earth Pressures

Below grade structures may experience lateral earth pressures from a combination of soil pressure, hydrostatic water pressure, and any surcharge loads. A triangular stress distribution will be imposed on the structures by soil and hydrostatic water pressures against below-grade structures. Additionally, surcharge loads will impose a rectangular stress distribution. Given the estimated undrained cohesion of the encountered soils, the lateral earth pressures shall be evaluated based on a lateral earth pressure coefficient of ($K = 0.5$ for active and at-rest conditions) with a cohesion of 2500 psf. With these values, the lateral earth pressure may become insignificant if surface surcharge is below 2000 psf. However, any buried structures shall be evaluated based on these parameters with a minimum equivalent fluid unit weight (γK) of not less than 30 psf (where γ is the unit weight of soil). This way, the lateral earth pressure at any depth (z) shall not be calculated as: $\gamma z K - 2 C K^{0.5}$ but not less than 30 psf.

4.9 Site Excavation Characteristics

Finished grades at the Site have not been provided. We present the following general comments regarding our opinion of the excavation conditions for the designers' information with the understanding that they are opinions based on information from widely spaced test borings. More accurate information regarding the excavation conditions should be evaluated by contractors or other interested parties from test excavations using the equipment that will be used during construction.

Borings drilled as part of our field exploration were advanced using continuous augers. Drilling efforts were relatively easy to moderate through the native in-situ soils. Based on this, we consider that conventional heavy-duty earthmoving equipment should be capable of excavating the in-situ soils. However, if the weathered rock is anticipated to be excavated, earthmoving equipment appropriate for hard rock excavation may be required. The contractor is responsible for evaluating the excavation characteristics of the soil. Areas of lower density, lower blow count soils, or excavations below groundwater levels will likely experience sloughing, and the use of temporary shoring will likely be required to complete excavations through the lower density or saturated soils. Planning and budgeting should consider these items and provide for a contingency.

In accordance with Texas State law, the design and maintenance of all excavations and excavation retention systems is the sole responsibility of the Contractor. Attention is drawn to OSHA Standards 29 CFR - 1926 Subpart P for guidance in the design of such systems.

Stockpiles should be located well away from the edge of excavations, and their heights should be controlled so they do not excessively surcharge sides of the excavation. Surface drainage should be carefully controlled to prevent flow of water into the excavations. Construction slopes should be closely observed for signs of mass movement, including tension cracks near the crest or structures at the toe. If potential stability problems are observed, a geotechnical engineer should be contacted immediately. Shoring, bracing, or underpinning may be required to provide structural stability and to protect personnel working within the excavation. Shoring, bracing, or underpinning required for the project (if any) should be designed by a professional engineer registered in the State of Texas.

4.10 Temporary Excavations

The contractor is solely responsible for designing, constructing, and maintaining stable, temporary excavations and should shore, slope, or bench the sides of any confined excavations deeper than 4 ft as required to maintain stability of both the excavation sides and bottom. All excavations for the project should comply with applicable local, state, and federal safety regulations including the current United States Department of Labor, Occupational Safety and Health Administration (OSHA) guidelines for Excavation and Trench Safety Standards (29 CFR Part 1926, Part P, Excavations) or other applicable jurisdictional codes for permissible temporary side-slope ratios and or shoring requirements. The contractor should avoid stockpiling excavated materials or placing construction equipment immediately adjacent to the excavation unless the excavation sidewalls are braced to withstand the anticipated surcharge load.

The onsite soils are classified as Type B soils according to OSHA 29 CFR 1926. Short-term open excavations in the existing surficial soils that are 20 ft or less in depth shall have a maximum allowable slope of 1H:1V (45°). Alternately, trench boxes and/or sheeting could be used in conjunction with open cut slopes when performed in accordance with OSHA 29 CFR 1926.652(b). Sloping or benching for excavations greater than 20 feet deep shall be designed by a registered professional engineer.

Daily inspections of excavations, adjacent areas and protective systems by a “competent person” should be performed for evidence of situations that could result in cave-ins, indications of failure of a protective system, or other hazardous conditions. The information in this report is being provided solely as a service to our client. Under no circumstance should the information provided be interpreted to mean TRC is assuming responsibility for construction Site safety.

4.11 Soil Corrosion

To evaluate the corrosion potential of the subsurface soils, portions of composite soil samples encountered near the surface were collected in Boring B-1 and submitted to an accredited laboratory for corrosivity testing (including electrical resistivity- ER, pH, chlorides, redox potential, sulfides, and sulfates). The results are summarized in Table 4 below.

Table 4: Soil Corrosivity Testing Results

Boring	Sample Depth (ft bgs)	Electrical Resistivity (ohm-cm)	Sulfates (mg/kg)	Chlorides (mg/kg)	pH	Oxidation-Reduction (mV)	Corrosivity based on ER	Sulfate Exposure
B-1	0 to 2	1,380	105	75	5.83	+689	Very Severely Corrosive	Negligible

mg/kg = milligrams per kilogram.

Many factors can affect the corrosion potential of soil including soil moisture content, resistivity, permeability and pH, as well as chloride and sulfate concentration. In general, soil resistivity, which is a measure of how easily electrical current flows through soils, is considered the most influential factor for the assessment of soil corrosion. Based on classification developed by William J. Ellis (1978), the approximate relationship between soil corrosiveness was developed as shown in Table 5 below.

Table 5: Relationship Between Soil Electrical Resistivity and Soil Corrosivity

Electrical Resistivity (ohm-cm)	Classification of Soil Corrosiveness
0 to 900	Very Severely Corrosive
900 to 2,300	Severely Corrosive
2,300 to 5,000	Moderately Corrosive
5,000 to 10,000	Mildly Corrosive
10,000 to >100,000	Very Mildly Corrosive

Chloride and sulfate ion concentrations and pH appear to play secondary roles in affecting corrosion potential. High chloride levels tend to reduce soil resistivity and break down otherwise protective surface deposits, which can result in corrosion of buried metallic improvements or reinforced concrete structures. Sulfate ions in the soil can lower the soil resistivity and can be highly aggressive to Portland cement concrete (PCC) by combining chemically with certain constituents of the concrete, principally tricalcium aluminate. This reaction is accompanied by expansion and eventual disruption of the concrete matrix. Soils containing high sulfate content could also cause corrosion of the reinforcing steel in concrete. Table 4.2.1 of the American Concrete Institute (ACI, 2008) provides requirements for concrete exposed to sulfate-containing solutions as summarized in Table 6 below.

Table 6: Relationship Between Sulfate Concentration and Sulfate Exposure (Table 4.2.1 of ACI)

Water-Soluble Sulfate (SO₄) in soil, ppm	Sulfate Exposure
0 to 1,000	Negligible
1,000 to 2,000	Moderate
2,000 to 20,000	Severe
over 20,000	Very Severe

(For soil, 1 ppm = 1 mg/kg)

Acidity is an important factor of soil corrosivity. The lower the pH (the more acidic the environment), the higher will the soil corrosivity be with respect to buried metallic structures. As soil pH increases above 7 (the neutral value), the soil is increasingly more alkaline and less corrosive to buried steel structures due to protective surface films which form on steel in high pH environments. A pH value between 5 and 8.5 is generally considered relatively passive from a corrosion standpoint.

The laboratory electrical resistivity tests completed on the samples collected yielded a value of 1,380 ohm-centimeters, which indicates that the soil has a severe potential to corrosivity for buried metals and uncoated steel. Based on our previous experience and Table 4.2.1 of the ACI, it is our opinion that sulfate exposure to PCC may be mostly considered negligible for the soils sampled. The project Structural Engineer should review the testing results to determine if corrosion protection measures are necessary for buried steel.

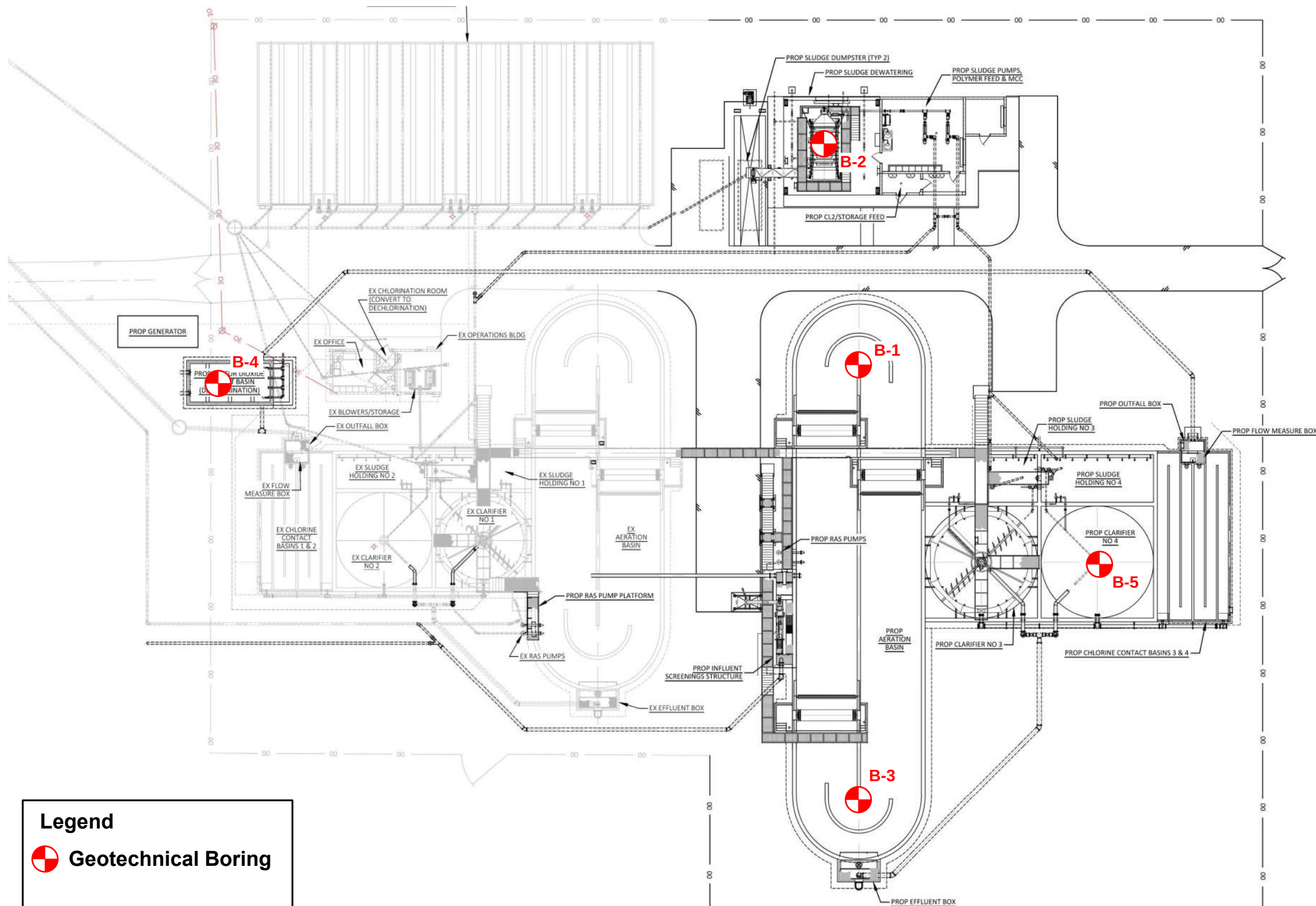
4.12 Recommendations for Further Services

We recommend that qualified personnel be retained to provide engineering consultation, field inspection, and construction material testing services during construction operations to determine if soils, other materials, and ground water conditions encountered during construction are similar to those encountered in the borings, and that they have comparable engineering properties and influences on the design of the structures. A qualified geotechnical engineer should review foundation design submittals and specifications for foundation construction when they are prepared.

5.0 Limitations

This work has been performed in accordance with our authorized scope of work and in accordance with generally accepted practice in the fields of geotechnical and foundation engineering. This warranty is in lieu of all other warranties either expressed or implied. Our conclusions and recommendations are based on the data revealed by this exploration. We are not responsible for any conclusions or opinions drawn from the data included herein, other than those specifically stated, nor are the recommendations presented in this report intended for direct use as construction specifications. This report is intended for use with regard to the specific project discussed herein and any changes in loads, structures, or locations should be brought to our attention so that we may determine how they may affect our conclusions. An attempt has been made to provide for normal contingencies, but the possibility remains that unexpected conditions may be encountered during construction. If this should occur, or if additional or contradictory data are revealed in the future, we should be notified so that modifications to this report can be made, if necessary. If we do not review the relevant construction documents and witness the relevant construction operations, then we cannot be responsible for any problem, which may arise, from the misunderstanding or misinterpretation of this report or failure to comply with our recommendations.

Appendix A: Site/Boring Location Map



Legend

 Geotechnical Boring

Notes:

- Not to scale.
- Boring locations are approximate.

Project No. 536680

Date: October 13, 2023

For: City of Lytle



505 E. Huntland Drive, Suite 250, Austin, Texas 78752
PH. (512) 329-6080 www.trccompanies.com

BORING LOCATION PLAN

WWTP AND LIFT STATION EXPANSION

LYTLE WASTEWATER TREATMENT PLANT

LYTLE, ATASCOSA COUNTY, TEXAS

FIGURE

1



Notes:
- Not to scale.
- Boring locations are approximate.

Project No. 536680	 505 E. Huntland Drive, Suite 250, Austin, Texas 78752 PH. (512) 329-6080 www.trccompanies.com	BORING LOCATION PLAN – LIFT STATION WWTP AND LIFT STATION EXPANSION LYTLE WASTEWATER TREATMENT PLANT LYTLE, ATASCOSA COUNTY, TEXAS	FIGURE 2
Date: October 13, 2023			
For: City of Lytle			

Appendix B: Boring Logs



TEST BORING LOG

PROJECT: LYTLE WWTP AND LIFT STATION EXPANSION

LOCATION: LYTLE, TEXAS

BORING **B-1**

G.S. ELEV.

FILE 536680

SHEET 1 OF 2

GROUNDWATER DATA

FIRST ENCOUNTERED NR			
DEPTH	HOUR	DATE	ELAPSED TIME

METHOD OF ADVANCING BOREHOLE

d	FROM	0.0'	TO	40.0'

DRILLER **ENVIROCORE**

HELPER

INSPECTOR

DATE STARTED 09/15/2023

DATE COMPLETED 09/15/2023

DEPTH	A	B	C	DESCRIPTION	Wn	REMARKS
5	SPT-1	5 6 7		SANDY LEAN CLAY (CLS), very stiff, brown, with sand pockets and calcareous nodules		MC=8%
	SPT-2	6 11 12				
	SPT-3	7 12 13				
	SPT-4	5 7 11				
	SPT-5	5 8 12				
10				LEAN CLAY with SAND (CL), very stiff, tan and gray, slightly varved		LL= 28%; PI= 11% MC=12%; FINES=83%
	SPT-6	4 7 11				
20	SPT-7	6 8 13				
25	SPT-8	7 16 22				
30	SPT-9	10 16 23		CLAYEY SAND (SC), dense, tan and gray, fine grained		Cave-in at 29'
35	SPT-10	14 21 26		SANDY LEAN CLAY (CLS), hard, tan and gray, with sandstone fragments		

Groundwater was not observed during drilling.

DRN. **OLB**

CKD. **DA**



TEST BORING LOG

PROJECT: LYTLE WWTP AND LIFT STATION EXPANSION

LOCATION: LYTLE, TEXAS

BORING **B-1**

G.S. ELEV.

FILE 536680

SHEET 2 OF 2

DEPTH	A	B	C	DESCRIPTION	Wn	REMARKS
40	X	16 19 22		SANDY LEAN CLAY (CLS), hard, tan and gray, with sandstone fragments		
40.0				END OF BORING AT 40'		
45						
50						
55						
60						
65						
70						
75						



TEST BORING LOG

PROJECT: LYTLE WWTP AND LIFT STATION EXPANSION

LOCATION: LYTLE, TEXAS

BORING **B-2**

G.S. ELEV.

FILE 536680

SHEET 1 OF 2

GROUNDWATER DATA

FIRST ENCOUNTERED NR			
DEPTH	HOUR	DATE	ELAPSED TIME

METHOD OF ADVANCING BOREHOLE

d	FROM	0.0'	TO	40.0'

DRILLER **ENVIROCORE**

HELPER

INSPECTOR

DATE STARTED 09/15/2023

DATE COMPLETED 09/15/2023

DEPTH	A	B	C	DESCRIPTION	Wn	REMARKS
5	SPT-1	5 7 8		SANDY LEAN CLAY (CLS), very stiff, brown, with sand pockets and calcareous nodules		LL= 32%; Pl= 18% MC=8%; FINES=73%
	SPT-2	7 12 13				
	SPT-3	8 9 11				
	SPT-4	4 8 12				
	SPT-5	6 9 11				
10						MC=13%
15	SPT-6	4 8 13		LEAN CLAY with SAND (CL), very stiff, tan and gray, slightly varved		
20	SPT-7	5 6 11				
25	SPT-8	8 15 24				
30	SPT-9	9 17 21		CLAYEY SAND (SC), dense, tan and gray, fine grained		MC=17%; FINES=64%
35	SPT-10	15 23 31		SANDY LEAN CLAY (CLS), hard, tan and gray, with sandstone fragments		Cave-in at 31.5'

Groundwater was not observed during drilling.

DRN. **OLB**

CKD. **DA**

NEW PROJECTS TEST BORING LOG 536680 LYTLE WWTP AND LIFT STATION.GPJ SITE BLAUVELT.GDT 6/17/24



TEST BORING LOG

PROJECT: LYTLE WWTP AND LIFT STATION EXPANSION

LOCATION: LYTLE, TEXAS

BORING B-2

G.S. ELEV.

FILE 536680

SHEET 2 OF 2

DEPTH	A	B	C	DESCRIPTION	Wn	REMARKS
40				<i>SANDY LEAN CLAY (CLS), hard, tan and gray, with sandstone fragments</i>		
40.0				<i>END OF BORING AT 40'</i>		
45						
50						
55						
60						
65						
70						
75						



TEST BORING LOG

PROJECT: LYTLE WWTP AND LIFT STATION EXPANSION

LOCATION: LYTLE, TEXAS

BORING **B-3**

G.S. ELEV.

FILE 536680

SHEET 1 OF 2

GROUNDWATER DATA

FIRST ENCOUNTERED NR			
DEPTH	HOUR	DATE	ELAPSED TIME

METHOD OF ADVANCING BOREHOLE

d	FROM	0.0'	TO	40.0'

DRILLER **ENVIROCORE**

HELPER

INSPECTOR

DATE STARTED 09/11/2023

DATE COMPLETED 09/11/2023

DEPTH	A	B	C	DESCRIPTION	Wn	REMARKS
	X SPT-1	4 5 6		SANDY LEAN CLAY (CLS), very stiff, brown, with sand pockets and calcareous nodules	6.0	MC=7%
	X SPT-2	7 13 14				
5	X SPT-3	6 13 14				
	X SPT-4	4 13 15		LEAN CLAY with SAND (CL), very stiff, tan and gray, slightly varved	18.5	MC=11%
	X SPT-5	4 10 18				
10						
	X SPT-6	5 10 18		CLAYEY SAND (SC), dense, tan and gray, fine grained	28.5	LL= 22%; PI= 3% MC=12%; FINES=42%
15						
	X SPT-7	12 20 18		SANDY LEAN CLAY (CLS), very stiff to hard, tan and gray		MC=21%; FINES=73%
	X SPT-8	8 16 24				
20						
	X SPT-9	6 12 15				
25						
	X SPT-10	8 21 34				
30						
35						

Groundwater was not observed during drilling.

DRN. **OLB**

CKD. **DA**

NEW PROJECTS TEST BORING LOG 536680 LYTLE WWTP AND LIFT STATION.GPJ SITE BLAUVELT.GDT 6/17/24



TEST BORING LOG

PROJECT: LYTLE WWTP AND LIFT STATION EXPANSION

LOCATION: LYTLE, TEXAS

BORING **B-3**

G.S. ELEV.

FILE 536680

SHEET 2 OF 2

DEPTH	A	B	C	DESCRIPTION	Wn	REMARKS
40	X	SPT-11 21 26 31		<i>SANDY LEAN CLAY (CLS), very stiff to hard, tan and gray</i>		
40.0				<i>END OF BORING AT 40'</i>		
45						
50						
55						
60						
65						
70						
75						



TEST BORING LOG

PROJECT: LYTLE WWTP AND LIFT STATION EXPANSION

LOCATION: LYTLE, TEXAS

BORING **B-4**

G.S. ELEV.

FILE 536680

SHEET 1 OF 2

GROUNDWATER DATA

FIRST ENCOUNTERED NR

DEPTH HOUR DATE ELAPSED TIME

METHOD OF ADVANCING BOREHOLE

d FROM 0.0' TO 40.0'

DRILLER **ENVIROCORE**

HELPER

INSPECTOR

DATE STARTED 09/11/2023

DATE COMPLETED 09/11/2023

DEPTH	A	B	C	DESCRIPTION	Wn	REMARKS
5	X SPT-1	5 5 6				
	X SPT-2	4 9 13				
	X SPT-3	6 11 12				
	X SPT-4	4 8 13				
10	X SPT-5	5 7 11				
15	X SPT-6	5 8 14				
20	X SPT-7	7 7 12				
25	X SPT-8	6 17 20				
30	X SPT-9	13 19 30				
35						

SANDY LEAN CLAY (CLS), very stiff, brown, with sand pockets and calcareous nodules

8.0

MC=7%

MC=15%

LEAN CLAY with SAND (CL), very stiff to hard, tan and gray, varved

Cave-in at 22'

LL= 28%; PI= 9%
MC=23%; FINES=77%

Groundwater was not observed during drilling.

DRN. **OLB**

CKD. **DA**



TEST BORING LOG

PROJECT: LYTLE WWTP AND LIFT STATION EXPANSION

LOCATION: LYTLE, TEXAS

BORING **B-4**

G.S. ELEV.

FILE 536680

SHEET 2 OF 2

DEPTH	A	B	C	DESCRIPTION	Wn	REMARKS
40				<i>LEAN CLAY with SAND (CL), very stiff to hard, tan and gray, varved</i>		
40.0				<i>END OF BORING AT 40'</i>		
45						
50						
55						
60						
65						
70						
75						



TEST BORING LOG

PROJECT: LYTLE WWTP AND LIFT STATION EXPANSION

LOCATION: LYTLE, TEXAS

BORING **B-5**

G.S. ELEV.

FILE 536680

SHEET 1 OF 2

GROUNDWATER DATA

FIRST ENCOUNTERED NR			
DEPTH	HOUR	DATE	ELAPSED TIME

METHOD OF ADVANCING BOREHOLE

d	FROM	0.0'	TO	40.0'

DRILLER **ENVIROCORE**

HELPER

INSPECTOR

DATE STARTED 09/11/2023

DATE COMPLETED 09/11/2023

DEPTH	A	B	C	DESCRIPTION	Wn	REMARKS
5	SPT-1	4 5 7		SANDY LEAN CLAY (CLS), very stiff, brown, with sand pockets and calcareous nodules		LL= 37%; PI= 22% MC=8%; FINES=82%
	SPT-2	5 13 18				
	SPT-3	10 12 15				
	SPT-4	6 11 14				
	SPT-5	6 13 18				
10						
15	SPT-6	7 14 26		LEAN CLAY with SAND (CL), very stiff, tan and gray, slightly varved		Cave-in at 18' MC=17%; FINES=42%
20	SPT-7	6 15 23				
25	SPT-8	8 9 16				
30	SPT-9	11 14 19		CLAYEY SAND (SC), dense, tan and gray, fine grained		
35	SPT-10	10 31 34		SANDY LEAN CLAY (CLS), hard, tan and gray, with sandstone fragments		MC=19%; FINES=58%

Groundwater was not observed during drilling.

DRN. **OLB**

CKD. **DA**

NEW PROJECTS TEST BORING LOG 536680 LYTLE WWTP AND LIFT STATION.GPJ SITE BLAUVELT.GDT 6/17/24



TEST BORING LOG

PROJECT: LYTLE WWTP AND LIFT STATION EXPANSION

LOCATION: LYTLE, TEXAS

BORING **B-5**

G.S. ELEV.

FILE 536680

SHEET 2 OF 2

DEPTH	A	B	C	DESCRIPTION	Wn	REMARKS
40	X	18 28 36		<i>SANDY LEAN CLAY (CLS), hard, tan and gray, with sandstone fragments</i>		
				<i>END OF BORING AT 40'</i>		
45						
50						
55						
60						
65						
70						
75						



TEST BORING LOG

PROJECT: LYTLE WWTP AND LIFT STATION EXPANSION

LOCATION: LYTLE, TEXAS

BORING **B-6**

G.S. ELEV.

FILE 536680

SHEET 1 OF 2

GROUNDWATER DATA

FIRST ENCOUNTERED NR			
DEPTH	HOUR	DATE	ELAPSED TIME

METHOD OF ADVANCING BOREHOLE

d	FROM	0.0'	TO	40.0'

DRILLER **ENVIROCORE**

HELPER

INSPECTOR

DATE STARTED 09/11/2023

DATE COMPLETED 09/11/2023

DEPTH	A	B	C	DESCRIPTION	Wn	REMARKS
5	X SPT-1	5 5 3				
	X SPT-2	4 9 9				MC=5%
	X SPT-3	6 7 7				LL= 27%; PI= 14% MC=6%; FINES=51%
	X SPT-4	3 5 6				
10	X SPT-5	4 5 5		SANDY LEAN CLAY (CLS), stiff to very stiff, brown, with sand pockets and calcareous nodules		
15	X SPT-6	3 4 7				LL= 31%; PI= 16% MC=17%; FINES=66%
20	X SPT-7	2 5 8				
25	X SPT-8	3 8 12				
30	X SPT-9	7 7 9		LEAN CLAY with SAND (CL), stiff to very stiff, tan and gray, varved		MC=20%; FINES=86%
	SPT-10	50/1"				
35				Possible SANDSTONE, highly weathered, fine grained		

DRN. **OLB**

CKD. **DA**

KEY TO SYMBOLS

Symbol Description

Strata symbols



Clay with Low Plasticity



USCS Low Plasticity
Sandy Clay



Sandstone



Clayey Sand

Symbol Description

Misc. Symbols



Water table first encountered



Water table first reading after drilling



Water table second reading after drilling



Water table third reading after drilling

NR

Not Recorded

MH

Moh's Hardness

Sample Type



Standard Penetration Test

Lab Symbols

FINES = Fines %

LL = Liquid Limit %

PI = Plasticity Index %

U_c = Unconfined Compressive Strength

W/V = Unit Weight

Notes:

COLUMN A) Soil sample number.

COLUMN B) FOR SOIL SAMPLE (ASTM D 1586): indicates number of blows obtained for each 6 ins. penetration of the standard split-barrel sampler. FOR ROCK CORING (ASTM D2113): indicates percent recovery (REC) per run and rock quality designation (RQD). RQD is the % of rock pieces that are 4 ins. or greater in length in a core run.

COLUMN C) Strata symbol as assigned by the geotechnical engineer.

DESCRIPTION) Description including color, texture and classification of subsurface material as applicable (see Descriptive Terms). Estimated depths to bottom of strata as interpolated from the borings are also shown.

DESCRIPTIVE TERMS: F = fine M = medium C = coarse

RELATIVE PROPORTIONS:

-Descriptive Term-	-Symbol-	-Est. Percentages-
Trace	TR	1-10
Trace to Some	TR to SM	10-15
Some	SM	15-30
Silty, Sandy, Clayey, Gravelly	-	30-40
And	and	40-50

REMARKS) Special conditions or test data as noted during investigation. Note that W.O.P. indicates water observation pipes.

* Free water level as noted may not be indicative of daily, seasonal, tidal, flood, and/or long term fluctuations.

Appendix C: Laboratory Testing Results



SUMMARY OF LABORATORY TEST DATA

Project Name: Lytle WWTP
Lytle, TX
 Client Name: City of Lytle
 TRC Project #: 536680

SAMPLE IDENTIFICATION		USCS Group	Moisture Content (%)	GRAIN SIZE DISTRIBUTION USCS GRADATION				PLASTICITY			
Source #	Depth (ft)			Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Liquidity Index (%)
B-1	8.0-10.0	CL	11.7	0.3	16.9	82.8		28	17	11	-0.5
B-2	2.0-4.0	CL	8.1	1.2	25.4	73.4		32	14	18	-0.3
B-2	28.0-30.0	ML ^{1,2}	17.0	3.5	32.9	63.6		-	-	-	-
B-3	18.0-20.0	SM	11.9	8.5	49.6	41.9		22	19	3	-2.4
B-3	33.0-35.0	CL ^{1,2}	20.6	27.1		72.9		-	-	-	-
B-4	23.0-25.0	CL	23.1	1.0	22.2	76.8		28	19	9	0.5
B-5	4.0-6.0	CL	7.7	0.6	17.7	81.7		37	15	22	-0.3
B-5	18.0-20.0	SM ^{1,2}	16.5	58.4		41.6		-	-	-	-
B-5	33.0-35.0	ML ^{1,2}	18.6	41.8		58.2		-	-	-	-
B-6	4.0-6.0	CL	5.7	3.2	45.9	50.9		27	13	14	-0.5
B-6	13.0-15.0	CL	17.0	0.5	33.2	66.3		31	15	16	0.1
B-6	28.0-30.	SM ^{1,2}	20.0	14.3		85.7		-	-	-	-

Notes:

1. USCS based on grain-size distribution and visual classification. An Atterberg Limits was not requested to be completed.
2. Varves of silt clay throughout specimen.

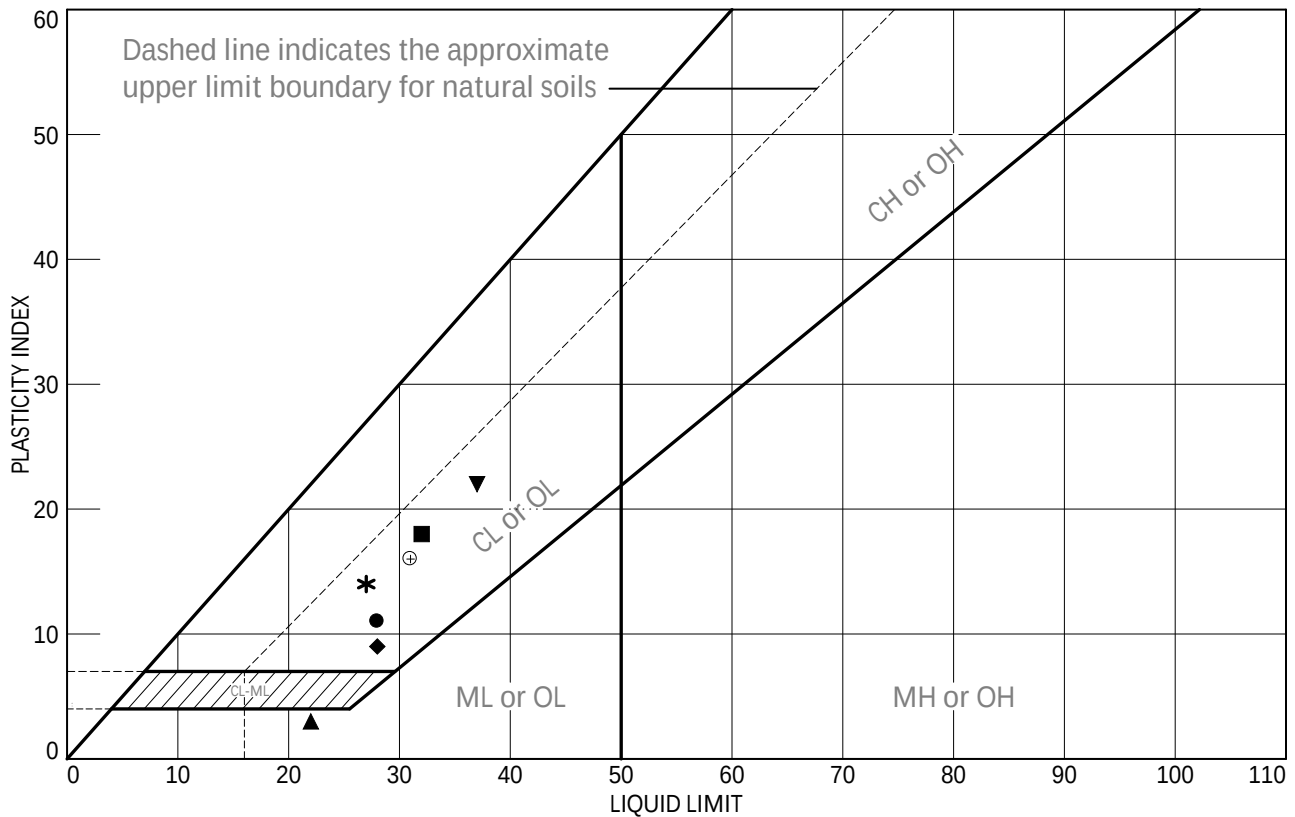


TRC ENGINEERS, INC
NATURAL MOISTURE CONTENT

Project Name: Lytle WWTP
Lytle, TX
Client Name: City of Lytle
TRC Project #: 536680

Source #	Depth (ft)	Natural Moisture Content			
		Wet Wt + Tare (g)	Dry Wt + Tare (g)	Tare (g)	% Moisture Content
B-1	4.0-6.0	227.45	219.87	127.17	8.2
B-2	6.0-8.0	234.96	223.39	131.06	12.5
B-3	0.0-2.0	228.89	222.85	133.61	6.8
B-3	6.0-8.0	212.50	203.80	124.56	11.0
B-4	6.0-8.0	240.58	232.92	127.37	7.3
B-4	13.0-15.0	223.34	210.88	129.34	15.3
B-6	2.0-4.0	241.17	235.69	130.47	5.2

Atterberg Limits and Moisture Content Report



SOIL DATA

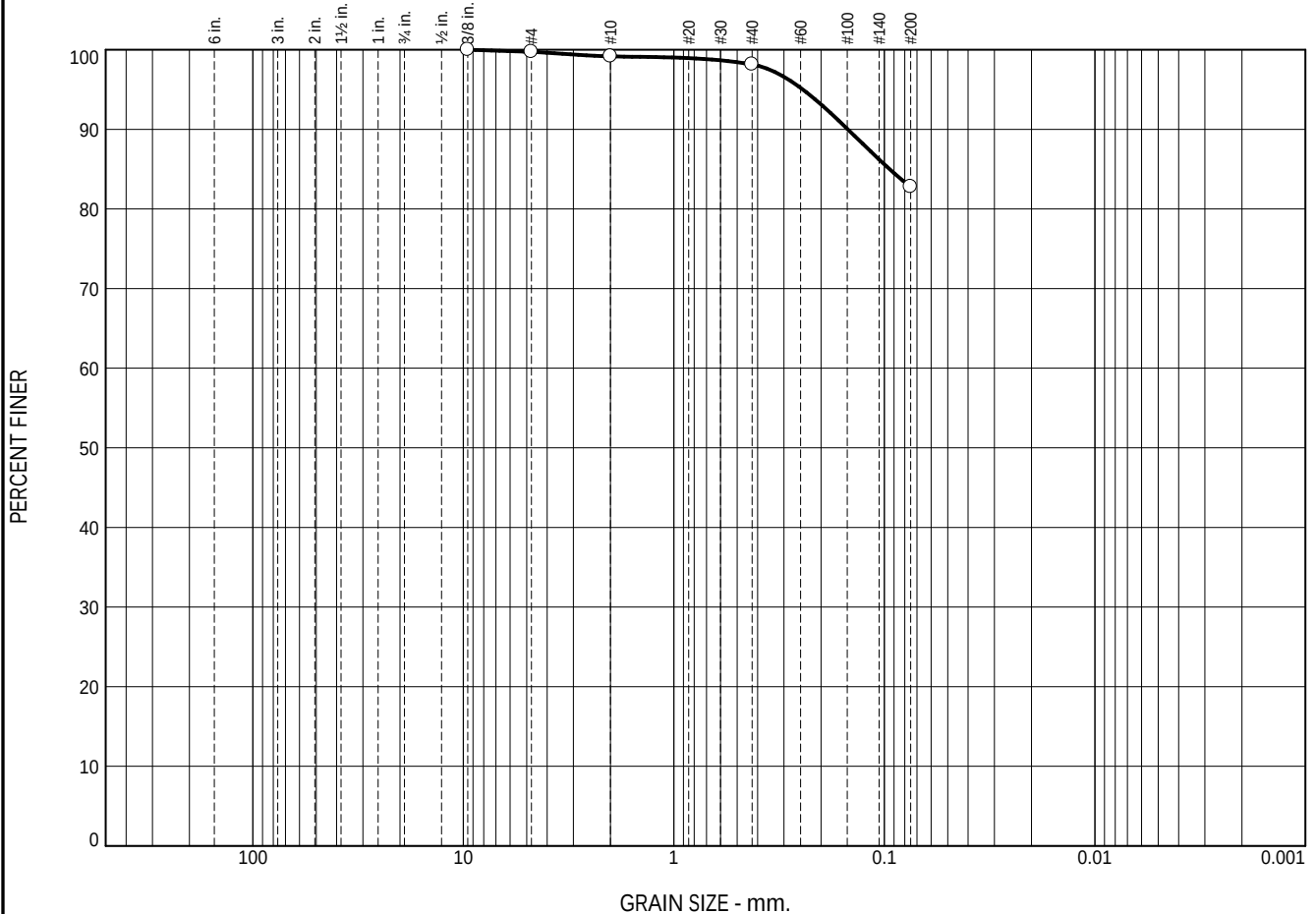
	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LIQUIDITY INDEX	USCS
●	B-1		8.0-10.0 FT	11.7	17	28	11	-0.5	CL
■	B-2		2.0-4.0 FT	8.1	14	32	18	-0.3	CL
▲	B-3		18.0-20.0 FT	11.9	19	22	3	-2.4	SM
◆	B-4		23.0-25.0 FT	23.1	19	28	9	0.5	CL
▼	B-5		4.0-6.0 FT	7.7	15	37	22	-0.3	CL
*	B-6		4.0-6.0 FT	5.7	13	27	14	-0.5	CL
⊕	B-6		13.0-15.0 FT	17.0	15	31	16	0.1	CL

TRC
Engineers, Inc.
Mt. Laurel, NJ

Client: CITY OF LYTLE
Project: CITY OF LYTLE WWTP EXPANSION
LYTLE, TX
Project No.: 536680

Figure 1

Particle Size Distribution Report



	% +3"		% Gravel		% Sand			% Fines	
			Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0		0.0	0.3	0.5	1.0	15.4	82.8	
×	LL	PL	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c
○	28	17	0.0944						C _u

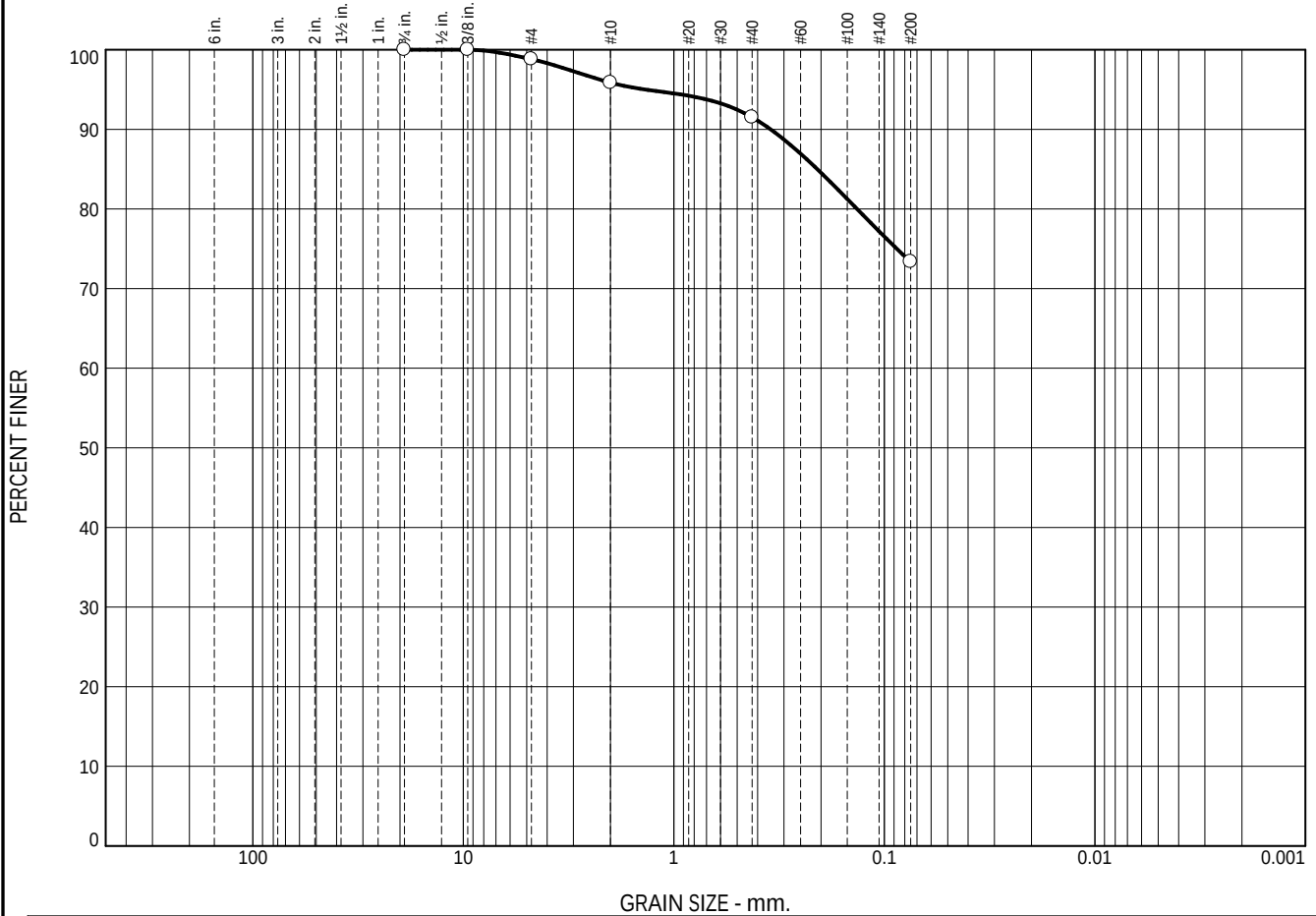
MATERIAL DESCRIPTION								TEST DATE	USCS	NM
○ BROWN LEAN CLAY WITH SAND								10/02/23	CL	11.7

Project No. 536680		Client: CITY OF LYTLE		Remarks: ○SAMPLE DESCRIPTION BASED ON USCS
Project: CITY OF LYTLE WWTP EXPANSION LYTLE, TX				
○ Source of Sample: B-1		Depth: 8.0-10.0 FT		
TRC Engineers, Inc.				Figure 2
Mt. Laurel, NJ				

Figure 2

Tested By: JC 10/02/23 Checked By: OB 10/05/23

Particle Size Distribution Report



GRAIN SIZE - mm.										
% +3"			% Gravel		% Sand			% Fines		
			Coarse	Fine	Coarse	Medium	Fine	Silt		Clay
○	0.0		0.0	1.2	2.9	4.4	18.1	73.4		
×	LL	PL	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
○	32	14	0.2082							

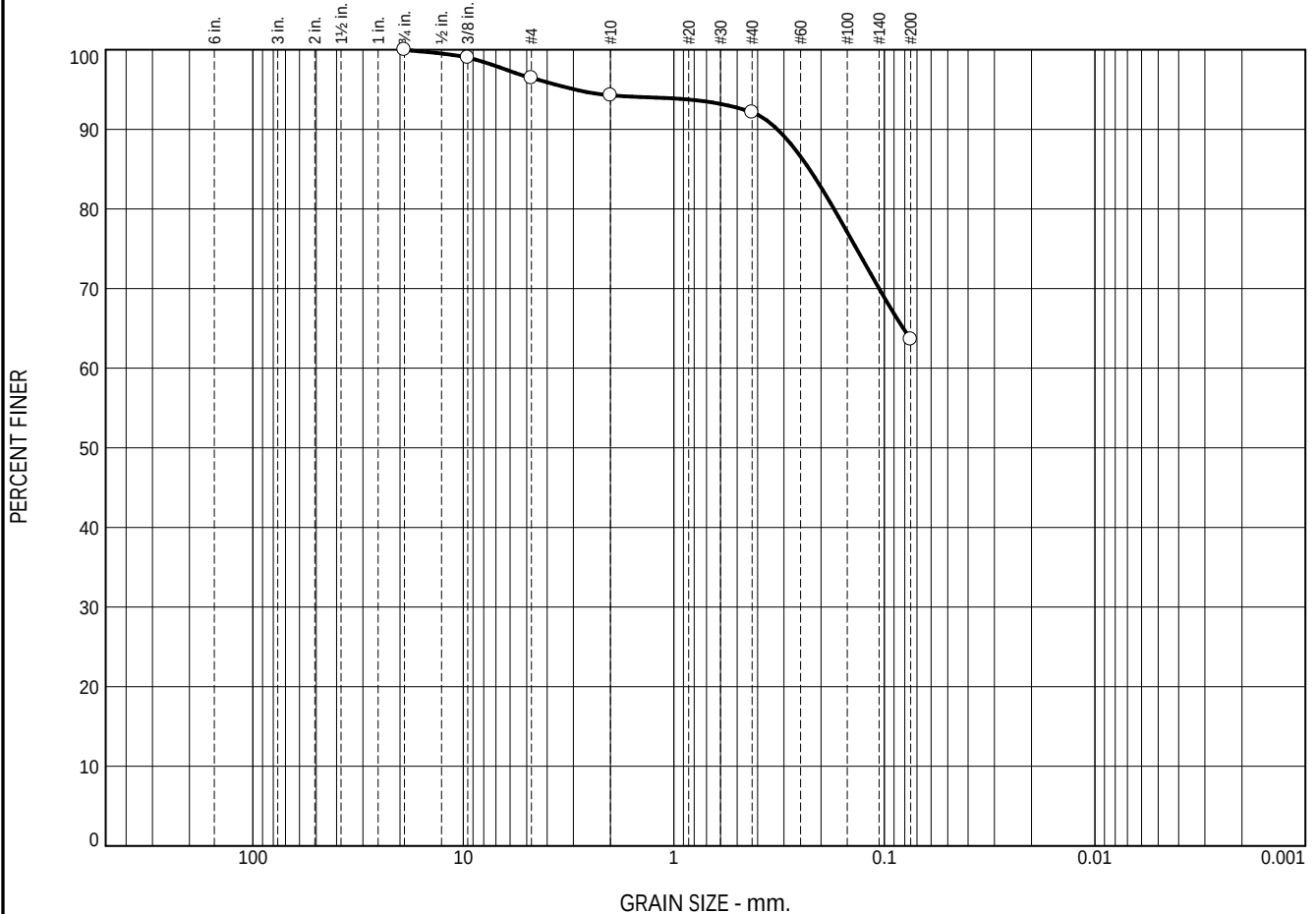
MATERIAL DESCRIPTION							TEST DATE	USCS	NM
○ BROWN LEAN CLAY WITH SAND							10/03/23	CL	8.1

Project No. 536680 Client: CITY OF LYTLE		Remarks: ○SAMPLE DESCRIPTION BASED ON USCS
Project: CITY OF LYTLE WWTP EXPANSION LYTLE, TX		
○ Source of Sample: B-2	Depth: 2.0-4.0 FT	
TRC Engineers, Inc.		
Mt. Laurel, NJ		Figure 3

Figure 3

Tested By: JC 10/03/23 Checked By: OB 10/05/23

Particle Size Distribution Report



GRAIN SIZE - mm.									
% +3"		% Gravel		% Sand			% Fines		
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay	
0.0		0.0	3.5	2.2	2.2	28.5	63.6		
LL	PL	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
ML		0.2270							

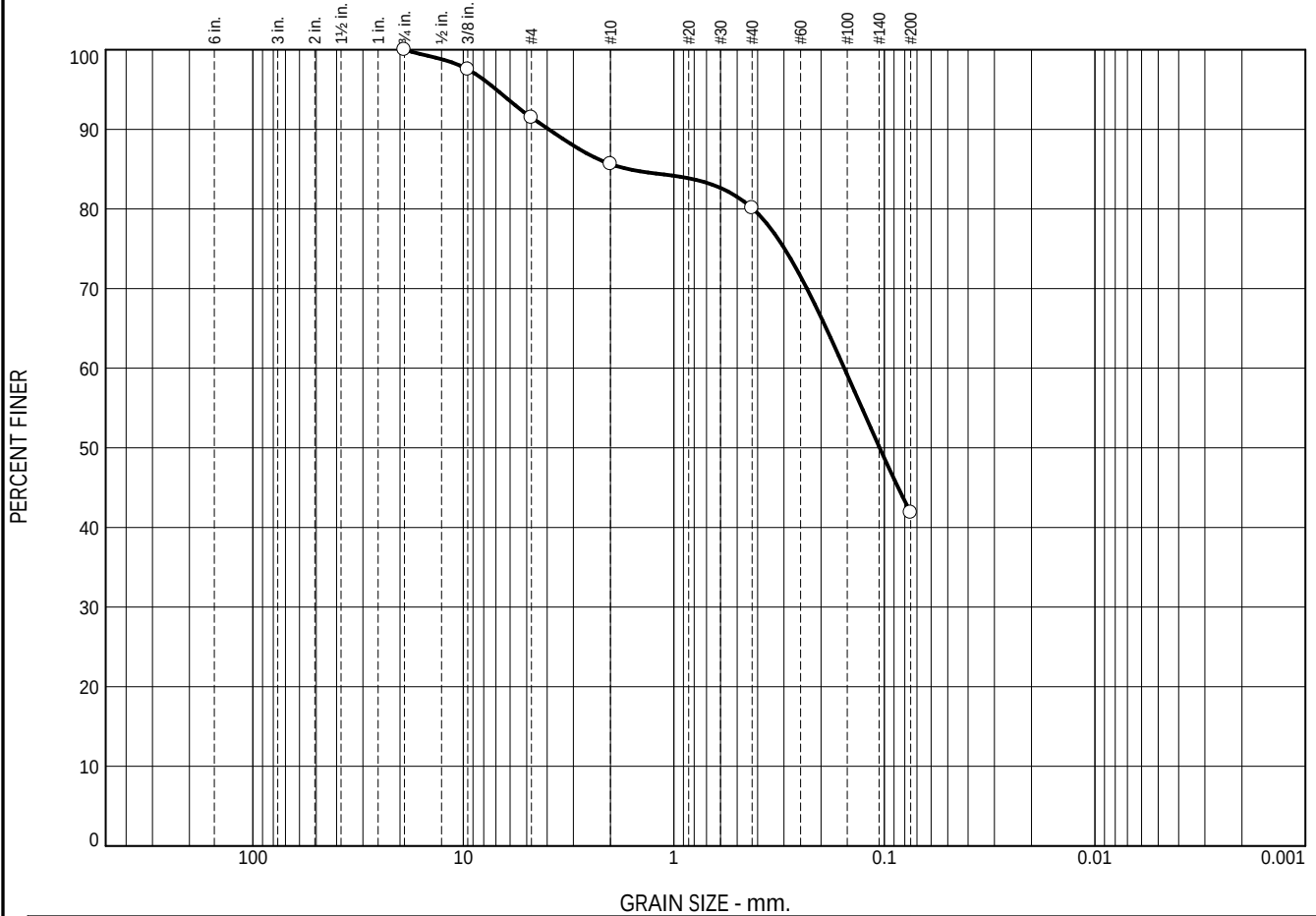
MATERIAL DESCRIPTION							TEST DATE	USCS	NM
○ LIGHT BROWN SANDY SILT WITH CLAY*							10/04/23		17.0

Project No. 536680 Client: CITY OF LYTLE		Remarks: ○SAMPLE DESCRIPTION BASED ON GRAIN-SIZE DISTRIBUTION AND VISUAL CLASSIFICATION *SPECIMEN CONTAINED THIN BROWN LAYERS OF
Project: CITY OF LYTLE WWTP EXPANSION LYTLE, TX		
○ Source of Sample: B-2	Depth: 28.0-30.0 FT	
TRC Engineers, Inc.		
Mt. Laurel, NJ		Figure 4

Figure 4

Tested By: JC 10/04/23 Checked By: OB 10/05/23

Particle Size Distribution Report



GRAIN SIZE - mm.									
% +3"		% Gravel		% Sand			% Fines		
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay	
○	0.0	0.0	8.5	5.9	5.5	38.2	41.9		
×	LL	PL	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c
○	22	19	1.6363	0.1549	0.1053				

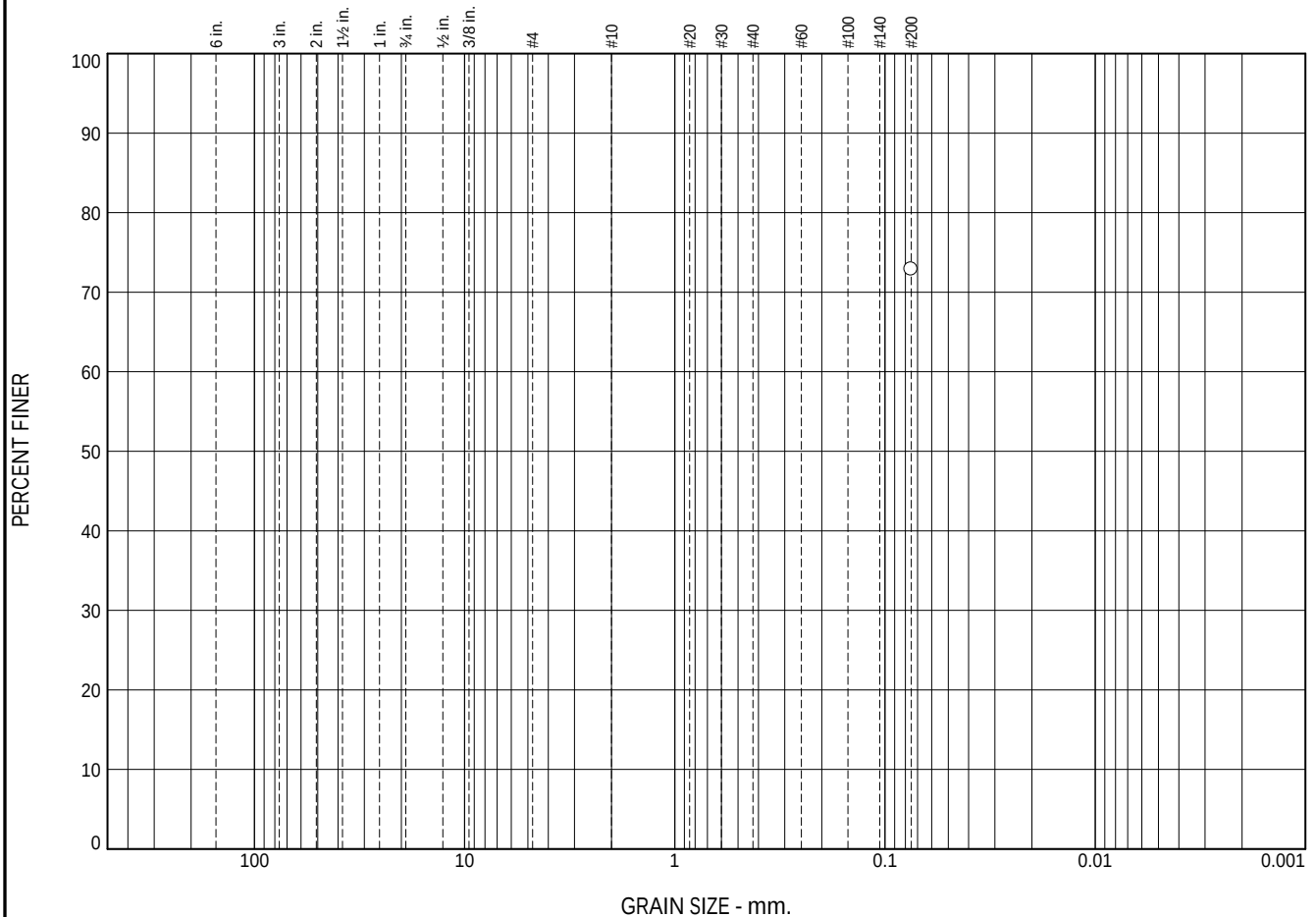
MATERIAL DESCRIPTION							TEST DATE	USCS	NM
○ BROWN SILTY SAND							10/04/23	SM	11.9

Project No. 536680 Client: CITY OF LYTLE		Remarks: ○SAMPLE DESCRIPTION BASED ON USCS
Project: CITY OF LYTLE WWTP EXPANSION LYTLE, TX		
○ Source of Sample: B-3	Depth: 18.0-20.0 FT	
TRC Engineers, Inc.		
Mt. Laurel, NJ		Figure 5

Figure 5

Tested By: JC 10/04/23 Checked By: OB 10/05/23

Particle Size Distribution Report



GRAIN SIZE - mm.												
% +3"			% Gravel		% Sand				% Fines			
			Coarse	Fine	Coarse	Medium	Fine	Silt		Clay		
☐								72.9				
☒	LL	PL	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u		
☐												

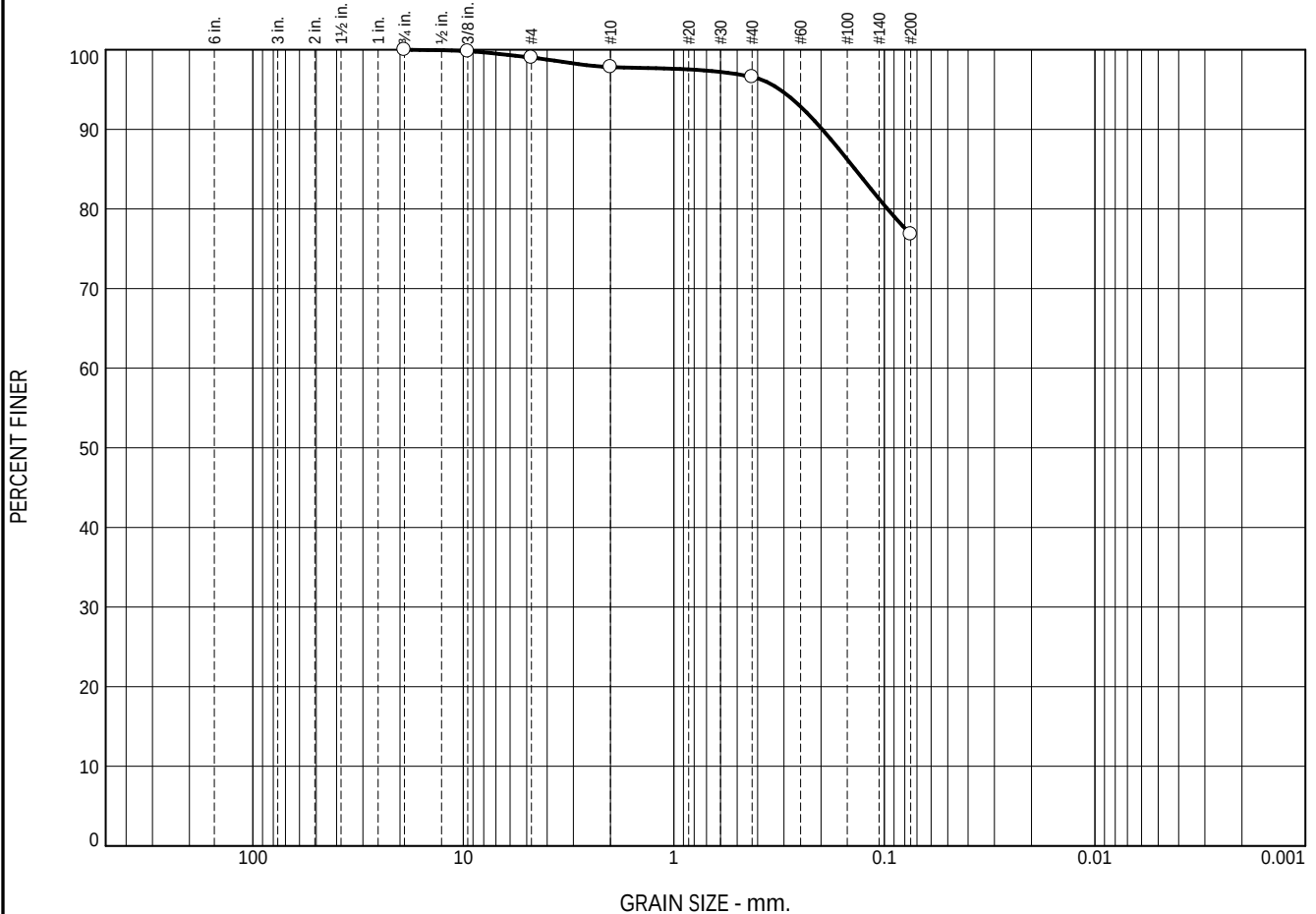
MATERIAL DESCRIPTION							TEST DATE	USCS	NM
☐ BROWN AND GRAY SANDY CLAY WITH GRAY SILT							10/02/23	CL*	20.6

Project No. 536680 Client: CITY OF LYTLE		Remarks: ○SAMPLE DESCRIPTION BASED ON GRAIN-SIZE DISTRIBUTION AND VISUAL CLASSIFICATION *SPECIMEN CONSISTED OF VARVES WITH SILT AND
Project: CITY OF LYTLE WWTP EXPANSION LYTLE, TX		
○ Source of Sample: B-3	Depth: 33.0-35.0 FT	
TRC Engineers, Inc.		
Mt. Laurel, NJ		Figure 6

Figure 6

Tested By: JC 10/02/23 Checked By: OB 10/05/23

Particle Size Distribution Report



GRAIN SIZE - mm.									
% +3"		% Gravel		% Sand			% Fines		
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay	
○	0.0	0.0	1.0	1.2	1.2	19.8	76.8		
×	LL	PL	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c
○	28	19	0.1377						C _u

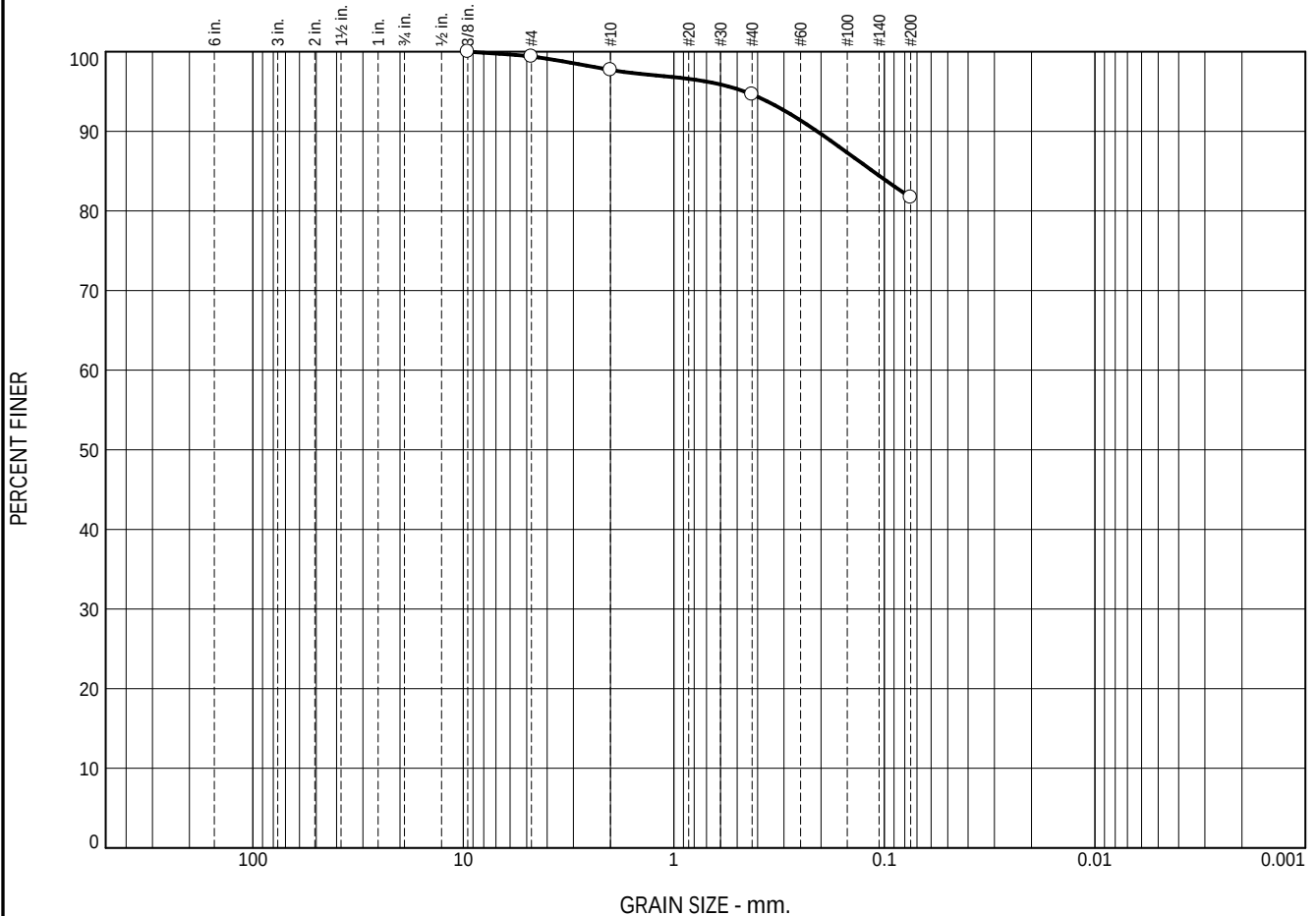
MATERIAL DESCRIPTION							TEST DATE	USCS	NM
○ BROWN LEAN CLAY WITH SAND*							10/03/23	CL	23.1

Project No. 536680 Client: CITY OF LYTLE		Remarks: ○SAMPLE DESCRIPTION BASED ON USCS *SPECIMEN CONTAINED FEW VARVE LAYERS WITH GRAY SANDY SILT
Project: CITY OF LYTLE WWTP EXPANSION LYTLE, TX		
○ Source of Sample: B-4	Depth: 23.0-25.0 FT	
TRC Engineers, Inc.		
Mt. Laurel, NJ		Figure 7

Figure 7

Tested By: JC 10/04/23 Checked By: OB 10/05/23

Particle Size Distribution Report



GRAIN SIZE - mm.										
% +3"			% Gravel		% Sand			% Fines		
			Coarse	Fine	Coarse	Medium	Fine	Silt		Clay
○	0.0		0.0	0.6	1.7	3.1	12.9	81.7		
×	LL	PL	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
○	37	15	0.1135							

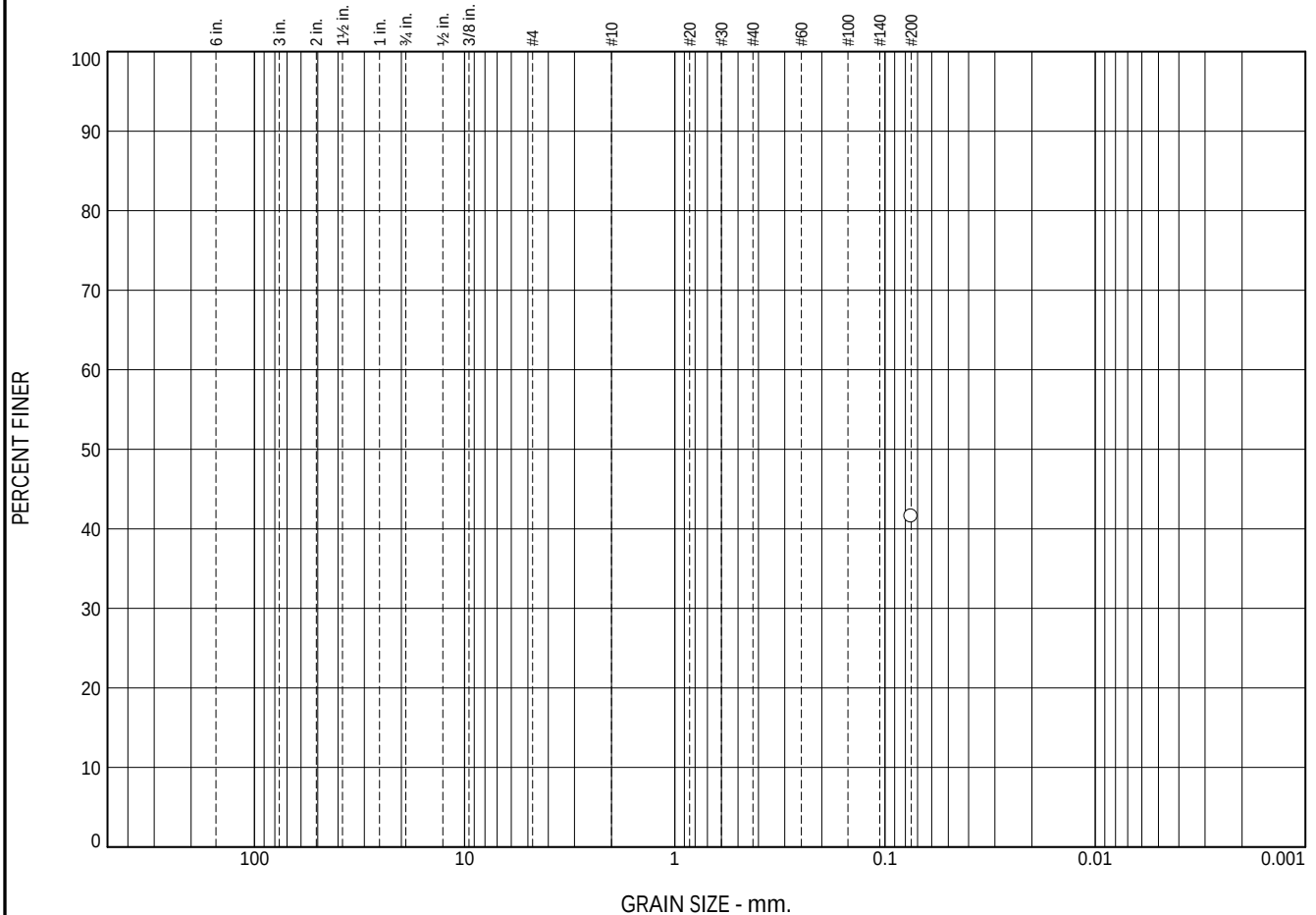
MATERIAL DESCRIPTION							TEST DATE	USCS	NM
○ BROWN LEAN CLAY WITH SAND							10/04/23	CL	7.7

Project No. 536680 Client: CITY OF LYTLE		Remarks: ○SAMPLE DESCRIPTION BASED ON USCS
Project: CITY OF LYTLE WWTP EXPANSION LYTLE, TX		
○ Source of Sample: B-5	Depth: 4.0-6.0 FT	
TRC Engineers, Inc.		
Mt. Laurel, NJ		Figure 8

Figure 8

Tested By: JC 10/04/23 Checked By: OB 10/05/23

Particle Size Distribution Report



	% +3"		% Gravel		% Sand			% Fines	
			Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
☐								41.6	
☐									
☒	LL	PL	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c
☐									C _u
☐									

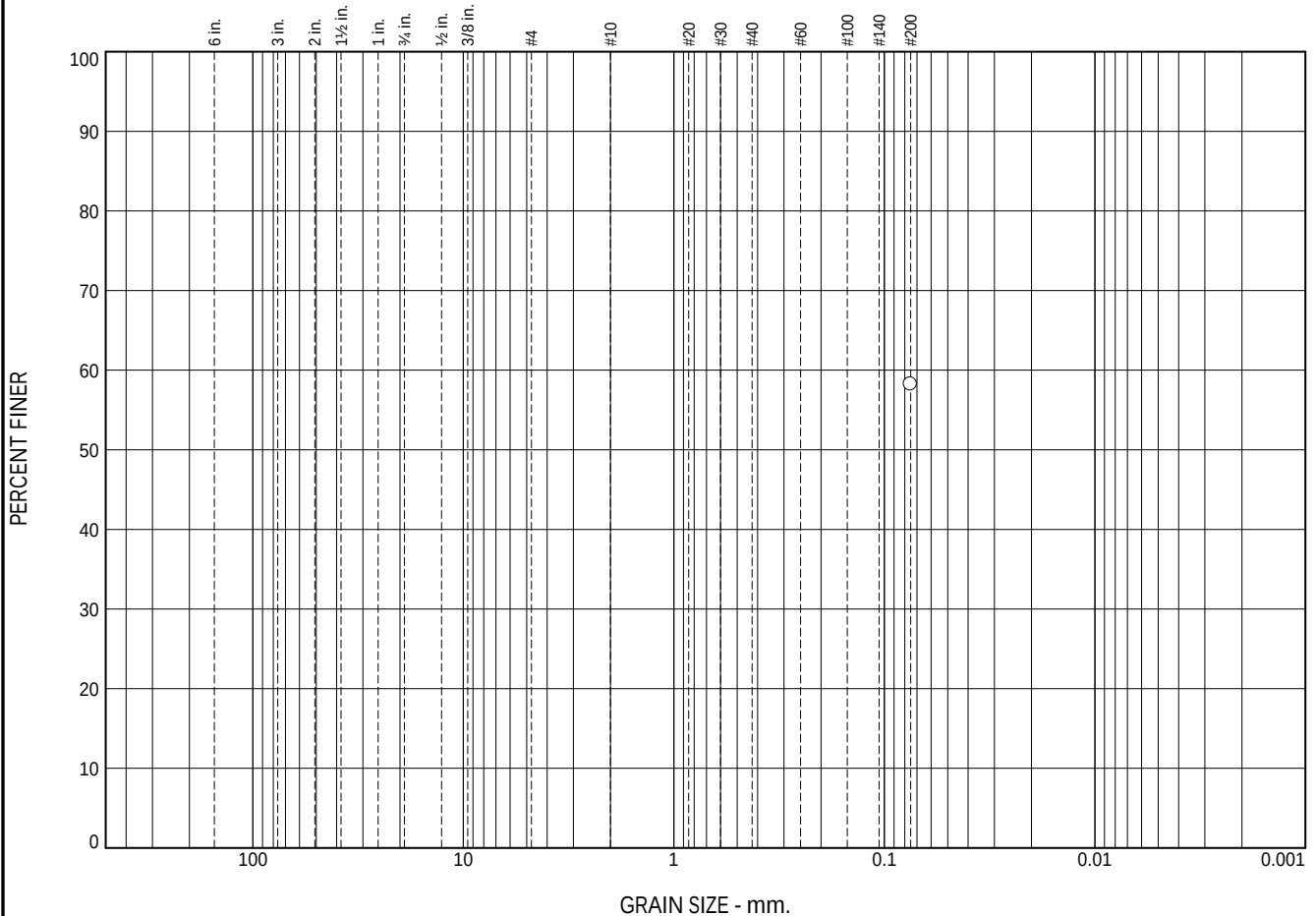
MATERIAL DESCRIPTION								TEST DATE	USCS	NM
☐ LIGHT BROWN SILTY SAND*								10/02/23	SM	16.5

Project No. 536680 Client: CITY OF LYTLE		Remarks: ○SAMPLE DESCRIPTION BASED ON GRAIN-SIZE DISTRIBUTION AND VISUAL CLASSIFICATION *SPECIMEN CONTAINED VARVES OF SILT & CLAY
Project: CITY OF LYTLE WWTP EXPANSION LYTLE, TX		
○ Source of Sample: B-5	Depth: 18.0-20.0 FT	
TRC Engineers, Inc.		
Mt. Laurel, NJ		Figure 9

Figure 9

Tested By: JC 10/02/23 Checked By: OB 10/05/23

Particle Size Distribution Report



	% +3"		% Gravel		% Sand			% Fines		
			Coarse	Fine	Coarse	Medium	Fine	Silt	Clay	
☐								58.2		
☐										
☒	LL	PL	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
☐										
☐										

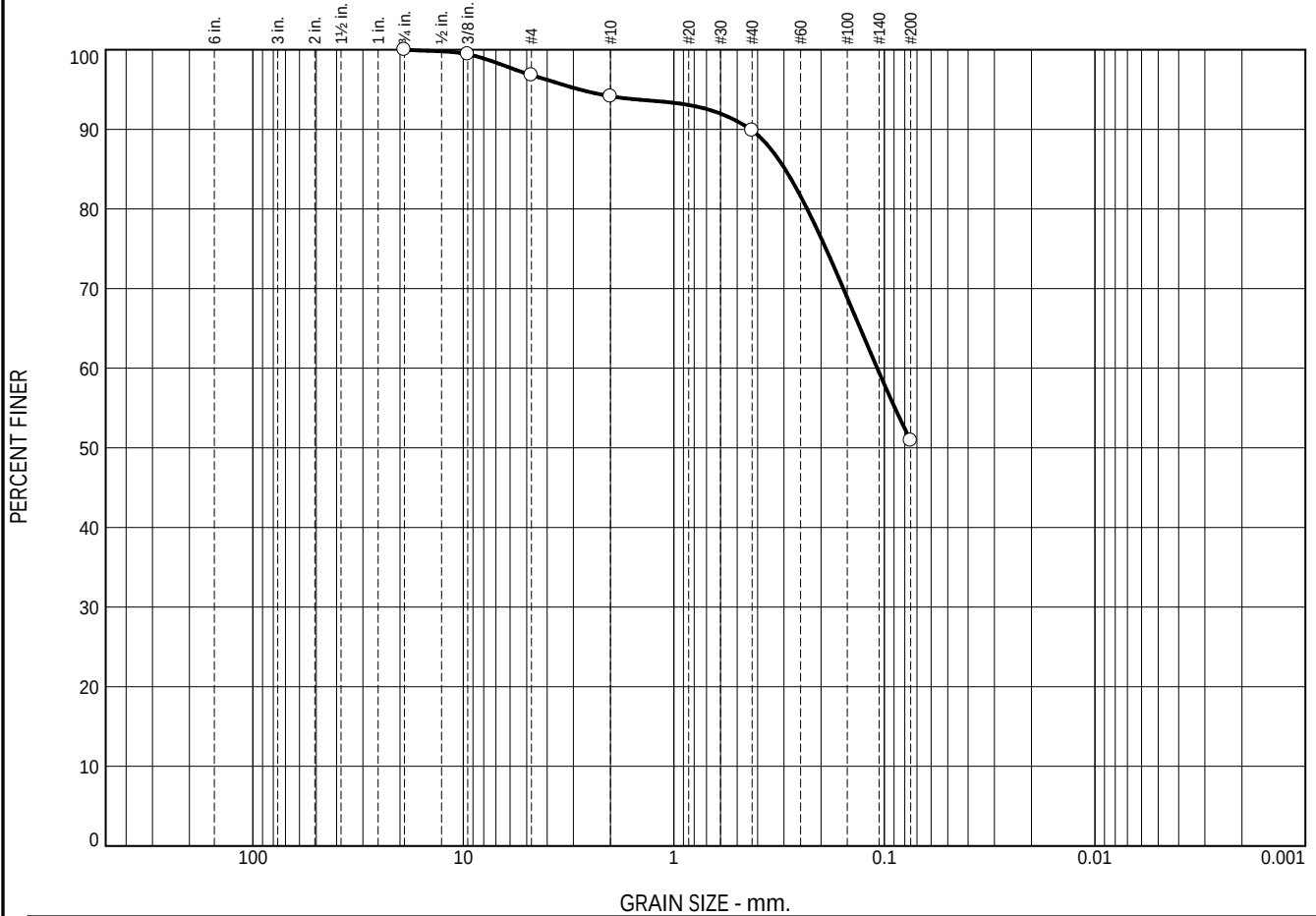
MATERIAL DESCRIPTION								TEST DATE	USCS	NM
○ LIGHT BROWN SANDY SILT*								10/02/23	ML	18.6

Project No. 536680		Client: CITY OF LYTLE		Remarks: ○SAMPLE DESCRIPTION BASED ON GRAIN-SIZE DISTRIBUTION AND VISUAL CLASSIFICATION *SPECIMEN CONTAINED VARVES OF SILT & CLAY
Project: CITY OF LYTLE WWTP EXPANSION LYTLE, TX				
○ Source of Sample: B-5		Depth: 33.0-35.0 FT		
TRC Engineers, Inc.				
Mt. Laurel, NJ				Figure 10

Figure 10

Tested By: JC 10/02/23 Checked By: OB 10/05/23

Particle Size Distribution Report



GRAVEL SIZE ANALYSIS										
% +3"			% Gravel		% Sand			% Fines		
			Coarse	Fine	Coarse	Medium	Fine	Silt		Clay
○	0.0		0.0	3.2	2.6	4.3	39.0	50.9		
×	LL	PL	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
○	27	13	0.2962	0.1081						

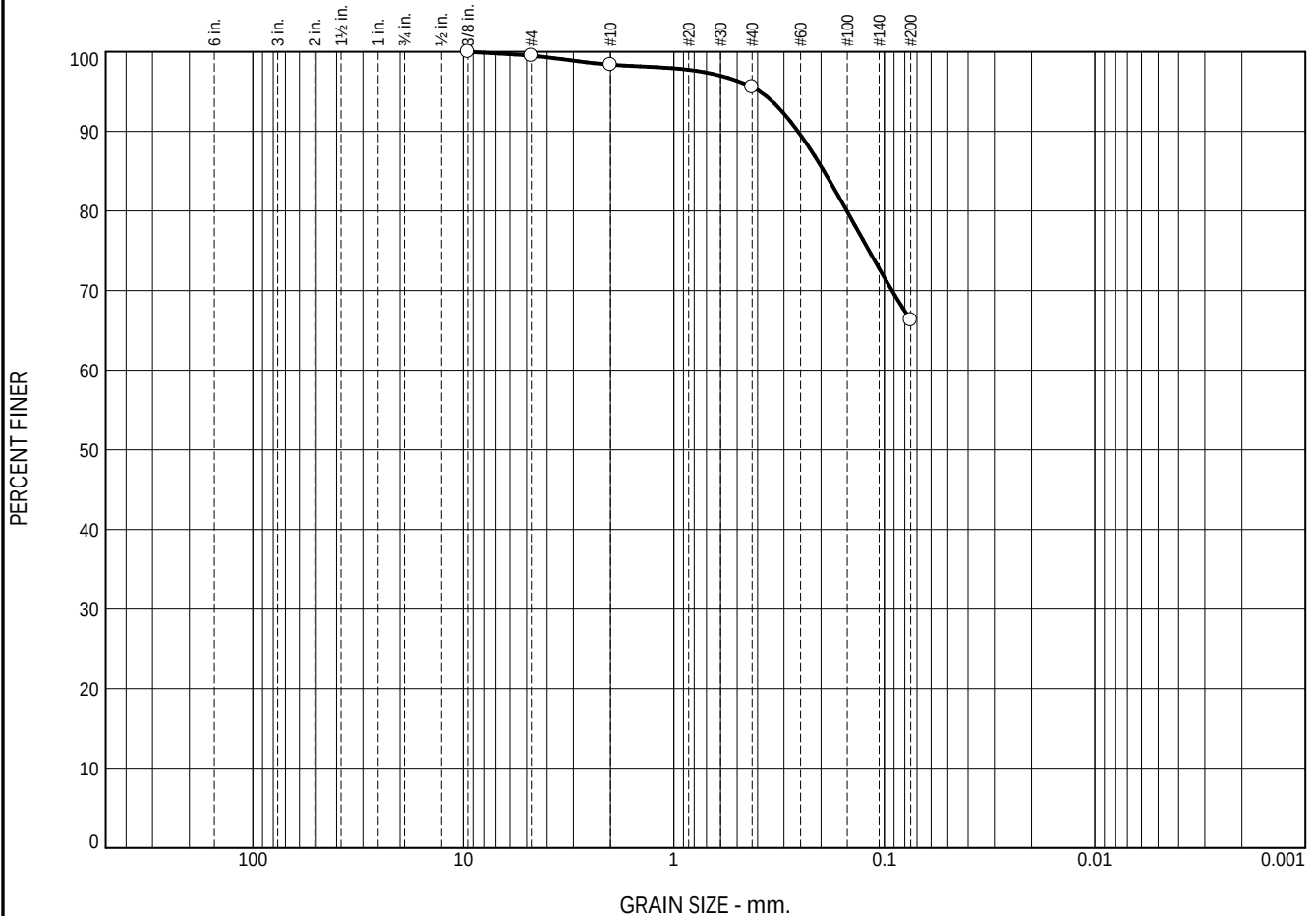
MATERIAL DESCRIPTION							TEST DATE	USCS	NM
○ BROWN SANDY LEAN CLAY							10/02/23	CL	5.7

Project No. 536680		Client: CITY OF LYTLE		Remarks: ○SAMPLE DESCRIPTION BASED ON USCS
Project: CITY OF LYTLE WWTP EXPANSION LYTLE, TX				
○ Source of Sample: B-6		Depth: 4.0-6.0 FT		
TRC Engineers, Inc.				
Mt. Laurel, NJ				
				Figure 11

Figure 11

Tested By: JC 10/04/23 Checked By: OB 10/05/23

Particle Size Distribution Report



GRAIN SIZE - mm.									
% +3"		% Gravel		% Sand			% Fines		
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay	
○	0.0	0.0	0.5	1.1	2.8	29.3	66.3		
×	LL	PL	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c
○	31	15	0.1936						C _u

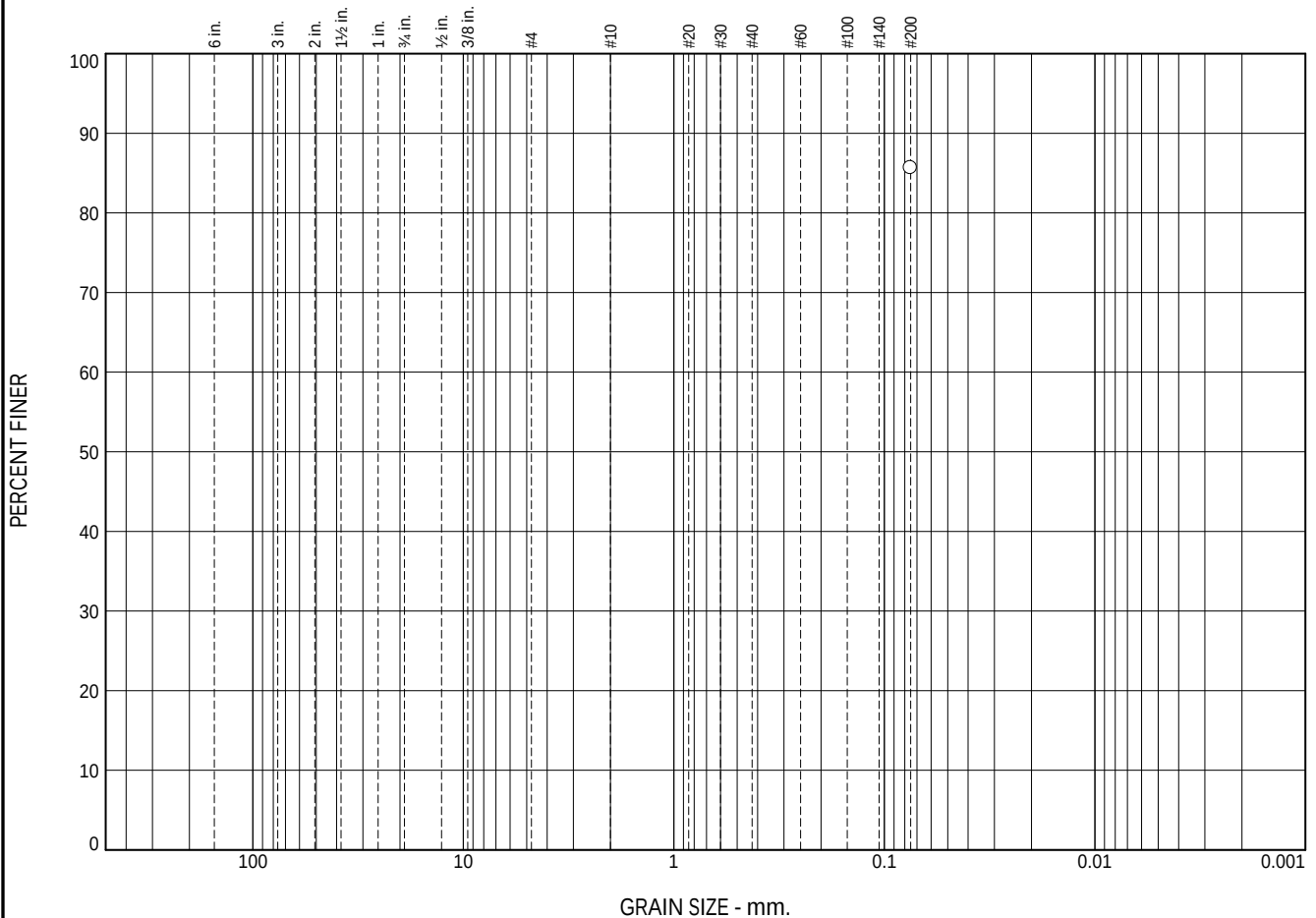
MATERIAL DESCRIPTION							TEST DATE	USCS	NM
○ BROWN AND GRAY SANDY LEAN CLAY							10/04/23	CL	17.0

Project No. 536680 Client: CITY OF LYTLE		Remarks: ○SAMPLE DESCRIPTION BASED ON USCS
Project: CITY OF LYTLE WWTP EXPANSION LYTLE, TX		
○ Source of Sample: B-6	Depth: 13.0-15.0 FT	
TRC Engineers, Inc.		
Mt. Laurel, NJ		Figure 12

Figure 12

Tested By: JC 10/04/23 Checked By: OB 10/05/23

Particle Size Distribution Report



% +3"		% Gravel		% Sand			% Fines			
		Coarse	Fine	Coarse	Medium	Fine	Silt		Clay	
☐							85.7			
☒	LL	PL	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
☐										

MATERIAL DESCRIPTION							TEST DATE	USCS	NM
☐ GRAY AND BROWN SILTY SAND AND CLAY*							10/02/23	SM	20.0

Project No. 536680 Client: CITY OF LYTLE		Remarks: ○SAMPLE DESCRIPTION BASED ON GRAIN-SIZE DISTRIBUTION AND VISUAL CLASSIFICATION *SPECIMEN CONTAINED VARVES OF SILT & CLAY
Project: CITY OF LYTLE WWTP EXPANSION LYTLE, TX		
○ Source of Sample: B-6	Depth: 28.0-30.0 FT	
TRC Engineers, Inc.		
Mt. Laurel, NJ		Figure 13

Figure 13

Tested By: JC 10/04/23 Checked By: OB 10/05/23

KE CORROSION

3028 ALDON AVE. LAS VEGAS, NV 89121

702-340-1186 KDE@KECORROSION.COM

CLIENT

TRC Solutions, Inc.
16000 Commerce Parkway, Suite B
Mount Laurel, NJ 08054

PROJECT NO: 536680**PROJECT**

Lytle WWTP

DATE: October 6, 2023**LAB ID:** 23-0156**Sample By:** Client**Analyzed By:** Kurt D. Ergun

RESULTS FOR CORROSIVITY ANALYSIS OF SOILS

Sample Number:	
Sample Location:	B-1
Sample Depth:	0.0-2.0

Laboratory Testing Methods

pH Analysis, ASTM D4972(in H ₂ O)	6.41
PH Analysis, ASTM D4972(in CaCl ₂)	5.83
Water Soluble Sulfates, ASTM D516 (mg/kg)	105
Clorides, ASTM D512 (mg/kg)	75
Sulfides, AWWA 4500-S (mg/kg)	Nil
Oxidation-Reduction, ASTM D1498 (mV)	+689
Resistivity, ASTM G187 (ohm-cm)	1380

Nil = <1.0 mg/kg



Kurt D. Ergun
Chemist

Note: The tests were performed in accordance with applicable ASTM, AASHTO, or AWWA methods. Test results submitted are only applicable to samples tested at referenced locations and are not indicative of the results of similar materials.

APPENDIX B

FAA DETERMINATION LETTERS

**THE CONTRACTOR SHALL FILE A
NOTICE OF CONSTRUCTION (FORM
7560-2) WITH THE FAA AT LEAST TEN
(10) DAYS PRIOR TO BEGINNING
CONSTRUCTION**

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Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
10101 Hillwood Parkway
Fort Worth, TX 76177

Aeronautical Study No.
2024-ASW-6929-OE

Issued Date: 07/15/2024

Andres Carrasco
City of Lytle
14916 Main St
Lytle, TX 78052

****DETERMINATION OF NO HAZARD TO AIR NAVIGATION FOR TEMPORARY STRUCTURE****

The Federal Aviation Administration has conducted an aeronautical study under the provisions of 49 U.S.C., Section 44718 and if applicable Title 14 of the Code of Federal Regulations, part 77, concerning:

Structure:	Crane Elevated Water Storage Tank Crane
Location:	Lytle, TX
Latitude:	29-13-53.25N NAD 83
Longitude:	98-46-56.14W
Heights:	718 feet site elevation (SE) 215 feet above ground level (AGL) 933 feet above mean sea level (AMSL)

This aeronautical study revealed that the temporary structure does not exceed obstruction standards and would not be a hazard to air navigation provided the condition(s), if any, in this letter is (are) met:

****SEE ATTACHMENT FOR ADDITIONAL CONDITION(S) OR INFORMATION****

This determination is based, in part, on the foregoing description which includes specific coordinates, heights, frequency(ies) and power. Any changes in coordinates, heights and frequencies or use of greater power, except those frequencies specified in the Colo Void Clause Coalition; Antenna System Co-Location; Voluntary Best Practices, will void this determination. Any future construction or alteration, including increase to heights, power or the addition of other transmitters, requires separate notice to the FAA. This determination includes all previously filed frequencies and power for this structure.

This determination does include temporary construction equipment such as cranes, derricks, etc., which may be used during actual construction of a structure. However, this equipment shall not exceed the overall heights as indicated above. Equipment which has a height greater than the studied structure requires separate notice to the FAA.

This determination concerns the effect of this temporary structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

A copy of this determination will be forwarded to the Federal Aviation Administration Flight Procedures Office if the structure is subject to the issuance of a Notice To Air Missions (NOTAM).

If you have any questions, please contact our office at (817) 222-5933, or andrew.hollie@faa.gov. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2024-ASW-6929-OE

Signature Control No: 622618278-627220235

(TMP)

Andrew Hollie

Specialist

Additional Condition(s) or Information for ASN 2024-ASW-6929-OE

Proposal: To construct and/or operate a(n) Crane to a height of 215 feet above ground level, 933 feet above mean sea level.

Location: The structure will be located 7.56 nautical miles southeast of CVB Airport reference point.

Case Description for ASN 2024-ASW-6929-OE

Temporary construction of crane with a maximum height of 215 feet to construct elevated water tank

Part 77 Obstruction Standard(s) Exceeded and Aeronautical Impacts, if any:

Aeronautical study revealed that the temporary structure will not exceed any Part 77 obstruction standard. Aeronautical study confirmed that the temporary structure will have no effect on any existing or proposed arrival, departure or en route instrument/visual flight rules (IFR/VFR) operations or procedures. Additionally, aeronautical study confirmed that the temporary structure will have no physical or electromagnetic effect on the operation of air navigation and communications facilities and will not impact any airspace and routes used by the military. Based on this aeronautical study, the FAA finds that the temporary structure will have no adverse effect on air navigation and will not impact any aeronautical operations or procedures.

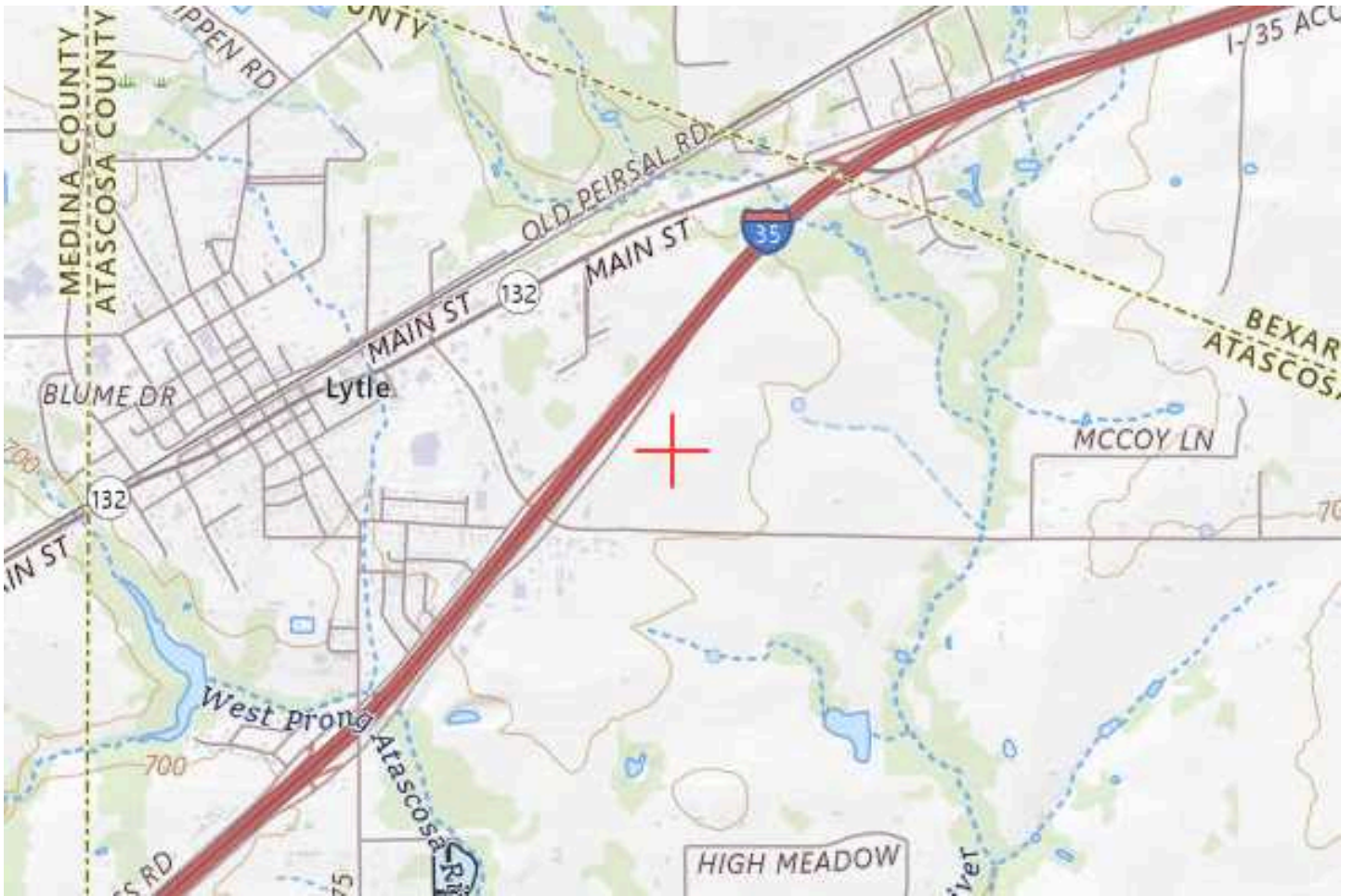
Based on this aeronautical study, the structure would not constitute a substantial adverse effect on aeronautical operations or procedures because it will be temporary. The temporary structure would not be considered a hazard to air navigation provided all of the conditions specified in this determination are strictly met.

As a condition to this Determination, the structure is to be marked/lighted in accordance with FAA Advisory circular 70/7460-1 M, Obstruction Marking and Lighting, flags/red lights-Chapters 3(Marked),4,5(Red),14(Temporary),&15.

Any failure or malfunction that lasts more than thirty (30) minutes and affects a top light or flashing obstruction light, regardless of its position, should be reported immediately to (877) 487-6867 so a Notice to Air Missions (NOTAM) can be issued. As soon as the normal operation is restored, notify the same number.

This determination expires on 01/15/2026 unless extended, revised, or terminated by the issuing office.

NOTE: REQUEST FOR EXTENSION OF THE EFFECTIVE PERIOD OF THIS DETERMINATION MUST BE E-FILED AT LEAST 15 DAYS PRIOR TO THE EXPIRATION DATE. AFTER RE-EVALUATION OF CURRENT OPERATIONS IN THE AREA OF THE STRUCTURE TO DETERMINE THAT NO SIGNIFICANT AERONAUTICAL CHANGES HAVE OCCURRED, YOUR DETERMINATION MAY BE ELIGIBLE FOR ONE EXTENSION OF THE EFFECTIVE PERIOD.







Mail Processing Center
Federal Aviation Administration
Southwest Regional Office
Obstruction Evaluation Group
10101 Hillwood Parkway
Fort Worth, TX 76177

Aeronautical Study No.
2024-ASW-6928-OE

Issued Date: 07/15/2024

Andres Carrasco
City of Lytle
14916 Main St
Lytle, TX 78052

**** DETERMINATION OF NO HAZARD TO AIR NAVIGATION ****

The Federal Aviation Administration has conducted an aeronautical study under the provisions of 49 U.S.C., Section 44718 and if applicable Title 14 of the Code of Federal Regulations, part 77, concerning:

Structure:	Water Tank Elevated Water Storage Tank
Location:	Lytle, TX
Latitude:	29-13-53.25N NAD 83
Longitude:	98-46-56.14W
Heights:	718 feet site elevation (SE) 170 feet above ground level (AGL) 888 feet above mean sea level (AMSL)

This aeronautical study revealed that the structure does not exceed obstruction standards and would not be a hazard to air navigation provided the following condition(s), if any, is(are) met:

Based on this evaluation, marking and lighting are not necessary for aviation safety. However, if marking/lighting are accomplished on a voluntary basis, we recommend it be installed in accordance with FAA Advisory circular 70/7460-1 M.

This determination expires on 01/15/2026 unless:

- (a) the construction is started (not necessarily completed) and FAA Form 7460-2, Notice of Actual Construction or Alteration, is received by this office.
- (b) extended, revised, or terminated by the issuing office.
- (c) the construction is subject to the licensing authority of the Federal Communications Commission (FCC) and an application for a construction permit has been filed, as required by the FCC, within 6 months of the date of this determination. In such case, the determination expires on the date prescribed by the FCC for completion of construction, or the date the FCC denies the application.

NOTE: REQUEST FOR EXTENSION OF THE EFFECTIVE PERIOD OF THIS DETERMINATION MUST BE E-FILED AT LEAST 15 DAYS PRIOR TO THE EXPIRATION DATE. AFTER RE-EVALUATION OF CURRENT OPERATIONS IN THE AREA OF THE STRUCTURE TO DETERMINE THAT NO

SIGNIFICANT AERONAUTICAL CHANGES HAVE OCCURRED, YOUR DETERMINATION MAY BE ELIGIBLE FOR ONE EXTENSION OF THE EFFECTIVE PERIOD.

This determination is based, in part, on the foregoing description which includes specific coordinates, heights, frequency(ies) and power. Any changes in coordinates, heights, and frequencies or use of greater power, except those frequencies specified in the Colo Void Clause Coalition; Antenna System Co-Location; Voluntary Best Practices, will void this determination. Any future construction or alteration, including increase to heights, power, or the addition of other transmitters, requires separate notice to the FAA. This determination includes all previously filed frequencies and power for this structure.

If construction or alteration is dismantled or destroyed, you must submit notice to the FAA within 5 days after the construction or alteration is dismantled or destroyed.

This determination does include temporary construction equipment such as cranes, derricks, etc., which may be used during actual construction of the structure. However, this equipment shall not exceed the overall heights as indicated above. Equipment which has a height greater than the studied structure requires separate notice to the FAA.

This determination concerns the effect of this structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (817) 222-5933, or andrew.hollie@faa.gov. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2024-ASW-6928-OE.

Signature Control No: 622616374-627220031

(DNE)

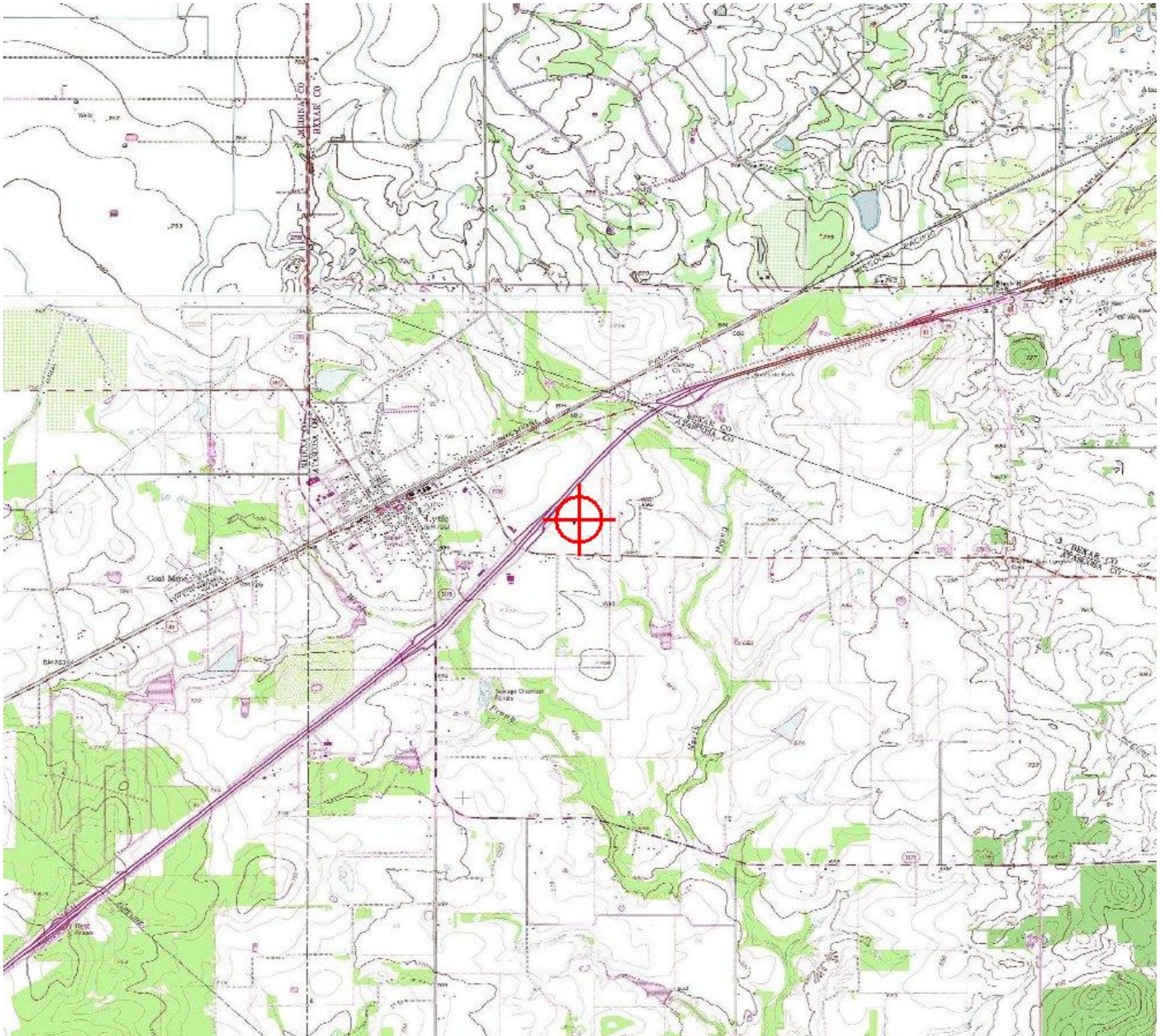
Andrew Hollie
Specialist

Attachment(s)
Case Description
Map(s)

Case Description for ASN 2024-ASW-6928-OE

Construction of 170 foot tall 0.250 MG or 0.400 MG elevated water storage tank

TOPO Map for ASN 2024-ASW-6928-OE





APPENDIX C

TEMPORARY CONSTRUCTION EASEMENT

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NOTICE OF CONFIDENTIALITY RIGHTS: IF YOU ARE A NATURAL PERSON, YOU MAY REMOVE OR STRIKE ANY OR ALL OF THE FOLLOWING INFORMATION FROM ANY INSTRUMENT THAT TRANSFERS AN INTEREST IN REAL PROPERTY BEFORE IT IS FILED FOR RECORD IN THE PUBLIC RECORDS: YOUR SOCIAL SECURITY NUMBER OR YOUR DRIVER'S LICENSE NUMBER.

**TEMPORARY CONSTRUCTION EASEMENT
AND TEMPORARY RIGHT-OF-WAY**

STATE OF TEXAS §
 §
COUNTY OF ATASCOSA §

KNOW ALL BY THESE PRESENTS:

THAT **LYTLE GLADYS McDONALD MJW PARTNERS, LTD.**, a Texas limited partnership whose mailing address is 13010 Conifer Road, Houston, Texas 77079 ("Grantor"), for and in consideration of the sum of ONE DOLLAR (\$1.00) and other good and valuable consideration to Grantor, the receipt and sufficiency of which is hereby acknowledged, does **BARGAIN, GRANT, AND CONVEY**, to the **CITY OF LYTLE**, a Texas municipal corporation, whose mailing address is 14916 Main Street, Lytle, Atascosa County, Texas 78052 ("City" or "Grantee"), a temporary construction easement and right-of-way in, over, and across the following property of Grantor (the "Land"):

Atascosa County Plat Records and Appraisal District

Property ID Numbers: 16190, 216050, 216059, 216062

City Block: N/A

Block: N/A

Lot Number: N/A

Physical Address: 19384 IH 35 S, Lytle, Texas 78052

The terms and conditions of this Easement (the "Agreement") are as follows:

- 1) Purpose of Easement and Right-of-way. This Temporary Construction Easement and Temporary Right-of-Way is granted to City and its Contractor for the purpose of providing access and for the purpose of temporary work space during the construction, installation and initial maintenance, operation, inspection, patrolling, testing, repair, alteration, substitution, relocation, resizing, replacement and removal of a municipal water line and tower, including above-ground, surface and subsurface appurtenances thereto, on, under, above, across, within and through properties adjacent to the Land (the "Facilities") together with the right of ingress and egress.

City and/or its Contractor may lay down and store materials and equipment on the Lands, remove any obstructions such as fences, concrete driveways, sidewalks, trees, shrubs, landscaping, sprinkler system, etc., and trim and remove tree branches and shrubs as may be needed in order to utilize the temporary construction easement granted herein, and

borrow and/or deposit fill material thereon, move, store and remove equipment and supplies, and erect and remove temporary structures in and from the Land.

- 2) Term of Easement. This Temporary Construction Easement will be a temporary easement and right-of-way in, under, over and across the Land for a period not to exceed 24 months, beginning with the date that City (or City's contractor(s)) commence construction activities on the Land and will automatically terminate 24 months from the Effective Date. City will endeavor to provide at least 48 hours prior notice to City's commencement of construction activities on the Land. City will provide a general description of construction work and/or equipment (if any equipment is expected) that may be located on the Land. City will provide Grantor a contact person and telephone numbers to address Grantor's questions or concerns with the City's construction activities on the Land.
- 3) Restoration of Land. City and/or its Contractor agrees to replace or restore any existing fencing, sidewalks, driveways, and irrigation systems damaged during construction to restore the surface of the ground as nearly as reasonably practicable to as good condition as existed at the time of commencement of the construction. Notwithstanding the foregoing, City shall not be required to: 1) replace any removed trees, bushes, shrubbery, brush or undergrowth; 2) provide identical replacements or identical matching of masonry or natural materials due to inconsistencies in material and natural weathering; or, 3) replace or restore existing structures, improvements or systems located on any permanent utility easements granted to the City by other grant or deed, if such structure, improvement or system interferes with proper function of the utility.
- 4) Recording and Construction. This Agreement shall be construed and enforced in accordance with the laws of the State of Texas. City, at its election, may record this instrument or may prepare, execute, acknowledge, and record a memorandum of same. Grantor will execute and acknowledge any such memorandum at City's request.
- 5) No Waiver of Immunity. Nothing herein shall be deemed to limit or waive the sovereign or governmental immunity of City.

Grantor WARRANTS and FOREVER DEFENDS the Temporary Construction Easement and the rights granted to City for the purposes set out above, against every person claiming any right in the Temporary Construction Easement and Temporary Right-of-Way.

This Temporary Construction Easement runs with the land described in **EXHIBIT "A"**, attached hereto and incorporated herein for all purposes, and inures to the benefit of and is binding upon Grantor and City and their respective successors and assigns.

**(SIGNATURES AND ACKNOWLEDGMENT
BEGIN ON NEXT PAGE)**

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EXECUTED this the 13th day of JUNE 2024 (the "Effective Date").

GRANTOR:

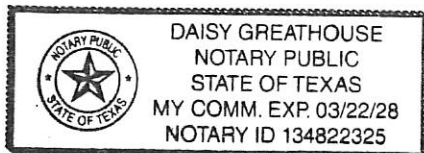
LYTLE GLADYS McDONALD MJW PARTNERS, LTD.,
a Texas limited partnership

By: [Signature]
Name: BROOKS WATKINS
Title: MANAGER OF GP

ACKNOWLEDGEMENT

STATE OF TEXAS §
 §
COUNTY OF ATASCOSA §

This instrument was acknowledged before me on the 13th day of JUNE, 2024, by Daisy Greathouse.



[Signature]
Notary Public, State of Texas

CITY:

CITY OF LTYLE,

a Texas municipal corporation

By:

Name: Zachary Meadows

Title: City Administrator

ACKNOWLEDGEMENT

STATE OF TEXAS §

§

COUNTY OF ATASCOSA §

This instrument was acknowledged before me on the 27th day of June, 2024, by Zachary Meadows, in his her capacity as City Administrator, on behalf of the CITY OF LTYLE, a Texas municipal corporation, and acknowledged and executed the same for the purposes and consideration therein expressed on behalf of said City.

Paola L. Rios

Notary Public, State of Texas

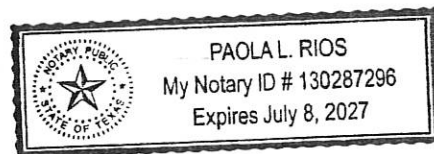
AFTER RECORDING RETURN TO:

City of Lytle

Attn: Zachary Meadows, City Administrator

14916 Main Street,

Lytle, Texas 78052



**TEMPORARY CONSTRUCTION EASEMENT AND TEMPORARY RIGHT-OF-WAY
LEGAL DESCRIPTION/SKETCH**

