

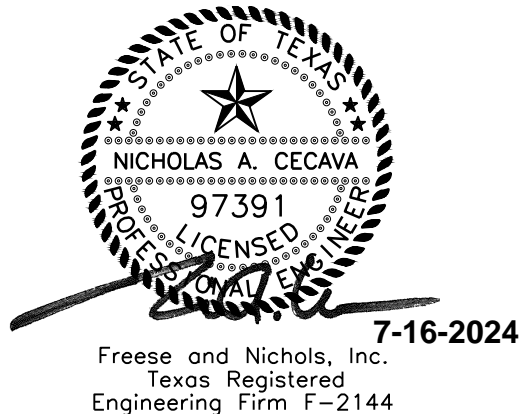


Request for Bids

Sabinetown Recreation Area

RFB 25-1202

July 18, 2024



Authority General Office
12777 Hwy. 87 N.
Orange, TX 77632
409.746.2192

Toledo Bend Division
450 Spur 135
Burkeville, TX 75932
409-565-2273



TABLE OF CONTENTS

Table of Contents

Addenda (as issued)

Notice to Bidders (C-111)

Instructions to Bidders (C-200)

Bid Proposal Form (C410)

Exhibit A - Bid Form

- **C430 Bid Bond**
- **Bid Opening**
- **C451 Qualification Statement**
- **Vendor Certification to State Law**
- **Bonding Company Information**
- **Non-Collusion Affidavit**
- **Form W-9 Request for Taxpayer Identification Number and Certification**
- **Conflict of Interest Questionnaire Form**

Standard form of Agreement (C520)

Insurance Certificate(s)

Performance and Payment Bonds

- **Performance Bond (C610)**
- **Payment Bond (C615)**

General Contract Conditions (C700)

Supplementary Conditions of the Contract (C800)

- **C625 Certificate of Completion**
- **C626 Notice of Acceptance**
- **C940 Work Directive**
- **C942 Field Order**

Prevailing Wage Rates

Technical Specifications

"A" Denotes Architectural Specifications

DIVISION 2	EXISTING CONDITIONS
02 41 00	DEMOLITION
DIVISION 3	CONCRETE
03 11 00	CONCRETE FORMING
03 20 00-A	CONCRETE REINFORCING
03 21 00	REINFORCING STEEL
03 30 00	CAST IN PLACE CONCRETE
03 30 00-A	CAST IN PLACE CONCRETE
DIVISION 4	MASONRY
04 10 00-A	MORTAR AND MASONRY GROUT
04 22 00-A	CONCRETE UNIT MASONRY
04 80 00-A	MASONRY ASSEMBLIES
DIVISION 5	METALS
05 12 00-A	STRUCTURAL STEEL
05 50 00-A	METAL FABRICATIONS
05 52 00-A	PIPE AND TUBE RAILING
DIVISION 6	WOODS, PLASTICS, AND COMPOSITES
06 10 00-A	ROUGH CARPENTRY
06 11 00-A	WOOD FRAMING
06 18 00-A	STRUCTURAL GLUE LAMINATED TIMBER
DIVISION 7	THERMAL AND MOISTURE PROTECTION
07 10 00-A	DAMPROOFING AND WATERPROOFING
07 41 00-A	PREFORMED METAL ROOFING
07 62 00-A	SHEET METAL FLASHING AND TRIM
07 90 00-A	JOINT SEALANTS
DIVISION 9	FINISHES
09 80 00-A	SPECIAL COATINGS
09 90 00-A	PAINTING
09 97 00-A	COATING SYSTEMS FOR STEEL
DIVISION 26	ELECTRICAL
26 00 00	BASIC ELECTRICAL REQUIREMENTS
26 05 00	BASIC ELECTRICAL MATERIALS AND METHODS
26 05 12	ELECTRICAL TESTING AND LOAD BALANCING
26 05 13	MEDIUM VOLTAGE CABLES

26 05 18	ELECTRICAL CONNECTIONS TO EQUIPMENT
26 05 19	CABLE, WIRE AND CONNECTORS, 600 VOLT
26 05 26	GROUNDING
26 05 29	SECURING AND SUPPORTING METHODS
26 05 33	RACEWAYS, CONDUITS AND BOXES
26 05 53	ELECTRICAL IDENTIFICATION
26 05 73	SYSTEM COORDINATION AND ANALYSIS
26 09 23	LIGHTING CONTROL DEVICES
26 12 13	PAD MOUNTED TRANSFORMERS (LIQUID FILLED)
26 13 00	PMH-7 SWITCHGEAR (MEDIUM VOLTAGE)
26 24 16	PANELBOARDS
26 27 26	WIRING DEVICES
26 28 13	FUSES, 600 VOLT
26 28 16	DISCONNECT SWITCHES
26 36 23	MANUAL TRANSFER SWITCHES
26 51 00	INTERIOR AND EXTERIOR LIGHTING

DIVISION 31

EARTHWORK

31 05 13	SOILS FOR EARTHWORK
31 11 00	CLEARING AND GRUBBING
31 23 10	STRUCTURAL EXCAVATION AND BACKFILL
31 23 19.01	CARE OF WATER DURING CONSTRUCTION
31 23 33	TRENCHING AND BACKFILL
31 23 33.14	TRENCH SAFETY
31 32 19.15	GEOTEXTILE
31 37 00	ROCK RIPRAP

DIVISION 32

EXTERIOR IMPROVEMENTS

32 12 16	ASPHALT PAVING
32 16 13	CURBS AND GUTTERS
32 91 19	TOPSOIL
32 91 19.13	TOPSOIL PLACEMENT AND GRADING
32 92 00	SODDING
32 93 13	HYDROMULCHING

DIVISION 33

UTILITIES

33 05 01.09	POLYVINYL CHLORIDE (PVC) PRESSURE PIPE AND FITTINGS
33 71 19	UNDERGROUND DUCTBANKS

TXDOT STANDARD SPECIFICATIONS: ADOPTED BY THE TEXAS DEPARTMENT OF TRANSPORTATION
NOVEMBER 1, 2014.

ITEM 110 EXCAVATION

ITEM 132 EMBANKMENT

ITEM 210 ROLLING



ITEM 216 PROOF ROLLING

ITEM 247 FLEXIBLE BASE

ITEM 340 DENSE GRADED HOT-MIX ASPHALT (SMALL QUANTITY)

ITEM 400 EXCAVATION AND BACKFILL FOR STRUCTURES

ITEM 404 DRIVING PILING

ITEM 406 TIMBER PILING

ITEM 416 DRILLED SHAFT FOUNDATIONS

ITEM 464 REINFORCED CONCRETE PIPE

ITEM 492 TIMBER PRESERVATIVE AND TREATMENT

ITEM 500 MOBILIZATION

ITEM 644 SMALL ROADSIDE SIGN ASSEMBLIES

ITEM 666 RETROREFLECTORIZED PAVEMENT MARKINGS

ITEM 668 PREFABRICATED PAVEMENT MARKINGS

ITEM 672 RAISED PAVEMENT MARKERS

ITEM 760 CLEANING AND RESHAPING DITCHES

ITEM 3075 GEOGRID BASE REINFORCEMENT

GEOGRID MATERIAL PRODUCER LIST – JUNE 2024

Appendix A - Geotechnical Report

Appendix B – Onsite Sewage Facility Design Package

Appendix C – AccuDock Floating Boat Dock and Gangway System Specifications

Appendix D – CXT Prefabricated Restroom Building Specifications



NOTICE TO BIDDERS

Sabine River Authority of Texas Sabinetown Recreation Area

General Notice:

Sabine River Authority of Texas (Owner) is requesting Bids for the construction of the following Project:

Sabinetown Recreation Area RFB 25-1202

Sealed bids for the construction of the Project will be received at the **Toledo Bend Division Office** located at **450 Spur 135, Burkeville TX 75932**, until **Thursday, August 8th, 2024**, at **2PM** local time. At that time the Bids received will be **publicly** opened and read.

Bids must be submitted and received no later than the opening date and time specified above. Any Bid received later than the specified time will not be considered and will be returned unopened. The SRA is not responsible for ensuring the delivery of Bids to our offices. Bids shall be sealed and clearly marked, "Request for Bid – PROJECT NAME & NUMBER".

A mandatory Pre-Bid Conference between the SRA, prospective bidders, suppliers, etc. will be held on July 30th, 2024 at 2PM at the Toledo Bend Division Office, 450 Spur 135, Burkeville TX 75932, to make certain that the scope of work is fully understood. All interested parties are requested to attend.

The Sabine River Authority reserves the right to adopt the most advantageous interpretation of the bids submitted in the case of ambiguity or lack of clearness in stating proposal prices, to reject any or all bids, and/or waive any formalities.

Contract documents may be obtained by downloading (1) from www.sratx.org under doing business "bid opportunities" or (2) from CIVCAST USA Website. Hard copies of plans will not be made available for purchase.

Questions regarding contract documents may be sent via CIVCAST Website or emailed to purchasing@sratx.org.

Publication of Advertisement Dates: **July 18th, 2024, and July 25th, 2024**



INSTRUCTION to BIDDERS

INSTRUCTIONS TO BIDDERS FOR CONSTRUCTION CONTRACT

TABLE OF CONTENTS

	Page
Article 1— Defined Terms.....	1
Article 2— Bidding Documents	1
Article 3— Qualifications of Bidders.....	2
Article 4— Pre-Bid Conference	2
Article 5— Site and Other Areas; Existing Site Conditions; Examination of Site; Owner’s Safety Program; Other Work at the Site	3
Article 6— Bidder’s Representations and Certifications.....	5
Article 7— Interpretations and Addenda	5
Article 8— Bid Security	5
Article 9— Contract Times	6
Article 10— Substitute and “Or Equal” Items.....	6
Article 11— Subcontractors, Suppliers, and Others	7
Article 12— Preparation of Bid	7
Article 13— Basis of Bid	8
Article 14— Submittal of Bid.....	9
Article 15— Modification and Withdrawal of Bid.....	9
Article 16— Opening of Bids	10
Article 17— Bids to Remain Subject to Acceptance	10
Article 18— Evaluation of Bids and Award of Contract	10
Article 19— Bonds and Insurance.....	11
Article 20— Signing of Agreement.....	11
Article 21— Sales and Use Taxes	11
Article 22— Confidentiality of Documents	11
Article 21— Conflicts of Interest.....	12
Article 21— Equal Opportunity.....	12

ARTICLE 1—DEFINED TERMS

- 1.01 Terms used in these Instructions to Bidders have the meanings indicated in the General Conditions and Supplementary Conditions. Additional terms used in these Instructions to Bidders have the meanings indicated below:
- A. *Issuing Office*—The office from which the Bidding Documents are to be issued, and which registers plan holders (refer to the Notice to Bidders).

ARTICLE 2—BIDDING DOCUMENTS

- 2.01 The bidder shall obtain a complete set of Bidding Requirements and proposed Contract Documents (together, the Bidding Documents). See the Agreement for a list of the Contract Documents. It is the Bidder's responsibility to determine that it is using a complete set of documents in the preparation of a Bid. Bidder assumes sole responsibility for errors or misinterpretations resulting from the use of incomplete documents, by Bidder itself or by its prospective Subcontractors and Suppliers.
- 2.02 Bidding Documents are made available for the sole purpose of obtaining Bids for completion of the Project and permission to download or distribution of the Bidding Documents does not confer a license or grant permission or authorization for any other use. Authorization to download documents, or other distribution, includes the right for plan holders to print documents solely for their use, and the use of their prospective Subcontractors and Suppliers, provided the plan holder pays all costs associated with printing or reproduction. Printed documents may not be re-sold under any circumstances.
- 2.03 Owner has established a Bidding Documents Website (CIVCAST USA) as indicated in the Notice to Bidders. Owner recommends that Bidder register as a plan holder with the Issuing Office at such website, and obtain a complete set of the Bidding Documents from such website. Bidders may rely that sets of Bidding Documents obtained from the Bidding Documents Website are complete, unless an omission is blatant. Registered plan holders will receive Addenda issued by Owner.
- 2.04 Bidder may register as a plan holder and obtain complete sets of Bidding Documents, in the number and format stated in the notice to bid, from the Issuing Office. Bidders may rely that sets of Bidding Documents obtained from the Issuing Office are complete, unless an omission is blatant. Registered plan holders will receive Addenda issued by Owner.
- 2.05 Plan rooms (including construction information subscription services, and electronic and virtual plan rooms) may distribute the Bidding Documents, or make them available for examination. Those prospective bidders that obtain an electronic (digital) copy of the Bidding Documents from a plan room are encouraged to register as plan holders from the Bidding Documents Website or Issuing Office. Owner is not responsible for omissions in Bidding Documents or other documents obtained from plan rooms, or for a Bidder's failure to obtain Addenda from a plan room.
- 2.06 *Electronic Documents*
- A. When the Bidding Requirements indicate that electronic (digital) copies of the Bidding Documents are available, such documents will be made available to the Bidders as Electronic Documents in the manner specified.
1. Bidding Documents will be provided in Adobe PDF (Portable Document Format) (.pdf) that is readable by Adobe Acrobat Reader. It is the intent of the Engineer and Owner

that such Electronic Documents are to be exactly representative of the paper copies of the documents. However, because the Owner and Engineer cannot totally control the transmission and receipt of Electronic Documents nor the Contractor's means of reproduction of such documents, the Owner and Engineer cannot and do not guarantee that Electronic Documents and reproductions prepared from those versions are identical in every manner to the paper copies.

- B. Unless otherwise stated in the Bidding Documents, the Bidder may use and rely upon complete sets of Electronic Documents of the Bidding Documents, described in Paragraph 2.06.A above. However, Bidder assumes all risks associated with differences arising from transmission/receipt of Electronic Documents versions of Bidding Documents and reproductions prepared from those versions and, further, assumes all risks, costs, and responsibility associated with use of the Electronic Documents versions to derive information that is not explicitly contained in printed paper versions of the documents, and for Bidder's reliance upon such derived information.

ARTICLE 3—QUALIFICATIONS OF BIDDERS

- 3.01 Bidder is to submit the following information with its Bid to demonstrate Bidder's qualifications to perform the Work:
 - A. Written evidence establishing its qualifications such as financial data, previous experience, and present commitments.
 - B. A written statement that Bidder is authorized to do business in the state where the Project is located, or a written certification that Bidder will obtain such authority prior to the Effective Date of the Contract.
 - C. Bidder's state or other contractor license number, if applicable.
 - D. Subcontractor and Supplier qualification information.
 - E. Other required information regarding qualifications.
- 3.02 A Bidder's failure to submit required qualification information within the times indicated may disqualify Bidder from receiving an award of the Contract.
- 3.03 No requirement in this Article 3 to submit information will prejudice the right of Owner to seek additional pertinent information regarding Bidder's qualifications.

ARTICLE 4—PRE-BID CONFERENCE

- 4.01 A **mandatory** pre-bid conference will be held at the time and location indicated in the notice to bid. Representatives of Owner and Engineer will be present to discuss the Project. Proposals will not be accepted from Bidders who do not attend the conference. It is each Bidder's responsibility to sign in at the pre-bid conference to verify its participation. Bidders must sign in using the name of the organization that will be submitting a Bid. A list of qualified Bidders that attended the pre-bid conference and are eligible to submit a Bid for this Project, will be made available upon request.
- 4.02 Information presented at the pre-Bid conference does not alter the Contract Documents. Owner will issue Addenda to make any changes to the Contract Documents that result from discussions

at the pre-bid conference. Information presented, and statements made at the pre-bid conference will not be binding or legally effective unless incorporated in an Addendum.

ARTICLE 5—SITE AND OTHER AREAS; EXISTING SITE CONDITIONS; EXAMINATION OF SITE; OWNER'S SAFETY PROGRAM; OTHER WORK AT THE SITE

5.01 *Site and Other Areas*

- A. The Site is identified in the Bidding Documents. By definition, the Site includes rights-of-way, easements, and other lands furnished by Owner for the use of the Contractor. Any additional lands required for temporary construction facilities, construction equipment, or storage of materials and equipment, and any access needed for such additional lands, are to be obtained and paid for by Contractor.

5.02 *Existing Site Conditions*

A. *Subsurface and Physical Conditions; Hazardous Environmental Conditions*

1. The Supplementary Conditions identify the following regarding existing conditions at or adjacent to the Site:
 - a. Those reports of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data.
 - b. Those drawings known to Owner of existing physical conditions at or adjacent to the Site, including those drawings depicting existing surface or subsurface structures at or adjacent to the Site (except Underground Facilities), that contain Technical Data.
 - c. Reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site.
 - d. Technical Data contained in such reports and drawings.
2. Owner will make copies of reports and drawings referenced above available to any Bidder on request. These reports and drawings are not part of the Contract Documents, but the Technical Data contained therein upon whose accuracy Bidder is entitled to rely, as provided in the General Conditions, has been identified and established in the Supplementary Conditions. Bidder is responsible for any interpretation or conclusion Bidder draws from any Technical Data or any other data, interpretations, opinions, or information contained in such reports or shown or indicated in such drawings.
3. If the Supplementary Conditions do not identify Technical Data, the default definition of Technical Data set forth in Article 1 of the General Conditions will apply.
4. *Geotechnical Baseline Report/Geotechnical Data Report:*
 - a. Is included in the project documents

- B. *Underground Facilities:* Underground Facilities are shown or indicated on the Drawings, pursuant to Paragraph 5.05 of the General Conditions, and not in the drawings referred to in Paragraph 5.02.A of these Instructions to Bidders. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data.

5.03 *Other Site-related Documents*

- A. In addition to the documents regarding existing Site conditions referred to in Paragraph 5.02.A, the following other documents relating to conditions at or adjacent to the Site are known to Owner and made available to Bidders for reference:

- 1. **(None)**

- Owner will make copies of these other Site-related documents available to any Bidder on request.

- B. Owner has not verified the contents of these other Site-related documents, and Bidder may not rely on the accuracy of any data or information in such documents. Bidder is responsible for any interpretation or conclusion Bidder draws from the other Site-related documents.
- C. The other Site-related documents are not part of the Contract Documents.
- D. Bidders are encouraged to review the other Site-related documents, but Bidders will not be held accountable for any data or information in such documents. The requirement to review and take responsibility for documentary Site information is limited to information in (1) the Contract Documents and (2) the Technical Data.
- E. No other Site-related documents are available.

5.04 *Site Visit and Testing by Bidders*

- A. Bidder is required to visit the Site and conduct a thorough visual examination of the Site and adjacent areas. During the visit the Bidder must not disturb any ongoing operations at the Site.
- B. Bidders visiting the Site are required to arrange their own transportation to the Site.
- C. All access to the Site other than during a regularly scheduled Site visit must be coordinated through the following Owner or Engineer contact for visiting the Site: **Sabine River Authority**. Bidder must conduct the required Site visit during normal working hours.
- D. Bidder is not required to conduct any subsurface testing, or exhaustive investigations of Site conditions.
- E. On request, and to the extent Owner has control over the Site, and schedule permitting, the Owner will provide Bidder general access to the Site to conduct such additional examinations, investigations, explorations, tests, and studies as Bidder deems necessary for preparing and submitting a successful Bid. Owner will not have any obligation to grant such access if doing so is not practical because of existing operations, security or safety concerns, or restraints on Owner's authority regarding the Site. Bidder is responsible for establishing access needed to reach specific selected test sites.
- F. Bidder must comply with all applicable Laws and Regulations regarding excavation and location of utilities, obtain all permits, and comply with all terms and conditions established by Owner or by property owners or other entities controlling the Site with respect to schedule, access, existing operations, security, liability insurance, and applicable safety programs.
- G. Bidder must fill all holes and clean up and restore the Site to its former condition upon completion of such explorations, investigations, tests, and studies.

5.05 *Owner's Safety Program*

- A. Site visits and work at the Site may be governed by an Owner safety program. If an Owner safety program exists, it will be noted in the Supplementary Conditions.

5.06 *Other Work at the Site*

- A. Reference is made to Article 8 of the Supplementary Conditions for the identification of the general nature of other work of which Owner is aware (if any) that is to be performed at the Site by Owner or others (such as utilities and other prime contractors) and relates to the Work contemplated by these Bidding Documents. If Owner is party to a written contract for such other work, then on request, Owner will provide to each Bidder access to examine such contracts (other than portions thereof related to price and other confidential matters), if any.

ARTICLE 6—BIDDER'S REPRESENTATIONS AND CERTIFICATIONS

6.01 *Express Representations and Certifications in Bid Form, Agreement*

- A. The Bid Form that each Bidder will submit contains express representations regarding the Bidder's examination of Project documentation, Site visit, and preparation of the Bid, and certifications regarding lack of collusion or fraud in connection with the Bid. Bidder should review these representations and certifications, and assure that Bidder can make the representations and certifications in good faith, before executing and submitting its Bid.
- B. If Bidder is awarded the Contract, Bidder (as Contractor) will make similar express representations and certifications when it executes the Agreement.

ARTICLE 7—INTERPRETATIONS AND ADDENDA

- 7.01 Owner on its own initiative may issue Addenda to clarify, correct, supplement, or change the Bidding Documents.
- 7.02 Bidder shall submit all questions about the meaning or intent of the Bidding Documents to Engineer in writing. All questions shall be received no later than 10 days prior to the bid opening date. Contact information and submittal procedures for such questions are as follows:
 - A. **Questions shall be submitted via CIVCAST USA Website.**
- 7.03 Interpretations or clarifications considered necessary by Engineer in response to such questions will be issued by Addenda delivered to all registered plan holders. Questions received less than seven days prior to the date for opening of Bids may not be answered.
- 7.04 Only responses set forth in an Addendum will be binding. Oral and other interpretations or clarifications will be without legal effect. Responses to questions are not part of the Contract Documents unless set forth in an Addendum that expressly modifies or supplements the Contract Documents.

ARTICLE 8—BID SECURITY

- 8.01 A Bid must be accompanied by Bid security made payable to Owner. Bidder must meet the following bid security requirements as set forth in Texas Water Code Chapter 49 Subchapter I. If the Bid proposal exceeds \$50,000 up to \$250,000, the Bidder must submit a bid security in the amount of at least two (2%) percent of the amount of the maximum total bid in the form of a

certified or cashier's check on a responsible bank in the state. If the Bid exceeds \$250,000, the Bidder must submit a bid bond in the amount of five (5%) percent of the amount of the maximum total bid in the form of an approved Bidder's Bond underwritten by a surety authorized to conduct business in the State of Texas. The surety must also meet the requirements of Paragraph 6.01 of the General Conditions. Such Bid bond will be issued in the form included in the Bidding Documents

- 8.02 The Bid security of the apparent Successful Bidder will be retained until Owner awards the contract to such Bidder, and such Bidder has executed the Contract, furnished the required Contract security, and met the other conditions of the Notice of Award, whereupon the Bid security will be released. If the Successful Bidder fails to execute and deliver the Contract and furnish the required Contract security within 15 days after the Notice of Award, Owner may consider Bidder to be in default, annul the Notice of Award, and the Bid security of that Bidder will be forfeited, in whole in the case of a penal sum bid bond, and to the extent of Owner's damages in the case of a damages-form bond. Such forfeiture will be Owner's exclusive remedy if Bidder defaults.
- 8.03 The Bid security of other Bidders that Owner believes to have a reasonable chance of receiving the award may be retained by Owner until the earlier of 7 days after the Effective Date of the Contract or 61 days after the Bid opening, whereupon Bid security furnished by such Bidders will be released.
- 8.04 Bid security of other Bidders that Owner believes do not have a reasonable chance of receiving the award will be released after the Contract Award.

ARTICLE 9—CONTRACT TIMES

- 9.01 The number of days within which, or the dates by which, the Work is to be (a) substantially completed and (b) ready for final payment, and (c) Milestones (if any) are to be achieved, are set forth in the Agreement.
- 9.02 Provisions for liquidated damages, if any, for failure to timely attain a Milestone, Substantial Completion, or completion of the Work in readiness for final payment, are set forth in the Agreement.

ARTICLE 10—SUBSTITUTE AND "OR EQUAL" ITEMS

- 10.01 The Contract for the Work, as awarded, will be on the basis of materials and equipment specified or described in the Bidding Documents without consideration during the bidding and Contract award process of possible substitute or "or-equal" items. In cases in which the Contract allows the Contractor to request that Engineer authorize the use of a substitute or "or-equal" item of material or equipment, application for such acceptance may not be made to and will not be considered by Engineer until after the Effective Date of the Contract.
- 10.02 The Contract for the Work, as awarded, will be on the basis of materials and equipment specified or described in the Bidding Documents, and those "or-equal" or substitute or materials and equipment subsequently approved by Engineer prior to the submittal of Bids and identified by Addendum. No item of material or equipment will be considered by Engineer as an "or-equal" or substitute unless written request for approval has been submitted by Bidder and has been received by Engineer prior to the pre-bid meeting. Each such request must comply with the requirements of Paragraphs 7.05 and 7.06 of the General Conditions, and the review of the

request will be governed by the principles in those paragraphs. The burden of proof of the merit of the proposed item is upon Bidder. Engineer's decision of approval or disapproval of a proposed item will be final. If Engineer approves any such proposed item, such approval will be set forth in an Addendum issued to all registered Bidders. Bidders cannot rely upon approvals made in any other manner.

- 10.03 All prices that Bidder sets forth in its Bid will be based on the presumption that the Contractor will furnish the materials and equipment specified or described in the Bidding Documents, as supplemented by Addenda. Any assumptions regarding the possibility of post-Bid approvals of "or-equal" or substitution requests are made at Bidder's sole risk.

ARTICLE 11—SUBCONTRACTORS, SUPPLIERS, AND OTHERS

- 11.01 A Bidder must be prepared to retain specific Subcontractors and Suppliers for the performance of the Work if required to do so by the Bidding Documents or in the Specifications. If a prospective Bidder objects to retaining any such Subcontractor or Supplier and the concern is not relieved by an Addendum, then the prospective Bidder should refrain from submitting a Bid.
- 11.02 The apparent Successful Bidder, and any other Bidder so requested, must submit to Owner a list of the Subcontractors or Suppliers proposed for the following portions of the Work with the qualifications statement or within 5 days of Owner's request.
- 11.03 If requested by Owner, such list must be accompanied by an experience statement with pertinent information regarding similar projects and other evidence of qualification for each such Subcontractor or Supplier. If Owner or Engineer, after due investigation, has reasonable objection to any proposed Subcontractor or Supplier, Owner may, before the Notice of Award is given, request apparent Successful Bidder to submit an acceptable substitute, in which case apparent Successful Bidder will submit a substitute, Bidder's Bid price will be increased (or decreased) by the difference in cost occasioned by such substitution, and Owner may consider such price adjustment in evaluating Bids and making the Contract award.
- 11.04 If apparent Successful Bidder declines to make any such substitution, Owner may award the Contract to the next lowest Bidder that proposes to use acceptable Subcontractors and Suppliers. Declining to make requested substitutions will constitute grounds for forfeiture of the Bid security of any Bidder. Any Subcontractor or Supplier, so listed and against which Owner or Engineer makes no written objection prior to the giving of the Notice of Award will be deemed acceptable to Owner and Engineer subject to subsequent revocation of such acceptance as provided in Paragraph 7.07 of the General Conditions.

ARTICLE 12—PREPARATION OF BID

- 12.01 The Bid Form is included with the Bidding Documents.
- A. All blanks on the Bid Form must be completed in ink and the Bid Form signed in ink. Erasures or alterations must be initialed in ink by the person signing the Bid Form. A Bid price must be indicated for each section, Bid item, alternate, adjustment unit price item, and unit price item listed therein.
- B. If the Bid Form expressly indicates that submitting pricing on a specific alternate item is optional, and Bidder elects to not furnish pricing for such optional alternate item, then Bidder may enter the words "No Bid" or "Not Applicable."

- 12.02 If Bidder has obtained the Bidding Documents as Electronic Documents, then Bidder shall prepare its Bid on a paper copy of the Bid Form printed from the Electronic Documents version of the Bidding Documents. The printed copy of the Bid Form must be clearly legible, printed on 8½ inch by 11-inch paper and as closely identical in appearance to the Electronic Document version of the Bid Form as may be practical. The Owner reserves the right to accept Bid Forms which nominally vary in appearance from the original paper version of the Bid Form, providing that all required information and submittals are included with the Bid.
- 12.03 A Bid by a corporation must be executed in the corporate name by a corporate officer (whose title must appear under the signature), accompanied by evidence of authority to sign. The corporate address and state of incorporation must be shown.
- 12.04 A Bid by a partnership must be executed in the partnership name and signed by a partner (whose title must appear under the signature), accompanied by evidence of authority to sign. The official address of the partnership must be shown.
- 12.05 A Bid by a limited liability company must be executed in the name of the firm by a member or other authorized person and accompanied by evidence of authority to sign. The state of formation of the firm and the official address of the firm must be shown.
- 12.06 A Bid by an individual must show the Bidder's name and official address.
- 12.07 A Bid by a joint venture must be executed by an authorized representative of each joint venturer in the manner indicated on the Bid Form. The joint venture must have been formally established prior to submittal of a Bid, and the official address of the joint venture must be shown.
- 12.08 All names must be printed in ink below the signatures.
- 12.09 The Bid must contain an acknowledgment of receipt of all Addenda, the numbers of which must be filled in on the Bid Form.
- 12.10 Postal and e-mail addresses and telephone number for communications regarding the Bid must be shown.
- 12.11 The Bid must contain evidence of Bidder's authority to do business in the state where the Project is located, or Bidder must certify in writing that it will obtain such authority within the time for acceptance of Bids and attach such certification to the Bid.
- 12.12 If Bidder is required to be licensed to submit a Bid or perform the Work in the state where the Project is located, the Bid must contain evidence of Bidder's licensure, or Bidder must certify in writing that it will obtain such licensure within the time for acceptance of Bids and attach such certification to the Bid. Bidder's state contractor license number, if any, must also be shown on the Bid Form.

ARTICLE 13—BASIS OF BID

13.01 *Unit Price*

- A. Bidders must submit a Bid on a unit price basis for each item of Work listed in the unit price section of the Bid Form.
- B. The "Bid Price" (sometimes referred to as the extended price) for each unit price Bid item will be the product of the "Estimated Quantity", which Owner or its representative has set forth in the Bid Form, for the item and the corresponding "Bid Unit Price" offered by the

Bidder. The total of all unit price Bid items will be the sum of these "Bid Prices"; such total will be used by Owner for Bid comparison purposes. The final quantities and Contract Price will be determined in accordance with Paragraph 13.03 of the General Conditions.

- C. Discrepancies between the multiplication of units of Work and unit prices will be resolved in favor of the unit prices. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum. In case of discrepancy between the written amounts and figures, the written amounts shall govern.

13.02 Allowances

- A. For cash allowances the Bid price must include such amounts as the Bidder deems proper for Contractor's overhead, costs, profit, and other expenses on account of cash allowances, if any, named in the Contract Documents, in accordance with Paragraph 13.02.B of the General Conditions.

ARTICLE 14—SUBMITTAL OF BID

- 14.01 The Bid Form is to be completed and submitted with the Bid security and the other documents required to be submitted under the terms of Article 2 of the Bid Form.
- 14.02 A Bid must be received no later than the date and time prescribed and at the place indicated in the Advertisement or notice to bid and must be enclosed in a plainly marked package with the Project title, and, if applicable, the designated portion of the Project for which the Bid is submitted, the name and address of Bidder, and must be accompanied by the Bid security and other required documents. If a Bid is sent by mail or other delivery system, the sealed envelope containing the Bid must be enclosed in a separate package plainly marked on the outside with the notation "BID ENCLOSED." A mailed Bid must be addressed to the location designated in the notice to bidders.
- 14.03 Bids received after the date and time prescribed for the opening of bids, or not submitted at the correct location or in the designated manner, will not be accepted and will be returned to the Bidder unopened.

ARTICLE 15—MODIFICATION AND WITHDRAWAL OF BID

- 15.01 An unopened Bid may be withdrawn by an appropriate document duly executed in the same manner that a Bid must be executed and delivered to the place where Bids are to be submitted prior to the date and time for the opening of Bids. Upon receipt of such notice, the unopened Bid will be returned to the Bidder.
- 15.02 If a Bidder wishes to modify its Bid prior to Bid opening, Bidder must withdraw its initial Bid in the manner specified in Paragraph 15.01 and submit a new Bid prior to the date and time for the opening of Bids.
- 15.03 If within 24 hours after Bids are opened any Bidder files a duly signed written notice with Owner and promptly thereafter demonstrates to the reasonable satisfaction of Owner that there was a material and substantial mistake in the preparation of its Bid, the Bidder may withdraw its Bid,

and the Bid security will be returned. Thereafter, if the Work is rebid, the Bidder will be disqualified from further bidding on the Work.

ARTICLE 16—OPENING OF BIDS

- 16.01 Bids will be opened at the time and place indicated in the advertisement or notice to bid and, unless obviously non-responsive, read aloud publicly. A summary of the amounts of the base Bids and major alternates, if any, will be made available to Bidders after the opening of Bids. Bidders and other interested parties may be present at the public bid opening.

ARTICLE 17—BIDS TO REMAIN SUBJECT TO ACCEPTANCE

- 17.01 All Bids will remain subject to acceptance for a period of 60 days as shown in the Bid Form, but Owner may, in its sole discretion, release any Bid and return the Bid security prior to the end of this period.

ARTICLE 18—EVALUATION OF BIDS AND AWARD OF CONTRACT

- 18.01 Owner reserves the right to reject any or all Bids, including without limitation, nonconforming, nonresponsive, unbalanced, or conditional Bids. Owner also reserves the right to waive all minor Bid informalities not involving price, time, or changes in the Work.
- 18.02 Owner will reject the Bid of any Bidder that Owner finds, after reasonable inquiry and evaluation, to not be responsible.
- 18.03 If Bidder purports to add terms or conditions to its Bid, takes exception to any provision of the Bidding Documents, or attempts to alter the contents of the Contract Documents for purposes of the Bid, whether in the Bid itself or in a separate communication to Owner or Engineer, then Owner will reject the Bid as nonresponsive.
- 18.04 If Owner awards the contract for the Work, such award will be to the responsible Bidder submitting the lowest responsive Bid.
- 18.05 *Evaluation of Bids*
- A. In evaluating Bids, Owner will consider whether the Bids comply with the prescribed requirements, and such alternates, unit prices, and other data, as may be requested in the Bid Form or prior to the Notice of Award. The Owner may consider the following in determining the best value:
- In the comparison of Bids, The amount bid;
 - Reputation of the bidder and the bidder's goods or services;
 - Quality of the bidder's goods or services;
 - Extent to which the goods or services meet the needs of SRA;
 - Bidder's past relationship with SRA;
 - Total long-term cost to SRA to acquire the bidder's goods or services;
 - Bidder's past experience in performing similar work;
 - Bidder's financial record indicating the stability of the bidder;
 - Bidder's history of successfully completing projects; and
 - Any relevant criteria specifically listed in the request for bids or proposals.

- B. For the determination of the apparent low Bidder when unit price bids are submitted, Bids will be compared on the basis of the total of the products of the estimated quantity of each item and unit price Bid for that item, together with any lump sum items.
- 18.06 In evaluating whether a Bidder is responsible, Owner will consider the qualifications of the Bidder and may consider the qualifications and experience of Subcontractors and Suppliers proposed for those portions of the Work for which the identity of Subcontractors and Suppliers must be submitted as provided in the Bidding Documents.
- 18.07 Owner may conduct such investigations as Owner deems necessary to establish the responsibility, qualifications, and financial ability of Bidders and any proposed Subcontractors or Suppliers.

ARTICLE 19—BONDS AND INSURANCE

- 19.01 Article 6 of the General Conditions and the Supplementary Conditions, sets forth Owner's requirements as to performance and payment bonds, other required bonds (if any), and insurance. When the Successful Bidder delivers the executed Agreement to Owner, it must be accompanied by required bonds and insurance documentation.
- 19.02 Article 8, Bid Security, of these Instructions, addresses any requirements for providing bid bonds as part of the bidding process.

ARTICLE 20—SIGNING OF AGREEMENT

- 20.01 When Owner issues a Notice of Award to the Successful Bidder, it will be accompanied by the unexecuted counterparts of the Agreement along with the other Contract Documents as identified in the Agreement. Within 15 days thereafter, Successful Bidder must execute and deliver the required number of counterparts of the Agreement and any bonds and insurance documentation required to be delivered by the Contract Documents to Owner. Within 10 days thereafter, Owner will deliver one fully executed counterpart of the Agreement to Successful Bidder, together with copies of the Contract Documents as stated in Paragraph 2.02 of the General Conditions.

ARTICLE 21—SALES AND USE TAXES

- 21.01 Owner is exempt by law from **State of Texas** sales and Use Tax Laws, and Federal Excise Tax on materials and equipment to be incorporated in the Work. Said taxes must not be included in the Bid. Refer to Paragraph SC-7.10 of the Supplementary Conditions for additional information.

ARTICLE 22—CONFIDENTIALITY OF DOCUMENTS

The SRA is subject to the Texas Public Information Act (PIA). Any information submitted to the SRA by the Bidder shall be considered non-confidential and available to the public, except as follows:

In the event a Bidder considers a specific portion of their Bid to be confidential and subject to an exception to disclosure under the PIA, such portion must be clearly identified and marked "CONFIDENTIAL". Do not mark an entire proposal confidential, as this is not in conformance with the PIA and is not acceptable. Only the specific portion or portions of the Bid that the Bidder considers to be confidential pursuant to the PIA should be marked. IF AN ENTIRE BID IS MARKED CONFIDENTIAL, THE SRA WILL NOT TREAT ANY PORTION OF THE BID AS CONFIDENTIAL AND THE BID MAY BE REJECTED AS NON-CONFORMING. The SRA

will honor notations of confidentiality in accordance with this paragraph and decline to release such information initially; however, final determination of whether a particular portion of a Bid may in fact be withheld pursuant to the PIA will be made by the Texas Attorney General or a court of competent jurisdiction.

In the event a public information request is received for a portion of a Bid that has been marked confidential, the SRA will ask the affected Bidder if the information may be released. If the release is agreed to, the SRA shall release the information.

If the release is denied, the matter shall be referred to the Texas Attorney General's Office in accordance with the process set forth in the PIA. The Bidder shall be fully and solely responsible for submitting arguments and evidence within the statutory timeframes to the Texas Attorney General's Office regarding its claim of confidentiality. The SRA will NOT submit arguments on behalf of the Bidder.

The Texas Attorney General's Office shall rule on the matter. In the event that it is determined by opinion of the Texas Attorney General or court of competent jurisdiction that such information may not be withheld, then such information will be made available to the requestor. If it is determined that the information may be withheld, SRA will withhold the information from the requestor.

Pricing information contained in bids or contracts is not considered confidential under the PIA and will be disclosed without making a request to the Texas Attorney General.

ARTICLE 23—CONFLICT OF INTEREST

Pursuant to Chapter 176 of the Local Government Code, any person or agent of a person who contracts or seeks to contract for the sale or purchase of property, goods, or services with a local government entity (i.e. Sabine River Authority) must disclose in the Conflicts of Interest Questionnaire Form (CIQ) the person's affiliation or business relationship that might cause a conflict of interest with the local government entity. By law, the CIQ must be filed with the SRA Records Management Officer no later than seven (7) days after the date the person begins contract discussions or negotiations with the SRA, or submits an application or response to a Request for Bids, correspondence, or another writing related to a potential agreement with SRA. Updated Questionnaires must be filed in conformance with Chapter 176.

A copy of the CIQ is included. If you have any questions about compliance, please consult your own legal counsel. Compliance is the individual responsibility of each person or agent of a person who is subject to the filing requirement. An offense under Chapter 176 carries a penalty up to a Class A misdemeanor.

ARTICLE 24—EQUAL OPPORTUNITY

Sabine River Authority provides for equal opportunity for all qualified parties including Historically Underutilized Business (HUBs). If your organization or any associated sub-contractor on the project area a certified HUB with the State of Texas, please submit documentation of the certified organization, including description of the work, percentage of the contract expected to be completed by the HB, and the certification number of the HUB.



BID PROPOSAL

BID FORM FOR CONSTRUCTION CONTRACT

The terms used in this Bid with initial capital letters have the meanings stated in the Instructions to Bidders, the General Conditions, and the Supplementary Conditions.

ARTICLE 1—OWNER AND BIDDER

- 1.01 This Bid is submitted to: **Sabine River Authority of Texas: Toledo Bend Division**
- 1.02 The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an Agreement with Owner in the form included in the Bidding Documents to perform all Work as specified or indicated in the Bidding Documents for the prices and within the times indicated in this Bid and in accordance with the other terms and conditions of the Bidding Documents. All prices shall be stated in both words and figures; however, do not extend the unit price. If the unit price is extended, the extension shall be ignored in tabulating the bids (*). In case of discrepancy between the written amounts and the figures, the written amounts shall govern.

ARTICLE 2—ATTACHMENTS TO THIS BID

- 2.01 The following documents are submitted with and made a condition of this Bid:
 - A. Required Bid security;
 - B. Vendor Certification to State Law;
 - C. Conflict of Interest;
 - D. Required Bidder Qualification Statement with supporting data;
 - E. Form W-9;
 - F. Bonding Company Information
 - G. Bid Opening Sheet
 - H. Non-Collusion Affidavit(s)
 - I. Additional Items as stipulated in the request

ARTICLE 3—BASIS OF BID—LUMP SUM BID AND UNIT PRICES

3.01 *Unit Price Bids*

- A. Bidder will perform the following Work at the indicated unit prices shown in **Exhibit A - Bid Form**:
- B. Bidder acknowledges that:
 - each Bid Unit Price includes an amount considered by Bidder to be adequate to cover Contractor's overhead and profit for each separately identified item, and estimated quantities are not guaranteed, and are solely for the purpose of comparison of Bids, and final payment for all Unit Price Work will be based on actual quantities, determined as provided in the Contract Documents.

ARTICLE 4—TIME OF COMPLETION

- 4.01 Bidder agrees that the Work will be substantially complete and will be completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions on or before the dates or within the number of calendar days indicated in the Agreement.
- 4.02 Bidder agrees that the Work will be substantially complete as indicated in the Agreement and will be completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions.
- 4.03 Bidder agrees that the Work will be substantially complete within the time stipulated in the Agreement and as provided in Paragraph 4.01 of the General Conditions and will be completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions.
- 4.04 Bidder accepts the provisions of the Agreement as to liquidated damages.

ARTICLE 5—BIDDER'S ACKNOWLEDGEMENTS: ACCEPTANCE PERIOD, INSTRUCTIONS, AND RECEIPT OF ADDENDA

5.01 *Bid Acceptance Period*

- A. This Bid will remain subject to acceptance for 60 days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner.

5.02 *Instructions to Bidders*

- A. Bidder accepts all of the terms and conditions of the Instructions to Bidders, including without limitation those dealing with the disposition of Bid security.

5.03 *Receipt of Addenda*

- A. Bidder hereby acknowledges receipt of the following Addenda:

Addendum Number	Addendum Date	Received

ARTICLE 6—BIDDER’S REPRESENTATIONS AND CERTIFICATIONS

6.01 *Bidder’s Representations*

- A. In submitting this Bid, Bidder represents the following:
1. Bidder has examined and carefully studied the Bidding Documents, including Addenda.
 2. Bidder has visited the Site, conducted a thorough visual examination of the Site and adjacent areas, and become familiar with the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
 3. Bidder is familiar with all Laws and Regulations that may affect cost, progress, and performance of the Work.
 4. Bidder has carefully studied the reports of explorations and tests of subsurface conditions at or adjacent to the Site and the drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, with respect to the Technical Data in such reports and drawings.
 5. Bidder has carefully studied the reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, with respect to Technical Data in such reports and drawings.
 6. Bidder has considered the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and the Technical Data identified in the Supplementary Conditions or by definition, with respect to the effect of such information, observations, and Technical Data on (a) the cost, progress, and performance of the Work; (b) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, if selected as Contractor; and (c) Bidder’s (Contractor’s) safety precautions and programs.
 7. Based on the information and observations referred to in the preceding paragraph, Bidder agrees that no further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.
 8. Bidder is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents.
 9. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and of discrepancies between Site conditions and the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.
 10. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.
 11. The submission of this Bid constitutes an incontrovertible representation by Bidder that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

6.02 *Bidder's Certifications*

A. The Bidder certifies the following:

1. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation.
2. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid.
3. Bidder has not solicited or induced any individual or entity to refrain from bidding.
4. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Paragraph 8.02.A:
 - a. Corrupt practice means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process.
 - b. Fraudulent practice means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Owner, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition.
 - c. Collusive practice means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish bid prices at artificial, non-competitive levels.
 - d. Coercive practice means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

BIDDER hereby submits this Bid as set forth above:

Bidder:

(typed or printed name of organization)

By:

(individual's signature)

Name:

(typed or printed)

Title:

(typed or printed)

Date:

(typed or printed)

If Bidder is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.

Attest:

(individual's signature)

Name:

(typed or printed)

Title:

(typed or printed)

Date:

(typed or printed)

Address for giving notices:

Bidder's Contact:

Name:

(typed or printed)

Title:

(typed or printed)

Phone:

Email:

Address:

Bidder's Contractor License No.: (if applicable)

EXHIBIT A - BID FORM

Project Name:	Sabinetown Recreation Area
Project Number:	RFB 25-1202
Owner:	Sabine River Authority of Texas
Designer:	Freese and Nichols, Inc.

Basis of Bid

Item	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	EXTENDED AMOUNT
Part A - Site Work					
A1	MOBILIZATION (5% MAX, BASE BID)	1	LS		
A2	EXCAVATION	30500	CY		
A3	EMBANKMENT (TY D) (FINAL)	35000	CY		
A4	CLEARING AND GRUBBING	4363	SY		
A5	EROSION CONTROL BLANKET	5638	SY		
A6	HYDROMULCH	45575	SY		
A7	SODDING	6204	SY		
A8	4" TOPSOIL	6204	SY		
A9	INSTALL NEW SILT FENCE	500	LF		
A10	REMOVE SILT FENCE	4626	LF		
A11	STORM WATER POLLUTION PREVENTION PLAN	1	LS		
SUBTOTAL PART A - Site Work (Items A1 thru A11)					

Part B - Parking Area					
B1	12" COMPACTED SUBGRADE	31423	SY		
B2	GEOGRID (TXDOT, TYPE II)	31423	SY		
B3	6" LIMESTONE FLEXIBLE BASE, TYPE A, GRADE 1-2	5237	CY		
B4	PRIME COAT (0.15 GAL/SY)	4591	GAL		
B5	2" HMAC, TYPE C	30610	SY		
B6	PAVEMENT MARKING, TYPE 2, (W) (4")	15397	LF		
B7	PAVEMENT MARKING, TYPE 2, (Y) (4")	3750	LF		
B8	PAVEMENT MARKING, TYPE 2, (Y) (4") (DBL)	369	LF		
B9	PAVEMENT MARKING, TYPE 2, (RED) (4")	335	LF		
B10	PAVEMENT MARKINGS (RED) (FIRST RESPONDER PARKING)	2	EA		
B11	PAVEMENT MARKING, TYPE 2, (W) (24")	254	LF		
B12	PAVEMENT MARKINGS (W)(NO PARKING)	4	EA		
B13	PAVEMENT MARKINGS (W) (ARROW)	30	EA		
B14	PAVEMENT MARKINGS (W) (WORD)	1	EA		
B15	24" LAYDOWN CURB	233	LF		
B16	CONCRETE VALLEY GUTTER	52	LF		
B17	SMALL RDSD SIGN ASSM	6	EA		
B18	ACCESSIBLE PAINTED SYMBOL	7	EA		
B19	ACCESSIBLE PARKING SIGN	7	EA		
B20	PRECAST WHEEL STOPS	7	EA		
SUBTOTAL PART B - Parking Area (Items B1 thru B20)					

Part C - Vantage Point Roadway Extension					
C1	EXCAVATION	150	CY		
C2	EMBANKMENT (TY A) (FINAL)	50	CY		
C3	GEOGRID (TXDOT, TYPE II)	903	SY		
C4	6" LIMESTONE FLEXIBLE BASE, TYPE A, GRADE 1-2	151	CY		
C5	PRIME COAT (0.15 GAL/SY)	118	GAL		
C6	2" HMAC, TYPE C	783	SY		
SUBTOTAL PART C - Vantage Point Roadway Extension (Items C1 thru C6)					

Part D - Waterline					
D1	2" WATER SERVICE LINE	1540	LF		
D2	3/4" HOSE BIB AND VALVE BOX	1	EA		

EXHIBIT A - BID FORM

Item	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	EXTENDED AMOUNT
D3	2" GATE VALVE AND VALVE BOX	3	EA		
SUBTOTAL PART D - Waterline (D1 THRU D3)					

Part E - Storm Sewer					
E1	15" CLASS III RCP	93	LF		
E2	15" S.E.T.	2	EA		
SUBTOTAL PART E - Storm Sewer (E1 THRU E2)					

Part F - Boat Ramp					
F1	DEWATERING (COFFERDAMMING)	1	LS		
F2	SHORELINE EXCAVATION	4500	CY		
F3	FILTER FABRIC	2950	SY		
F4	BOAT RAMP 8" GRAVEL BASE	685	CY		
F5	CIP CONCRETE BOAT RAMP SLAB	675	CY		
SUBTOTAL PART F - Boat Ramp (F1 thru F5)					

Part G - Site Facilities					
G1	PREFABRICATED RESTROOM BUILDING	1	LS		
G2	EXCAVATION FOR RESTROOM BUILDING FOUNDATION	252	CY		
G3	SELECT FILL FOR RESTROOM BUILDING FOUNDATION	272	CY		
G4	GRAVEL BASE FOR RESTROOM BUILDING FOUNDATION	10	CY		
G5	ONSITE SEWAGE FACILITY	1	LS		
G6	PAVILION	1	LS		
G7	PAVILLION FOUNDATION	1	LS		
G8	6" CONCRETE DRIVEWAY	167	SY		
G9	PARK ENTRY SIGNAGE	1	LS		
G10	CONCRETE LOW RETAINING WALL	95	LF		
G11	4" CONCRETE SIDEWALK AROUND PAVILION AND RESTROOM	891	SY		
G12	CONCRETE RETAINING WALL AND STAIRS	310	CY		
G13	RETAINING WALL DRAINAGE	360	LF		
G14	CABLE GUARD RAIL AT TOP OF RETAINING WALL AND STAIRS	270	LF		
SUBTOTAL PART G - Site Facilities (G1 THRU G14)					

Part H - Electrical and Illumination					
H1	SITE PRIMARY POWER	1	LS		
H2	SITE BRANCH POWER/CIRCUITS	1	LS		
H3	FIXTURES	1	LS		
H4	GEAR AND EQUIPMENT	1	LS		
SUBTOTAL PART H - Electrical and Illumination (H1 THRU H4)					

Part I - Alternate #1 - Overflow Parking Lot Expansion					
I1	MOBILIZATION (5% MAX, PART I)	1	LS		
I2	12" COMPACTED SUBGRADE	13500	SY		
I3	GEOGRID (TXDOT, TYPE II)	13500	SY		
I4	6" LIMESTONE FLEXIBLE BASE, TYPE A, GRADE 1-2	2170	CY		
I5	PRIME COAT (0.15 GAL/SY)	1950	GAL		
I6	2" HMAC, TYPE C	13000	SY		
I7	PAVEMENT MARKING, TYPE 2, (W) (4")	5000	LF		
I8	SITE ELECTRICAL & ILLUMINATION (OVERFLOW PARKING AREA)	1	LS		
I9	DEDUCT: HYDROMULCH (ITEM A6)	(13500)	SY		
SUBTOTAL PART I - Alternate #1 - Overflow Parking Lot Expansion (I1 THRU I9)					

Part J - Alternate #2 - ADA Walkway and Floating Dock (North)					
J1	MOBILIZATION (5% MAX, PART J)	1	LS		
J2	PERMATRAK PRECAST ADA CONCRETE BOARDWALK	1	LS		
J3	DRILL SHAFT (24") FOR BOARDWALK	578	LF		
J4	CONCRETE PIER CAPS FOR BOARDWALK	15	CY		

EXHIBIT A - BID FORM

Item	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	EXTENDED AMOUNT
J5	HANDRAILS FOR CONCRETE BOARDWALK	670	LF		
J6	ROCK RIPRAP (LABOR ONLY)	104	CY		
J7	ACCUDOCK ADA ALUMINUM GANGWAY W/ ALL HARDWARE	1	LS		
J8	ACCUDOCK FLOATING DOCK W/ ALL HARDWARE	1	LS		
J9	12" DIA. TREATED TIMBER DRIVEN PILES	5	EA		
SUBTOTAL PART J - Alternate #2 - ADA Walkway and Floating Dock (North) (J1 THRU J9)					

Part K - Alternate #3 - Floating Dock (South)					
K1	MOBILIZATION (5% MAX, PART K)	1	LS		
K2	6" CONCRETE WALKWAY (MATCH BOAT RAMP SLOPE)	120	SY		
K3	ACCUDOCK ALUMINUM GANGWAY W/ ALL HARDWARE	1	LS		
K4	ACCUDOCK FLOATING DOCK W/ ALL HARDWARE	1	LS		
K5	12" DIA. TREATED TIMBER DRIVEN PILES	5	EA		
K6	ROCK RIPRAP (LABOR ONLY)	109	CY		
K7	ADDITIONAL CLEARING AT SHORELINE	1	LS		
SUBTOTAL PART K - Alternate #3 - Floating Dock (South) (K1 THRU K7)					

Part L - Alternate #4 - Transfer Platform					
L1	MOBILIZATION (5% MAX, PART L)	1	LS		
L2	TIMBER LOADING RAMP	1	LS		
L3	6" CONCRETE WALKWAY	5	SY		
SUBTOTAL PART L - Alternate #4 - Transfer Platform (L1 THRU L3)					

Part M - Alternate #5 - Decorative Stone Veneer					
M1	MOBILIZATION (5% MAX, PART M)	1	LS		
M2	4" STONE VENEER ON RETAINING WALLS	3000	SF		
SUBTOTAL PART M - Alternate #5 - Decorative Stone Veneer (M1 THRU M2)					

Part N - Alternate #6 - Wood Framed Alternative Design					
N1	DEDUCT: WOOD FRAMED ALTERNATIVE DESIGN	(1)	LS		
SUBTOTAL PART N - Alternate #6 - Wood Framed Alternative Design (N1)					

EXHIBIT A - BID FORM

Item	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	EXTENDED AMOUNT
BID SUMMARY					
SUBTOTAL PART A - Site Work (Items A1 thru A11)					
SUBTOTAL PART B - Parking Area (Items B1 thru B20)					
SUBTOTAL PART C - Vantage Point Roadway Extension (Items C1 thru C6)					
SUBTOTAL PART D - Waterline (Items D1 thru D3)					
SUBTOTAL PART E - Storm Sewer (Items E1 thru E2)					
SUBTOTAL PART F - Boat Ramp (Items F1 thru F5)					
SUBTOTAL PART G - Site Facilities (Items G1 thru G14)					
SUBTOTAL PART H - Electrical and Illumination (Items H1 thru H4)					
BASE BID TOTAL (PARTS A THRU H)					
SUBTOTAL PART I - Alternate #1 - Overflow Parking Lot Expansion (Items I1 thru I9)					
SUBTOTAL PART J - Alternate #2 - ADA Walkway and Floating Dock (North) (Items J1 thru J9)					
SUBTOTAL PART K - Alternate #3 - Floating Dock (South) (Items K1 thru K7)					
SUBTOTAL PART L - Alternate #4 - Transfer Platform (Items L1 thru L3)					
SUBTOTAL PART M - Alternate #5 - Decorative Stone Veneer (Items M1 thru M2)					
SUBTOTAL PART N - Alternate #6 - Wood Framed Alternative Design (Item N1)					

BID BOND (PENAL SUM FORM)

Bidder Name: Address <i>(principal place of business)</i> :	Surety Name: Address <i>(principal place of business)</i> :
Owner Name: Sabine River Authority of Texas Address <i>(principal place of business)</i> : 12777 Hwy 87 N Orange, Texas 77632	Bid Project <i>(name and location)</i> : Sabinetown Recreation Area RFB 25-1202 Bid Due Date: Thursday, August 8th, 2024, at 2:00PM
Bond Penal Sum: Date of Bond:	
Surety and Bidder, intending to be legally bound hereby, subject to the terms set forth in this Bid Bond, do each cause this Bid Bond to be duly executed by an authorized officer, agent, or representative.	
Bidder	Surety
_____ <i>(Full formal name of Bidder)</i>	_____ <i>(Full formal name of Surety) (corporate seal)</i>
By: _____ <i>(Signature)</i>	By: _____ <i>(Signature) (Attach Power of Attorney)</i>
Name: _____ <i>(Printed or typed)</i>	Name: _____ <i>(Printed or typed)</i>
Title: _____	Title: _____
Attest: _____ <i>(Signature)</i>	Attest: _____ <i>(Signature)</i>
Name: _____ <i>(Printed or typed)</i>	Name: _____ <i>(Printed or typed)</i>
Title: _____	Title: _____
<i>Notes: (1) Note: Addresses are to be used for giving any required notice. (2) Provide execution by any additional parties, such as joint venturers, if necessary.</i>	

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to pay to Owner upon default of Bidder the penal sum set forth on the face of this Bond. Payment of the penal sum is the extent of Bidder's and Surety's liability. Recovery of such penal sum under the terms of this Bond will be Owner's sole and exclusive remedy upon default of Bidder.
2. Default of Bidder occurs upon the failure of Bidder to deliver within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents.
3. This obligation will be null and void if:
 - 3.1. Owner accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents, or
 - 3.2. All Bids are rejected by Owner, or
 - 3.3. Owner fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by Paragraph 5 hereof).
4. Payment under this Bond will be due and payable upon default of Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from Owner, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.
5. Surety waives notice of any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by Owner and Bidder, provided that the total time for issuing Notice of Award including extensions does not in the aggregate exceed 120 days from the Bid due date without Surety's written consent.
6. No suit or action will be commenced under this Bond prior to 30 calendar days after the notice of default required in Paragraph 4 above is received by Bidder and Surety, and in no case later than one year after the Bid due date.
7. Any suit or action under this Bond will be commenced only in a court of competent jurisdiction located in the state in which the Project is located.
8. Notices required hereunder must be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier, or by United States Postal Service registered or certified mail, return receipt requested, postage pre-paid, and will be deemed to be effective upon receipt by the party concerned.
9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent, or representative who executed this Bond on behalf of Surety to execute, seal, and deliver such Bond and bind the Surety thereby.
10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond will be deemed to be included herein as if set forth at length. If any provision of this Bond conflicts with any applicable statute, then the provision of said statute governs and the remainder of this Bond that is not in conflict therewith continues in full force and effect.
11. The term "Bid" as used herein includes a Bid, offer, or proposal as applicable.

BID OPENING

In the space provided below, enter your total Base Bid amount for this project. Only this figure will be read publicly at the public bid opening.

It is understood and agreed by the bidder in signing the proposal that the total bid amount entered below is not binding on either the bidder or the Owner. It is further agreed that the official total bid amount for this proposal will be determined by multiplying the unit prices for each unit price pay item by the respective estimated quantities shown in this proposal, and then totaling all of the extended amounts plus the amounts bid for all lump sum items.

Project: Sabinetown Recreation Area
 RFB 25-1202

Owner: Sabine River Authority of Texas
 Orange County, Texas

\$

Total Base Bid Amount

Name of Bidder

ARTICLE 1—GENERAL INFORMATION

1.01 Provide contact information for the Business:

Legal Name of Business:			
Corporate Office			
Name:		Phone number:	
Title:		Email address:	
Business address of corporate office:			
Local Office			
Name:		Phone number:	
Title:		Email address:	
Business address of local office:			

ARTICLE 2—DIVERSE BUSINESS CERTIFICATIONS

2.01 Provide information regarding Business's Diverse Business Certification, if any. Provide evidence of current certification.

Certification	Certifying Agency	Certification Date
<input type="checkbox"/> Disadvantaged Business Enterprise		
<input type="checkbox"/> Minority Business Enterprise		
<input type="checkbox"/> Woman-Owned Business Enterprise		
<input type="checkbox"/> Small Business Enterprise		
<input type="checkbox"/> Disabled Business Enterprise		
<input type="checkbox"/> Veteran-Owned Business Enterprise		
<input type="checkbox"/> Service-Disabled Veteran-Owned Business		
<input type="checkbox"/> HUBZone Business (Historically Underutilized) Business		
<input type="checkbox"/> Other		
<input type="checkbox"/> None		

ARTICLE 3—CONSTRUCTION EXPERIENCE

3.01 Provide information that will identify the overall size and capacity of the Business.

Average number of current full-time employees:	
Estimate of revenue for the current year:	
Estimate of revenue for the previous year:	

3.02 Provide information regarding the Business's previous contracting experience.

Years of experience with projects like the proposed project:				
As a general contractor:		As a joint venturer:		
Has Business, or a predecessor in interest, or an affiliate identified in Paragraph 1.03:				
Been disqualified as a bidder by any local, state, or federal agency within the last 5 years? <input type="checkbox"/> Yes <input type="checkbox"/> No				
Been barred from contracting by any local, state, or federal agency within the last 5 years? <input type="checkbox"/> Yes <input type="checkbox"/> No				
Been released from a bid in the past 5 years? <input type="checkbox"/> Yes <input type="checkbox"/> No				
Defaulted on a project or failed to complete any contract awarded to it? <input type="checkbox"/> Yes <input type="checkbox"/> No				
Refused to construct or refused to provide materials defined in the contract documents or in a change order? <input type="checkbox"/> Yes <input type="checkbox"/> No				
Been a party to any currently pending litigation or arbitration? <input type="checkbox"/> Yes <input type="checkbox"/> No				
Provide full details in a separate attachment if the response to any of these questions is Yes.				

3.03 List all projects currently under contract in Schedule A and provide indicated information.

3.04 List a minimum of three and a maximum of six projects completed in the last 5 years in Schedule B and provide indicated information to demonstrate the Business's experience with projects similar in type and cost of construction.

3.05 In Schedule C, provide information on key individuals whom Business intends to assign to the Project. Provide resumes for those individuals included in Schedule C. Key individuals include the Project Manager, Project Superintendent, Quality Manager, and Safety Manager. Resumes may be provided for Business's key leaders as well.

ARTICLE 4—REQUIRED ATTACHMENTS

4.01 Provide the following information with the Statement of Qualifications:

- A. Schedule A (Current Projects) as required by Paragraph 8.03.
- B. Schedule B (Previous Experience with Similar Projects) as required by Paragraph 8.04.
- C. Schedule C (Key Individuals) and resumes for the key individuals listed, as required by Paragraph 8.05.
- D. Financial Statements shall be provided upon request.

This Statement of Qualifications is offered by:

Business:

(typed or printed name of organization)

By:

(individual's signature)

Name:

(typed or printed)

Title:

(typed or printed)

Date:

(date signed)

(If Business is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.)

Attest:

(individual's signature)

Name:

(typed or printed)

Title:

(typed or printed)

Address for giving notices:

Designated Representative:

Name:

(typed or printed)

Title:

(typed or printed)

Address:

Phone:

Email:

Schedule A—Current Projects

Name of Organization					
Project Owner			Project Name		
General Description of Project					
Project Cost			Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager	
Name					
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Project Owner			Project Name		
General Description of Project					
Project Cost			Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager	
Name					
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Project Owner			Project Name		
General Description of Project					
Project Cost			Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager	
Name					
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Schedule B—Previous Experience with Similar Projects

Name of Organization					
Project Owner			Project Name		
General Description of Project					
Project Cost			Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager	
Name					
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Project Owner			Project Name		
General Description of Project					
Project Cost			Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager	
Name					
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Project Owner			Project Name		
General Description of Project					
Project Cost			Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager	
Name					
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Schedule B—Previous Experience with Similar Projects

Name of Organization					
Project Owner			Project Name		
General Description of Project					
Project Cost			Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager	
Name					
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Project Owner			Project Name		
General Description of Project					
Project Cost			Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager	
Name					
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Project Owner			Project Name		
General Description of Project					
Project Cost			Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager	
Name					
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Schedule C—Key Individuals

Project Manager			
Name of individual			
Years of experience as project manager			
Years of experience with this organization			
Number of similar projects as project manager			
Number of similar projects in other positions			
Current Project Assignments			
Name of assignment		Percent of time used for this project	Estimated project completion date
Reference Contact Information (listing names indicates approval to contact named individuals as a reference)			
Name		Name	
Title/Position		Title/Position	
Organization		Organization	
Telephone		Telephone	
Email		Email	
Project		Project	
Candidate's role on project		Candidate's role on project	
Project Superintendent			
Name of individual			
Years of experience as project superintendent			
Years of experience with this organization			
Number of similar projects as project superintendent			
Number of similar projects in other positions			
Current Project Assignments			
Name of assignment		Percent of time used for this project	Estimated project completion date
Reference Contact Information (listing names indicates approval to contact named individuals as a reference)			
Name		Name	
Title/Position		Title/Position	
Organization		Organization	
Telephone		Telephone	
Email		Email	
Project		Project	
Candidate's role on project		Candidate's role on project	

Safety Manager			
Name of individual			
Years of experience as project manager			
Years of experience with this organization			
Number of similar projects as project manager			
Number of similar projects in other positions			
Current Project Assignments			
Name of assignment		Percent of time used for this project	Estimated project completion date
Reference Contact Information (listing names indicates approval to contact named individuals as a reference)			
Name		Name	
Title/Position		Title/Position	
Organization		Organization	
Telephone		Telephone	
Email		Email	
Project		Project	
Candidate's role on project		Candidate's role on project	
Quality Control Manager			
Name of individual			
Years of experience as project superintendent			
Years of experience with this organization			
Number of similar projects as project superintendent			
Number of similar projects in other positions			
Current Project Assignments			
Name of assignment		Percent of time used for this project	Estimated project completion date
Reference Contact Information (listing names indicates approval to contact named individuals as a reference)			
Name		Name	
Title/Position		Title/Position	
Organization		Organization	
Telephone		Telephone	
Email		Email	
Project		Project	
Candidate's role on project		Candidate's role on project	

VENDOR COMPLIANCE TO STATE LAW

Chapter 2252.002, of the Texas Government Code applies to the award of government contract to non-resident bidders. This law provides that:

“A government 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 less than the greater of 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

“Nonresident Bidder” refers to a person who is not a resident of Texas

“Resident Bidder” refers to a person whose principal place of business is in this state, including a contractor whose ultimate parent company or majority owner has its principal place of business in this state.

Check the statement that is correct for Bidder.

- ☐ Non-resident bidders in _____ (give state), our principal place of business, are required to be _____ percent lower than resident bidders by state law. A copy of the statute is attached.
- ☐ Non-resident bidders in _____ (give state), our principal place of business, are not required to underbid resident bidders.
- ☐ Our principal place of business or corporate offices is in the State of Texas.

BIDDER:

By: _____

Signature: _____

Title: _____

Address: _____



BONDING COMPANY INFORMATION

The following person, firm, or corporation has agreed to execute the required payment and performance bonds in the event this contract is awarded to the bidder:

Name of Surety: _____

Mailing Address: _____

City, State, Zip: _____

Telephone Number: _____

Is surety authorized to operate in Texas? _____

Is surety aware of size of project? _____

Does surety have adequate authorization and resources to cover bonds for the amount of this contract? _____

Rating from Best's Key Rating Guide _____

Project: **Sabinetown Recreation Area**
RFB 25-1202

Name of Bidder

NON-COLLUSION AFFIDAVIT
FOR PRIME CONTRACTOR

State of _____)
) ss.
County of _____)

_____, being first duly sworn, deposes and says that:

(1) He is _____ of
, the Bidder that has submitted the referenced Bid;

(2) He is fully informed respecting the preparation and contents of the referenced Bid submitted to _____ (Owner) in connection with _____ (name of contract), and of pertinent circumstances respecting such Bid;

(3) Such Bid is genuine and is not a collusive or sham Bid;

(4) Neither the said Bidder nor any of its officers, partners, owners, agents, representatives, employees, or parties in interest, including this affiant, has in any way colluded, conspired, connived, or agreed, directly or indirectly, with any other Bidder, firm, or person to submit a collusive or sham Bid in connection with such Contract, or to refrain from bidding in connection with such Contract, or has in any manner, directly or indirectly, sought by agreement or collusion or communication or conference with any other Bidder, firm, or person to fix the price or prices in the referenced Bid or in the Bid of any other bidder, or to fix an overhead, profit, or cost element of the Bid price or the Bid price of any other Bidder, or to secure through collusion, conspiracy, connivance, or unlawful agreement any advantage against the _____ (Owner) or any person interested in the proposed Contract; and

(5) The price or prices quoted in the referenced Bid are fair and proper and are not tainted by any collusion, conspiracy, connivance, or unlawful agreement on the part of the Bidder or any of its agents, representatives, owners, employees, or parties in interest, including this affidavit.

(Signed) _____

Title _____

Subscribed and sworn to before me by the said _____ on this ____ day
of _____, 20 ____.

By: _____
Notary Public

_____ County, _____

[Notary Seal]

My commission expires _____, 20 ____.

NON-COLLUSION AFFIDAVIT
FOR PROPOSED SUBCONTRACTOR

State of _____)
) ss.
County of _____)

_____, being first duly sworn, deposes and says that:

(1) He is _____ of _____,
hereinafter referred to as the "Subcontractor";

(2) He is fully informed respecting the preparation and contents of the subcontractor's Proposal submitted by the subcontractor to _____,
the Contractor for certain work in connection with _____ (name
of contract), for _____ (Owner);

(3) Such subcontractor's Proposal is genuine and is not a collusive or sham proposal;

(4) Neither the subcontractor nor any of its officers, partners, owners, agents, representatives, employees, or parties in interest, including this affiant, has in any way colluded, conspired, connived, or agreed, directly or indirectly, with any other Bidder, firm, or person to submit a collusive or sham Proposal in connection with such Contract, or to refrain from submitting a Proposal in connection with such Contract, or has in any manner, directly or indirectly, sought by agreement or collusion or communication or conference with any other Bidder, firm, or person to fix the price or prices in said subcontractor's Proposal or any other subcontractor's proposal, or to secure through collusion, conspiracy, connivance, or unlawful agreement any advantage against the (Owner) or any person interested in the proposed Contract; and

(5) The price or prices quoted in the subcontractor's Proposal are fair and proper and are not tainted by any collusion, conspiracy, connivance, or unlawful agreement on the part of the Bidder or any of its agents, representatives, owners, employees, or parties in interest, including this affidavit.

(Signed) _____.

Title _____.

Subscribed and sworn to before me by the said
on this ____ day of _____, 20 ____.

By:

Notary Public
_____, County, _____

[Notary Seal]

My commission expires _____, 20 ____.

Request for Taxpayer Identification Number and Certification

► Go to www.irs.gov/FormW9 for instructions and the latest information.

Give Form to the
requester. Do not
send to the IRS.

Print or type. See Specific Instructions on page 3.	1 Name (as shown on your income tax return). Name is required on this line; do not leave this line blank.	
	2 Business name/disregarded entity name, if different from above	
	3 Check appropriate box for federal tax classification of the person whose name is entered on line 1. Check only one of the following seven boxes. <input type="checkbox"/> Individual/sole proprietor or single-member LLC <input type="checkbox"/> Limited liability company. Enter the tax classification (C=C corporation, S=S corporation, P=Partnership) ► _____ Note: Check the appropriate box in the line above for the tax classification of the single-member owner. Do not check LLC if the LLC is classified as a single-member LLC that is disregarded from the owner unless the owner of the LLC is another LLC that is not disregarded from the owner for U.S. federal tax purposes. Otherwise, a single-member LLC that is disregarded from the owner should check the appropriate box for the tax classification of its owner. <input type="checkbox"/> Other (see instructions) ► _____	4 Exemptions (codes apply only to certain entities, not individuals; see instructions on page 3): Exempt payee code (if any) _____ Exemption from FATCA reporting code (if any) _____ <small>(Applies to accounts maintained outside the U.S.)</small>
	5 Address (number, street, and apt. or suite no.) See instructions.	Requester's name and address (optional)
	6 City, state, and ZIP code	
7 List account number(s) here (optional)		

Part I Taxpayer Identification Number (TIN)

Enter your TIN in the appropriate box. The TIN provided must match the name given on line 1 to avoid backup withholding. For individuals, this is generally your social security number (SSN). However, for a resident alien, sole proprietor, or disregarded entity, see the instructions for Part I, later. For other entities, it is your employer identification number (EIN). If you do not have a number, see *How to get a TIN*, later.

Note: If the account is in more than one name, see the instructions for line 1. Also see *What Name and Number To Give the Requester* for guidelines on whose number to enter.

Social security number									
				-					
or									
Employer identification number									
				-					

Part II Certification

Under penalties of perjury, I certify that:

1. The number shown on this form is my correct taxpayer identification number (or I am waiting for a number to be issued to me); and
2. I am not subject to backup withholding because: (a) I am exempt from backup withholding, or (b) I have not been notified by the Internal Revenue Service (IRS) that I am subject to backup withholding as a result of a failure to report all interest or dividends, or (c) the IRS has notified me that I am no longer subject to backup withholding; and
3. I am a U.S. citizen or other U.S. person (defined below); and
4. The FATCA code(s) entered on this form (if any) indicating that I am exempt from FATCA reporting is correct.

Certification instructions. You must cross out item 2 above if you have been notified by the IRS that you are currently subject to backup withholding because you have failed to report all interest and dividends on your tax return. For real estate transactions, item 2 does not apply. For mortgage interest paid, acquisition or abandonment of secured property, cancellation of debt, contributions to an individual retirement arrangement (IRA), and generally, payments other than interest and dividends, you are not required to sign the certification, but you must provide your correct TIN. See the instructions for Part II, later.

Sign Here	Signature of U.S. person ►	Date ►
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General Instructions

Section references are to the Internal Revenue Code unless otherwise noted.

Future developments. For the latest information about developments related to Form W-9 and its instructions, such as legislation enacted after they were published, go to www.irs.gov/FormW9.

Purpose of Form

An individual or entity (Form W-9 requester) who is required to file an information return with the IRS must obtain your correct taxpayer identification number (TIN) which may be your social security number (SSN), individual taxpayer identification number (ITIN), adoption taxpayer identification number (ATIN), or employer identification number (EIN), to report on an information return the amount paid to you, or other amount reportable on an information return. Examples of information returns include, but are not limited to, the following.

- Form 1099-INT (interest earned or paid)

- Form 1099-DIV (dividends, including those from stocks or mutual funds)
- Form 1099-MISC (various types of income, prizes, awards, or gross proceeds)
- Form 1099-B (stock or mutual fund sales and certain other transactions by brokers)
- Form 1099-S (proceeds from real estate transactions)
- Form 1099-K (merchant card and third party network transactions)
- Form 1098 (home mortgage interest), 1098-E (student loan interest), 1098-T (tuition)
- Form 1099-C (canceled debt)
- Form 1099-A (acquisition or abandonment of secured property)

Use Form W-9 only if you are a U.S. person (including a resident alien), to provide your correct TIN.

If you do not return Form W-9 to the requester with a TIN, you might be subject to backup withholding. See What is backup withholding, later.

By signing the filled-out form, you:

1. Certify that the TIN you are giving is correct (or you are waiting for a number to be issued),
2. Certify that you are not subject to backup withholding, or
3. Claim exemption from backup withholding if you are a U.S. exempt payee. If applicable, you are also certifying that as a U.S. person, your allocable share of any partnership income from a U.S. trade or business is not subject to the withholding tax on foreign partners' share of effectively connected income, and
4. Certify that FATCA code(s) entered on this form (if any) indicating that you are exempt from the FATCA reporting, is correct. See *What is FATCA reporting*, later, for further information.

Note: If you are a U.S. person and a requester gives you a form other than Form W-9 to request your TIN, you must use the requester's form if it is substantially similar to this Form W-9.

Definition of a U.S. person. For federal tax purposes, you are considered a U.S. person if you are:

- An individual who is a U.S. citizen or U.S. resident alien;
- A partnership, corporation, company, or association created or organized in the United States or under the laws of the United States;
- An estate (other than a foreign estate); or
- A domestic trust (as defined in Regulations section 301.7701-7).

Special rules for partnerships. Partnerships that conduct a trade or business in the United States are generally required to pay a withholding tax under section 1446 on any foreign partners' share of effectively connected taxable income from such business. Further, in certain cases where a Form W-9 has not been received, the rules under section 1446 require a partnership to presume that a partner is a foreign person, and pay the section 1446 withholding tax. Therefore, if you are a U.S. person that is a partner in a partnership conducting a trade or business in the United States, provide Form W-9 to the partnership to establish your U.S. status and avoid section 1446 withholding on your share of partnership income.

In the cases below, the following person must give Form W-9 to the partnership for purposes of establishing its U.S. status and avoiding withholding on its allocable share of net income from the partnership conducting a trade or business in the United States.

- In the case of a disregarded entity with a U.S. owner, the U.S. owner of the disregarded entity and not the entity;
- In the case of a grantor trust with a U.S. grantor or other U.S. owner, generally, the U.S. grantor or other U.S. owner of the grantor trust and not the trust; and
- In the case of a U.S. trust (other than a grantor trust), the U.S. trust (other than a grantor trust) and not the beneficiaries of the trust.

Foreign person. If you are a foreign person or the U.S. branch of a foreign bank that has elected to be treated as a U.S. person, do not use Form W-9. Instead, use the appropriate Form W-8 or Form 8233 (see Pub. 515, *Withholding of Tax on Nonresident Aliens and Foreign Entities*).

Nonresident alien who becomes a resident alien. Generally, only a nonresident alien individual may use the terms of a tax treaty to reduce or eliminate U.S. tax on certain types of income. However, most tax treaties contain a provision known as a "saving clause." Exceptions specified in the saving clause may permit an exemption from tax to continue for certain types of income even after the payee has otherwise become a U.S. resident alien for tax purposes.

If you are a U.S. resident alien who is relying on an exception contained in the saving clause of a tax treaty to claim an exemption from U.S. tax on certain types of income, you must attach a statement to Form W-9 that specifies the following five items.

1. The treaty country. Generally, this must be the same treaty under which you claimed exemption from tax as a nonresident alien.
2. The treaty article addressing the income.
3. The article number (or location) in the tax treaty that contains the saving clause and its exceptions.
4. The type and amount of income that qualifies for the exemption from tax.
5. Sufficient facts to justify the exemption from tax under the terms of the treaty article.

Example. Article 20 of the U.S.-China income tax treaty allows an exemption from tax for scholarship income received by a Chinese student temporarily present in the United States. Under U.S. law, this student will become a resident alien for tax purposes if his or her stay in the United States exceeds 5 calendar years. However, paragraph 2 of the first Protocol to the U.S.-China treaty (dated April 30, 1984) allows the provisions of Article 20 to continue to apply even after the Chinese student becomes a resident alien of the United States. A Chinese student who qualifies for this exception (under paragraph 2 of the first protocol) and is relying on this exception to claim an exemption from tax on his or her scholarship or fellowship income would attach to Form W-9 a statement that includes the information described above to support that exemption.

If you are a nonresident alien or a foreign entity, give the requester the appropriate completed Form W-8 or Form 8233.

Backup Withholding

What is backup withholding? Persons making certain payments to you must under certain conditions withhold and pay to the IRS 24% of such payments. This is called "backup withholding." Payments that may be subject to backup withholding include interest, tax-exempt interest, dividends, broker and barter exchange transactions, rents, royalties, nonemployee pay, payments made in settlement of payment card and third party network transactions, and certain payments from fishing boat operators. Real estate transactions are not subject to backup withholding.

You will not be subject to backup withholding on payments you receive if you give the requester your correct TIN, make the proper certifications, and report all your taxable interest and dividends on your tax return.

Payments you receive will be subject to backup withholding if:

1. You do not furnish your TIN to the requester,
2. You do not certify your TIN when required (see the instructions for Part II for details),
3. The IRS tells the requester that you furnished an incorrect TIN,
4. The IRS tells you that you are subject to backup withholding because you did not report all your interest and dividends on your tax return (for reportable interest and dividends only), or
5. You do not certify to the requester that you are not subject to backup withholding under 4 above (for reportable interest and dividend accounts opened after 1983 only).

Certain payees and payments are exempt from backup withholding. See *Exempt payee code*, later, and the separate Instructions for the Requester of Form W-9 for more information.

Also see *Special rules for partnerships*, earlier.

What is FATCA Reporting?

The Foreign Account Tax Compliance Act (FATCA) requires a participating foreign financial institution to report all United States account holders that are specified United States persons. Certain payees are exempt from FATCA reporting. See *Exemption from FATCA reporting code*, later, and the Instructions for the Requester of Form W-9 for more information.

Updating Your Information

You must provide updated information to any person to whom you claimed to be an exempt payee if you are no longer an exempt payee and anticipate receiving reportable payments in the future from this person. For example, you may need to provide updated information if you are a C corporation that elects to be an S corporation, or if you no longer are tax exempt. In addition, you must furnish a new Form W-9 if the name or TIN changes for the account; for example, if the grantor of a grantor trust dies.

Penalties

Failure to furnish TIN. If you fail to furnish your correct TIN to a requester, you are subject to a penalty of \$50 for each such failure unless your failure is due to reasonable cause and not to willful neglect.

Civil penalty for false information with respect to withholding. If you make a false statement with no reasonable basis that results in no backup withholding, you are subject to a \$500 penalty.

Criminal penalty for falsifying information. Willfully falsifying certifications or affirmations may subject you to criminal penalties including fines and/or imprisonment.

Misuse of TINs. If the requester discloses or uses TINs in violation of federal law, the requester may be subject to civil and criminal penalties.

Specific Instructions

Line 1

You must enter one of the following on this line; **do not** leave this line blank. The name should match the name on your tax return.

If this Form W-9 is for a joint account (other than an account maintained by a foreign financial institution (FFI)), list first, and then circle, the name of the person or entity whose number you entered in Part I of Form W-9. If you are providing Form W-9 to an FFI to document a joint account, each holder of the account that is a U.S. person must provide a Form W-9.

a. **Individual.** Generally, enter the name shown on your tax return. If you have changed your last name without informing the Social Security Administration (SSA) of the name change, enter your first name, the last name as shown on your social security card, and your new last name.

Note: ITIN applicant: Enter your individual name as it was entered on your Form W-7 application, line 1a. This should also be the same as the name you entered on the Form 1040/1040A/1040EZ you filed with your application.

b. **Sole proprietor or single-member LLC.** Enter your individual name as shown on your 1040/1040A/1040EZ on line 1. You may enter your business, trade, or "doing business as" (DBA) name on line 2.

c. **Partnership, LLC that is not a single-member LLC, C corporation, or S corporation.** Enter the entity's name as shown on the entity's tax return on line 1 and any business, trade, or DBA name on line 2.

d. **Other entities.** Enter your name as shown on required U.S. federal tax documents on line 1. This name should match the name shown on the charter or other legal document creating the entity. You may enter any business, trade, or DBA name on line 2.

e. **Disregarded entity.** For U.S. federal tax purposes, an entity that is disregarded as an entity separate from its owner is treated as a "disregarded entity." See Regulations section 301.7701-2(c)(2)(iii). Enter the owner's name on line 1. The name of the entity entered on line 1 should never be a disregarded entity. The name on line 1 should be the name shown on the income tax return on which the income should be reported. For example, if a foreign LLC that is treated as a disregarded entity for U.S. federal tax purposes has a single owner that is a U.S. person, the U.S. owner's name is required to be provided on line 1. If the direct owner of the entity is also a disregarded entity, enter the first owner that is not disregarded for federal tax purposes. Enter the disregarded entity's name on line 2, "Business name/disregarded entity name." If the owner of the disregarded entity is a foreign person, the owner must complete an appropriate Form W-8 instead of a Form W-9. This is the case even if the foreign person has a U.S. TIN.

Line 2

If you have a business name, trade name, DBA name, or disregarded entity name, you may enter it on line 2.

Line 3

Check the appropriate box on line 3 for the U.S. federal tax classification of the person whose name is entered on line 1. Check only one box on line 3.

IF the entity/person on line 1 is a(n) . . .	THEN check the box for . . .
• Corporation	Corporation
• Individual • Sole proprietorship, or • Single-member limited liability company (LLC) owned by an individual and disregarded for U.S. federal tax purposes.	Individual/sole proprietor or single-member LLC
• LLC treated as a partnership for U.S. federal tax purposes, • LLC that has filed Form 8832 or 2553 to be taxed as a corporation, or • LLC that is disregarded as an entity separate from its owner but the owner is another LLC that is not disregarded for U.S. federal tax purposes.	Limited liability company and enter the appropriate tax classification. (P= Partnership; C= C corporation; or S= S corporation)
• Partnership	Partnership
• Trust/estate	Trust/estate

Line 4, Exemptions

If you are exempt from backup withholding and/or FATCA reporting, enter in the appropriate space on line 4 any code(s) that may apply to you.

Exempt payee code.

- Generally, individuals (including sole proprietors) are not exempt from backup withholding.
- Except as provided below, corporations are exempt from backup withholding for certain payments, including interest and dividends.
- Corporations are not exempt from backup withholding for payments made in settlement of payment card or third party network transactions.
- Corporations are not exempt from backup withholding with respect to attorneys' fees or gross proceeds paid to attorneys, and corporations that provide medical or health care services are not exempt with respect to payments reportable on Form 1099-MISC.

The following codes identify payees that are exempt from backup withholding. Enter the appropriate code in the space in line 4.

- 1—An organization exempt from tax under section 501(a), any IRA, or a custodial account under section 403(b)(7) if the account satisfies the requirements of section 401(f)(2)
- 2—The United States or any of its agencies or instrumentalities
- 3—A state, the District of Columbia, a U.S. commonwealth or possession, or any of their political subdivisions or instrumentalities
- 4—A foreign government or any of its political subdivisions, agencies, or instrumentalities
- 5—A corporation
- 6—A dealer in securities or commodities required to register in the United States, the District of Columbia, or a U.S. commonwealth or possession
- 7—A futures commission merchant registered with the Commodity Futures Trading Commission
- 8—A real estate investment trust
- 9—An entity registered at all times during the tax year under the Investment Company Act of 1940
- 10—A common trust fund operated by a bank under section 584(a)
- 11—A financial institution
- 12—A middleman known in the investment community as a nominee or custodian
- 13—A trust exempt from tax under section 664 or described in section 4947

The following chart shows types of payments that may be exempt from backup withholding. The chart applies to the exempt payees listed above, 1 through 13.

IF the payment is for . . .	THEN the payment is exempt for . . .
Interest and dividend payments	All exempt payees except for 7
Broker transactions	Exempt payees 1 through 4 and 6 through 11 and all C corporations. S corporations must not enter an exempt payee code because they are exempt only for sales of noncovered securities acquired prior to 2012.
Barter exchange transactions and patronage dividends	Exempt payees 1 through 4
Payments over \$600 required to be reported and direct sales over \$5,000 ¹	Generally, exempt payees 1 through 5 ²
Payments made in settlement of payment card or third party network transactions	Exempt payees 1 through 4

¹ See Form 1099-MISC, Miscellaneous Income, and its instructions.

² However, the following payments made to a corporation and reportable on Form 1099-MISC are not exempt from backup withholding: medical and health care payments, attorneys' fees, gross proceeds paid to an attorney reportable under section 6045(f), and payments for services paid by a federal executive agency.

Exemption from FATCA reporting code. The following codes identify payees that are exempt from reporting under FATCA. These codes apply to persons submitting this form for accounts maintained outside of the United States by certain foreign financial institutions. Therefore, if you are only submitting this form for an account you hold in the United States, you may leave this field blank. Consult with the person requesting this form if you are uncertain if the financial institution is subject to these requirements. A requester may indicate that a code is not required by providing you with a Form W-9 with "Not Applicable" (or any similar indication) written or printed on the line for a FATCA exemption code.

A—An organization exempt from tax under section 501(a) or any individual retirement plan as defined in section 7701(a)(37)

B—The United States or any of its agencies or instrumentalities

C—A state, the District of Columbia, a U.S. commonwealth or possession, or any of their political subdivisions or instrumentalities

D—A corporation the stock of which is regularly traded on one or more established securities markets, as described in Regulations section 1.1472-1(c)(1)(i)

E—A corporation that is a member of the same expanded affiliated group as a corporation described in Regulations section 1.1472-1(c)(1)(i)

F—A dealer in securities, commodities, or derivative financial instruments (including notional principal contracts, futures, forwards, and options) that is registered as such under the laws of the United States or any state

G—A real estate investment trust

H—A regulated investment company as defined in section 851 or an entity registered at all times during the tax year under the Investment Company Act of 1940

I—A common trust fund as defined in section 584(a)

J—A bank as defined in section 581

K—A broker

L—A trust exempt from tax under section 664 or described in section 4947(a)(1)

M—A tax exempt trust under a section 403(b) plan or section 457(g) plan

Note: You may wish to consult with the financial institution requesting this form to determine whether the FATCA code and/or exempt payee code should be completed.

Line 5

Enter your address (number, street, and apartment or suite number). This is where the requester of this Form W-9 will mail your information returns. If this address differs from the one the requester already has on file, write NEW at the top. If a new address is provided, there is still a chance the old address will be used until the payor changes your address in their records.

Line 6

Enter your city, state, and ZIP code.

Part I. Taxpayer Identification Number (TIN)

Enter your TIN in the appropriate box. If you are a resident alien and you do not have and are not eligible to get an SSN, your TIN is your IRS individual taxpayer identification number (ITIN). Enter it in the social security number box. If you do not have an ITIN, see *How to get a TIN* below.

If you are a sole proprietor and you have an EIN, you may enter either your SSN or EIN.

If you are a single-member LLC that is disregarded as an entity separate from its owner, enter the owner's SSN (or EIN, if the owner has one). Do not enter the disregarded entity's EIN. If the LLC is classified as a corporation or partnership, enter the entity's EIN.

Note: See *What Name and Number To Give the Requester*, later, for further clarification of name and TIN combinations.

How to get a TIN. If you do not have a TIN, apply for one immediately. To apply for an SSN, get Form SS-5, Application for a Social Security Card, from your local SSA office or get this form online at www.SSA.gov. You may also get this form by calling 1-800-772-1213. Use Form W-7, Application for IRS Individual Taxpayer Identification Number, to apply for an ITIN, or Form SS-4, Application for Employer Identification Number, to apply for an EIN. You can apply for an EIN online by accessing the IRS website at www.irs.gov/Businesses and clicking on Employer Identification Number (EIN) under Starting a Business. Go to www.irs.gov/Forms to view, download, or print Form W-7 and/or Form SS-4. Or, you can go to www.irs.gov/OrderForms to place an order and have Form W-7 and/or SS-4 mailed to you within 10 business days.

If you are asked to complete Form W-9 but do not have a TIN, apply for a TIN and write "Applied For" in the space for the TIN, sign and date the form, and give it to the requester. For interest and dividend payments, and certain payments made with respect to readily tradable instruments, generally you will have 60 days to get a TIN and give it to the requester before you are subject to backup withholding on payments. The 60-day rule does not apply to other types of payments. You will be subject to backup withholding on all such payments until you provide your TIN to the requester.

Note: Entering "Applied For" means that you have already applied for a TIN or that you intend to apply for one soon.

Caution: A disregarded U.S. entity that has a foreign owner must use the appropriate Form W-8.

Part II. Certification

To establish to the withholding agent that you are a U.S. person, or resident alien, sign Form W-9. You may be requested to sign by the withholding agent even if item 1, 4, or 5 below indicates otherwise.

For a joint account, only the person whose TIN is shown in Part I should sign (when required). In the case of a disregarded entity, the person identified on line 1 must sign. Exempt payees, see *Exempt payee code*, earlier.

Signature requirements. Complete the certification as indicated in items 1 through 5 below.

1. Interest, dividend, and barter exchange accounts opened before 1984 and broker accounts considered active during 1983. You must give your correct TIN, but you do not have to sign the certification.

2. Interest, dividend, broker, and barter exchange accounts opened after 1983 and broker accounts considered inactive during 1983. You must sign the certification or backup withholding will apply. If you are subject to backup withholding and you are merely providing your correct TIN to the requester, you must cross out item 2 in the certification before signing the form.

3. Real estate transactions. You must sign the certification. You may cross out item 2 of the certification.

4. Other payments. You must give your correct TIN, but you do not have to sign the certification unless you have been notified that you have previously given an incorrect TIN. "Other payments" include payments made in the course of the requester's trade or business for rents, royalties, goods (other than bills for merchandise), medical and health care services (including payments to corporations), payments to a nonemployee for services, payments made in settlement of payment card and third party network transactions, payments to certain fishing boat crew members and fishermen, and gross proceeds paid to attorneys (including payments to corporations).

5. Mortgage interest paid by you, acquisition or abandonment of secured property, cancellation of debt, qualified tuition program payments (under section 529), ABLE accounts (under section 529A), IRA, Coverdell ESA, Archer MSA or HSA contributions or distributions, and pension distributions. You must give your correct TIN, but you do not have to sign the certification.

What Name and Number To Give the Requester

For this type of account:	Give name and SSN of:
1. Individual	The individual
2. Two or more individuals (joint account) other than an account maintained by an FFI	The actual owner of the account or, if combined funds, the first individual on the account ¹
3. Two or more U.S. persons (joint account maintained by an FFI)	Each holder of the account
4. Custodial account of a minor (Uniform Gift to Minors Act)	The minor ²
5. a. The usual revocable savings trust (grantor is also trustee)	The grantor-trustee ¹
b. So-called trust account that is not a legal or valid trust under state law	The actual owner ¹
6. Sole proprietorship or disregarded entity owned by an individual	The owner ³
7. Grantor trust filing under Optional Form 1099 Filing Method 1 (see Regulations section 1.671-4(b)(2)(i)(A))	The grantor*
For this type of account:	Give name and EIN of:
8. Disregarded entity not owned by an individual	The owner
9. A valid trust, estate, or pension trust	Legal entity ⁴
10. Corporation or LLC electing corporate status on Form 8832 or Form 2553	The corporation
11. Association, club, religious, charitable, educational, or other tax-exempt organization	The organization
12. Partnership or multi-member LLC	The partnership
13. A broker or registered nominee	The broker or nominee

For this type of account:	Give name and EIN of:
14. Account with the Department of Agriculture in the name of a public entity (such as a state or local government, school district, or prison) that receives agricultural program payments	The public entity
15. Grantor trust filing under the Form 1041 Filing Method or the Optional Form 1099 Filing Method 2 (see Regulations section 1.671-4(b)(2)(i)(B))	The trust

¹ List first and circle the name of the person whose number you furnish. If only one person on a joint account has an SSN, that person's number must be furnished.

² Circle the minor's name and furnish the minor's SSN.

³ You must show your individual name and you may also enter your business or DBA name on the "Business name/disregarded entity" name line. You may use either your SSN or EIN (if you have one), but the IRS encourages you to use your SSN.

⁴ List first and circle the name of the trust, estate, or pension trust. (Do not furnish the TIN of the personal representative or trustee unless the legal entity itself is not designated in the account title.) Also see *Special rules for partnerships*, earlier.

***Note:** The grantor also must provide a Form W-9 to trustee of trust.

Note: If no name is circled when more than one name is listed, the number will be considered to be that of the first name listed.

Secure Your Tax Records From Identity Theft

Identity theft occurs when someone uses your personal information such as your name, SSN, or other identifying information, without your permission, to commit fraud or other crimes. An identity thief may use your SSN to get a job or may file a tax return using your SSN to receive a refund.

To reduce your risk:

- Protect your SSN,
- Ensure your employer is protecting your SSN, and
- Be careful when choosing a tax preparer.

If your tax records are affected by identity theft and you receive a notice from the IRS, respond right away to the name and phone number printed on the IRS notice or letter.

If your tax records are not currently affected by identity theft but you think you are at risk due to a lost or stolen purse or wallet, questionable credit card activity or credit report, contact the IRS Identity Theft Hotline at 1-800-908-4490 or submit Form 14039.

For more information, see Pub. 5027, Identity Theft Information for Taxpayers.

Victims of identity theft who are experiencing economic harm or a systemic problem, or are seeking help in resolving tax problems that have not been resolved through normal channels, may be eligible for Taxpayer Advocate Service (TAS) assistance. You can reach TAS by calling the TAS toll-free case intake line at 1-877-777-4778 or TTY/TDD 1-800-829-4059.

Protect yourself from suspicious emails or phishing schemes. Phishing is the creation and use of email and websites designed to mimic legitimate business emails and websites. The most common act is sending an email to a user falsely claiming to be an established legitimate enterprise in an attempt to scam the user into surrendering private information that will be used for identity theft.

The IRS does not initiate contacts with taxpayers via emails. Also, the IRS does not request personal detailed information through email or ask taxpayers for the PIN numbers, passwords, or similar secret access information for their credit card, bank, or other financial accounts.

If you receive an unsolicited email claiming to be from the IRS, forward this message to phishing@irs.gov. You may also report misuse of the IRS name, logo, or other IRS property to the Treasury Inspector General for Tax Administration (TIGTA) at 1-800-366-4484. You can forward suspicious emails to the Federal Trade Commission at spam@uce.gov or report them at www.ftc.gov/complaint. You can contact the FTC at www.ftc.gov/idtheft or 877-IDTHEFT (877-438-4338). If you have been the victim of identity theft, see www.IdentityTheft.gov and Pub. 5027.

Visit www.irs.gov/IdentityTheft to learn more about identity theft and how to reduce your risk.

Privacy Act Notice

Section 6109 of the Internal Revenue Code requires you to provide your correct TIN to persons (including federal agencies) who are required to file information returns with the IRS to report interest, dividends, or certain other income paid to you; mortgage interest you paid; the acquisition or abandonment of secured property; the cancellation of debt; or contributions you made to an IRA, Archer MSA, or HSA. The person collecting this form uses the information on the form to file information returns with the IRS, reporting the above information. Routine uses of this information include giving it to the Department of Justice for civil and criminal litigation and to cities, states, the District of Columbia, and U.S. commonwealths and possessions for use in administering their laws. The information also may be disclosed to other countries under a treaty, to federal and state agencies to enforce civil and criminal laws, or to federal law enforcement and intelligence agencies to combat terrorism. You must provide your TIN whether or not you are required to file a tax return. Under section 3406, payers must generally withhold a percentage of taxable interest, dividend, and certain other payments to a payee who does not give a TIN to the payer. Certain penalties may also apply for providing false or fraudulent information.

CONFLICT OF INTEREST QUESTIONNAIRE

For vendor doing business with local governmental entity

FORM CIQ

This questionnaire reflects changes made to the law by H.B. 23, 84th Leg., Regular Session.

This questionnaire is being filed in accordance with Chapter 176, Local Government Code, by a vendor who has a business relationship as defined by Section 176.001(1-a) with a local governmental entity and the vendor meets requirements under Section 176.006(a).

By law this questionnaire must be filed with the records administrator of the local governmental entity not later than the 7th business day after the date the vendor becomes aware of facts that require the statement to be filed. See Section 176.006(a-1), Local Government Code.

A vendor commits an offense if the vendor knowingly violates Section 176.006, Local Government Code. An offense under this section is a misdemeanor.

OFFICE USE ONLY

Date Received

1 Name of vendor who has a business relationship with local governmental entity.

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 appropriate filing authority not later than the 7th business day after the date on which you became aware that the originally filed questionnaire was incomplete or inaccurate.)

3 Name of local government officer about whom the information is being disclosed.

Name of Officer

4 Describe each employment or other business relationship with the local government officer, or a family member of the officer, as described by Section 176.003(a)(2)(A). Also describe any family relationship with the local government officer. Complete subparts A and B for each employment or business relationship described. Attach additional pages to this Form CIQ as necessary.

A. Is the local government officer or a family member of the officer receiving or likely to receive taxable income, other than investment income, from the vendor?

☐

Yes

☐

No

B. Is the vendor receiving or likely to receive taxable income, other than investment income, from or at the direction of the local government officer or a family member of the officer AND the taxable income is not received from the local governmental entity?

☐

Yes

☐

No

5 Describe each employment or business relationship that the vendor named in Section 1 maintains with a corporation or other business entity with respect to which the local government officer serves as an officer or director, or holds an ownership interest of one percent or more.

6 ☐ Check this box if the vendor has given the local government officer or a family member of the officer one or more gifts as described in Section 176.003(a)(2)(B), excluding gifts described in Section 176.003(a-1).

7

Signature of vendor doing business with the governmental entity

Date

CONFLICT OF INTEREST QUESTIONNAIRE

For vendor doing business with local governmental entity

A complete copy of Chapter 176 of the Local Government Code may be found at <http://www.statutes.legis.state.tx.us/Docs/LG/htm/LG.176.htm>. For easy reference, below are some of the sections cited on this form.

Local Government Code § 176.001(1-a): "Business relationship" means a connection between two or more parties based on commercial activity of one of the parties. The term does not include a connection based on:

- (A) a transaction that is subject to rate or fee regulation by a federal, state, or local governmental entity or an agency of a federal, state, or local governmental entity;
- (B) a transaction conducted at a price and subject to terms available to the public; or
- (C) a purchase or lease of goods or services from a person that is chartered by a state or federal agency and that is subject to regular examination by, and reporting to, that agency.

Local Government Code § 176.003(a)(2)(A) and (B):

(a) A local government officer shall file a conflicts disclosure statement with respect to a vendor if:

(2) the vendor:

(A) has an employment or other business relationship with the local government officer or a family member of the officer that results in the officer or family member receiving taxable income, other than investment income, that exceeds \$2,500 during the 12-month period preceding the date that the officer becomes aware that

(i) a contract between the local governmental entity and vendor has been executed;

or

(ii) the local governmental entity is considering entering into a contract with the vendor;

(B) has given to the local government officer or a family member of the officer one or more gifts that have an aggregate value of more than \$100 in the 12-month period preceding the date the officer becomes aware that:

(i) a contract between the local governmental entity and vendor has been executed; or

(ii) the local governmental entity is considering entering into a contract with the vendor.

Local Government Code § 176.006(a) and (a-1)

(a) A vendor shall file a completed conflict of interest questionnaire if the vendor has a business relationship with a local governmental entity and:

(1) has an employment or other business relationship with a local government officer of that local governmental entity, or a family member of the officer, described by Section 176.003(a)(2)(A);

(2) has given a local government officer of that local governmental entity, or a family member of the officer, one or more gifts with the aggregate value specified by Section 176.003(a)(2)(B), excluding any gift described by Section 176.003(a-1); or

(3) has a family relationship with a local government officer of that local governmental entity.

(a-1) The completed conflict of interest questionnaire must be filed with the appropriate records administrator not later than the seventh business day after the later of:

(1) the date that the vendor:

(A) begins discussions or negotiations to enter into a contract with the local governmental entity; or

(B) submits to the local governmental entity an application, response to a request for proposals or bids, correspondence, or another writing related to a potential contract with the local governmental entity; or

(2) the date the vendor becomes aware:

(A) of an employment or other business relationship with a local government officer, or a family member of the officer, described by Subsection (a);

(B) that the vendor has given one or more gifts described by Subsection (a); or

(C) of a family relationship with a local government officer.



STANDARD FORM OF AGREEMENT (CONTRACT)

AGREEMENT BETWEEN OWNER AND CONTRACTOR FOR CONSTRUCTION CONTRACT (STIPULATED PRICE)

This Agreement is by and between **Sabine River Authority of Texas**, a Texas governmental entity ("Owner") and **[name of contracting entity]**, a _____ ("Contractor").

Terms used in this Agreement have the meanings stated in the General Conditions and the Supplementary Conditions.

Owner and Contractor hereby agree as follows:

ARTICLE 1—WORK

- 1.01 Contractor shall complete all Work as specified or indicated in the Contract Documents. The Work is generally described as follows: **This project includes additions of a new boat ramp and parking facilities to update the Sabinetown park and fishing facilities. The work will include necessary demolition and structural excavation of existing conditions, structural concrete flatwork, metal fabrications, trenching and backfill, steel sheet piling, paving and curbs/gutters, signage, striping, trash cans, and other parking lot appurtenances, dredging, sanitary systems, and coordination with private utility owners and the city on existing utilities.**

There are five bid alternatives for this project,

1. Alternate No. 1 (Overflow Parking Lot Expansion)
2. Alternate No. 2 (ADA Walkway and Floating Dock North)
3. Alternate No. 3 (Floating Dock South)
4. Alternate No. 4 (Accessible Transfer Platform)
5. Alternate No. 5 (Decorative Stone Veneer)
6. Alternate No. 6 (Wood Framed Alternative Design)

ARTICLE 2—THE PROJECT

- 2.01 The Project, of which the Work under the Contract Documents is a part, is generally described as follows: **Sabinetown Recreation Area
RFB 25-1202**

ARTICLE 3—ENGINEER

- 3.01 The Owner has retained **Freese and Nichols** ("Engineer") to act as Owner's representative, assume all duties and responsibilities of Engineer, and have the rights and authority assigned to Engineer in the Contract.

ARTICLE 4—CONTRACT TIMES

- 4.01 *Time is of the Essence*

- A. All time limits for Milestones, if any, Substantial Completion, and completion and readiness for final payment as stated in the Contract Documents are of the essence of the Contract.

4.03 *Contract Times: Days*

- A. The Work will be substantially complete within **270** consecutive calendar days after the date when the Contract Times commence to run as provided in Paragraph 4.01 of the General Conditions, and completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions within **300** consecutive calendar days after the date when the Contract Times commence to run.

4.05 *Liquidated Damages*

- A. Contractor and Owner recognize that time is of the essence as stated in Paragraph 4.01 above and that Owner will suffer financial and other losses if the Work is not completed and Milestones not achieved within the Contract Times, as duly modified. The parties also recognize the delays, expense, and difficulties involved in proving, in a legal or arbitration proceeding, the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty):
 - 1. *Substantial Completion:* Contractor shall pay Owner **\$500** for each day that expires after the time (as duly adjusted pursuant to the Contract) specified above for Substantial Completion, until the Work is substantially complete.
 - 2. *Completion of Remaining Work:* After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Times (as duly adjusted pursuant to the Contract) for completion and readiness for final payment, Contractor shall pay Owner **\$500** for each day that expires after such time until the Work is completed and ready for final payment.
 - 3. Liquidated damages for failing to timely attain Milestones, Substantial Completion, and final completion are not additive, and will not be imposed concurrently.
- B. If Owner recovers liquidated damages for a delay in completion by Contractor, then such liquidated damages are Owner's sole and exclusive remedy for such delay, and Owner is precluded from recovering any other damages, whether actual, direct, excess, or consequential, for such delay, except for special damages (if any) specified in this Agreement.

ARTICLE 5—CONTRACT PRICE

- 5.01 Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents, the amounts that follow, subject to adjustment under the Contract:
 - A. For all Work, at the prices stated in Contractor's Bid, attached hereto as an exhibit. Total Contract Amount: \$_____.

ARTICLE 6—PAYMENT PROCEDURES

6.01 *Submittal and Processing of Payments*

- A. Contractor shall submit Applications for Payment in accordance with Article 15 of the General Conditions. Applications for Payment will be processed by Engineer as provided in the General Conditions.

6.02 *Progress Payments; Retainage*

- A. Owner shall make progress payments on the basis of Contractor's Applications for Payment within 30 days of receiving engineer approved pay request, as provided in Paragraph 6.02.A.1 below, provided that such Applications for Payment have been submitted in a timely manner and otherwise meet the requirements of the Contract. All such payments will be measured by the Schedule of Values established as provided in the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no Schedule of Values, as provided elsewhere in the Contract.
 - 1. Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below but, in each case, less the aggregate of payments previously made and less such amounts as Owner may withhold, including but not limited to liquidated damages, in accordance with the Contract and Texas Water Code Chapter 49.276 .
 - a. **95%** percent of the value of the Work completed (with the balance being retainage).
 - b. **95%** percent of cost of materials and equipment not incorporated in the Work (with the balance being retainage).
- B. Upon Substantial Completion, Owner shall pay an amount sufficient to increase total payments to Contractor to the Work completed, less such amounts set off by Owner pursuant to Paragraph 15.01.E of the General Conditions, and less Engineer's estimate of the value of Work to be completed or corrected as shown on the punch list of items to be completed or corrected prior to final payment.

6.03 *Final Payment*

- A. Upon final completion and acceptance of the Work, Owner shall pay the remainder of the Contract Price in accordance with Paragraph 15.06 of the General Conditions.

6.04 *Consent of Surety*

- A. Owner will not make final payment, or return or release retainage at Substantial Completion or any other time, unless Contractor submits written consent of the surety to such payment, return, or release.

6.05 *Interest*

- A. All amounts not paid when due will bear interest at the lowest amount allowed by law.

ARTICLE 7—CONTRACT DOCUMENTS

7.01 *Contents*

- A. The Contract Documents consist of all of the following:
 - 1. This Agreement.
 - 2. Bonds:
 - a. Performance bond (together with power of attorney).
 - b. Payment bond (together with power of attorney).
 - 3. General Conditions.

4. Supplementary Conditions.
5. Specifications as listed in the table of contents of the project manual (copy of list attached).
6. Drawings (not attached but incorporated by reference) consisting of **68** sheets with each sheet bearing the following general title: **Sabinetown Recreation Area**.
7. Addenda (numbers **[number]** to **[number]**, inclusive).
8. Exhibits to this Agreement (enumerated as follows):
 - a. **Contractors Bid (C-410)**
10. The following which may be delivered or issued on or after the Effective Date of the Contract and are not attached hereto:
 - a. Notice to Proceed.
 - b. Work Change Directives.
 - c. Change Orders.
 - d. Field Orders.
 - e. Warranty Bond, if any.
- B. The Contract Documents listed in Paragraph 7.01.A are attached to this Agreement (except as expressly noted otherwise above).
- C. There are no Contract Documents other than those listed above in this Article 7.
- D. The Contract Documents may only be amended, modified, or supplemented as provided in the Contract.

ARTICLE 8—REPRESENTATIONS, CERTIFICATIONS, AND STIPULATIONS

8.01 Contractor's Representations

- A. In order to induce Owner to enter into this Contract, Contractor makes the following representations:
 1. Contractor has examined and carefully studied the Contract Documents, including Addenda.
 2. Contractor has visited the Site, conducted a thorough visual examination of the Site and adjacent areas, and become familiar with the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
 3. Contractor is familiar with all Laws and Regulations that may affect cost, progress, and performance of the Work.
 4. Contractor has carefully studied the reports of explorations and tests of subsurface conditions at or adjacent to the Site and the drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, with respect to the Technical Data in such reports and drawings.

5. Contractor has carefully studied the reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, with respect to Technical Data in such reports and drawings.
6. Contractor has considered the information known to Contractor itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Contract Documents; and the Technical Data identified in the Supplementary Conditions or by definition, with respect to the effect of such information, observations, and Technical Data on (a) the cost, progress, and performance of the Work; (b) the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor; and (c) Contractor's safety precautions and programs.
7. Based on the information and observations referred to in the preceding paragraph, Contractor agrees that no further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.
8. Contractor is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Contract Documents.
9. Contractor has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents, and of discrepancies between Site conditions and the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.
10. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.
11. Contractor's entry into this Contract constitutes an incontrovertible representation by Contractor that without exception all prices in the Agreement are premised upon performing and furnishing the Work required by the Contract Documents.

8.02 *Contractor's Certifications*

- A. Contractor certifies that it has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Contract. For the purposes of this Paragraph 8.02:
 1. "corrupt practice" means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process or in the Contract execution;
 2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process or the execution of the Contract to the detriment of Owner, (b) to establish Bid or Contract prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;
 3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish Bid prices at artificial, non-competitive levels; and

4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

8.03 *Standard General Conditions*

- A. Owner stipulates that if the General Conditions that are made a part of this Contract are EJCDC® C-700, Standard General Conditions for the Construction Contract (2018), published by the Engineers Joint Contract Documents Committee, and if Owner is the party that has furnished said General Conditions, then Owner has plainly shown all modifications to the standard wording of such published document to the Contractor, through a process such as highlighting or "track changes" (redline/strikeout), or in the Supplementary Conditions.

IN WITNESS WHEREOF, Owner and Contractor have signed this Agreement.

This Agreement will be effective on _____ (which is the Effective Date of the Contract).

1.

Owner:

Sabine River Authority of Texas

(typed or printed name of organization)

By:

(individual's signature)

Date:

(date signed)

Name:

David Montagne

(typed or printed)

Title:

General Manager

(typed or printed)

Attest:

(individual's signature)

Title:

(typed or printed)

Address for giving notices:

Sabine River Authority of Texas

PO Box 579

Orange Texas, 77631

Designated Representative:

Name:

(typed or printed)

Title:

(typed or printed)

Address:

Contractor:

(typed or printed name of organization)

By:

(individual's signature)

Date:

(date signed)

Name:

(typed or printed)

Title:

(typed or printed)

(If [Type of Entity] is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.)

Attest:

(individual's signature)

Title:

(typed or printed)

Address for giving notices:

Designated Representative:

Name:

(typed or printed)

Title:

(typed or printed)

Address:

Phone: _____
Email: _____

Phone: _____
Email: _____
License No.: _____
(where applicable)
State: _____



INSURANCE CERTIFICATES
(TO BE INSERTED AT TIME OF EXECUTION)



PERFORMANCE and PAYMENT BONDS

PERFORMANCE BOND

Contractor Name: Address <i>(principal place of business)</i> :	Surety Name: Address <i>(principal place of business)</i> :
Owner Name: Sabine River Authority of Texas Mailing address <i>(principal place of business)</i> : 12777 Highway 87 N Orange, Texas 77632	Contract Description <i>(name and location)</i> : Sabinetown Recreation Area RFB 25-1202 Sabine County, TX Contract Price: Effective Date of Contract:
Bond Bond Amount: Date of Bond: <i>(Date of Bond cannot be earlier than Effective Date of Contract)</i> Modifications to this Bond form: <input type="checkbox"/> None <input type="checkbox"/> See Paragraph 16	
Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth in this Performance Bond, do each cause this Performance Bond to be duly executed by an authorized officer, agent, or representative.	
Contractor as Principal	Surety
<i>(Full formal name of Contractor)</i>	<i>(Full formal name of Surety) (corporate seal)</i>
By: _____ <div style="text-align: center;"><i>(Signature)</i></div>	By: _____ <div style="text-align: center;"><i>(Signature)(Attach Power of Attorney)</i></div>
Name: _____ <div style="text-align: center;"><i>(Printed or typed)</i></div>	Name: _____ <div style="text-align: center;"><i>(Printed or typed)</i></div>
Title: _____	Title: _____
Attest: _____ <div style="text-align: center;"><i>(Signature)</i></div>	Attest: _____ <div style="text-align: center;"><i>(Signature)</i></div>
Name: _____ <div style="text-align: center;"><i>(Printed or typed)</i></div>	Name: _____ <div style="text-align: center;"><i>(Printed or typed)</i></div>
Title: _____	Title: _____
<i>Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party is considered plural where applicable.</i>	

The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference.

1. If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except when applicable to participate in a conference as provided in Paragraph 3.
2. If there is no Owner Default under the Construction Contract, the Surety's obligation under this Bond will arise after:
 - 2.1. The Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice may indicate whether the Owner is requesting a conference among the Owner, Contractor, and Surety to discuss the Contractor's performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner's notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Paragraph 3.1 will be held within ten (10) business days of the Surety's receipt of the Owner's notice. If the Owner, the Contractor, and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement does not waive the Owner's right, if any, subsequently to declare a Contractor Default;
 - 2.2. The Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and
 - 2.3. The Owner has agreed to pay the Balance of the Contract Price in accordance with the terms of the Construction Contract to the Surety or to a contractor selected to perform the Construction Contract.
3. Failure on the part of the Owner to comply with the notice requirement in Paragraph 3.1 does not constitute a failure to comply with a condition precedent to the Surety's obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.
4. When the Owner has satisfied the conditions of Paragraph 3, the Surety shall promptly and at the Surety's expense take one of the following actions:
 - 4.1. Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract;
 - 4.2. Undertake to perform and complete the Construction Contract itself, through its agents or independent contractors;
 - 4.3. Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and a contractor selected with the Owners concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Paragraph 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or
 - 4.4. Waive its right to perform and complete, arrange for completion, or obtain a new contractor, and with reasonable promptness under the circumstances:

- 5.4.1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, make payment to the Owner; or
 - 5.4.2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.
- 5. If the Surety does not proceed as provided in Paragraph 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Paragraph 5.4, and the Owner refuses the payment, or the Surety has denied liability, in whole or in part, without further notice, the Owner shall be entitled to enforce any remedy available to the Owner.
- 6. If the Surety elects to act under Paragraph 5.1, 5.2, or 5.3, then the responsibilities of the Surety to the Owner will not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety will not be greater than those of the Owner under the Construction Contract. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication for:
 - 6.1. the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;
 - 6.2. additional legal, design professional, and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Paragraph 5; and
 - 6.3. liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.
- 7. If the Surety elects to act under Paragraph 5.1, 5.3, or 5.4, the Surety's liability is limited to the amount of this Bond.
- 8. The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price will not be reduced or set off on account of any such unrelated obligations. No right of action will accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators, successors, and assigns.
- 9. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.
- 10. Any proceeding, legal or equitable, under this Bond must be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and must be instituted within two years after a declaration of Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this paragraph are void or prohibited by law, the minimum periods of limitations available to sureties as a defense in the jurisdiction of the suit will be applicable.
- 11. Notice to the Surety, the Owner, or the Contractor must be mailed or delivered to the address shown on the page on which their signature appears.
- 12. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement will be deemed deleted therefrom and provisions conforming to such

statutory or other legal requirement will be deemed incorporated herein. When so furnished, the intent is that this Bond will be construed as a statutory bond and not as a common law bond.

13. Definitions

- 13.1. *Balance of the Contract Price*—The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made including allowance for the Contractor for any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.
 - 13.2. *Construction Contract*—The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.
 - 13.3. *Contractor Default*—Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.
 - 13.4. *Owner Default*—Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.
 - 13.5. *Contract Documents*—All the documents that comprise the agreement between the Owner and Contractor.
14. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond will be deemed to be Subcontractor and the term Owner will be deemed to be Contractor.
15. Modifications to this Bond are as follows: **[None]**

PAYMENT BOND

Contractor Name: Address <i>(principal place of business)</i> :	Surety Name: Address <i>(principal place of business)</i> :
Owner Name: Sabine River Authority of Texas Mailing address <i>(principal place of business)</i> : 12777 Highway 87 N Orange, Texas 77632	Contract Description <i>(name and location)</i> : Sabinetown Recreation Area RFB 25-1202 Sabine County, TX Contract Price: Effective Date of Contract:
Bond Bond Amount: Date of Bond: <i>(Date of Bond cannot be earlier than Effective Date of Contract)</i> Modifications to this Bond form: <input type="checkbox"/> None <input type="checkbox"/> See Paragraph 18	
Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth in this Payment Bond, do each cause this Payment Bond to be duly executed by an authorized officer, agent, or representative.	
Contractor as Principal	Surety
<i>(Full formal name of Contractor)</i>	<i>(Full formal name of Surety) (corporate seal)</i>
By: _____ <div style="text-align: center;"><i>(Signature)</i></div>	By: _____ <div style="text-align: center;"><i>(Signature)(Attach Power of Attorney)</i></div>
Name: _____ <div style="text-align: center;"><i>(Printed or typed)</i></div>	Name: _____ <div style="text-align: center;"><i>(Printed or typed)</i></div>
Title: _____	Title: _____
Attest: _____ <div style="text-align: center;"><i>(Signature)</i></div>	Attest: _____ <div style="text-align: center;"><i>(Signature)</i></div>
Name: _____ <div style="text-align: center;"><i>(Printed or typed)</i></div>	Name: _____ <div style="text-align: center;"><i>(Printed or typed)</i></div>
Title: _____	Title: _____
<i>Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party is considered plural where applicable.</i>	

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner to pay for labor, materials, and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference, subject to the following terms.
2. If the Contractor promptly makes payment of all sums due to Claimants, and defends, indemnifies, and holds harmless the Owner from claims, demands, liens, or suits by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, then the Surety and the Contractor shall have no obligation under this Bond.
3. If there is no Owner Default under the Construction Contract, the Surety's obligation to the Owner under this Bond will arise after the Owner has promptly notified the Contractor and the Surety (at the address described in Paragraph 13) of claims, demands, liens, or suits against the Owner or the Owner's property by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, and tendered defense of such claims, demands, liens, or suits to the Contractor and the Surety.
4. When the Owner has satisfied the conditions in Paragraph 3, the Surety shall promptly and at the Surety's expense defend, indemnify, and hold harmless the Owner against a duly tendered claim, demand, lien, or suit.
5. The Surety's obligations to a Claimant under this Bond will arise after the following:
 - 5.1. Claimants who do not have a direct contract with the Contractor
 - 5.1.1. have furnished a written notice of non-payment to the Contractor, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was, furnished or supplied or for whom the labor was done or performed, within ninety (90) days after having last performed labor or last furnished materials or equipment included in the Claim; and
 - 5.1.2. have sent a Claim to the Surety (at the address described in Paragraph 13).
 - 5.2. Claimants who are employed by or have a direct contract with the Contractor have sent a Claim to the Surety (at the address described in Paragraph 13).
6. If a notice of non-payment required by Paragraph 5.1.1 is given by the Owner to the Contractor, that is sufficient to satisfy a Claimant's obligation to furnish a written notice of non-payment under Paragraph 5.1.1.
7. When a Claimant has satisfied the conditions of Paragraph 5.1 or 5.2, whichever is applicable, the Surety shall promptly and at the Surety's expense take the following actions:
 - 7.1. Send an answer to the Claimant, with a copy to the Owner, within sixty (60) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and
 - 7.2. Pay or arrange for payment of any undisputed amounts.
 - 7.3. The Surety's failure to discharge its obligations under Paragraph 7.1 or 7.2 will not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a Claim, except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Paragraph 7.1 or 7.2, the Surety shall indemnify the Claimant for the reasonable attorney's fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.

8. The Surety's total obligation will not exceed the amount of this Bond, plus the amount of reasonable attorney's fees provided under Paragraph 7.3, and the amount of this Bond will be credited for any payments made in good faith by the Surety.
9. Amounts owed by the Owner to the Contractor under the Construction Contract will be used for the performance of the Construction Contract and to satisfy claims, if any, under any construction performance bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfying obligations of the Contractor and Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.
10. The Surety shall not be liable to the Owner, Claimants, or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for the payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to or give notice on behalf of Claimants, or otherwise have any obligations to Claimants under this Bond.
11. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.
12. No suit or action will be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Paragraph 5.1.2 or 5.2, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit will be applicable.
13. Notice and Claims to the Surety, the Owner, or the Contractor must be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, will be sufficient compliance as of the date received.
14. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement will be deemed deleted here from and provisions conforming to such statutory or other legal requirement will be deemed incorporated herein. When so furnished, the intent is that this Bond will be construed as a statutory bond and not as a common law bond.
15. Upon requests by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.
16. Definitions
 - 16.1. *Claim*—A written statement by the Claimant including at a minimum:
 - 16.1.1. The name of the Claimant;
 - 16.1.2. The name of the person for whom the labor was done, or materials or equipment furnished;
 - 16.1.3. A copy of the agreement or purchase order pursuant to which labor, materials, or equipment was furnished for use in the performance of the Construction Contract;
 - 16.1.4. A brief description of the labor, materials, or equipment furnished;

- 16.1.5. The date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;
 - 16.1.6. The total amount earned by the Claimant for labor, materials, or equipment furnished as of the date of the Claim;
 - 16.1.7. The total amount of previous payments received by the Claimant; and
 - 16.1.8. The total amount due and unpaid to the Claimant for labor, materials, or equipment furnished as of the date of the Claim.
- 16.2. *Claimant*—An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials, or equipment for use in the performance of the Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic's lien or similar statute against the real property upon which the Project is located. The intent of this Bond is to include without limitation in the terms of "labor, materials, or equipment" that part of the water, gas, power, light, heat, oil, gasoline, telephone service, or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor's subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials, or equipment were furnished.
- 16.3. *Construction Contract*—The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and all changes made to the agreement and the Contract Documents.
- 16.4. *Owner Default*—Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.
- 16.5. *Contract Documents*—All the documents that comprise the agreement between the Owner and Contractor.
17. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond will be deemed to be Subcontractor and the term Owner will be deemed to be Contractor.
18. Modifications to this Bond are as follows: **[None]**



GENERAL CONTRACT CONDITIONS

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

TABLE OF CONTENTS

	Page
Article 1—Definitions and Terminology.....	1
1.01 Defined Terms.....	1
1.02 Terminology	6
Article 2—Preliminary Matters	7
2.01 Delivery of Performance and Payment Bonds; Evidence of Insurance.....	7
2.02 Copies of Documents	7
2.03 Before Starting Construction	7
2.04 Preconstruction Conference; Designation of Authorized Representatives	8
2.05 Acceptance of Schedules	8
2.06 Electronic Transmittals	8
Article 3—Contract Documents: Intent, Requirements, Reuse	9
3.01 Intent.....	9
3.02 Reference Standards	9
3.03 Reporting and Resolving Discrepancies	10
3.04 Requirements of the Contract Documents.....	10
3.05 Reuse of Documents	11
Article 4—Commencement and Progress of the Work	11
4.01 Commencement of Contract Times; Notice to Proceed	11
4.02 Starting the Work.....	11
4.03 Reference Points	11
4.04 Progress Schedule	12
4.05 Delays in Contractor’s Progress	12
Article 5—Site; Subsurface and Physical Conditions; Hazardous Environmental Conditions	13
5.01 Availability of Lands	13
5.02 Use of Site and Other Areas.....	14
5.03 Subsurface and Physical Conditions.....	15
5.04 Differing Subsurface or Physical Conditions	16

5.05	Underground Facilities.....	17
5.06	Hazardous Environmental Conditions at Site	19
Article 6—Bonds and Insurance.....		21
6.01	Performance, Payment, and Other Bonds	21
6.02	Insurance—General Provisions.....	22
6.03	Contractor’s Insurance.....	24
6.04	Builder’s Risk and Other Property Insurance	25
6.05	Property Losses; Subrogation	25
6.06	Receipt and Application of Property Insurance Proceeds	27
Article 7—Contractor’s Responsibilities		27
7.01	Contractor’s Means and Methods of Construction	27
7.02	Supervision and Superintendence	27
7.03	Labor; Working Hours	27
7.04	Services, Materials, and Equipment	28
7.05	“Or Equals”	28
7.06	Substitutes	29
7.07	Concerning Subcontractors and Suppliers.....	31
7.08	Patent Fees and Royalties.....	32
7.09	Permits	33
7.10	Taxes	33
7.11	Laws and Regulations.....	33
7.12	Record Documents.....	33
7.13	Safety and Protection	34
7.14	Hazard Communication Programs	35
7.15	Emergencies	35
7.16	Submittals	35
7.17	Contractor’s General Warranty and Guarantee	38
7.18	Indemnification	39
7.19	Delegation of Professional Design Services	39
Article 8—Other Work at the Site.....		40
8.01	Other Work	40
8.02	Coordination	41
8.03	Legal Relationships.....	41

Article 9—Owner’s Responsibilities	42
9.01 Communications to Contractor	42
9.02 Replacement of Engineer	42
9.03 Furnish Data	42
9.04 Pay When Due.....	42
9.05 Lands and Easements; Reports, Tests, and Drawings	43
9.06 Insurance.....	43
9.07 Change Orders	43
9.08 Inspections, Tests, and Approvals.....	43
9.09 Limitations on Owner’s Responsibilities	43
9.10 Undisclosed Hazardous Environmental Condition.....	43
9.11 Evidence of Financial Arrangements.....	43
9.12 Safety Programs	43
Article 10—Engineer’s Status During Construction	44
10.01 Owner’s Representative.....	44
10.02 Visits to Site.....	44
10.03 Resident Project Representative.....	44
10.04 Engineer’s Authority	44
10.05 Determinations for Unit Price Work	45
10.06 Decisions on Requirements of Contract Documents and Acceptability of Work	45
10.07 Limitations on Engineer’s Authority and Responsibilities	45
10.08 Compliance with Safety Program.....	45
Article 11—Changes to the Contract	46
11.01 Amending and Supplementing the Contract	46
11.02 Change Orders	46
11.03 Work Change Directives.....	46
11.04 Field Orders.....	47
11.05 Owner-Authorized Changes in the Work	47
11.06 Unauthorized Changes in the Work.....	47
11.07 Change of Contract Price	47
11.08 Change of Contract Times.....	49
11.09 Change Proposals.....	49
11.10 Notification to Surety.....	50

Article 12—Claims.....	50
12.01 Claims.....	50
Article 13—Cost of the Work; Allowances; Unit Price Work	51
13.01 Cost of the Work	51
13.02 Allowances	55
13.03 Unit Price Work.....	55
Article 14—Tests and Inspections; Correction, Removal, or Acceptance of Defective Work	56
14.01 Access to Work.....	56
14.02 Tests, Inspections, and Approvals.....	56
14.03 Defective Work	57
14.04 Acceptance of Defective Work.....	58
14.05 Uncovering Work	58
14.06 Owner May Stop the Work	58
14.07 Owner May Correct Defective Work.....	59
Article 15—Payments to Contractor; Set-Offs; Completion; Correction Period	59
15.01 Progress Payments.....	59
15.02 Contractor’s Warranty of Title	62
15.03 Substantial Completion.....	62
15.04 Partial Use or Occupancy	63
15.05 Final Inspection	64
15.06 Final Payment.....	64
15.07 Waiver of Claims	65
15.08 Correction Period.....	66
Article 16—Suspension of Work and Termination	67
16.01 Owner May Suspend Work	67
16.02 Owner May Terminate for Cause.....	67
16.03 Owner May Terminate for Convenience.....	68
16.04 Contractor May Stop Work or Terminate	68
Article 17—Final Resolution of Disputes	69
17.01 Methods and Procedures.....	69
Article 18—Miscellaneous	69
18.01 Giving Notice	69
18.02 Computation of Times.....	69

18.03	Cumulative Remedies	70
18.04	Limitation of Damages	70
18.05	No Waiver	70
18.06	Survival of Obligations	70
18.07	Controlling Law	70
18.08	Assignment of Contract.....	70
18.09	Successors and Assigns	70
18.10	Headings.....	70

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

ARTICLE 1—DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

- A. Wherever used in the Bidding Requirements or Contract Documents, a term printed with initial capital letters, including the term's singular and plural forms, will have the meaning indicated in the definitions below. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.
1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.
 2. *Agreement*—The written instrument, executed by Owner and Contractor, that sets forth the Contract Price and Contract Times, identifies the parties and the Engineer, and designates the specific items that are Contract Documents.
 3. *Application for Payment*—The document prepared by Contractor, in a form acceptable to Engineer, to request progress or final payments, and which is to be accompanied by such supporting documentation as is required by the Contract Documents.
 4. *Bid*—The offer of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.
 5. *Bidder*—An individual or entity that submits a Bid to Owner.
 6. *Bidding Documents*—The Bidding Requirements, the proposed Contract Documents, and all Addenda.
 7. *Bidding Requirements*—The Advertisement or invitation to bid, Instructions to Bidders, Bid Bond or other Bid security, if any, the Bid Form, and the Bid with any attachments.
 8. *Change Order*—A document which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, or other revision to the Contract, issued on or after the Effective Date of the Contract.
 9. *Change Proposal*—A written request by Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment in Contract Price or Contract Times; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; challenging a set-off against payments due; or seeking other relief with respect to the terms of the Contract.
 10. *Claim*
 - a. A demand or assertion by Owner directly to Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment of Contract Price or Contract Times; contesting an initial decision by Engineer concerning the

requirements of the Contract Documents or the acceptability of Work under the Contract Documents; contesting Engineer's decision regarding a Change Proposal; seeking resolution of a contractual issue that Engineer has declined to address; or seeking other relief with respect to the terms of the Contract.

- b. A demand or assertion by Contractor directly to Owner, duly submitted in compliance with the procedural requirements set forth herein, contesting Engineer's decision regarding a Change Proposal, or seeking resolution of a contractual issue that Engineer has declined to address.
 - c. A demand or assertion by Owner or Contractor, duly submitted in compliance with the procedural requirements set forth herein, made pursuant to Paragraph 12.01.A.4, concerning disputes arising after Engineer has issued a recommendation of final payment.
 - d. A demand for money or services by a third party is not a Claim.
- 11. *Constituent of Concern*—Asbestos, petroleum, radioactive materials, polychlorinated biphenyls (PCBs), lead-based paint (as defined by the HUD/EPA standard), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to Laws and Regulations regulating, relating to, or imposing liability or standards of conduct concerning, any hazardous, toxic, or dangerous waste, substance, or material.
 - 12. *Contract*—The entire and integrated written contract between Owner and Contractor concerning the Work.
 - 13. *Contract Documents*—Those items so designated in the Agreement, and which together comprise the Contract.
 - 14. *Contract Price*—The money that Owner has agreed to pay Contractor for completion of the Work in accordance with the Contract Documents.
 - 15. *Contract Times*—The number of days or the dates by which Contractor shall: (a) achieve Milestones, if any; (b) achieve Substantial Completion; and (c) complete the Work.
 - 16. *Contractor*—The individual or entity with which Owner has contracted for performance of the Work.
 - 17. *Cost of the Work*—See Paragraph 13.01 for definition.
 - 18. *Drawings*—The part of the Contract that graphically shows the scope, extent, and character of the Work to be performed by Contractor.
 - 19. *Effective Date of the Contract*—The date, indicated in the Agreement, on which the Contract becomes effective.
 - 20. *Electronic Document*—Any Project-related correspondence, attachments to correspondence, data, documents, drawings, information, or graphics, including but not limited to Shop Drawings and other Submittals, that are in an electronic or digital format.
 - 21. *Electronic Means*—Electronic mail (email), upload/download from a secure Project website, or other communications methods that allow: (a) the transmission or communication of Electronic Documents; (b) the documentation of transmissions, including sending and receipt; (c) printing of the transmitted Electronic Document by the

recipient; (d) the storage and archiving of the Electronic Document by sender and recipient; and (e) the use by recipient of the Electronic Document for purposes permitted by this Contract. Electronic Means does not include the use of text messaging, or of Facebook, Twitter, Instagram, or similar social media services for transmission of Electronic Documents.

22. *Engineer*—The individual or entity named as such in the Agreement.
23. *Field Order*—A written order issued by Engineer which requires minor changes in the Work but does not change the Contract Price or the Contract Times.
24. *Hazardous Environmental Condition*—The presence at the Site of Constituents of Concern in such quantities or circumstances that may present a danger to persons or property exposed thereto.
 - a. The presence at the Site of materials that are necessary for the execution of the Work, or that are to be incorporated into the Work, and that are controlled and contained pursuant to industry practices, Laws and Regulations, and the requirements of the Contract, is not a Hazardous Environmental Condition.
 - b. The presence of Constituents of Concern that are to be removed or remediated as part of the Work is not a Hazardous Environmental Condition.
 - c. The presence of Constituents of Concern as part of the routine, anticipated, and obvious working conditions at the Site, is not a Hazardous Environmental Condition.
25. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, statutes, rules, regulations, ordinances, codes, and binding decrees, resolutions, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.
26. *Liens*—Charges, security interests, or encumbrances upon Contract-related funds, real property, or personal property.
27. *Milestone*—A principal event in the performance of the Work that the Contract requires Contractor to achieve by an intermediate completion date, or by a time prior to Substantial Completion of all the Work.
28. *Notice of Award*—The written notice by Owner to a Bidder of Owner's acceptance of the Bid.
29. *Notice to Proceed*—A written notice by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work.
30. *Owner*—The individual or entity with which Contractor has contracted regarding the Work, and which has agreed to pay Contractor for the performance of the Work, pursuant to the terms of the Contract.
31. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising Contractor's plan to accomplish the Work within the Contract Times.
32. *Project*—The total undertaking to be accomplished for Owner by engineers, contractors, and others, including planning, study, design, construction, testing, commissioning, and start-up, and of which the Work to be performed under the Contract Documents is a part.

33. *Resident Project Representative*—The authorized representative of Engineer assigned to assist Engineer at the Site. As used herein, the term Resident Project Representative (RPR) includes any assistants or field staff of Resident Project Representative.
34. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and that establish the standards by which such portion of the Work will be judged.
35. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements for Engineer's review of the submittals.
36. *Schedule of Values*—A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.
37. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information that are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work. Shop Drawings, whether approved or not, are not Drawings and are not Contract Documents.
38. *Site*—Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements, and such other lands or areas furnished by Owner which are designated for the use of Contractor.
39. *Specifications*—The part of the Contract that consists of written requirements for materials, equipment, systems, standards, and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable to the Work.
40. *Subcontractor*—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work.
41. *Submittal*—A written or graphic document, prepared by or for Contractor, which the Contract Documents require Contractor to submit to Engineer, or that is indicated as a Submittal in the Schedule of Submittals accepted by Engineer. Submittals may include Shop Drawings and Samples; schedules; product data; Owner-delegated designs; sustainable design information; information on special procedures; testing plans; results of tests and evaluations, source quality-control testing and inspections, and field or Site quality-control testing and inspections; warranties and certifications; Suppliers' instructions and reports; records of delivery of spare parts and tools; operations and maintenance data; Project photographic documentation; record documents; and other such documents required by the Contract Documents. Submittals, whether or not approved or accepted by Engineer, are not Contract Documents. Change Proposals, Change Orders, Claims, notices, Applications for Payment, and requests for interpretation or clarification are not Submittals.
42. *Substantial Completion*—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion of such Work.

43. *Successful Bidder*—The Bidder to which the Owner makes an award of contract.
44. *Supplementary Conditions*—The part of the Contract that amends or supplements these General Conditions.
45. *Supplier*—A manufacturer, fabricator, supplier, distributor, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or a Subcontractor.
46. *Technical Data*
- a. Those items expressly identified as Technical Data in the Supplementary Conditions, with respect to either (1) existing subsurface conditions at or adjacent to the Site, or existing physical conditions at or adjacent to the Site including existing surface or subsurface structures (except Underground Facilities) or (2) Hazardous Environmental Conditions at the Site.
 - b. If no such express identifications of Technical Data have been made with respect to conditions at the Site, then Technical Data is defined, with respect to conditions at the Site under Paragraphs 5.03, 5.04, and 5.06, as the data contained in boring logs, recorded measurements of subsurface water levels, assessments of the condition of subsurface facilities, laboratory test results, and other factual, objective information regarding conditions at the Site that are set forth in any geotechnical, environmental, or other Site or facilities conditions report prepared for the Project and made available to Contractor.
 - c. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data, and instead Underground Facilities are shown or indicated on the Drawings.
47. *Underground Facilities*—All active or not-in-service underground lines, pipelines, conduits, ducts, encasements, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or systems at the Site, including but not limited to those facilities or systems that produce, transmit, distribute, or convey telephone or other communications, cable television, fiber optic transmissions, power, electricity, light, heat, gases, oil, crude oil products, liquid petroleum products, water, steam, waste, wastewater, storm water, other liquids or chemicals, or traffic or other control systems. An abandoned facility or system is not an Underground Facility.
48. *Unit Price Work*—Work to be paid for on the basis of unit prices.
49. *Work*—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction; furnishing, installing, and incorporating all materials and equipment into such construction; and may include related services such as testing, start-up, and commissioning, all as required by the Contract Documents.
50. *Work Change Directive*—A written directive to Contractor issued on or after the Effective Date of the Contract, signed by Owner and recommended by Engineer, ordering an addition, deletion, or revision in the Work.

1.02 Terminology

- A. The words and terms discussed in Paragraphs 1.02.B, C, D, and E are not defined terms that require initial capital letters, but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.
- B. *Intent of Certain Terms or Adjectives:* The Contract Documents include the terms “as allowed,” “as approved,” “as ordered,” “as directed” or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives “reasonable,” “suitable,” “acceptable,” “proper,” “satisfactory,” or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of Article 10 or any other provision of the Contract Documents.
- C. *Day:* The word “day” means a calendar day of 24 hours measured from midnight to the next midnight.
- D. *Defective:* The word “defective,” when modifying the word “Work,” refers to Work that is unsatisfactory, faulty, or deficient in that it:
 - 1. does not conform to the Contract Documents;
 - 2. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or
 - 3. has been damaged prior to Engineer’s recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 15.03 or Paragraph 15.04).
- E. *Furnish, Install, Perform, Provide*
 - 1. The word “furnish,” when used in connection with services, materials, or equipment, means to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.
 - 2. The word “install,” when used in connection with services, materials, or equipment, means to put into use or place in final position said services, materials, or equipment complete and ready for intended use.
 - 3. The words “perform” or “provide,” when used in connection with services, materials, or equipment, means to furnish and install said services, materials, or equipment complete and ready for intended use.
 - 4. If the Contract Documents establish an obligation of Contractor with respect to specific services, materials, or equipment, but do not expressly use any of the four words “furnish,” “install,” “perform,” or “provide,” then Contractor shall furnish and install said services, materials, or equipment complete and ready for intended use.

- F. *Contract Price or Contract Times*: References to a change in “Contract Price or Contract Times” or “Contract Times or Contract Price” or similar, indicate that such change applies to (1) Contract Price, (2) Contract Times, or (3) both Contract Price and Contract Times, as warranted, even if the term “or both” is not expressed.
- G. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2—PRELIMINARY MATTERS

2.01 *Delivery of Performance and Payment Bonds; Evidence of Insurance*

- A. *Performance and Payment Bonds*: When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner the performance bond and payment bond (if the Contract requires Contractor to furnish such bonds).
- B. *Evidence of Contractor’s Insurance*: When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner, with copies to each additional insured (as identified in the Contract), the certificates, endorsements, and other evidence of insurance required to be provided by Contractor in accordance with Article 6, except to the extent the Supplementary Conditions expressly establish other dates for delivery of specific insurance policies.
- C. *Evidence of Owner’s Insurance*: After receipt of the signed counterparts of the Agreement and all required bonds and insurance documentation, Owner shall promptly deliver to Contractor, with copies to each additional insured (as identified in the Contract), the certificates and other evidence of insurance required to be provided by Owner under Article 6.

2.02 *Copies of Documents*

- A. Owner shall furnish to Contractor four printed copies of the Contract (including one fully signed counterpart of the Agreement), and one copy in electronic portable document format (PDF). Additional printed copies will be furnished upon request at the cost of reproduction.
- B. Owner shall maintain and safeguard at least one original printed record version of the Contract, including Drawings and Specifications signed and sealed by Engineer and other design professionals. Owner shall make such original printed record version of the Contract available to Contractor for review. Owner may delegate the responsibilities under this provision to Engineer.

2.03 *Before Starting Construction*

- A. *Preliminary Schedules*: Within 10 days after the Effective Date of the Contract (or as otherwise required by the Contract Documents), Contractor shall submit to Engineer for timely review:
 - 1. a preliminary Progress Schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract;
 - 2. a preliminary Schedule of Submittals; and
 - 3. a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work

into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

2.04 *Preconstruction Conference; Designation of Authorized Representatives*

- A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work, and to discuss the schedules referred to in Paragraph 2.03.A, procedures for handling Shop Drawings, Samples, and other Submittals, processing Applications for Payment, electronic or digital transmittals, and maintaining required records.
- B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit and receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

2.05 *Acceptance of Schedules*

- A. At least 10 days before submission of the first Application for Payment a conference, attended by Contractor, Engineer, and others as appropriate, will be held to review the schedules submitted in accordance with Paragraph 2.03.A. No progress payment will be made to Contractor until acceptable schedules are submitted to Engineer.
 - 1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work, nor interfere with or relieve Contractor from Contractor's full responsibility therefore.
 - 2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.
 - 3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to the component parts of the Work.
 - 4. If a schedule is not acceptable, Contractor will have an additional 10 days to revise and resubmit the schedule.

2.06 *Electronic Transmittals*

- A. Except as otherwise stated elsewhere in the Contract, the Owner, Engineer, and Contractor may send, and shall accept, Electronic Documents transmitted by Electronic Means.
- B. If the Contract does not establish protocols for Electronic Means, then Owner, Engineer, and Contractor shall jointly develop such protocols.
- C. Subject to any governing protocols for Electronic Means, when transmitting Electronic Documents by Electronic Means, the transmitting party makes no representations as to long-term compatibility, usability, or readability of the Electronic Documents resulting from the recipient's use of software application packages, operating systems, or computer hardware differing from those used in the drafting or transmittal of the Electronic Documents.

ARTICLE 3—CONTRACT DOCUMENTS: INTENT, REQUIREMENTS, REUSE

3.01 *Intent*

- A. The Contract Documents are complementary; what is required by one Contract Document is as binding as if required by all.
- B. It is the intent of the Contract Documents to describe a functionally complete Project (or part thereof) to be constructed in accordance with the Contract Documents.
- C. Unless otherwise stated in the Contract Documents, if there is a discrepancy between the electronic versions of the Contract Documents (including any printed copies derived from such electronic versions) and the printed record version, the printed record version will govern.
- D. The Contract supersedes prior negotiations, representations, and agreements, whether written or oral.
- E. Engineer will issue clarifications and interpretations of the Contract Documents as provided herein.
- F. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation will be deemed stricken, and all remaining provisions will continue to be valid and binding upon Owner and Contractor, which agree that the Contract Documents will be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.
- G. Nothing in the Contract Documents creates:
 - 1. any contractual relationship between Owner or Engineer and any Subcontractor, Supplier, or other individual or entity performing or furnishing any of the Work, for the benefit of such Subcontractor, Supplier, or other individual or entity; or
 - 2. any obligation on the part of Owner or Engineer to pay or to see to the payment of any money due any such Subcontractor, Supplier, or other individual or entity, except as may otherwise be required by Laws and Regulations.

3.02 *Reference Standards*

- A. *Standards Specifications, Codes, Laws and Regulations*
 - 1. Reference in the Contract Documents to standard specifications, manuals, reference standards, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, means the standard specification, manual, reference standard, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Contract if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.
 - 2. No provision of any such standard specification, manual, reference standard, or code, and no instruction of a Supplier, will be effective to change the duties or responsibilities of Owner, Contractor, or Engineer from those set forth in the part of the Contract Documents prepared by or for Engineer. No such provision or instruction shall be effective to assign to Owner or Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility

inconsistent with the provisions of the part of the Contract Documents prepared by or for Engineer.

3.03 *Reporting and Resolving Discrepancies*

A. *Reporting Discrepancies*

1. *Contractor's Verification of Figures and Field Measurements:* Before undertaking each part of the Work, Contractor shall carefully study the Contract Documents, and check and verify pertinent figures and dimensions therein, particularly with respect to applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy that Contractor discovers, or has actual knowledge of, and shall not proceed with any Work affected thereby until the conflict, error, ambiguity, or discrepancy is resolved by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract issued pursuant to Paragraph 11.01.
2. *Contractor's Review of Contract Documents:* If, before or during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents, or between the Contract Documents and (a) any applicable Law or Regulation, (b) actual field conditions, (c) any standard specification, manual, reference standard, or code, or (d) any instruction of any Supplier, then Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 7.15) until the conflict, error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract issued pursuant to Paragraph 11.01.
3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor had actual knowledge thereof.

B. *Resolving Discrepancies*

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the part of the Contract Documents prepared by or for Engineer take precedence in resolving any conflict, error, ambiguity, or discrepancy between such provisions of the Contract Documents and:
 - a. the provisions of any standard specification, manual, reference standard, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference as a Contract Document); or
 - b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 *Requirements of the Contract Documents*

- A. During the performance of the Work and until final payment, Contractor and Owner shall submit to the Engineer in writing all matters in question concerning the requirements of the Contract Documents (sometimes referred to as requests for information or interpretation—RFIs), or relating to the acceptability of the Work under the Contract Documents, as soon as possible after such matters arise. Engineer will be the initial interpreter of the requirements of the Contract Documents, and judge of the acceptability of the Work.

- B. Engineer will, with reasonable promptness, render a written clarification, interpretation, or decision on the issue submitted, or initiate an amendment or supplement to the Contract Documents. Engineer's written clarification, interpretation, or decision will be final and binding on Contractor, unless it appeals by submitting a Change Proposal, and on Owner, unless it appeals by filing a Claim.
- C. If a submitted matter in question concerns terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work under the Contract Documents, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, then Engineer will promptly notify Owner and Contractor in writing that Engineer is unable to provide a decision or interpretation. If Owner and Contractor are unable to agree on resolution of such a matter in question, either party may pursue resolution as provided in Article 12.

3.05 *Reuse of Documents*

- A. Contractor and its Subcontractors and Suppliers shall not:
 - 1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media versions, or reuse any such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer; or
 - 2. have or acquire any title or ownership rights in any other Contract Documents, reuse any such Contract Documents for any purpose without Owner's express written consent, or violate any copyrights pertaining to such Contract Documents.
- B. The prohibitions of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein precludes Contractor from retaining copies of the Contract Documents for record purposes.

ARTICLE 4—COMMENCEMENT AND PROGRESS OF THE WORK

4.01 *Commencement of Contract Times; Notice to Proceed*

- A. The Contract Times will commence to run on the 30th day after the Effective Date of the Contract or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Contract. In no event will the Contract Times commence to run later than the 60th day after the day of Bid opening or the 30th day after the Effective Date of the Contract, whichever date is earlier.

4.02 *Starting the Work*

- A. Contractor shall start to perform the Work on the date when the Contract Times commence to run. No Work may be done at the Site prior to such date.

4.03 *Reference Points*

- A. Owner shall provide engineering surveys to establish reference points for construction which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, shall protect and preserve the

established reference points and property monuments, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

4.04 *Progress Schedule*

- A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.05 as it may be adjusted from time to time as provided below.
 - 1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.05) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times.
 - 2. Proposed adjustments in the Progress Schedule that will change the Contract Times must be submitted in accordance with the requirements of Article 11.
- B. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work will be delayed or postponed pending resolution of any disputes or disagreements, or during any appeal process, except as permitted by Paragraph 16.04, or as Owner and Contractor may otherwise agree in writing.

4.05 *Delays in Contractor's Progress*

- A. If Owner, Engineer, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times.
- B. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delay, disruption, or interference caused by or within the control of Contractor. Delay, disruption, and interference attributable to and within the control of a Subcontractor or Supplier shall be deemed to be within the control of Contractor.
- C. If Contractor's performance or progress is delayed, disrupted, or interfered with by unanticipated causes not the fault of and beyond the control of Owner, Contractor, and those for which they are responsible, then Contractor shall be entitled to an equitable adjustment in Contract Times. Such an adjustment will be Contractor's sole and exclusive remedy for the delays, disruption, and interference described in this paragraph. Causes of delay, disruption, or interference that may give rise to an adjustment in Contract Times under this paragraph include but are not limited to the following:
 - 1. Severe and unavoidable natural catastrophes such as fires, floods, epidemics, and earthquakes;
 - 2. Abnormal weather conditions;
 - 3. Acts or failures to act of third-party utility owners or other third-party entities (other than those third-party utility owners or other third-party entities performing other work at or adjacent to the Site as arranged by or under contract with Owner, as contemplated in Article 8); and
 - 4. Acts of war or terrorism.

- D. Contractor's entitlement to an adjustment of Contract Times or Contract Price is limited as follows:
1. Contractor's entitlement to an adjustment of the Contract Times is conditioned on the delay, disruption, or interference adversely affecting an activity on the critical path to completion of the Work, as of the time of the delay, disruption, or interference.
 2. Contractor shall not be entitled to an adjustment in Contract Price for any delay, disruption, or interference if such delay is concurrent with a delay, disruption, or interference caused by or within the control of Contractor. Such a concurrent delay by Contractor shall not preclude an adjustment of Contract Times to which Contractor is otherwise entitled.
 3. Adjustments of Contract Times or Contract Price are subject to the provisions of Article 11.
- E. Each Contractor request or Change Proposal seeking an increase in Contract Times or Contract Price must be supplemented by supporting data that sets forth in detail the following:
1. The circumstances that form the basis for the requested adjustment;
 2. The date upon which each cause of delay, disruption, or interference began to affect the progress of the Work;
 3. The date upon which each cause of delay, disruption, or interference ceased to affect the progress of the Work;
 4. The number of days' increase in Contract Times claimed as a consequence of each such cause of delay, disruption, or interference; and
 5. The impact on Contract Price, in accordance with the provisions of Paragraph 11.07.
- Contractor shall also furnish such additional supporting documentation as Owner or Engineer may require including, where appropriate, a revised progress schedule indicating all the activities affected by the delay, disruption, or interference, and an explanation of the effect of the delay, disruption, or interference on the critical path to completion of the Work.
- F. Delays, disruption, and interference to the performance or progress of the Work resulting from the existence of a differing subsurface or physical condition, an Underground Facility that was not shown or indicated by the Contract Documents, or not shown or indicated with reasonable accuracy, and those resulting from Hazardous Environmental Conditions, are governed by Article 5, together with the provisions of Paragraphs 4.05.D and 4.05.E.
- G. Paragraph 8.03 addresses delays, disruption, and interference to the performance or progress of the Work resulting from the performance of certain other work at or adjacent to the Site.

ARTICLE 5—SITE; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS

5.01 *Availability of Lands*

- A. Owner shall furnish the Site. Owner shall notify Contractor in writing of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work.

- B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which permanent improvements are to be made and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.
- C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

5.02 *Use of Site and Other Areas*

A. *Limitation on Use of Site and Other Areas*

1. Contractor shall confine construction equipment, temporary construction facilities, the storage of materials and equipment, and the operations of workers to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and such other adjacent areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for (a) damage to the Site; (b) damage to any such other adjacent areas used for Contractor's operations; (c) damage to any other adjacent land or areas, or to improvements, structures, utilities, or similar facilities located at such adjacent lands or areas; and (d) for injuries and losses sustained by the owners or occupants of any such land or areas; provided that such damage or injuries result from the performance of the Work or from other actions or conduct of the Contractor or those for which Contractor is responsible.
 2. If a damage or injury claim is made by the owner or occupant of any such land or area because of the performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible, Contractor shall (a) take immediate corrective or remedial action as required by Paragraph 7.13, or otherwise; (b) promptly attempt to settle the claim as to all parties through negotiations with such owner or occupant, or otherwise resolve the claim by arbitration or other dispute resolution proceeding, or in a court of competent jurisdiction; and (c) to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from and against any such claim, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused directly or indirectly, in whole or in part by, or based upon, Contractor's performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible.
- B. *Removal of Debris During Performance of the Work:* During the progress of the Work the Contractor shall keep the Site and other adjacent areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris will conform to applicable Laws and Regulations.
 - C. *Cleaning:* Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site and adjacent areas all tools, appliances, construction equipment

and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.

- D. *Loading of Structures:* Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent structures or land to stresses or pressures that will endanger them.

5.03 *Subsurface and Physical Conditions*

- A. *Reports and Drawings:* The Supplementary Conditions identify:

1. Those reports of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data;
2. Those drawings of existing physical conditions at or adjacent to the Site, including those drawings depicting existing surface or subsurface structures at or adjacent to the Site (except Underground Facilities), that contain Technical Data; and
3. Technical Data contained in such reports and drawings.

- B. *Underground Facilities:* Underground Facilities are shown or indicated on the Drawings, pursuant to Paragraph 5.05, and not in the drawings referred to in Paragraph 5.03.A. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data.

- C. *Reliance by Contractor on Technical Data:* Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely upon the accuracy of the Technical Data as defined in Paragraph 1.01.A.46.b.

- D. *Limitations of Other Data and Documents:* Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:
1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto;
 2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings;
 3. the contents of other Site-related documents made available to Contractor, such as record drawings from other projects at or adjacent to the Site, or Owner's archival documents concerning the Site; or
 4. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions, or information.

5.04 *Differing Subsurface or Physical Conditions*

- A. *Notice by Contractor:* If Contractor believes that any subsurface or physical condition that is uncovered or revealed at the Site:
1. is of such a nature as to establish that any Technical Data on which Contractor is entitled to rely as provided in Paragraph 5.03 is materially inaccurate;
 2. is of such a nature as to require a change in the Drawings or Specifications;
 3. differs materially from that shown or indicated in the Contract Documents; or
 4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except with respect to an emergency) until receipt of a written statement permitting Contractor to do so.

- B. *Engineer's Review:* After receipt of written notice as required by the preceding paragraph, Engineer will promptly review the subsurface or physical condition in question; determine whether it is necessary for Owner to obtain additional exploration or tests with respect to the condition; conclude whether the condition falls within any one or more of the differing site condition categories in Paragraph 5.04.A; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the subsurface or physical condition in question and the need for any change in the Drawings or Specifications; and advise Owner in writing of Engineer's findings, conclusions, and recommendations.
- C. *Owner's Statement to Contractor Regarding Site Condition:* After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the subsurface or physical condition in question, addressing the resumption of Work in connection with such condition, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations, in whole or in part.
- D. *Early Resumption of Work:* If at any time Engineer determines that Work in connection with the subsurface or physical condition in question may resume prior to completion of Engineer's review or Owner's issuance of its statement to Contractor, because the condition in question has been adequately documented, and analyzed on a preliminary basis, then the Engineer may at its discretion instruct Contractor to resume such Work.
- E. *Possible Price and Times Adjustments*
1. Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times, to the extent that the existence of a differing subsurface or physical condition, or any related delay, disruption, or interference, causes an increase or decrease in

Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

- a. Such condition must fall within any one or more of the categories described in Paragraph 5.04.A;
 - b. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03; and,
 - c. Contractor's entitlement to an adjustment of the Contract Times is subject to the provisions of Paragraphs 4.05.D and 4.05.E.
2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times with respect to a subsurface or physical condition if:
 - a. Contractor knew of the existence of such condition at the time Contractor made a commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract, or otherwise;
 - b. The existence of such condition reasonably could have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas expressly required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such commitment; or
 - c. Contractor failed to give the written notice required by Paragraph 5.04.A.
 3. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, then any such adjustment will be set forth in a Change Order.
 4. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the subsurface or physical condition in question.
- F. *Underground Facilities; Hazardous Environmental Conditions:* Paragraph 5.05 governs rights and responsibilities regarding the presence or location of Underground Facilities. Paragraph 5.06 governs rights and responsibilities regarding Hazardous Environmental Conditions. The provisions of Paragraphs 5.03 and 5.04 are not applicable to the presence or location of Underground Facilities, or to Hazardous Environmental Conditions.

5.05 *Underground Facilities*

- A. *Contractor's Responsibilities:* Unless it is otherwise expressly provided in the Supplementary Conditions, the cost of all of the following are included in the Contract Price, and Contractor shall have full responsibility for:
1. reviewing and checking all information and data regarding existing Underground Facilities at the Site;
 2. complying with applicable state and local utility damage prevention Laws and Regulations;

3. verifying the actual location of those Underground Facilities shown or indicated in the Contract Documents as being within the area affected by the Work, by exposing such Underground Facilities during the course of construction;
 4. coordination of the Work with the owners (including Owner) of such Underground Facilities, during construction; and
 5. the safety and protection of all existing Underground Facilities at the Site, and repairing any damage thereto resulting from the Work.
- B. *Notice by Contractor:* If Contractor believes that an Underground Facility that is uncovered or revealed at the Site was not shown or indicated on the Drawings, or was not shown or indicated on the Drawings with reasonable accuracy, then Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), notify Owner and Engineer in writing regarding such Underground Facility.
- C. *Engineer's Review:* Engineer will:
1. promptly review the Underground Facility and conclude whether such Underground Facility was not shown or indicated on the Drawings, or was not shown or indicated with reasonable accuracy;
 2. identify and communicate with the owner of the Underground Facility; prepare recommendations to Owner (and if necessary issue any preliminary instructions to Contractor) regarding the Contractor's resumption of Work in connection with the Underground Facility in question;
 3. obtain any pertinent cost or schedule information from Contractor; determine the extent, if any, to which a change is required in the Drawings or Specifications to reflect and document the consequences of the existence or location of the Underground Facility; and
 4. advise Owner in writing of Engineer's findings, conclusions, and recommendations.
- During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.
- D. *Owner's Statement to Contractor Regarding Underground Facility:* After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the Underground Facility in question addressing the resumption of Work in connection with such Underground Facility, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations in whole or in part.
- E. *Early Resumption of Work:* If at any time Engineer determines that Work in connection with the Underground Facility may resume prior to completion of Engineer's review or Owner's issuance of its statement to Contractor, because the Underground Facility in question and conditions affected by its presence have been adequately documented, and analyzed on a preliminary basis, then the Engineer may at its discretion instruct Contractor to resume such Work.
- F. *Possible Price and Times Adjustments*
1. Contractor shall be entitled to an equitable adjustment in the Contract Price or Contract Times, to the extent that any existing Underground Facility at the Site that was not shown

or indicated on the Drawings, or was not shown or indicated with reasonable accuracy, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

- a. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03;
 - b. Contractor's entitlement to an adjustment of the Contract Times is subject to the provisions of Paragraphs 4.05.D and 4.05.E; and
 - c. Contractor gave the notice required in Paragraph 5.05.B.
2. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, then any such adjustment will be set forth in a Change Order.
 3. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the Underground Facility in question.
 4. The information and data shown or indicated on the Drawings with respect to existing Underground Facilities at the Site is based on information and data (a) furnished by the owners of such Underground Facilities, or by others, (b) obtained from available records, or (c) gathered in an investigation conducted in accordance with the current edition of ASCE 38, Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data, by the American Society of Civil Engineers. If such information or data is incorrect or incomplete, Contractor's remedies are limited to those set forth in this Paragraph 5.05.F.

5.06 *Hazardous Environmental Conditions at Site*

A. *Reports and Drawings:* The Supplementary Conditions identify:

1. those reports known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site;
2. drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site; and
3. Technical Data contained in such reports and drawings.

B. *Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely on the accuracy of the Technical Data as defined in Paragraph 1.01.A.46.b. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures

- of construction to be employed by Contractor, and safety precautions and programs incident thereto;
2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or
 3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions or information.
- C. Contractor shall not be responsible for removing or remediating any Hazardous Environmental Condition encountered, uncovered, or revealed at the Site unless such removal or remediation is expressly identified in the Contract Documents to be within the scope of the Work.
- D. Contractor shall be responsible for controlling, containing, and duly removing all Constituents of Concern brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible, and for any associated costs; and for the costs of removing and remediating any Hazardous Environmental Condition created by the presence of any such Constituents of Concern.
- E. If Contractor encounters, uncovers, or reveals a Hazardous Environmental Condition whose removal or remediation is not expressly identified in the Contract Documents as being within the scope of the Work, or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, then Contractor shall immediately: (1) secure or otherwise isolate such condition; (2) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 7.15); and (3) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 5.06.F. If Contractor or anyone for whom Contractor is responsible created the Hazardous Environmental Condition in question, then Owner may remove and remediate the Hazardous Environmental Condition, and impose a set-off against payments to account for the associated costs.
- F. Contractor shall not resume Work in connection with such Hazardous Environmental Condition or in any affected area until after Owner has obtained any required permits related thereto, and delivered written notice to Contractor either (1) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or (2) specifying any special conditions under which such Work may be resumed safely.
- G. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, as a result of such Work stoppage, such special conditions under which Work is agreed to be resumed by Contractor, or any costs or expenses incurred in response to the Hazardous Environmental Condition, then within 30 days of Owner's written notice regarding the resumption of Work, Contractor may submit a Change Proposal, or Owner may impose a set-off. Entitlement to any such adjustment is subject to the provisions of Paragraphs 4.05.D, 4.05.E, 11.07, and 11.08.
- H. If, after receipt of such written notice, Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special

conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work, following the contractual change procedures in Article 11. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 8.

- I. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court, arbitration, or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition (1) was not shown or indicated in the Drawings, Specifications, or other Contract Documents, identified as Technical Data entitled to limited reliance pursuant to Paragraph 5.06.B, or identified in the Contract Documents to be included within the scope of the Work, and (2) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.I obligates Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- J. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the failure to control, contain, or remove a Constituent of Concern brought to the Site by Contractor or by anyone for whom Contractor is responsible, or to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.J obligates Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- K. The provisions of Paragraphs 5.03, 5.04, and 5.05 do not apply to the presence of Constituents of Concern or to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 6—BONDS AND INSURANCE

6.01 *Performance, Payment, and Other Bonds*

- A. Contractor shall furnish a performance bond and a payment bond, each in an amount at least equal to the Contract Price, as security for the faithful performance and payment of Contractor's obligations under the Contract. These bonds must remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 15.08, whichever is later, except as provided otherwise by Laws or Regulations, the terms of a prescribed bond form, the Supplementary Conditions, or other provisions of the Contract.
- B. Contractor shall also furnish such other bonds (if any) as are required by the Supplementary Conditions or other provisions of the Contract.
- C. All bonds must be in the form included in the Bidding Documents or otherwise specified by Owner prior to execution of the Contract, except as provided otherwise by Laws or

Regulations, and must be issued and signed by a surety named in “Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies” as published in Department Circular 570 (as amended and supplemented) by the Bureau of the Fiscal Service, U.S. Department of the Treasury. A bond signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual’s authority to bind the surety. The evidence of authority must show that it is effective on the date the agent or attorney-in-fact signed the accompanying bond.

- D. Contractor shall obtain the required bonds from surety companies that are duly licensed or authorized, in the state or jurisdiction in which the Project is located, to issue bonds in the required amounts.
- E. If the surety on a bond furnished by Contractor is declared bankrupt or becomes insolvent, or the surety ceases to meet the requirements above, then Contractor shall promptly notify Owner and Engineer in writing and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which must comply with the bond and surety requirements above.
- F. If Contractor has failed to obtain a required bond, Owner may exclude the Contractor from the Site and exercise Owner’s termination rights under Article 16.
- G. Upon request to Owner from any Subcontractor, Supplier, or other person or entity claiming to have furnished labor, services, materials, or equipment used in the performance of the Work, Owner shall provide a copy of the payment bond to such person or entity.
- H. Upon request to Contractor from any Subcontractor, Supplier, or other person or entity claiming to have furnished labor, services, materials, or equipment used in the performance of the Work, Contractor shall provide a copy of the payment bond to such person or entity.

6.02 *Insurance—General Provisions*

- A. Owner and Contractor shall obtain and maintain insurance as required in this article and in the Supplementary Conditions.
- B. All insurance required by the Contract to be purchased and maintained by Owner or Contractor shall be obtained from insurance companies that are duly licensed or authorized in the state or jurisdiction in which the Project is located to issue insurance policies for the required limits and coverages. Unless a different standard is indicated in the Supplementary Conditions, all companies that provide insurance policies required under this Contract shall have an A.M. Best rating of A-VII or better.
- C. Alternative forms of insurance coverage, including but not limited to self-insurance and “Occupational Accident and Excess Employer’s Indemnity Policies,” are not sufficient to meet the insurance requirements of this Contract, unless expressly allowed in the Supplementary Conditions.
- D. Contractor shall deliver to Owner, with copies to each additional insured identified in the Contract, certificates of insurance and endorsements establishing that Contractor has obtained and is maintaining the policies and coverages required by the Contract. Upon request by Owner or any other insured, Contractor shall also furnish other evidence of such required insurance, including but not limited to copies of policies, documentation of applicable self-insured retentions (if allowed) and deductibles, full disclosure of all relevant exclusions, and evidence of insurance required to be purchased and maintained by

Subcontractors or Suppliers. In any documentation furnished under this provision, Contractor, Subcontractors, and Suppliers may block out (redact) (1) any confidential premium or pricing information and (2) any wording specific to a project or jurisdiction other than those applicable to this Contract.

- E. Owner shall deliver to Contractor, with copies to each additional insured identified in the Contract, certificates of insurance and endorsements establishing that Owner has obtained and is maintaining the policies and coverages required of Owner by the Contract (if any). Upon request by Contractor or any other insured, Owner shall also provide other evidence of such required insurance (if any), including but not limited to copies of policies, documentation of applicable self-insured retentions (if allowed) and deductibles, and full disclosure of all relevant exclusions. In any documentation furnished under this provision, Owner may block out (redact) (1) any confidential premium or pricing information and (2) any wording specific to a project or jurisdiction other than those relevant to this Contract.
- F. Failure of Owner or Contractor to demand such certificates or other evidence of the other party's full compliance with these insurance requirements, or failure of Owner or Contractor to identify a deficiency in compliance from the evidence provided, will not be construed as a waiver of the other party's obligation to obtain and maintain such insurance.
- G. In addition to the liability insurance required to be provided by Contractor, the Owner, at Owner's option, may purchase and maintain Owner's own liability insurance. Owner's liability policies, if any, operate separately and independently from policies required to be provided by Contractor, and Contractor cannot rely upon Owner's liability policies for any of Contractor's obligations to the Owner, Engineer, or third parties.
- H. Contractor shall require:
 - 1. Subcontractors to purchase and maintain worker's compensation, commercial general liability, and other insurance that is appropriate for their participation in the Project, and to name as additional insureds Owner and Engineer (and any other individuals or entities identified in the Supplementary Conditions as additional insureds on Contractor's liability policies) on each Subcontractor's commercial general liability insurance policy; and
 - 2. Suppliers to purchase and maintain insurance that is appropriate for their participation in the Project.
- I. If either party does not purchase or maintain the insurance required of such party by the Contract, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage.
- J. If Contractor has failed to obtain and maintain required insurance, Contractor's entitlement to enter or remain at the Site will end immediately, and Owner may impose an appropriate set-off against payment for any associated costs (including but not limited to the cost of purchasing necessary insurance coverage), and exercise Owner's termination rights under Article 16.
- K. Without prejudice to any other right or remedy, if a party has failed to obtain required insurance, the other party may elect (but is in no way obligated) to obtain equivalent insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and the Contract Price will be adjusted accordingly.

- L. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor or Contractor's interests. Contractor is responsible for determining whether such coverage and limits are adequate to protect its interests, and for obtaining and maintaining any additional insurance that Contractor deems necessary.
- M. The insurance and insurance limits required herein will not be deemed as a limitation on Contractor's liability, or that of its Subcontractors or Suppliers, under the indemnities granted to Owner and other individuals and entities in the Contract or otherwise.
- N. All the policies of insurance required to be purchased and maintained under this Contract will contain a provision or endorsement that the coverage afforded will not be canceled, or renewal refused, until at least 10 days prior written notice has been given to the purchasing policyholder. Within three days of receipt of any such written notice, the purchasing policyholder shall provide a copy of the notice to each other insured and Engineer.

6.03 *Contractor's Insurance*

- A. *Required Insurance:* Contractor shall purchase and maintain Worker's Compensation, Commercial General Liability, and other insurance pursuant to the specific requirements of the Supplementary Conditions.
- B. *General Provisions:* The policies of insurance required by this Paragraph 6.03 as supplemented must:
 - 1. include at least the specific coverages required;
 - 2. be written for not less than the limits provided, or those required by Laws or Regulations, whichever is greater;
 - 3. remain in effect at least until the Work is complete (as set forth in Paragraph 15.06.D), and longer if expressly required elsewhere in this Contract, and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work as a warranty or correction obligation, or otherwise, or returning to the Site to conduct other tasks arising from the Contract;
 - 4. apply with respect to the performance of the Work, whether such performance is by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable; and
 - 5. include all necessary endorsements to support the stated requirements.
- C. *Additional Insureds:* The Contractor's commercial general liability, automobile liability, employer's liability, umbrella or excess, pollution liability, and unmanned aerial vehicle liability policies, if required by this Contract, must:
 - 1. include and list as additional insureds Owner and Engineer, and any individuals or entities identified as additional insureds in the Supplementary Conditions;
 - 2. include coverage for the respective officers, directors, members, partners, employees, and consultants of all such additional insureds;
 - 3. afford primary coverage to these additional insureds for all claims covered thereby (including as applicable those arising from both ongoing and completed operations);

4. not seek contribution from insurance maintained by the additional insured; and
5. as to commercial general liability insurance, apply to additional insureds with respect to liability caused in whole or in part by Contractor's acts or omissions, or the acts and omissions of those working on Contractor's behalf, in the performance of Contractor's operations.

6.04 *Builder's Risk and Other Property Insurance*

- A. *Builder's Risk*: Unless otherwise provided in the Supplementary Conditions, Contractor shall purchase and maintain builder's risk insurance upon the Work on a completed value basis, in the amount of the Work's full insurable replacement cost (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). The specific requirements applicable to the builder's risk insurance are set forth in the Supplementary Conditions.
- B. *Property Insurance for Facilities of Owner Where Work Will Occur*: Owner is responsible for obtaining and maintaining property insurance covering each existing structure, building, or facility in which any part of the Work will occur, or to which any part of the Work will attach or be adjoined. Such property insurance will be written on a special perils (all-risk) form, on a replacement cost basis, providing coverage consistent with that required for the builder's risk insurance, and will be maintained until the Work is complete, as set forth in Paragraph 15.06.D.
- C. *Property Insurance for Substantially Complete Facilities*: Promptly after Substantial Completion, and before actual occupancy or use of the substantially completed Work, Owner will obtain property insurance for such substantially completed Work, and maintain such property insurance at least until the Work is complete, as set forth in Paragraph 15.06.D. Such property insurance will be written on a special perils (all-risk) form, on a replacement cost basis, and provide coverage consistent with that required for the builder's risk insurance. The builder's risk insurance may terminate upon written confirmation of Owner's procurement of such property insurance.
- D. *Partial Occupancy or Use by Owner*: If Owner will occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work, as provided in Paragraph 15.04, then Owner (directly, if it is the purchaser of the builder's risk policy, or through Contractor) will provide advance notice of such occupancy or use to the builder's risk insurer, and obtain an endorsement consenting to the continuation of coverage prior to commencing such partial occupancy or use.
- E. *Insurance of Other Property; Additional Insurance*: If the express insurance provisions of the Contract do not require or address the insurance of a property item or interest, then the entity or individual owning such property item will be responsible for insuring it. If Contractor elects to obtain other special insurance to be included in or supplement the builder's risk or property insurance policies provided under this Paragraph 6.04, it may do so at Contractor's expense.

6.05 *Property Losses; Subrogation*

- A. The builder's risk insurance policy purchased and maintained in accordance with Paragraph 6.04 (or an installation floater policy if authorized by the Supplementary Conditions), will contain provisions to the effect that in the event of payment of any loss or damage the insurer will have no rights of recovery against any insureds thereunder, or against

Engineer or its consultants, or their officers, directors, members, partners, employees, agents, consultants, or subcontractors.

1. Owner and Contractor waive all rights against each other and the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, or resulting from any of the perils, risks, or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Engineer, its consultants, all individuals or entities identified in the Supplementary Conditions as builder's risk or installation floater insureds, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, under such policies for losses and damages so caused.
 2. None of the above waivers extends to the rights that any party making such waiver may have to the proceeds of insurance held by Owner or Contractor as trustee or fiduciary, or otherwise payable under any policy so issued.
- B. Any property insurance policy maintained by Owner covering any loss, damage, or consequential loss to Owner's existing structures, buildings, or facilities in which any part of the Work will occur, or to which any part of the Work will attach or adjoin; to adjacent structures, buildings, or facilities of Owner; or to part or all of the completed or substantially completed Work, during partial occupancy or use pursuant to Paragraph 15.04, after Substantial Completion pursuant to Paragraph 15.03, or after final payment pursuant to Paragraph 15.06, will contain provisions to the effect that in the event of payment of any loss or damage the insurer will have no rights of recovery against any insureds thereunder, or against Contractor, Subcontractors, or Engineer, or the officers, directors, members, partners, employees, agents, consultants, or subcontractors of each and any of them, and that the insured is allowed to waive the insurer's rights of subrogation in a written contract executed prior to the loss, damage, or consequential loss.
1. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, for all losses and damages caused by, arising out of, or resulting from fire or any of the perils, risks, or causes of loss covered by such policies.
- C. The waivers in this Paragraph 6.05 include the waiver of rights due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other insured peril, risk, or cause of loss.
- D. Contractor shall be responsible for assuring that each Subcontract contains provisions whereby the Subcontractor waives all rights against Owner, Contractor, all individuals or entities identified in the Supplementary Conditions as insureds, the Engineer and its consultants, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, relating to, or resulting from fire or other peril, risk, or cause of loss covered by builder's risk insurance, installation floater, and any other property insurance applicable to the Work.

6.06 *Receipt and Application of Property Insurance Proceeds*

- A. Any insured loss under the builder's risk and other policies of property insurance required by Paragraph 6.04 will be adjusted and settled with the named insured that purchased the policy. Such named insured shall act as fiduciary for the other insureds, and give notice to such other insureds that adjustment and settlement of a claim is in progress. Any other insured may state its position regarding a claim for insured loss in writing within 15 days after notice of such claim.
- B. Proceeds for such insured losses may be made payable by the insurer either jointly to multiple insureds, or to the named insured that purchased the policy in its own right and as fiduciary for other insureds, subject to the requirements of any applicable mortgage clause. A named insured receiving insurance proceeds under the builder's risk and other policies of insurance required by Paragraph 6.04 shall maintain such proceeds in a segregated account, and distribute such proceeds in accordance with such agreement as the parties in interest may reach, or as otherwise required under the dispute resolution provisions of this Contract or applicable Laws and Regulations.
- C. If no other special agreement is reached, Contractor shall repair or replace the damaged Work, using allocated insurance proceeds.

ARTICLE 7—CONTRACTOR'S RESPONSIBILITIES

7.01 *Contractor's Means and Methods of Construction*

- A. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction.
- B. If the Contract Documents note, or Contractor determines, that professional engineering or other design services are needed to carry out Contractor's responsibilities for construction means, methods, techniques, sequences, and procedures, or for Site safety, then Contractor shall cause such services to be provided by a properly licensed design professional, at Contractor's expense. Such services are not Owner-delegated professional design services under this Contract, and neither Owner nor Engineer has any responsibility with respect to (1) Contractor's determination of the need for such services, (2) the qualifications or licensing of the design professionals retained or employed by Contractor, (3) the performance of such services, or (4) any errors, omissions, or defects in such services.

7.02 *Supervision and Superintendence*

- A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents.
- B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who will not be replaced without written notice to Owner and Engineer except under extraordinary circumstances.

7.03 *Labor; Working Hours*

- A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall maintain good discipline and order at the Site.

- B. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of Contractor's employees; of Suppliers and Subcontractors, and their employees; and of any other individuals or entities performing or furnishing any of the Work, just as Contractor is responsible for Contractor's own acts and omissions.
- C. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site will be performed during regular working hours, Monday through Friday. Contractor will not perform Work on a Saturday, Sunday, or any legal holiday. Contractor may perform Work outside regular working hours or on Saturdays, Sundays, or legal holidays only with Owner's written consent, which will not be unreasonably withheld.

7.04 *Services, Materials, and Equipment*

- A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start up, and completion of the Work, whether or not such items are specifically called for in the Contract Documents.
- B. All materials and equipment incorporated into the Work must be new and of good quality, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications will expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.
- C. All materials and equipment must be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

7.05 *"Or Equals"*

- A. *Contractor's Request; Governing Criteria:* Whenever an item of equipment or material is specified or described in the Contract Documents by using the names of one or more proprietary items or specific Suppliers, the Contract Price has been based upon Contractor furnishing such item as specified. The specification or description of such an item is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or equal" item is permitted, Contractor may request that Engineer authorize the use of other items of equipment or material, or items from other proposed Suppliers, under the circumstances described below.
 - 1. If Engineer in its sole discretion determines that an item of equipment or material proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, Engineer will deem it an "or equal" item. For the purposes of this paragraph, a proposed item of equipment or material will be considered functionally equal to an item so named if:
 - a. in the exercise of reasonable judgment Engineer determines that the proposed item:
 - 1) is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;

- 2) will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole;
 - 3) has a proven record of performance and availability of responsive service; and
 - 4) is not objectionable to Owner.
- b. Contractor certifies that, if the proposed item is approved and incorporated into the Work:
 - 1) there will be no increase in cost to the Owner or increase in Contract Times; and
 - 2) the item will conform substantially to the detailed requirements of the item named in the Contract Documents.
- B. *Contractor's Expense*: Contractor shall provide all data in support of any proposed "or equal" item at Contractor's expense.
- C. *Engineer's Evaluation and Determination*: Engineer will be allowed a reasonable time to evaluate each "or-equal" request. Engineer may require Contractor to furnish additional data about the proposed "or-equal" item. Engineer will be the sole judge of acceptability. No "or-equal" item will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an "or-equal," which will be evidenced by an approved Shop Drawing or other written communication. Engineer will advise Contractor in writing of any negative determination.
- D. *Effect of Engineer's Determination*: Neither approval nor denial of an "or-equal" request will result in any change in Contract Price. The Engineer's denial of an "or-equal" request will be final and binding, and may not be reversed through an appeal under any provision of the Contract.
- E. *Treatment as a Substitution Request*: If Engineer determines that an item of equipment or material proposed by Contractor does not qualify as an "or-equal" item, Contractor may request that Engineer consider the item a proposed substitute pursuant to Paragraph 7.06.

7.06 Substitutes

- A. *Contractor's Request; Governing Criteria*: Unless the specification or description of an item of equipment or material required to be furnished under the Contract Documents contains or is followed by words reading that no substitution is permitted, Contractor may request that Engineer authorize the use of other items of equipment or material under the circumstances described below. To the extent possible such requests must be made before commencement of related construction at the Site.
1. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is functionally equivalent to that named and an acceptable substitute therefor. Engineer will not accept requests for review of proposed substitute items of equipment or material from anyone other than Contractor.
 2. The requirements for review by Engineer will be as set forth in Paragraph 7.06.B, as supplemented by the Specifications, and as Engineer may decide is appropriate under the circumstances.

3. Contractor shall make written application to Engineer for review of a proposed substitute item of equipment or material that Contractor seeks to furnish or use. The application:
 - a. will certify that the proposed substitute item will:
 - 1) perform adequately the functions and achieve the results called for by the general design;
 - 2) be similar in substance to the item specified; and
 - 3) be suited to the same use as the item specified.
 - b. will state:
 - 1) the extent, if any, to which the use of the proposed substitute item will necessitate a change in Contract Times;
 - 2) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item; and
 - 3) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty.
 - c. will identify:
 - 1) all variations of the proposed substitute item from the item specified; and
 - 2) available engineering, sales, maintenance, repair, and replacement services.
 - d. will contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including but not limited to changes in Contract Price, shared savings, costs of redesign, and claims of other contractors affected by any resulting change.
- B. *Engineer's Evaluation and Determination*: Engineer will be allowed a reasonable time to evaluate each substitute request, and to obtain comments and direction from Owner. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No substitute will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an acceptable substitute. Engineer's determination will be evidenced by a Field Order or a proposed Change Order accounting for the substitution itself and all related impacts, including changes in Contract Price or Contract Times. Engineer will advise Contractor in writing of any negative determination.
- C. *Special Guarantee*: Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.
- D. *Reimbursement of Engineer's Cost*: Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.

- E. *Contractor's Expense*: Contractor shall provide all data in support of any proposed substitute at Contractor's expense.
- F. *Effect of Engineer's Determination*: If Engineer approves the substitution request, Contractor shall execute the proposed Change Order and proceed with the substitution. The Engineer's denial of a substitution request will be final and binding, and may not be reversed through an appeal under any provision of the Contract. Contractor may challenge the scope of reimbursement costs imposed under Paragraph 7.06.D, by timely submittal of a Change Proposal.

7.07 *Concerning Subcontractors and Suppliers*

- A. Contractor may retain Subcontractors and Suppliers for the performance of parts of the Work. Such Subcontractors and Suppliers must be acceptable to Owner. The Contractor's retention of a Subcontractor or Supplier for the performance of parts of the Work will not relieve Contractor's obligation to Owner to perform and complete the Work in accordance with the Contract Documents.
- B. Contractor shall retain specific Subcontractors and Suppliers for the performance of designated parts of the Work if required by the Contract to do so.
- C. Subsequent to the submittal of Contractor's Bid or final negotiation of the terms of the Contract, Owner may not require Contractor to retain any Subcontractor or Supplier to furnish or perform any of the Work against which Contractor has reasonable objection.
- D. Prior to entry into any binding subcontract or purchase order, Contractor shall submit to Owner the identity of the proposed Subcontractor or Supplier (unless Owner has already deemed such proposed Subcontractor or Supplier acceptable during the bidding process or otherwise). Such proposed Subcontractor or Supplier shall be deemed acceptable to Owner unless Owner raises a substantive, reasonable objection within 5 days.
- E. Owner may require the replacement of any Subcontractor or Supplier. Owner also may require Contractor to retain specific replacements; provided, however, that Owner may not require a replacement to which Contractor has a reasonable objection. If Contractor has submitted the identity of certain Subcontractors or Suppliers for acceptance by Owner, and Owner has accepted it (either in writing or by failing to make written objection thereto), then Owner may subsequently revoke the acceptance of any such Subcontractor or Supplier so identified solely on the basis of substantive, reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor or Supplier.
- F. If Owner requires the replacement of any Subcontractor or Supplier retained by Contractor to perform any part of the Work, then Contractor shall be entitled to an adjustment in Contract Price or Contract Times, with respect to the replacement; and Contractor shall initiate a Change Proposal for such adjustment within 30 days of Owner's requirement of replacement.
- G. No acceptance by Owner of any such Subcontractor or Supplier, whether initially or as a replacement, will constitute a waiver of the right of Owner to the completion of the Work in accordance with the Contract Documents.

- H. On a monthly basis, Contractor shall submit to Engineer a complete list of all Subcontractors and Suppliers having a direct contract with Contractor, and of all other Subcontractors and Suppliers known to Contractor at the time of submittal.
- I. Contractor shall be solely responsible for scheduling and coordinating the work of Subcontractors and Suppliers.
- J. The divisions and sections of the Specifications and the identifications of any Drawings do not control Contractor in dividing the Work among Subcontractors or Suppliers, or in delineating the Work to be performed by any specific trade.
- K. All Work performed for Contractor by a Subcontractor or Supplier must be pursuant to an appropriate contractual agreement that specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract for the benefit of Owner and Engineer.
- L. Owner may furnish to any Subcontractor or Supplier, to the extent practicable, information about amounts paid to Contractor for Work performed for Contractor by the Subcontractor or Supplier.
- M. Contractor shall restrict all Subcontractors and Suppliers from communicating with Engineer or Owner, except through Contractor or in case of an emergency, or as otherwise expressly allowed in this Contract.

7.08 *Patent Fees and Royalties*

- A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If an invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if, to the actual knowledge of Owner or Engineer, its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights will be disclosed in the Contract Documents.
- B. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, and its officers, directors, members, partners, employees, agents, consultants, and subcontractors, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device specified in the Contract Documents, but not identified as being subject to payment of any license fee or royalty to others required by patent rights or copyrights.
- C. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

7.09 *Permits*

- A. Unless otherwise provided in the Contract Documents, Contractor shall obtain and pay for all construction permits, licenses, and certificates of occupancy. Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of the submission of Contractor's Bid (or when Contractor became bound under a negotiated contract). Owner shall pay all charges of utility owners for connections for providing permanent service to the Work.

7.10 *Taxes*

- A. Contractor shall pay all sales, consumer, use, and other similar taxes required to be paid by Contractor in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

7.11 *Laws and Regulations*

- A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.
- B. If Contractor performs any Work or takes any other action knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all resulting costs and losses, and shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work or other action. It is not Contractor's responsibility to make certain that the Work described in the Contract Documents is in accordance with Laws and Regulations, but this does not relieve Contractor of its obligations under Paragraph 3.03.
- C. Owner or Contractor may give written notice to the other party of any changes after the submission of Contractor's Bid (or after the date when Contractor became bound under a negotiated contract) in Laws or Regulations having an effect on the cost or time of performance of the Work, including but not limited to changes in Laws or Regulations having an effect on procuring permits and on sales, use, value-added, consumption, and other similar taxes. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times resulting from such changes, then within 30 days of such written notice Contractor may submit a Change Proposal, or Owner may initiate a Claim.

7.12 *Record Documents*

- A. Contractor shall maintain in a safe place at the Site one printed record copy of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field Orders, written interpretations and clarifications, and approved Shop Drawings. Contractor shall keep such record documents in good order and annotate them to show changes made during construction. These record documents, together with all approved Samples, will be available to Engineer for reference. Upon completion of the Work, Contractor shall deliver these record documents to Engineer.

7.13 *Safety and Protection*

- A. Contractor shall be solely responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations.
- B. Contractor shall designate a qualified and experienced safety representative whose duties and responsibilities are the prevention of Work-related accidents and the maintenance and supervision of safety precautions and programs.
- C. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury, or loss to:
 - 1. all persons on the Site or who may be affected by the Work;
 - 2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and
 - 3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, other work in progress, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.
- D. All damage, injury, or loss to any property referred to in Paragraph 7.13.C.2 or 7.13.C.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor at its expense (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).
- E. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection.
- F. Contractor shall notify Owner; the owners of adjacent property; the owners of Underground Facilities and other utilities (if the identity of such owners is known to Contractor); and other contractors and utility owners performing work at or adjacent to the Site, in writing, when Contractor knows that prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property or work in progress.
- G. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. Any Owner's safety programs that are applicable to the Work are identified or included in the Supplementary Conditions or Specifications.
- H. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.

- I. Contractor's duties and responsibilities for safety and protection will continue until all the Work is completed, Engineer has issued a written notice to Owner and Contractor in accordance with Paragraph 15.06.C that the Work is acceptable, and Contractor has left the Site (except as otherwise expressly provided in connection with Substantial Completion).
- J. Contractor's duties and responsibilities for safety and protection will resume whenever Contractor or any Subcontractor or Supplier returns to the Site to fulfill warranty or correction obligations, or to conduct other tasks arising from the Contract Documents.

7.14 *Hazard Communication Programs*

- A. Contractor shall be responsible for coordinating any exchange of safety data sheets (formerly known as material safety data sheets) or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with Laws or Regulations.

7.15 *Emergencies*

- A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent damage, injury, or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused by an emergency, or are required as a result of Contractor's response to an emergency. If Engineer determines that a change in the Contract Documents is required because of an emergency or Contractor's response, a Work Change Directive or Change Order will be issued.

7.16 *Submittals*

A. *Shop Drawing and Sample Requirements*

- 1. Before submitting a Shop Drawing or Sample, Contractor shall:
 - a. review and coordinate the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;
 - b. determine and verify:
 - 1) all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect to the Submittal;
 - 2) the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and
 - 3) all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto;
 - c. confirm that the Submittal is complete with respect to all related data included in the Submittal.
- 2. Each Shop Drawing or Sample must bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review of that Submittal, and that Contractor approves the Submittal.

3. With each Shop Drawing or Sample, Contractor shall give Engineer specific written notice of any variations that the Submittal may have from the requirements of the Contract Documents. This notice must be set forth in a written communication separate from the Submittal; and, in addition, in the case of a Shop Drawing by a specific notation made on the Shop Drawing itself.
- B. *Submittal Procedures for Shop Drawings and Samples:* Contractor shall label and submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals.
1. *Shop Drawings*
 - a. Contractor shall submit the number of copies required in the Specifications.
 - b. Data shown on the Shop Drawings must be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide, and to enable Engineer to review the information for the limited purposes required by Paragraph 7.16.C.
 2. *Samples*
 - a. Contractor shall submit the number of Samples required in the Specifications.
 - b. Contractor shall clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the Submittal for the limited purposes required by Paragraph 7.16.C.
 3. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals, any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.
- C. *Engineer's Review of Shop Drawings and Samples*
1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the accepted Schedule of Submittals. Engineer's review and approval will be only to determine if the items covered by the Submittals will, after installation or incorporation in the Work, comply with the requirements of the Contract Documents, and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.
 2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction, or to safety precautions or programs incident thereto.
 3. Engineer's review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.
 4. Engineer's review and approval of a Shop Drawing or Sample will not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 7.16.A.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer will

document any such approved variation from the requirements of the Contract Documents in a Field Order or other appropriate Contract modification.

5. Engineer's review and approval of a Shop Drawing or Sample will not relieve Contractor from responsibility for complying with the requirements of Paragraphs 7.16.A and B.
6. Engineer's review and approval of a Shop Drawing or Sample, or of a variation from the requirements of the Contract Documents, will not, under any circumstances, change the Contract Times or Contract Price, unless such changes are included in a Change Order.
7. Neither Engineer's receipt, review, acceptance, or approval of a Shop Drawing or Sample will result in such item becoming a Contract Document.
8. Contractor shall perform the Work in compliance with the requirements and commitments set forth in approved Shop Drawings and Samples, subject to the provisions of Paragraph 7.16.C.4.

D. Resubmittal Procedures for Shop Drawings and Samples

1. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous Submittals.
2. Contractor shall furnish required Shop Drawing and Sample submittals with sufficient information and accuracy to obtain required approval of an item with no more than two resubmittals. Engineer will record Engineer's time for reviewing a third or subsequent resubmittal of a Shop Drawing or Sample, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due Contractor to secure reimbursement for such charges.
3. If Contractor requests a change of a previously approved Shop Drawing or Sample, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-off against payments due Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

E. Submittals Other than Shop Drawings, Samples, and Owner-Delegated Designs

1. The following provisions apply to all Submittals other than Shop Drawings, Samples, and Owner-delegated designs:
 - a. Contractor shall submit all such Submittals to the Engineer in accordance with the Schedule of Submittals and pursuant to the applicable terms of the Contract Documents.
 - b. Engineer will provide timely review of all such Submittals in accordance with the Schedule of Submittals and return such Submittals with a notation of either Accepted or Not Accepted. Any such Submittal that is not returned within the time established in the Schedule of Submittals will be deemed accepted.
 - c. Engineer's review will be only to determine if the Submittal is acceptable under the requirements of the Contract Documents as to general form and content of the Submittal.

- d. If any such Submittal is not accepted, Contractor shall confer with Engineer regarding the reason for the non-acceptance, and resubmit an acceptable document.
- 2. Procedures for the submittal and acceptance of the Progress Schedule, the Schedule of Submittals, and the Schedule of Values are set forth in Paragraphs 2.03, 2.04, and 2.05.
- F. Owner-delegated Designs: Submittals pursuant to Owner-delegated designs are governed by the provisions of Paragraph 7.19.

7.17 Contractor's General Warranty and Guarantee

- A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer is entitled to rely on Contractor's warranty and guarantee.
- B. Owner's rights under this warranty and guarantee are in addition to, and are not limited by, Owner's rights under the correction period provisions of Paragraph 15.08. The time in which Owner may enforce its warranty and guarantee rights under this Paragraph 7.17 is limited only by applicable Laws and Regulations restricting actions to enforce such rights; provided, however, that after the end of the correction period under Paragraph 15.08:
 - 1. Owner shall give Contractor written notice of any defective Work within 60 days of the discovery that such Work is defective; and
 - 2. Such notice will be deemed the start of an event giving rise to a Claim under Paragraph 12.01.B, such that any related Claim must be brought within 30 days of the notice.
- C. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:
 - 1. abuse, or improper modification, maintenance, or operation, by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or
 - 2. normal wear and tear under normal usage.
- D. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents is absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents, a release of Contractor's obligation to perform the Work in accordance with the Contract Documents, or a release of Owner's warranty and guarantee rights under this Paragraph 7.17:
 - 1. Observations by Engineer;
 - 2. Recommendation by Engineer or payment by Owner of any progress or final payment;
 - 3. The issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;
 - 4. Use or occupancy of the Work or any part thereof by Owner;
 - 5. Any review and approval of a Shop Drawing or Sample submittal;
 - 6. The issuance of a notice of acceptability by Engineer;
 - 7. The end of the correction period established in Paragraph 15.08;
 - 8. Any inspection, test, or approval by others; or

9. Any correction of defective Work by Owner.
- E. If the Contract requires the Contractor to accept the assignment of a contract entered into by Owner, then the specific warranties, guarantees, and correction obligations contained in the assigned contract will govern with respect to Contractor's performance obligations to Owner for the Work described in the assigned contract.

7.18 Indemnification

- A. To the fullest extent permitted by Laws and Regulations, and in addition to any other obligations of Contractor under the Contract or otherwise, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them (the "Indemnified Parties"), from losses, damages, costs, and judgments (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising from third-party claims or actions relating to or resulting from the performance or furnishing of the Work, provided that any such claim, action, loss, cost, judgment or damage is attributable to bodily injury, sickness, disease, or death, or to damage to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom, but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable.
- B. In any and all claims against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 7.18.A will not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

7.19 Delegation of Professional Design Services

- A. Owner may require Contractor to provide professional design services for a portion of the Work by express delegation in the Contract Documents. Such delegation will specify the performance and design criteria that such services must satisfy, and the Submittals that Contractor must furnish to Engineer with respect to the Owner-delegated design.
- B. Contractor shall cause such Owner-delegated professional design services to be provided pursuant to the professional standard of care by a properly licensed design professional, whose signature and seal must appear on all drawings, calculations, specifications, certifications, and Submittals prepared by such design professional. Such design professional must issue all certifications of design required by Laws and Regulations.
- C. If a Shop Drawing or other Submittal related to the Owner-delegated design is prepared by Contractor, a Subcontractor, or others for submittal to Engineer, then such Shop Drawing or other Submittal must bear the written approval of Contractor's design professional when submitted by Contractor to Engineer.

- D. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, and approvals performed or provided by the design professionals retained or employed by Contractor under an Owner-delegated design, subject to the professional standard of care and the performance and design criteria stated in the Contract Documents.
- E. Pursuant to this Paragraph 7.19, Engineer's review, approval, and other determinations regarding design drawings, calculations, specifications, certifications, and other Submittals furnished by Contractor pursuant to an Owner-delegated design will be only for the following limited purposes:
 - 1. Checking for conformance with the requirements of this Paragraph 7.19;
 - 2. Confirming that Contractor (through its design professionals) has used the performance and design criteria specified in the Contract Documents; and
 - 3. Establishing that the design furnished by Contractor is consistent with the design concept expressed in the Contract Documents.
- F. Contractor shall not be responsible for the adequacy of performance or design criteria specified by Owner or Engineer.
- G. Contractor is not required to provide professional services in violation of applicable Laws and Regulations.

ARTICLE 8—OTHER WORK AT THE SITE

8.01 *Other Work*

- A. In addition to and apart from the Work under the Contract Documents, the Owner may perform other work at or adjacent to the Site. Such other work may be performed by Owner's employees, or through contracts between the Owner and third parties. Owner may also arrange to have third-party utility owners perform work on their utilities and facilities at or adjacent to the Site.
- B. If Owner performs other work at or adjacent to the Site with Owner's employees, or through contracts for such other work, then Owner shall give Contractor written notice thereof prior to starting any such other work. If Owner has advance information regarding the start of any third-party utility work that Owner has arranged to take place at or adjacent to the Site, Owner shall provide such information to Contractor.
- C. Contractor shall afford proper and safe access to the Site to each contractor that performs such other work, each utility owner performing other work, and Owner, if Owner is performing other work with Owner's employees, and provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work.
- D. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected.

- E. If the proper execution or results of any part of Contractor's Work depends upon work performed by others, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.
- F. The provisions of this article are not applicable to work that is performed by third-party utilities or other third-party entities without a contract with Owner, or that is performed without having been arranged by Owner. If such work occurs, then any related delay, disruption, or interference incurred by Contractor is governed by the provisions of Paragraph 4.05.C.3.

8.02 *Coordination*

- A. If Owner intends to contract with others for the performance of other work at or adjacent to the Site, to perform other work at or adjacent to the Site with Owner's employees, or to arrange to have utility owners perform work at or adjacent to the Site, the following will be set forth in the Supplementary Conditions or provided to Contractor prior to the start of any such other work:
 - 1. The identity of the individual or entity that will have authority and responsibility for coordination of the activities among the various contractors;
 - 2. An itemization of the specific matters to be covered by such authority and responsibility; and
 - 3. The extent of such authority and responsibilities.
- B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

8.03 *Legal Relationships*

- A. If, in the course of performing other work for Owner at or adjacent to the Site, the Owner's employees, any other contractor working for Owner, or any utility owner that Owner has arranged to perform work, causes damage to the Work or to the property of Contractor or its Subcontractors, or delays, disrupts, interferes with, or increases the scope or cost of the performance of the Work, through actions or inaction, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times. Contractor must submit any Change Proposal seeking an equitable adjustment in the Contract Price or the Contract Times under this paragraph within 30 days of the damaging, delaying, disrupting, or interfering event. The entitlement to, and extent of, any such equitable adjustment will take into account information (if any) regarding such other work that was provided to Contractor in the Contract Documents prior to the submittal of the Bid or the final negotiation of the terms of the Contract, and any remedies available to Contractor under Laws or Regulations concerning utility action or inaction. When applicable, any such equitable adjustment in Contract Price will be conditioned on Contractor assigning to Owner all Contractor's rights against such other contractor or utility owner with respect to the damage, delay, disruption, or interference that is the subject of the adjustment. Contractor's entitlement to an adjustment of the Contract Times or Contract Price is subject to the provisions of Paragraphs 4.05.D and 4.05.E.

- B. Contractor shall take reasonable and customary measures to avoid damaging, delaying, disrupting, or interfering with the work of Owner, any other contractor, or any utility owner performing other work at or adjacent to the Site.
 - 1. If Contractor fails to take such measures and as a result damages, delays, disrupts, or interferes with the work of any such other contractor or utility owner, then Owner may impose a set-off against payments due Contractor, and assign to such other contractor or utility owner the Owner's contractual rights against Contractor with respect to the breach of the obligations set forth in this Paragraph 8.03.B.
 - 2. When Owner is performing other work at or adjacent to the Site with Owner's employees, Contractor shall be liable to Owner for damage to such other work, and for the reasonable direct delay, disruption, and interference costs incurred by Owner as a result of Contractor's failure to take reasonable and customary measures with respect to Owner's other work. In response to such damage, delay, disruption, or interference, Owner may impose a set-off against payments due Contractor.
- C. If Contractor damages, delays, disrupts, or interferes with the work of any other contractor, or any utility owner performing other work at or adjacent to the Site, through Contractor's failure to take reasonable and customary measures to avoid such impacts, or if any claim arising out of Contractor's actions, inactions, or negligence in performance of the Work at or adjacent to the Site is made by any such other contractor or utility owner against Contractor, Owner, or Engineer, then Contractor shall (1) promptly attempt to settle the claim as to all parties through negotiations with such other contractor or utility owner, or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law, and (2) indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claims, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such damage, delay, disruption, or interference.

ARTICLE 9—OWNER'S RESPONSIBILITIES

9.01 *Communications to Contractor*

- A. Except as otherwise provided in these General Conditions, Owner shall issue all communications to Contractor through Engineer.

9.02 *Replacement of Engineer*

- A. Owner may at its discretion appoint an engineer to replace Engineer, provided Contractor makes no reasonable objection to the replacement engineer. The replacement engineer's status under the Contract Documents will be that of the former Engineer.

9.03 *Furnish Data*

- A. Owner shall promptly furnish the data required of Owner under the Contract Documents.

9.04 *Pay When Due*

- A. Owner shall make payments to Contractor when they are due as provided in the Agreement.

9.05 *Lands and Easements; Reports, Tests, and Drawings*

- A. Owner's duties with respect to providing lands and easements are set forth in Paragraph 5.01.
- B. Owner's duties with respect to providing engineering surveys to establish reference points are set forth in Paragraph 4.03.
- C. Article 5 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of conditions at the Site, and drawings of physical conditions relating to existing surface or subsurface structures at the Site.

9.06 *Insurance*

- A. Owner's responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 6.

9.07 *Change Orders*

- A. Owner's responsibilities with respect to Change Orders are set forth in Article 11.

9.08 *Inspections, Tests, and Approvals*

- A. Owner's responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 14.02.B.

9.09 *Limitations on Owner's Responsibilities*

- A. The Owner shall not supervise, direct, or have control or authority over, nor be responsible for, Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Owner will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

9.10 *Undisclosed Hazardous Environmental Condition*

- A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 5.06.

9.11 *Evidence of Financial Arrangements*

- A. Upon request of Contractor, Owner shall furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract (including obligations under proposed changes in the Work).

9.12 *Safety Programs*

- A. While at the Site, Owner's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Owner has been informed.
- B. Owner shall furnish copies of any applicable Owner safety programs to Contractor.

ARTICLE 10—ENGINEER'S STATUS DURING CONSTRUCTION

10.01 *Owner's Representative*

- A. Engineer will be Owner's representative during the construction period. The duties and responsibilities and the limitations of authority of Engineer as Owner's representative during construction are set forth in the Contract.

10.02 *Visits to Site*

- A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe, as an experienced and qualified design professional, the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.
- B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 10.07. Particularly, but without limitation, during or as a result of Engineer's visits or observations of Contractor's Work, Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

10.03 *Resident Project Representative*

- A. If Owner and Engineer have agreed that Engineer will furnish a Resident Project Representative to represent Engineer at the Site and assist Engineer in observing the progress and quality of the Work, then the authority and responsibilities of any such Resident Project Representative will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in the Supplementary Conditions and in Paragraph 10.07.
- B. If Owner designates an individual or entity who is not Engineer's consultant, agent, or employee to represent Owner at the Site, then the responsibilities and authority of such individual or entity will be as provided in the Supplementary Conditions.

10.04 *Engineer's Authority*

- A. Engineer has the authority to reject Work in accordance with Article 14.
- B. Engineer's authority as to Submittals is set forth in Paragraph 7.16.
- C. Engineer's authority as to design drawings, calculations, specifications, certifications and other Submittals from Contractor in response to Owner's delegation (if any) to Contractor of professional design services, is set forth in Paragraph 7.19.
- D. Engineer's authority as to changes in the Work is set forth in Article 11.

E. Engineer's authority as to Applications for Payment is set forth in Article 15.

10.05 *Determinations for Unit Price Work*

A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor as set forth in Paragraph 13.03.

10.06 *Decisions on Requirements of Contract Documents and Acceptability of Work*

A. Engineer will render decisions regarding the requirements of the Contract Documents, and judge the acceptability of the Work, pursuant to the specific procedures set forth herein for initial interpretations, Change Proposals, and acceptance of the Work. In rendering such decisions and judgments, Engineer will not show partiality to Owner or Contractor, and will not be liable to Owner, Contractor, or others in connection with any proceedings, interpretations, decisions, or judgments conducted or rendered in good faith.

10.07 *Limitations on Engineer's Authority and Responsibilities*

A. Neither Engineer's authority or responsibility under this Article 10 or under any other provision of the Contract, nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer, will create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.

D. Engineer's review of the final Application for Payment and accompanying documentation, and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Contractor under Paragraph 15.06.A, will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals, that the results certified indicate compliance with the Contract Documents.

E. The limitations upon authority and responsibility set forth in this Paragraph 10.07 also apply to the Resident Project Representative, if any.

10.08 *Compliance with Safety Program*

A. While at the Site, Engineer's employees and representatives will comply with the specific applicable requirements of Owner's and Contractor's safety programs of which Engineer has been informed.

ARTICLE 11—CHANGES TO THE CONTRACT

11.01 *Amending and Supplementing the Contract*

- A. The Contract may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order.
- B. If an amendment or supplement to the Contract includes a change in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order.
- C. All changes to the Contract that involve (1) the performance or acceptability of the Work, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, must be supported by Engineer's recommendation. Owner and Contractor may amend other terms and conditions of the Contract without the recommendation of the Engineer.

11.02 *Change Orders*

- A. Owner and Contractor shall execute appropriate Change Orders covering:
 - 1. Changes in Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive;
 - 2. Changes in Contract Price resulting from an Owner set-off, unless Contractor has duly contested such set-off;
 - 3. Changes in the Work which are: (a) ordered by Owner pursuant to Paragraph 11.05, (b) required because of Owner's acceptance of defective Work under Paragraph 14.04 or Owner's correction of defective Work under Paragraph 14.07, or (c) agreed to by the parties, subject to the need for Engineer's recommendation if the change in the Work involves the design (as set forth in the Drawings, Specifications, or otherwise) or other engineering or technical matters; and
 - 4. Changes that embody the substance of any final and binding results under: Paragraph 11.03.B, resolving the impact of a Work Change Directive; Paragraph 11.09, concerning Change Proposals; Article 12, Claims; Paragraph 13.02.D, final adjustments resulting from allowances; Paragraph 13.03.D, final adjustments relating to determination of quantities for Unit Price Work; and similar provisions.
- B. If Owner or Contractor refuses to execute a Change Order that is required to be executed under the terms of Paragraph 11.02.A, it will be deemed to be of full force and effect, as if fully executed.

11.03 *Work Change Directives*

- A. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the modification ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order, following negotiations by the parties as to the Work Change Directive's effect, if any, on the Contract Price and Contract Times; or, if negotiations are unsuccessful, by a determination under the terms of the Contract Documents governing adjustments, expressly including Paragraph 11.07 regarding change of Contract Price.

- B. If Owner has issued a Work Change Directive and:
 - 1. Contractor believes that an adjustment in Contract Times or Contract Price is necessary, then Contractor shall submit any Change Proposal seeking such an adjustment no later than 30 days after the completion of the Work set out in the Work Change Directive.
 - 2. Owner believes that an adjustment in Contract Times or Contract Price is necessary, then Owner shall submit any Claim seeking such an adjustment no later than 60 days after issuance of the Work Change Directive.

11.04 *Field Orders*

- A. Engineer may authorize minor changes in the Work if the changes do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Such changes will be accomplished by a Field Order and will be binding on Owner and also on Contractor, which shall perform the Work involved promptly.
- B. If Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, then before proceeding with the Work at issue, Contractor shall submit a Change Proposal as provided herein.

11.05 *Owner-Authorized Changes in the Work*

- A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work. Changes involving the design (as set forth in the Drawings, Specifications, or otherwise) or other engineering or technical matters will be supported by Engineer's recommendation.
- B. Such changes in the Work may be accomplished by a Change Order, if Owner and Contractor have agreed as to the effect, if any, of the changes on Contract Times or Contract Price; or by a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved; or, in the case of a deletion in the Work, promptly cease construction activities with respect to such deleted Work. Added or revised Work must be performed under the applicable conditions of the Contract Documents.
- C. Nothing in this Paragraph 11.05 obligates Contractor to undertake work that Contractor reasonably concludes cannot be performed in a manner consistent with Contractor's safety obligations under the Contract Documents or Laws and Regulations.

11.06 *Unauthorized Changes in the Work*

- A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents, as amended, modified, or supplemented, except in the case of an emergency as provided in Paragraph 7.15 or in the case of uncovering Work as provided in Paragraph 14.05.C.2.

11.07 *Change of Contract Price*

- A. The Contract Price may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Price must comply with the provisions of Paragraph 11.09. Any Claim for an adjustment of Contract Price must comply with the provisions of Article 12.
- B. An adjustment in the Contract Price will be determined as follows:

1. Where the Work involved is covered by unit prices contained in the Contract Documents, then by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 13.03);
 2. Where the Work involved is not covered by unit prices contained in the Contract Documents, then by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 11.07.C.2); or
 3. Where the Work involved is not covered by unit prices contained in the Contract Documents and the parties do not reach mutual agreement to a lump sum, then on the basis of the Cost of the Work (determined as provided in Paragraph 13.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 11.07.C).
- C. *Contractor's Fee:* When applicable, the Contractor's fee for overhead and profit will be determined as follows:
1. A mutually acceptable fixed fee; or
 2. If a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:
 - a. For costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2, the Contractor's fee will be 15 percent;
 - b. For costs incurred under Paragraph 13.01.B.3, the Contractor's fee will be 5 percent;
 - c. Where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 11.07.C.2.a and 11.07.C.2.b is that the Contractor's fee will be based on: (1) a fee of 15 percent of the costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2 by the Subcontractor that actually performs the Work, at whatever tier, and (2) with respect to Contractor itself and to any Subcontractors of a tier higher than that of the Subcontractor that actually performs the Work, a fee of 5 percent of the amount (fee plus underlying costs incurred) attributable to the next lower tier Subcontractor; provided, however, that for any such subcontracted Work the maximum total fee to be paid by Owner will be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the Work;
 - d. No fee will be payable on the basis of costs itemized under Paragraphs 13.01.B.4, 13.01.B.5, and 13.01.C;
 - e. The amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in Cost of the Work will be the amount of the actual net decrease in Cost of the Work and a deduction of an additional amount equal to 5 percent of such actual net decrease in Cost of the Work; and
 - f. When both additions and credits are involved in any one change or Change Proposal, the adjustment in Contractor's fee will be computed by determining the sum of the costs in each of the cost categories in Paragraph 13.01.B (specifically, payroll costs, Paragraph 13.01.B.1; incorporated materials and equipment costs, Paragraph 13.01.B.2; Subcontract costs, Paragraph 13.01.B.3; special consultants costs, Paragraph 13.01.B.4; and other costs, Paragraph 13.01.B.5) and applying to each such cost category sum the appropriate fee from Paragraphs 11.07.C.2.a through 11.07.C.2.e, inclusive.

11.08 *Change of Contract Times*

- A. The Contract Times may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Times must comply with the provisions of Paragraph 11.09. Any Claim for an adjustment in the Contract Times must comply with the provisions of Article 12.
- B. Delay, disruption, and interference in the Work, and any related changes in Contract Times, are addressed in and governed by Paragraph 4.05.

11.09 *Change Proposals*

- A. *Purpose and Content:* Contractor shall submit a Change Proposal to Engineer to request an adjustment in the Contract Times or Contract Price; contest an initial decision by Engineer concerning the requirements of the Contract Documents or relating to the acceptability of the Work under the Contract Documents; challenge a set-off against payment due; or seek other relief under the Contract. The Change Proposal will specify any proposed change in Contract Times or Contract Price, or other proposed relief, and explain the reason for the proposed change, with citations to any governing or applicable provisions of the Contract Documents. Each Change Proposal will address only one issue, or a set of closely related issues.
- B. *Change Proposal Procedures*
 - 1. *Submittal:* Contractor shall submit each Change Proposal to Engineer within 30 days after the start of the event giving rise thereto, or after such initial decision.
 - 2. *Supporting Data:* The Contractor shall submit supporting data, including the proposed change in Contract Price or Contract Time (if any), to the Engineer and Owner within 15 days after the submittal of the Change Proposal.
 - a. Change Proposals based on or related to delay, interruption, or interference must comply with the provisions of Paragraphs 4.05.D and 4.05.E.
 - b. Change proposals related to a change of Contract Price must include full and detailed accounts of materials incorporated into the Work and labor and equipment used for the subject Work.

The supporting data must be accompanied by a written statement that the supporting data are accurate and complete, and that any requested time or price adjustment is the entire adjustment to which Contractor believes it is entitled as a result of said event.

- 3. *Engineer's Initial Review:* Engineer will advise Owner regarding the Change Proposal, and consider any comments or response from Owner regarding the Change Proposal. If in its discretion Engineer concludes that additional supporting data is needed before conducting a full review and making a decision regarding the Change Proposal, then Engineer may request that Contractor submit such additional supporting data by a date specified by Engineer, prior to Engineer beginning its full review of the Change Proposal.
- 4. *Engineer's Full Review and Action on the Change Proposal:* Upon receipt of Contractor's supporting data (including any additional data requested by Engineer), Engineer will conduct a full review of each Change Proposal and, within 30 days after such receipt of the Contractor's supporting data, either approve the Change Proposal in whole, deny it in whole, or approve it in part and deny it in part. Such actions must be in writing, with a copy provided to Owner and Contractor. If Engineer does not take action on the Change

Proposal within 30 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of Engineer's inaction the Change Proposal is deemed denied, thereby commencing the time for appeal of the denial under Article 12.

5. *Binding Decision*: Engineer's decision is final and binding upon Owner and Contractor, unless Owner or Contractor appeals the decision by filing a Claim under Article 12.
- C. *Resolution of Certain Change Proposals*: If the Change Proposal does not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters, then Engineer will notify the parties in writing that the Engineer is unable to resolve the Change Proposal. For purposes of further resolution of such a Change Proposal, such notice will be deemed a denial, and Contractor may choose to seek resolution under the terms of Article 12.
- D. *Post-Completion*: Contractor shall not submit any Change Proposals after Engineer issues a written recommendation of final payment pursuant to Paragraph 15.06.B.

11.10 *Notification to Surety*

- A. If the provisions of any bond require notice to be given to a surety of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times), the giving of any such notice will be Contractor's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

ARTICLE 12—CLAIMS

12.01 *Claims*

- A. *Claims Process*: The following disputes between Owner and Contractor are subject to the Claims process set forth in this article:
 1. Appeals by Owner or Contractor of Engineer's decisions regarding Change Proposals;
 2. Owner demands for adjustments in the Contract Price or Contract Times, or other relief under the Contract Documents;
 3. Disputes that Engineer has been unable to address because they do not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters; and
 4. Subject to the waiver provisions of Paragraph 15.07, any dispute arising after Engineer has issued a written recommendation of final payment pursuant to Paragraph 15.06.B.
- B. *Submittal of Claim*: The party submitting a Claim shall deliver it directly to the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto; in the case of appeals regarding Change Proposals within 30 days of the decision under appeal. The party submitting the Claim shall also furnish a copy to the Engineer, for its information only. The responsibility to substantiate a Claim rests with the party making the Claim. In the case of a Claim by Contractor seeking an increase in the Contract Times or Contract Price, Contractor shall certify that the Claim is made in good faith, that the supporting data are accurate and complete, and that to the best of Contractor's knowledge

and belief the amount of time or money requested accurately reflects the full amount to which Contractor is entitled.

- C. *Review and Resolution*: The party receiving a Claim shall review it thoroughly, giving full consideration to its merits. The two parties shall seek to resolve the Claim through the exchange of information and direct negotiations. The parties may extend the time for resolving the Claim by mutual agreement. All actions taken on a Claim will be stated in writing and submitted to the other party, with a copy to Engineer.
- D. *Mediation*
 - 1. At any time after initiation of a Claim, Owner and Contractor may mutually agree to mediation of the underlying dispute. The agreement to mediate will stay the Claim submittal and response process.
 - 2. If Owner and Contractor agree to mediation, then after 60 days from such agreement, either Owner or Contractor may unilaterally terminate the mediation process, and the Claim submittal and decision process will resume as of the date of the termination. If the mediation proceeds but is unsuccessful in resolving the dispute, the Claim submittal and decision process will resume as of the date of the conclusion of the mediation, as determined by the mediator.
 - 3. Owner and Contractor shall each pay one-half of the mediator's fees and costs.
- E. *Partial Approval*: If the party receiving a Claim approves the Claim in part and denies it in part, such action will be final and binding unless within 30 days of such action the other party invokes the procedure set forth in Article 17 for final resolution of disputes.
- F. *Denial of Claim*: If efforts to resolve a Claim are not successful, the party receiving the Claim may deny it by giving written notice of denial to the other party. If the receiving party does not take action on the Claim within 90 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of the inaction, the Claim is deemed denied, thereby commencing the time for appeal of the denial. A denial of the Claim will be final and binding unless within 30 days of the denial the other party invokes the procedure set forth in Article 17 for the final resolution of disputes.
- G. *Final and Binding Results*: If the parties reach a mutual agreement regarding a Claim, whether through approval of the Claim, direct negotiations, mediation, or otherwise; or if a Claim is approved in part and denied in part, or denied in full, and such actions become final and binding; then the results of the agreement or action on the Claim will be incorporated in a Change Order or other written document to the extent they affect the Contract, including the Work, the Contract Times, or the Contract Price.

ARTICLE 13—COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

13.01 *Cost of the Work*

- A. *Purposes for Determination of Cost of the Work*: The term Cost of the Work means the sum of all costs necessary for the proper performance of the Work at issue, as further defined below. The provisions of this Paragraph 13.01 are used for two distinct purposes:
 - 1. To determine Cost of the Work when Cost of the Work is a component of the Contract Price, under cost-plus-fee, time-and-materials, or other cost-based terms; or

2. When needed to determine the value of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price. When the value of any such adjustment is determined on the basis of Cost of the Work, Contractor is entitled only to those additional or incremental costs required because of the change in the Work or because of the event giving rise to the adjustment.
- B. *Costs Included:* Except as otherwise may be agreed to in writing by Owner, costs included in the Cost of the Work will be in amounts no higher than those commonly incurred in the locality of the Project, will not include any of the costs itemized in Paragraph 13.01.C, and will include only the following items:
1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor in advance of the subject Work. Such employees include, without limitation, superintendents, foremen, safety managers, safety representatives, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work will be apportioned on the basis of their time spent on the Work. Payroll costs include, but are not limited to, salaries and wages plus the cost of fringe benefits, which include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, sick leave, and vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, will be included in the above to the extent authorized by Owner.
 2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts will accrue to Owner. All trade discounts, rebates, and refunds and returns from sale of surplus materials and equipment will accrue to Owner, and Contractor shall make provisions so that they may be obtained.
 3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, which will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee will be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 13.01.
 4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed or retained for services specifically related to the Work.
 5. Other costs consisting of the following:
 - a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.
 - b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, which are

consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.

- 1) In establishing included costs for materials such as scaffolding, plating, or sheeting, consideration will be given to the actual or the estimated life of the material for use on other projects; or rental rates may be established on the basis of purchase or salvage value of such items, whichever is less. Contractor will not be eligible for compensation for such items in an amount that exceeds the purchase cost of such item.

c. *Construction Equipment Rental*

- 1) Rentals of all construction equipment and machinery, and the parts thereof, in accordance with rental agreements approved by Owner as to price (including any surcharge or special rates applicable to overtime use of the construction equipment or machinery), and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs will be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts must cease when the use thereof is no longer necessary for the Work.
 - 2) Costs for equipment and machinery owned by Contractor or a Contractor-related entity will be paid at a rate shown for such equipment in the equipment rental rate book specified in the Supplementary Conditions. An hourly rate will be computed by dividing the monthly rates by 176. These computed rates will include all operating costs.
 - 3) With respect to Work that is the result of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price ("changed Work"), included costs will be based on the time the equipment or machinery is in use on the changed Work and the costs of transportation, loading, unloading, assembly, dismantling, and removal when directly attributable to the changed Work. The cost of any such equipment or machinery, or parts thereof, must cease to accrue when the use thereof is no longer necessary for the changed Work.
- d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.
- e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.
- f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of builder's risk or other property insurance established in accordance with Paragraph 6.04), provided such losses and damages have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses will be included in the Cost of the Work for the purpose of determining Contractor's fee.

- g. The cost of utilities, fuel, and sanitary facilities at the Site.
 - h. Minor expenses such as communication service at the Site, express and courier services, and similar petty cash items in connection with the Work.
 - i. The costs of premiums for all bonds and insurance that Contractor is required by the Contract Documents to purchase and maintain.
- C. *Costs Excluded:* The term Cost of the Work does not include any of the following items:
 - 1. Payroll costs and other compensation of Contractor's officers, executives, principals, general managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expeditors, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 13.01.B.1 or specifically covered by Paragraph 13.01.B.4. The payroll costs and other compensation excluded here are to be considered administrative costs covered by the Contractor's fee.
 - 2. The cost of purchasing, renting, or furnishing small tools and hand tools.
 - 3. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.
 - 4. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.
 - 5. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.
 - 6. Expenses incurred in preparing and advancing Claims.
 - 7. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraph 13.01.B.
- D. *Contractor's Fee*
 - 1. When the Work as a whole is performed on the basis of cost-plus-a-fee, then:
 - a. Contractor's fee for the Work set forth in the Contract Documents as of the Effective Date of the Contract will be determined as set forth in the Agreement.
 - b. for any Work covered by a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price on the basis of Cost of the Work, Contractor's fee will be determined as follows:
 - 1) When the fee for the Work as a whole is a percentage of the Cost of the Work, the fee will automatically adjust as the Cost of the Work changes.
 - 2) When the fee for the Work as a whole is a fixed fee, the fee for any additions or deletions will be determined in accordance with Paragraph 11.07.C.2.
 - 2. When the Work as a whole is performed on the basis of a stipulated sum, or any other basis other than cost-plus-a-fee, then Contractor's fee for any Work covered by a Change

Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price on the basis of Cost of the Work will be determined in accordance with Paragraph 11.07.C.2.

- E. *Documentation and Audit*: Whenever the Cost of the Work for any purpose is to be determined pursuant to this Article 13, Contractor and pertinent Subcontractors will establish and maintain records of the costs in accordance with generally accepted accounting practices. Subject to prior written notice, Owner will be afforded reasonable access, during normal business hours, to all Contractor's accounts, records, books, correspondence, instructions, drawings, receipts, vouchers, memoranda, and similar data relating to the Cost of the Work and Contractor's fee. Contractor shall preserve all such documents for a period of three years after the final payment by Owner. Pertinent Subcontractors will afford such access to Owner, and preserve such documents, to the same extent required of Contractor.

13.02 Allowances

- A. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.
- B. *Cash Allowances*: Contractor agrees that:
1. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and
 2. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment for any of the foregoing will be valid.
- C. *Owner's Contingency Allowance*: Contractor agrees that an Owner's contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.
- D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor for Work covered by allowances, and the Contract Price will be correspondingly adjusted.

13.03 Unit Price Work

- A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.
- B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Payments to Contractor for Unit Price Work will be based on actual quantities.
- C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.
- D. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision

thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, and the final adjustment of Contract Price will be set forth in a Change Order, subject to the provisions of the following paragraph.

E. *Adjustments in Unit Price*

1. Contractor or Owner shall be entitled to an adjustment in the unit price with respect to an item of Unit Price Work if:
 - a. the quantity of the item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and
 - b. Contractor's unit costs to perform the item of Unit Price Work have changed materially and significantly as a result of the quantity change.
2. The adjustment in unit price will account for and be coordinated with any related changes in quantities of other items of Work, and in Contractor's costs to perform such other Work, such that the resulting overall change in Contract Price is equitable to Owner and Contractor.
3. Adjusted unit prices will apply to all units of that item.

ARTICLE 14—TESTS AND INSPECTIONS; CORRECTION, REMOVAL, OR ACCEPTANCE OF DEFECTIVE WORK

14.01 *Access to Work*

- A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and authorities having jurisdiction have access to the Site and the Work at reasonable times for their observation, inspection, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply with such procedures and programs as applicable.

14.02 *Tests, Inspections, and Approvals*

- A. Contractor shall give Engineer timely notice of readiness of the Work (or specific parts thereof) for all required inspections and tests, and shall cooperate with inspection and testing personnel to facilitate required inspections and tests.
- B. Owner shall retain and pay for the services of an independent inspector, testing laboratory, or other qualified individual or entity to perform all inspections and tests expressly required by the Contract Documents to be furnished and paid for by Owner, except that costs incurred in connection with tests or inspections of covered Work will be governed by the provisions of Paragraph 14.05.
- C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.

- D. Contractor shall be responsible for arranging, obtaining, and paying for all inspections and tests required:
1. by the Contract Documents, unless the Contract Documents expressly allocate responsibility for a specific inspection or test to Owner;
 2. to attain Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work;
 3. by manufacturers of equipment furnished under the Contract Documents;
 4. for testing, adjusting, and balancing of mechanical, electrical, and other equipment to be incorporated into the Work; and
 5. for acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work.

Such inspections and tests will be performed by independent inspectors, testing laboratories, or other qualified individuals or entities acceptable to Owner and Engineer.

- E. If the Contract Documents require the Work (or part thereof) to be approved by Owner, Engineer, or another designated individual or entity, then Contractor shall assume full responsibility for arranging and obtaining such approvals.
- F. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation. Such uncovering will be at Contractor's expense unless Contractor had given Engineer timely notice of Contractor's intention to cover the same and Engineer had not acted with reasonable promptness in response to such notice.

14.03 *Defective Work*

- A. *Contractor's Obligation:* It is Contractor's obligation to assure that the Work is not defective.
- B. *Engineer's Authority:* Engineer has the authority to determine whether Work is defective, and to reject defective Work.
- C. *Notice of Defects:* Prompt written notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor.
- D. *Correction, or Removal and Replacement:* Promptly after receipt of written notice of defective Work, Contractor shall correct all such defective Work, whether or not fabricated, installed, or completed, or, if Engineer has rejected the defective Work, remove it from the Project and replace it with Work that is not defective.
- E. *Preservation of Warranties:* When correcting defective Work, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.
- F. *Costs and Damages:* In addition to its correction, removal, and replacement obligations with respect to defective Work, Contractor shall pay all claims, costs, losses, and damages arising out of or relating to defective Work, including but not limited to the cost of the inspection, testing, correction, removal, replacement, or reconstruction of such defective Work, fines levied against Owner by governmental authorities because the Work is defective, and the costs of repair or replacement of work of others resulting from defective Work. Prior to final payment, if Owner and Contractor are unable to agree as to the measure of such claims, costs,

losses, and damages resulting from defective Work, then Owner may impose a reasonable set-off against payments due under Article 15.

14.04 *Acceptance of Defective Work*

- A. If, instead of requiring correction or removal and replacement of defective Work, Owner prefers to accept it, Owner may do so (subject, if such acceptance occurs prior to final payment, to Engineer's confirmation that such acceptance is in general accord with the design intent and applicable engineering principles, and will not endanger public safety). Contractor shall pay all claims, costs, losses, and damages attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness), and for the diminished value of the Work to the extent not otherwise paid by Contractor. If any such acceptance occurs prior to final payment, the necessary revisions in the Contract Documents with respect to the Work will be incorporated in a Change Order. If the parties are unable to agree as to the decrease in the Contract Price, reflecting the diminished value of Work so accepted, then Owner may impose a reasonable set-off against payments due under Article 15. If the acceptance of defective Work occurs after final payment, Contractor shall pay an appropriate amount to Owner.

14.05 *Uncovering Work*

- A. Engineer has the authority to require additional inspection or testing of the Work, whether or not the Work is fabricated, installed, or completed.
- B. If any Work is covered contrary to the written request of Engineer, then Contractor shall, if requested by Engineer, uncover such Work for Engineer's observation, and then replace the covering, all at Contractor's expense.
- C. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, then Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, and provide all necessary labor, material, and equipment.
 - 1. If it is found that the uncovered Work is defective, Contractor shall be responsible for all claims, costs, losses, and damages arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and pending Contractor's full discharge of this responsibility the Owner shall be entitled to impose a reasonable set-off against payments due under Article 15.
 - 2. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, then Contractor may submit a Change Proposal within 30 days of the determination that the Work is not defective.

14.06 *Owner May Stop the Work*

- A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, then Owner may order Contractor to stop the Work,

or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work will not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

14.07 Owner May Correct Defective Work

- A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace defective Work as required by Engineer, then Owner may, after 7 days' written notice to Contractor, correct or remedy any such deficiency.
- B. In exercising the rights and remedies under this Paragraph 14.07, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this paragraph.
- C. All claims, costs, losses, and damages incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 14.07 will be charged against Contractor as set-offs against payments due under Article 15. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.
- D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 14.07.

ARTICLE 15—PAYMENTS TO CONTRACTOR; SET-OFFS; COMPLETION; CORRECTION PERIOD

15.01 Progress Payments

- A. *Basis for Progress Payments:* The Schedule of Values established as provided in Article 2 will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments for Unit Price Work will be based on the number of units completed during the pay period, as determined under the provisions of Paragraph 13.03. Progress payments for cost-based Work will be based on Cost of the Work completed by Contractor during the pay period.
- B. *Applications for Payments*
 - 1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents.
 - 2. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment must also be accompanied by: (a) a bill of sale, invoice, copies of subcontract or purchase order payments, or other documentation

establishing full payment by Contractor for the materials and equipment; (b) at Owner's request, documentation warranting that Owner has received the materials and equipment free and clear of all Liens; and (c) evidence that the materials and equipment are covered by appropriate property insurance, a warehouse bond, or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.

3. Beginning with the second Application for Payment, each Application must include an affidavit of Contractor stating that all previous progress payments received by Contractor have been applied to discharge Contractor's legitimate obligations associated with prior Applications for Payment.
4. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

C. Review of Applications

1. Engineer will, within 10 days after receipt of each Application for Payment, including each resubmittal, either indicate in writing a recommendation of payment and present the Application to Owner, or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.
2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:
 - a. the Work has progressed to the point indicated;
 - b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 13.03, and any other qualifications stated in the recommendation); and
 - c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.
3. By recommending any such payment Engineer will not thereby be deemed to have represented that:
 - a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract; or
 - b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.

4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:
 - a. to supervise, direct, or control the Work;
 - b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto;
 - c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work;
 - d. to make any examination to ascertain how or for what purposes Contractor has used the money paid by Owner; or
 - e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.
5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 15.01.C.2.
6. Engineer will recommend reductions in payment (set-offs) necessary in Engineer's opinion to protect Owner from loss because:
 - a. the Work is defective, requiring correction or replacement;
 - b. the Contract Price has been reduced by Change Orders;
 - c. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;
 - d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible; or
 - e. Engineer has actual knowledge of the occurrence of any of the events that would constitute a default by Contractor and therefore justify termination for cause under the Contract Documents.

D. *Payment Becomes Due*

1. Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended (subject to any Owner set-offs) will become due, and when due will be paid by Owner to Contractor.

E. *Reductions in Payment by Owner*

1. In addition to any reductions in payment (set-offs) recommended by Engineer, Owner is entitled to impose a set-off against payment based on any of the following:
 - a. Claims have been made against Owner based on Contractor's conduct in the performance or furnishing of the Work, or Owner has incurred costs, losses, or damages resulting from Contractor's conduct in the performance or furnishing of the Work, including but not limited to claims, costs, losses, or damages from workplace injuries, adjacent property damage, non-compliance with Laws and Regulations, and patent infringement;

- b. Contractor has failed to take reasonable and customary measures to avoid damage, delay, disruption, and interference with other work at or adjacent to the Site;
 - c. Contractor has failed to provide and maintain required bonds or insurance;
 - d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible;
 - e. Owner has incurred extra charges or engineering costs related to submittal reviews, evaluations of proposed substitutes, tests and inspections, or return visits to manufacturing or assembly facilities;
 - f. The Work is defective, requiring correction or replacement;
 - g. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;
 - h. The Contract Price has been reduced by Change Orders;
 - i. An event has occurred that would constitute a default by Contractor and therefore justify a termination for cause;
 - j. Liquidated or other damages have accrued as a result of Contractor's failure to achieve Milestones, Substantial Completion, or final completion of the Work;
 - k. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens; or
 - l. Other items entitle Owner to a set-off against the amount recommended.
2. If Owner imposes any set-off against payment, whether based on its own knowledge or on the written recommendations of Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and the specific amount of the reduction, and promptly pay Contractor any amount remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, if Contractor remedies the reasons for such action. The reduction imposed will be binding on Contractor unless it duly submits a Change Proposal contesting the reduction.
 3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld will be treated as an amount due as determined by Paragraph 15.01.D.1 and subject to interest as provided in the Agreement.

15.02 *Contractor's Warranty of Title*

- A. Contractor warrants and guarantees that title to all Work, materials, and equipment furnished under the Contract will pass to Owner free and clear of (1) all Liens and other title defects, and (2) all patent, licensing, copyright, or royalty obligations, no later than 7 days after the time of payment by Owner.

15.03 *Substantial Completion*

- A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete and request that Engineer issue a certificate of Substantial Completion. Contractor shall at the same time

submit to Owner and Engineer an initial draft of punch list items to be completed or corrected before final payment.

- B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.
- C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a preliminary certificate of Substantial Completion which will fix the date of Substantial Completion. Engineer shall attach to the certificate a punch list of items to be completed or corrected before final payment. Owner shall have 7 days after receipt of the preliminary certificate during which to make written objection to Engineer as to any provisions of the certificate or attached punch list. If, after considering the objections to the provisions of the preliminary certificate, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the preliminary certificate to Owner, notify Contractor in writing that the Work is not substantially complete, stating the reasons therefor. If Owner does not object to the provisions of the certificate, or if despite consideration of Owner's objections Engineer concludes that the Work is substantially complete, then Engineer will, within said 14 days, execute and deliver to Owner and Contractor a final certificate of Substantial Completion (with a revised punch list of items to be completed or corrected) reflecting such changes from the preliminary certificate as Engineer believes justified after consideration of any objections from Owner.
- D. At the time of receipt of the preliminary certificate of Substantial Completion, Owner and Contractor will confer regarding Owner's use or occupancy of the Work following Substantial Completion, review the builder's risk insurance policy with respect to the end of the builder's risk coverage, and confirm the transition to coverage of the Work under a permanent property insurance policy held by Owner. Unless Owner and Contractor agree otherwise in writing, Owner shall bear responsibility for security, operation, protection of the Work, property insurance, maintenance, heat, and utilities upon Owner's use or occupancy of the Work.
- E. After Substantial Completion the Contractor shall promptly begin work on the punch list of items to be completed or corrected prior to final payment. In appropriate cases Contractor may submit monthly Applications for Payment for completed punch list items, following the progress payment procedures set forth above.
- F. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the punch list.

15.04 *Partial Use or Occupancy*

- A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without

significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:

1. At any time, Owner may request in writing that Contractor permit Owner to use or occupy any such part of the Work that Owner believes to be substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 15.03.A through 15.03.E for that part of the Work.
2. At any time, Contractor may notify Owner and Engineer in writing that Contractor considers any such part of the Work substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.
3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 15.03 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.
4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 6.04 regarding builder's risk or other property insurance.

15.05 *Final Inspection*

- A. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly make a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work, or agreed portion thereof, is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

15.06 *Final Payment*

A. *Application for Payment*

1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of inspection, annotated record documents (as provided in Paragraph 7.12), and other documents, Contractor may make application for final payment.
2. The final Application for Payment must be accompanied (except as previously delivered) by:
 - a. all documentation called for in the Contract Documents;
 - b. consent of the surety, if any, to final payment;
 - c. satisfactory evidence that all title issues have been resolved such that title to all Work, materials, and equipment has passed to Owner free and clear of any Liens or other title defects, or will so pass upon final payment.

- d. a list of all duly pending Change Proposals and Claims; and
 - e. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of the Work, and of Liens filed in connection with the Work.
- 3. In lieu of the releases or waivers of Liens specified in Paragraph 15.06.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (a) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (b) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien, or Owner at its option may issue joint checks payable to Contractor and specified Subcontractors and Suppliers.
- B. *Engineer's Review of Final Application and Recommendation of Payment:* If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract have been fulfilled, Engineer will, within 10 days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of final payment and present the final Application for Payment to Owner for payment. Such recommendation will account for any set-offs against payment that are necessary in Engineer's opinion to protect Owner from loss for the reasons stated above with respect to progress payments. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.
- C. *Notice of Acceptability:* In support of its recommendation of payment of the final Application for Payment, Engineer will also give written notice to Owner and Contractor that the Work is acceptable, subject to stated limitations in the notice and to the provisions of Paragraph 15.07.
- D. *Completion of Work:* The Work is complete (subject to surviving obligations) when it is ready for final payment as established by the Engineer's written recommendation of final payment and issuance of notice of the acceptability of the Work.
- E. *Final Payment Becomes Due:* Upon receipt from Engineer of the final Application for Payment and accompanying documentation, Owner shall set off against the amount recommended by Engineer for final payment any further sum to which Owner is entitled, including but not limited to set-offs for liquidated damages and set-offs allowed under the provisions of this Contract with respect to progress payments. Owner shall pay the resulting balance due to Contractor within 30 days of Owner's receipt of the final Application for Payment from Engineer.

15.07 *Waiver of Claims*

- A. By making final payment, Owner waives its claim or right to liquidated damages or other damages for late completion by Contractor, except as set forth in an outstanding Claim,

appeal under the provisions of Article 17, set-off, or express reservation of rights by Owner. Owner reserves all other claims or rights after final payment.

- B. The acceptance of final payment by Contractor will constitute a waiver by Contractor of all claims and rights against Owner other than those pending matters that have been duly submitted as a Claim, or appealed under the provisions of Article 17.

15.08 *Correction Period*

- A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the Supplementary Conditions or the terms of any applicable special guarantee required by the Contract Documents), Owner gives Contractor written notice that any Work has been found to be defective, or that Contractor's repair of any damages to the Site or adjacent areas has been found to be defective, then after receipt of such notice of defect Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:
 - 1. correct the defective repairs to the Site or such adjacent areas;
 - 2. correct such defective Work;
 - 3. remove the defective Work from the Project and replace it with Work that is not defective, if the defective Work has been rejected by Owner, and
 - 4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others, or to other land or areas resulting from the corrective measures.
- B. Owner shall give any such notice of defect within 60 days of the discovery that such Work or repairs is defective. If such notice is given within such 60 days but after the end of the correction period, the notice will be deemed a notice of defective Work under Paragraph 7.17.B.
- C. If, after receipt of a notice of defect within 60 days and within the correction period, Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. Contractor shall pay all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others). Contractor's failure to pay such costs, losses, and damages within 10 days of invoice from Owner will be deemed the start of an event giving rise to a Claim under Paragraph 12.01.B, such that any related Claim must be brought within 30 days of the failure to pay.
- D. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.
- E. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this paragraph, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

- F. Contractor's obligations under this paragraph are in addition to all other obligations and warranties. The provisions of this paragraph are not to be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

ARTICLE 16—SUSPENSION OF WORK AND TERMINATION

16.01 *Owner May Suspend Work*

- A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by written notice to Contractor and Engineer. Such notice will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be entitled to an adjustment in the Contract Price or an extension of the Contract Times directly attributable to any such suspension. Any Change Proposal seeking such adjustments must be submitted no later than 30 days after the date fixed for resumption of Work.

16.02 *Owner May Terminate for Cause*

- A. The occurrence of any one or more of the following events will constitute a default by Contractor and justify termination for cause:
 - 1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment, or failure to adhere to the Progress Schedule);
 - 2. Failure of Contractor to perform or otherwise to comply with a material term of the Contract Documents;
 - 3. Contractor's disregard of Laws or Regulations of any public body having jurisdiction; or
 - 4. Contractor's repeated disregard of the authority of Owner or Engineer.
- B. If one or more of the events identified in Paragraph 16.02.A occurs, then after giving Contractor (and any surety) 10 days' written notice that Owner is considering a declaration that Contractor is in default and termination of the Contract, Owner may proceed to:
 - 1. declare Contractor to be in default, and give Contractor (and any surety) written notice that the Contract is terminated; and
 - 2. enforce the rights available to Owner under any applicable performance bond.
- C. Subject to the terms and operation of any applicable performance bond, if Owner has terminated the Contract for cause, Owner may exclude Contractor from the Site, take possession of the Work, incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere, and complete the Work as Owner may deem expedient.
- D. Owner may not proceed with termination of the Contract under Paragraph 16.02.B if Contractor within 7 days of receipt of notice of intent to terminate begins to correct its failure to perform and proceeds diligently to cure such failure.
- E. If Owner proceeds as provided in Paragraph 16.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds the cost to complete the Work, including all related claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects,

attorneys, and other professionals) sustained by Owner, such excess will be paid to Contractor. If the cost to complete the Work including such related claims, costs, losses, and damages exceeds such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this paragraph, Owner shall not be required to obtain the lowest price for the Work performed.

- F. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue, or any rights or remedies of Owner against Contractor or any surety under any payment bond or performance bond. Any retention or payment of money due Contractor by Owner will not release Contractor from liability.
- G. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 6.01.A, the provisions of that bond will govern over any inconsistent provisions of Paragraphs 16.02.B and 16.02.D.

16.03 *Owner May Terminate for Convenience*

- A. Upon 7 days' written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):
 - 1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;
 - 2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses; and
 - 3. other reasonable expenses directly attributable to termination, including costs incurred to prepare a termination for convenience cost proposal.
- B. Contractor shall not be paid for any loss of anticipated profits or revenue, post-termination overhead costs, or other economic loss arising out of or resulting from such termination.

16.04 *Contractor May Stop Work or Terminate*

- A. If, through no act or fault of Contractor, (1) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (2) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (3) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon 7 days' written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the contract and recover from Owner payment on the same terms as provided in Paragraph 16.03.
- B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, 7 days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The

provisions of this paragraph are not intended to preclude Contractor from submitting a Change Proposal for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this paragraph.

ARTICLE 17—FINAL RESOLUTION OF DISPUTES

17.01 *Methods and Procedures*

- A. *Disputes Subject to Final Resolution:* The following disputed matters are subject to final resolution under the provisions of this article:
 - 1. A timely appeal of an approval in part and denial in part of a Claim, or of a denial in full, pursuant to Article 12; and
 - 2. Disputes between Owner and Contractor concerning the Work, or obligations under the Contract Documents, that arise after final payment has been made.
- B. *Final Resolution of Disputes:* For any dispute subject to resolution under this article, Owner or Contractor may:
 - 1. elect in writing to invoke the dispute resolution process provided for in the Supplementary Conditions;
 - 2. agree with the other party to submit the dispute to another dispute resolution process; or
 - 3. if no dispute resolution process is provided for in the Supplementary Conditions or mutually agreed to, give written notice to the other party of the intent to submit the dispute to a court of competent jurisdiction.

ARTICLE 18—MISCELLANEOUS

18.01 *Giving Notice*

- A. Whenever any provision of the Contract requires the giving of written notice to Owner, Engineer, or Contractor, it will be deemed to have been validly given only if delivered:
 - 1. in person, by a commercial courier service or otherwise, to the recipient's place of business;
 - 2. by registered or certified mail, postage prepaid, to the recipient's place of business; or
 - 3. by e-mail to the recipient, with the words "Formal Notice" or similar in the e-mail's subject line.

18.02 *Computation of Times*

- A. When any period of time is referred to in the Contract by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

18.03 *Cumulative Remedies*

- A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract. The provisions of this paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

18.04 *Limitation of Damages*

- A. With respect to any and all Change Proposals, Claims, disputes subject to final resolution, and other matters at issue, neither Owner nor Engineer, nor any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, shall be liable to Contractor for any claims, costs, losses, or damages sustained by Contractor on or in connection with any other project or anticipated project.

18.05 *No Waiver*

- A. A party's non-enforcement of any provision will not constitute a waiver of that provision, nor will it affect the enforceability of that provision or of the remainder of this Contract.

18.06 *Survival of Obligations*

- A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract, as well as all continuing obligations indicated in the Contract, will survive final payment, completion, and acceptance of the Work or termination of the Contract or of the services of Contractor.

18.07 *Controlling Law*

- A. This Contract is to be governed by the laws of the State of Texas, which the Project is located.

18.08 *Assignment of Contract*

- A. Unless expressly agreed to elsewhere in the Contract, no assignment by a party to this Contract of any rights under or interests in the Contract will be binding on the other party without the written consent of the party sought to be bound; and, specifically but without limitation, money that may become due and money that is due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under the Contract.

18.09 *Successors and Assigns*

- A. Owner and Contractor each binds itself, its successors, assigns, and legal representatives to the other party hereto, its successors, assigns, and legal representatives in respect to all covenants, agreements, and obligations contained in the Contract Documents.

18.10 *Headings*

- A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.



SUPPLEMENTARY CONDITIONS

SUPPLEMENTARY CONDITIONS OF THE CONSTRUCTION CONTRACT

ARTICLE 1—DEFINITIONS AND TERMINOLOGY

SC1.01 – Add the following:

51. Working Day- Any day in which weather or other conditions, not under the control of the CONTRACTOR, will permit construction of the principal units of work for a period of not less than 7 hours between 7:00 am and 6:00 pm. Saturdays, Sundays, and legal holidays will not be counted as a work day if not worked. If the CONTRACTOR works any of these days, he will be charged a working day. Work will not be permitted on Saturdays, Sundays, or legal holidays without the prior written approval of the OWNER.

52. Calendar Day – Every day of the month including Saturday, Sunday, legal holidays, rain days, or other adverse weather days.

ARTICLE 2—PRELIMINARY MATTERS

2.01 Add the following:

D. Texas Ethics Commission – Contractor and Owner shall complete all documentation required to conform with HB 1295 including but not limited to Form 1295 “Certificate of Interested Parties”.

E. Prohibition on Boycotting Israel – In accordance with Section 2270.002 of the Texas Government Code, Contractor hereby represents and warrants that Contractor: 1) Does not boycott Israel; and 2) will not boycott Israel during the term of this contract.

F. Prohibition on Boycotting Power Companies – In accordance with Section 2274.001 of the Texas Government Code, Contractor hereby represents and warrants that Contractor: 1) Does not boycott power companies and 2) will not boycott power companies during the term of this contract.

G. Prohibition on Companies that discriminate against firearm and ammunition industries - In accordance with Section 2274.002 of the Texas Government Code, Contractor hereby represents and warrants that Contractor: 1) Does not have a practice, policy, guidance, or directive that discriminates against a firearm entity or firearm trade association; and 2) Will not discriminate during the term of the contract against a firearm entity or firearm trade association.

H. Posting of certain information at Commercial Building Construction Site Required – In accordance with Section 116.001 of the Texas Government Code, Contractor hereby represents and warrants that Contractor: 1) As soon as practicable after beginning construction of a commercial building project located in this state, the developer of the project shall visibly post the following information at the entrance to the construction site: a) the name and contact information of the developer; and b) a brief description of the project.

2.02 *Copies of Documents*

SC-2.02 Amend the first sentence of Paragraph 2.02.A. to read as follows:

Owner shall furnish to Contractor **[3]** printed copies of the Contract Documents (including one fully signed counterpart of the Agreement). Electronic portable document format (PDF) shall be available upon request.

ARTICLE 4—NO CHANGES

ARTICLE 5—SITE, SUBSURFACE AND PHYSICAL CONDITIONS, HAZARDOUS ENVIRONMENTAL CONDITIONS

5.03 *Subsurface and Physical Conditions*

SC-5.03 Add the following new paragraphs immediately after Paragraph 5.03.D:

- E. The following table lists the reports of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data, and specifically identifies the Technical Data in the report upon which Contractor may rely:

Report Title	Date of Report	Technical Data
Sabinetown Park Development-Phase 1	June 3, 2024	Geotechnical Engineering Report

- F. The following table lists the drawings of existing physical conditions at or adjacent to the Site, including those drawings depicting existing surface or subsurface structures at or adjacent to the Site (except Underground Facilities), that contain Technical Data, and specifically identifies the Technical Data upon which Contractor may rely:

Drawings Title	Date of Drawings	Technical Data
None		

- G. Contractor may examine copies of reports and drawings identified in SC-5.03.E and SC-5.03.F that were not included with the Bidding Documents at **CIVCAST USA website** during regular business hours, or may request copies from Engineer.

5.06 *Hazardous Environmental Conditions*

SC-5.06 Add the following new paragraphs immediately after Paragraph 5.06.A.3:

4. The following table lists the reports known to Owner relating to Hazardous Environmental Conditions at or adjacent to the Site, and the Technical Data (if any) upon which Contractor may rely:

Report Title	Date of Report	Technical Data
None		

5. The following table lists the drawings known to Owner relating to Hazardous Environmental Conditions at or adjacent to the Site, and Technical Data (if any) contained in such Drawings upon which Contractor may rely:

Drawings Title	Date of Drawings	Technical Data
None		

ARTICLE 6—BONDS AND INSURANCE

6.01 *Performance, Payment, and Other Bonds*

SC-6.01 Add the following paragraphs immediately after Paragraph 6.01.A:

1. *Required Performance Bond Form:* The performance bond that Contractor furnishes will be in the form of EJCDC® C-610, Performance Bond (2010, 2013, or 2018 edition). Performance Bond: By State statute, local governments must require a performance bond from all contractors where such contracts involve construction, alteration, or repair of buildings or other public works projects in excess of \$100,000.00. Such bonds must be executed by a corporate surety authorized to do business in the State of Texas in accordance with Article 7.19-1 Bond of Surety Company; Chapter 7 of the Insurance Code, must be for not less than one-hundred percent (100%) of the contract price, and remain in effect for one year beyond the date of acceptance by the Owner. Performance bonds are conditioned upon "the faithful performance of the work in accordance with the drawings, specifications, and contract documents". These are in effect performance guarantees to assure completion of construction. These bonds are solely for the protection of the Owner. (Texas Government Code 2253.021)

2. *Required Payment Bond Form:* The payment bond that Contractor furnishes will be in the form of EJCDC® C-615, Payment Bond (2010, 2013, or 2018 edition). Payment Bond: A payment bond is one executed in connection with a contract (construction, alteration, or repair) to assure payment as required by law to all persons supplying labor and materials in the execution of work provided for in the contract. These bonds are required solely for the protection of all such claimants. These, like performance bonds, must be issued by a State approved corporate surety in accordance with Article 7.19-1 Bond of Surety Company; Chapter 7 of the Insurance Code, must also be for not less than one hundred percent (100%) of the contract price, and remain in effect for one year beyond the date of acceptance by the Owner. The \$25,000.00 State requirement (i.e., all contracts over that amount will require the Owner to have one hundred percent (100%) payment bonds) is also the same. (Texas Government Code 2253.021)

6.03 *Contractor's Insurance*

Add the following language to 6.03.A.

- a) The Contractor shall not commence work under this contract until he has obtained all the insurance required under this paragraph and such insurance has been approved by the Owner.
- b) Worker's Compensation Insurance: The Contractor shall procure and shall maintain during the life of this Contract Worker's Compensation Insurance, including employer liability insurance and coverages for occupational illness or disease with an available limit of at least \$1,000,000 per occurrence for all of its employees to be engaged in work at the site of the project under this Contract and, in case of any such work sublet, the Contractor shall require the subcontractor similarly to provide Worker's Compensation Insurance for all of the employees to be engaged in such work unless such employees are covered by the protection afforded by the Contractor's Worker's Compensation Insurance.
- c) Commercial General Liability Insurance: including products/completed operation and broad form property damage limits with an available limit of at least \$1,000,000 per occurrence with a \$2,000,000 aggregate. The policy shall not exclude coverage for explosion, collapse or underground hazards, and pollution, or shall be endorsed for explosion, collapse or underground hazards, and pollution.
- d) Automobile Liability Insurance: including use of all owned, non-owned and hired vehicles with an available limit of not less than: Bodily Injury \$1,000,000 each person, \$1,000,000 each occurrence: Property Damage \$1,000,000 each occurrence, combined limit \$2,000,000.
- e) Longshoremen's and Harborworkers' Compensation Act insurance: to the extent required under such Act with regard to the work to be performed under the Contract.
- f) Excess liability insurance or Umbrella insurance: over all of the foregoing primary policies with an available limit of at least \$5,000,000.00 which follows form on Contractor's other policies.
- g) Owner and Engineer shall be listed as additional insured on all insurance, except for Worker's Compensation and Employer's Liability insurance. Contractor shall provide a waiver of subrogation in favor of the Sabine River Authority on all policies.
- h) Proof of Insurance: The Contractor shall furnish the Owner with certificates showing the type, amount, class of operations covered, effective dates and date of expiration of policies. Such certificates shall also contain substantially the following statement: "The insurance covered by this certificate will not be canceled or materially altered, except after ten (10) days written notice has been received by the Owner."

ARTICLE 7—CONTRACTOR'S RESPONSIBILITIES

7.10 *Taxes*

SC-7.10 Add a new paragraph immediately after Paragraph 7.10.A:

- A. Owner is exempt by law from **State of Texas** sales and Use Tax Laws, and Federal Excise Tax on materials and equipment to be incorporated in the Work. Said taxes must not be included in the Bid.

1. Owner will furnish the required certificates of tax exemption to Contractor for use in the purchase of supplies and materials to be incorporated into the Work.
2. Owner's exemption does not apply to construction tools, machinery, equipment, or other property purchased by or leased by Contractor, or to supplies or materials not incorporated into the Work.

SC-7.18 Add a new paragraph immediately after Paragraph 7.1B:

C. NOTWITHSTANDING ANYTHING IN PARAGRAPH 7.18.A TO THE CONTRARY, IN THE EVENT A CLAIM ARISES FROM BODILY INJURY (INCLUDING, WITHOUT LIMITATION, SICKNESS OR DISEASE) OR DEATH SUFFERED OR SUSTAINED BY AN EMPLOYEE OF CONTRACTOR OR ANY OF ITS AGENTS OR ITS SUBCONTRACTORS OF ANY TIER, THEN, TO THE FULLEST EXTENT PERMITTED BY LAW, CONTRACTOR AGREES TO INDEMNIFY AND SAVE HARMLESS THE INDEMNIFIED PARTIES, FROM AND AGAINST ANY AND ALL SUCH CLAIMS, WHICH ANY AND ALL OF THEM MAY HEREAFTER SUFFER, INCUR, BE RESPONSIBLE FOR OR PAY OUT, EVEN IF THE CLAIM WAS CAUSED, OR WAS ALLEGED TO BE CAUSED, IN WHOLE OR IN PART, BY THE NEGLIGENCE, FAULT, OMISSION, STRICT LIABILITY, STRICT PRODUCTS LIABILITY, OR NEGLIGENCE PER SE, OF THE INDEMNIFIED PARTIES, IT BEING THE EXPRESS INTENT OF OWNER AND CONTRACTOR THAT CONTRACTOR SHALL BE OBLIGATED TO INDEMNIFY THE INDEMNIFIED PARTIES IN THE MANNER PROVIDED IN THIS PARAGRAPH 7.18.C EVEN FOR THE CONSEQUENCES OF THE INDEMNIFIED PARTIES' OWN NEGLIGENCE, FAULT, OMISSION, STRICT LIABILITY, STRICT PRODUCTS LIABILITY, OR NEGLIGENCE PER SE, WHETHER OR NOT IT IS OR IS ALLEGED TO BE THE SOLE OR A CONCURRING CAUSE OF THE LOSSES GIVING RISE TO THE INDEMNIFIED CLAIMS.

ARTICLE 8—OTHER WORK AT THE SITE

8.02 Coordination

SC-8.02 Add the following new Paragraph 8.02.C immediately after Paragraph 8.02.B:

- C. Owner intends to contract with others for the performance of other work at or adjacent to the Site.

ARTICLE 10—ENGINEERS STATUS DURING CONSTRUCTION

10.03 Resident Project Representative

SC-10.03 Add the following new paragraphs immediately after Paragraph 10.03.B:

- C. The Resident Project Representative (RPR) will be Engineer's representative at the Site. RPR's dealings in matters pertaining to the Work in general will be with Engineer and Contractor. RPR's dealings with Subcontractors will only be through or with the full knowledge or approval of Contractor. The RPR will:
 1. *Conferences and Meetings:* Attend meetings with Contractor, such as preconstruction conferences, progress meetings, job conferences, and other Project-related meetings (but not including Contractor's safety meetings).

2. *Safety Compliance:* Comply with Site safety programs, as they apply to RPR, and if required to do so by such safety programs, receive safety training specifically related to RPR's own personal safety while at the Site.
 3. *Liaison*
 - a. Serve as Engineer's liaison with Contractor. Working principally through Contractor's authorized representative or designee, assist in providing information regarding the provisions and intent of the Contract Documents.
 - b. Assist Engineer in serving as Owner's liaison with Contractor when Contractor's operations affect Owner's on-Site operations.
 - c. Assist in obtaining from Owner additional details or information, when required for Contractor's proper execution of the Work.
 4. *Review of Work; Defective Work*
 - a. Conduct on-Site observations of the Work to assist Engineer in determining, to the extent set forth in Paragraph 10.02, if the Work is in general proceeding in accordance with the Contract Documents.
 - b. Observe whether any Work in place appears to be defective.
 - c. Observe whether any Work in place should be uncovered for observation, or requires special testing, inspection or approval.
 5. *Inspections and Tests*
 - a. Observe Contractor-arranged inspections required by Laws and Regulations, including but not limited to those performed by public or other agencies having jurisdiction over the Work.
 - b. Accompany visiting inspectors representing public or other agencies having jurisdiction over the Work.
 6. *Payment Requests:* Review Applications for Payment with Contractor.
 7. *Completion*
 - a. Participate in Engineer's visits regarding Substantial Completion.
 - b. Assist in the preparation of a punch list of items to be completed or corrected.
 - c. Participate in Engineer's visit to the Site in the company of Owner and Contractor regarding completion of the Work, and prepare a final punch list of items to be completed or corrected by Contractor.
 - d. Observe whether items on the final punch list have been completed or corrected.
- D. The RPR will not:
1. Authorize any deviation from the Contract Documents or substitution of materials or equipment (including "or-equal" items).
 2. Exceed limitations of Engineer's authority as set forth in the Contract Documents.
 3. Undertake any of the responsibilities of Contractor, Subcontractors, or Suppliers.

4. Advise on, issue directions relative to, or assume control over any aspect of the means, methods, techniques, sequences or procedures of construction.
5. Advise on, issue directions regarding, or assume control over security or safety practices, precautions, and programs in connection with the activities or operations of Owner or Contractor.
6. Participate in specialized field or laboratory tests or inspections conducted off-site by others except as specifically authorized by Engineer.
7. Authorize Owner to occupy the Project in whole or in part.

ARTICLE 15 PAYMENTS TO CONTRACTOR, SET OFFS; COMPLETIONS; CORRECTION PERIOD

SC 15.01.D.1. Replace paragraph in its entirety with the following:

Payment shall be made within 30 days of presentation of the application for Payment to the Owner with Engineer's recommendation, the amount recommended (subject to any owner set-offs) will become due, and when due will be paid by Owner to Contractor.

ARTICLE 17 FINAL RESOLUTIONS OF DISPUTES

Add the following to 17.01

- C. All disputes arising under this Contract or its interpretation except those disputes covered by FEDERAL LABOR STANDARDS PROVISIONS whether involving law or fact or both, or extra work, and all claims for alleged breach of contract shall, within ten (10) days of commencement of the dispute, be presented by the Contractor to the Owner for decision. Any claim not presented within the time limit specified in this paragraph shall be deemed to have been waived, except that if the claim is of a continuing character and notice of the claim is not given within ten (10) days of its commencement, the claim will be considered only for a period commencing ten (10) days prior to the receipt of the Owner.
- D. The Contractor shall submit in detail his claim and his proof thereof.
- E. If the Contractor does not agree with any decision of the Owner, he shall in no case allow the dispute to delay the work but shall notify the Owner promptly that he is proceeding with the work under protest.
- F. Venue for disputes shall lie exclusively in Orange County, Texas and none other.

ARTICLE 18 MISCELLANEOUS

Add the following Section

18.11 Contractors Field Office

The contractor shall furnish and maintain, during construction of the Improvements embraced in this Contract adequate facilities on the Project area or adjacent thereto for the use of the Local Public Agency and its Engineers as described below:

1. A field office is not required for this project, however the Contractor shall have readily accessible copies of plans and contract documents and working drawings shall be kept

on site. Provide cell phone, emails, and other communications for all superintendents, foreman, and project managers.

CERTIFICATE OF SUBSTANTIAL COMPLETION

Owner: Sabine River Authority of Texas Owner's Project No.: 25-1202
Engineer: Freese and Nichols, Inc. Engineer's Project No.: SRA23985
Contractor: Contractor's Project No.:
Project: Sabinetown Recreation Area
Contract Name:

This ☐ Preliminary ☐ Final Certificate of Substantial Completion applies to:

☐ All Work ☐ The following specified portions of the Work:

[Describe the portion of the work for which Certificate of Substantial Completion is issued]

Date of Substantial Completion: **[Enter date, as determined by Engineer]**

The Work to which this Certificate applies has been inspected by authorized representatives of Owner, Contractor, and Engineer, and found to be substantially complete. The Date of Substantial Completion of the Work or portion thereof designated above is hereby established, subject to the provisions of the Contract pertaining to Substantial Completion. The date of Substantial Completion in the final Certificate of Substantial Completion marks the commencement of the contractual correction period and applicable warranties required by the Contract.

A punch list of items to be completed or corrected is attached to this Certificate. This list may not be all-inclusive, and the failure to include any items on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

Amendments of contractual responsibilities recorded in this Certificate should be the product of mutual agreement of Owner and Contractor; see Paragraph 15.03.D of the General Conditions.

The responsibilities between Owner and Contractor for security, operation, safety, maintenance, heat, utilities, insurance, and warranties upon Owner's use or occupancy of the Work must be as provided in the Contract, except as amended as follows:

Amendments to Owner's Responsibilities: ☐ None ☐ As follows:

[List amendments to Owner's Responsibilities]

Amendments to Contractor's Responsibilities: ☐ None ☐ As follows:

[List amendments to Contractor's Responsibilities]

The following documents are attached to and made a part of this Certificate:

[List attachments such as punch list; other documents]

This Certificate does not constitute an acceptance of Work not in accordance with the Contract Documents, nor is it a release of Contractor's obligation to complete the Work in accordance with the Contract Documents.

Engineer

By *(signature)*: _____

Name *(printed)*: _____

Title: _____

NOTICE OF ACCEPTABILITY OF WORK

Owner:	Sabine River Authority of Texas	Owner's Project No.:	25-1202
Engineer:	Freese and Nichols, Inc.	Engineer's Project No.:	SRA23985
Contractor:		Contractor's Project No.:	
Project:	Sabinetown Recreation Area		
Contract Name:			
Notice Date:		Effective Date of the Construction Contract:	

The Engineer hereby gives notice to the Owner and Contractor that Engineer recommends final payment to Contractor, and that the Work furnished and performed by Contractor under the Construction Contract is acceptable, expressly subject to the provisions of the Construction Contract's Contract Documents ("Contract Documents") and of the Agreement between Owner and Engineer for Professional Services dated **[date of professional services agreement]** ("Owner-Engineer Agreement"). This Notice of Acceptability of Work (Notice) is made expressly subject to the following terms and conditions to which all who receive and rely on said Notice agree:

1. This Notice has been prepared with the skill and care ordinarily used by members of the engineering profession practicing under similar conditions at the same time and in the same locality.
2. This Notice reflects and is an expression of the Engineer's professional opinion.
3. This Notice has been prepared to the best of Engineer's knowledge, information, and belief as of the Notice Date.
4. This Notice is based entirely on and expressly limited by the scope of services Engineer has been employed by Owner to perform or furnish during construction of the Project (including observation of the Contractor's Work) under the Owner-Engineer Agreement, and applies only to facts that are within Engineer's knowledge or could reasonably have been ascertained by Engineer as a result of carrying out the responsibilities specifically assigned to Engineer under such Owner-Engineer Agreement.
5. This Notice is not a guarantee or warranty of Contractor's performance under the Construction Contract, an acceptance of Work that is not in accordance with the Contract Documents, including but not limited to defective Work discovered after final inspection, nor an assumption of responsibility for any failure of Contractor to furnish and perform the Work thereunder in accordance with the Contract Documents, or to otherwise comply with the Contract Documents or the terms of any special guarantees specified therein.
6. This Notice does not relieve Contractor of any surviving obligations under the Construction Contract, and is subject to Owner's reservations of rights with respect to completion and final payment.

Engineer

By *(signature)*: _____

Name *(printed)*: _____

Title: _____

WORK CHANGE DIRECTIVE NO.: [Number of Work Change Directive]

Owner: Sabine River Authority of Texas Owner's Project No.: 25-1202
Engineer: Freese and Nichols Engineer's Project No.: SRA23985
Contractor: Contractor's Project No.:
Project: Sabinetown Recreation Area
Contract Name:
Date Issued: Effective Date of Work Change Directive:

Contractor is directed to proceed promptly with the following change(s):

Description:

[Description of the change to the Work]

Attachments:

[List documents related to the change to the Work]

Purpose for the Work Change Directive:

[Describe the purpose for the change to the Work]

Directive to proceed promptly with the Work described herein, prior to agreeing to change in Contract Price and Contract Time, is issued due to:

Notes to User—Check one or both of the following

☐ Non-agreement on pricing of proposed change. ☐ Necessity to proceed for schedule or other reasons.

Estimated Change in Contract Price and Contract Times (non-binding, preliminary):

Contract Price: \$ _____ **[increase] [decrease] [not yet estimated].**

Contract Time: _____ days **[increase] [decrease] [not yet estimated].**

Basis of estimated change in Contract Price:

☐ Lump Sum ☐ Unit Price ☐ Cost of the Work ☐ Other

Recommended by Engineer

Authorized by Owner

By:

Title:

Date:

FIELD ORDER NO.: [Number of Field Order]

Owner:	Sabine River Authority of Texas	Owner's Project No.:	25-1202
Engineer:	Freese and Nichols	Engineer's Project No.:	SRA23985
Contractor:		Contractor's Project No.:	
Project:	Sabinetown Recreation Area		
Contract Name:			
Date Issued:		Effective Date of Field Order:	

Contractor is hereby directed to promptly perform the Work described in this Field Order, issued in accordance with Paragraph 11.04 of the General Conditions, for minor changes in the Work without changes in Contract Price or Contract Times. If Contractor considers that a change in Contract Price or Contract Times is required, submit a Change Proposal before proceeding with this Work.

Reference:

Specification Section(s):

Drawing(s) / Details (s):

Description:

[Description of the change to the Work]

Attachments:

[List documents supporting change]

Issued by Engineer

By: _____

Title: _____

Date: _____



WAGE RATE DETERMINATION

"General Decision Number: TX20240091 01/05/2024

Superseded General Decision Number: TX20230091

State: Texas

Construction Type: Heavy

Counties: Anderson, Falls, Freestone, Grimes, Houston, Jasper, Lee, Leon, Limestone, Madison, Milam, Newton, Polk, Sabine, San Augustine, Shelby, Trinity, Tyler, Walker and Washington Counties in Texas.

HEAVY 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	. Executive Order 14026	
into on or after January 30,	generally applies to the	
2022, or the contract is	contract.	
renewed or extended (e.g., an	. The contractor must pay	
option is exercised) on or	all covered workers at	
after January 30, 2022:	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

SUTX2009-122 04/21/2009

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER...	\$ 13.00 **	0.00
LABORER: Common or General.....	\$ 8.75 **	0.00
LABORER: Pipelayer.....	\$ 11.25 **	0.00

OPERATOR: Backhoe/Trackhoe.....\$ 15.89 **	0.00
OPERATOR: Bulldozer.....\$ 14.25 **	0.00
OPERATOR: Loader (Front End)....\$ 11.52 **	0.00
TRUCK DRIVER.....\$ 11.75 **	0.00

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

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** 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"

"General Decision Number: TX20240028 01/05/2024

Superseded General Decision Number: TX20230028

State: Texas

Construction Type: Highway

Counties: Anderson, Angelina, Bosque, Camp, Cass, Cherokee, Erath, Falls, Fannin, Franklin, Freestone, Grimes, Hamilton, Henderson, Hill, Hood, Hopkins, Houston, Jack, Jasper, Lamar, Leon, Limestone, Madison, Marion, Milam, Morris, Nacogdoches, Navarro, Newton, Palo Pinto, Panola, Polk, Rains, Red River, Sabine, San Augustine, Shelby, Somervell, Titus, Trinity, Tyler, Van Zandt, Walker, Washington and Wood Counties in Texas.

HIGHWAY CONSTRUCTION PROJECTS (excluding tunnels, building structures in rest area projects & railroad construction; bascule, suspension & spandrel arch bridges designed for commercial navigation, bridges involving marine construction; and other major bridges).

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	. Executive Order 14026	
into on or after January 30,	generally applies to the	
2022, or the contract is	contract.	
renewed or extended (e.g., an	. The contractor must pay	
option is exercised) on or	all covered workers at	

after January 30, 2022:	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:	<p>. Executive Order 13658 generally applies to the contract.</p> <p>. 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.</p>

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

SUTX2011-009 08/08/2011

	Rates	Fringes
CONCRETE FINISHER (Paving and Structures).....	\$ 13.38	**
ELECTRICIAN.....	\$ 20.92	
FORM BUILDER/FORM SETTER		
Paving & Curb.....	\$ 11.33	**
Structures.....	\$ 13.07	**
LABORER		
Asphalt Raker.....	\$ 11.34	**
Flagger.....	\$ 9.03	**
Laborer, Common.....	\$ 10.30	**
Laborer, Utility.....	\$ 11.53	**
Pipelayer.....	\$ 13.24	**
Work Zone Barricade Servicer.....	\$ 11.22	**
POWER EQUIPMENT OPERATOR:		
Agricultural Tractor.....	\$ 12.35	**
Asphalt Distributor.....	\$ 14.36	**
Asphalt Paving Machine.....	\$ 12.92	**
Broom or Sweeper.....	\$ 10.30	**
Concrete Pavement Finishing Machine.....	\$ 19.31	
Concrete Paving, Curing, Float, Texturing Machine....	\$ 16.34	**
Crane, Hydraulic 80 Tons or Less.....	\$ 20.21	
Crane, Lattice boom 80 Tons or less.....	\$ 14.67	**
Crane, Lattice boom over 80 Tons.....	\$ 17.49	
Crawler Tractor.....	\$ 13.38	**
Excavator 50,000 pounds or less.....	\$ 13.88	**

Excavator, Over 50,000 pounds.....	\$ 16.22	**
Foundation Drill, Truck Mounted.....	\$ 20.76	
Front End Loader 3 cu yd or Less.....	\$ 12.89	**
Front End Loader, over 3 cu yd.....	\$ 12.32	**
Loader/Backhoe.....	\$ 12.87	**
Mechanic.....	\$ 18.58	
Milling Machine.....	\$ 12.86	**
Motor Grader, Fine Grade....	\$ 17.07	**
Motor Grader, Rough.....	\$ 15.12	**
Pavement Marking Machine....	\$ 13.17	**
Reclaimer/Pulverizer.....	\$ 10.46	**
Roller, Asphalt.....	\$ 11.68	**
Roller, other.....	\$ 10.30	**
Scraper.....	\$ 12.43	**
Spreader Box.....	\$ 13.68	**
 Servicer.....	 \$ 13.83	 **
 Steel Worker (Reinforcing).....	 \$ 15.83	 **

TRUCK DRIVER

Lowboy-Float.....	\$ 14.30	**
Off Road Hauler.....	\$ 12.23	**
Single Axle.....	\$ 10.30	**
Single or Tandem Axle Dump..	\$ 12.28	**
Tandem Axle Tractor with Semi Trailer.....	\$ 12.50	**

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

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** 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

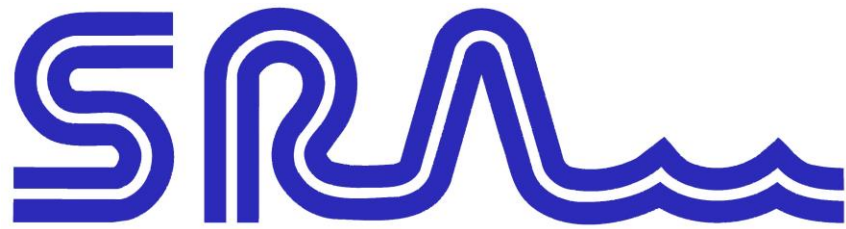
Review Board (formerly the Wage Appeals Board). Write to:

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"



TECHNICAL SPECIFICATIONS

02 41 00 DEMOLITION

1.00 GENERAL

1.01 WORK INCLUDED

- A. Furnish labor, materials, equipment and incidentals necessary for every type of required demolition.
- B. Furnish equipment of every type required to demolish and transport construction debris away from the Site.

1.02 STANDARDS

- A. Work shall be performed in accordance with the codes and ordinances of the agency having authority over the Place of Record.
- B. Occupational Safety and Health Association (OSHA), 29 CFR Parts 1010 and 1926, "Occupational Exposure to Asbestos, Tremolite, Anthophyllite, and Actinolite", 40 CFR Part 61 - "National Emission Standard for Hazardous Air Pollutants"

1.03 DELIVERY AND STORAGE

- A. Stockpile construction debris at the Site only as long as necessary to haul to a disposal site. Stack materials neatly and handle in an orderly manner until removed from the Site.

1.04 JOB CONDITIONS

- A. Contractor shall visit the Site and determine the extent of demolition required and the Site conditions that might affect its proposal. Include costs of covering all aspects of the demolition as part of the proposal.
- B. The Drawings shall be carefully reviewed to determine the extent of necessary demolition and to identify elements of the existing construction which are to remain in place. Report any discrepancies to Owner and Engineer before disturbing existing conditions. Property lines and limits of demolition shall be accurately located prior to beginning site demolition. Start of demolition activities shall represent confirmation by Contractor that existing conditions are as presented in the Contract Documents. Demolition outside the limits indicated on the Drawings, or outside the property lines shall not be performed.
 - 1. For electrical demolition, verify field measurements and circuiting arrangements are as shown on the Drawings. Verify that existing wiring and equipment designated to be abandoned or demolished serve only abandoned facilities.
- C. Material removed during demolition, and any equipment not otherwise designated to remain the property of the Owner, shall become the property of the Contractor, and shall be promptly removed from the Site.
- D. Equipment and material designated as remaining the property of the Owner shall be removed from the structure and transported to a designated location on the Site and stored for the Owner's use. Store on wood runners raised above the surrounding grade and cover with weather resistant covering that is tied securely in place.

- E. Take necessary precautions in removing Owner designated property to prevent damage during the demolition process. Equipment shall be removed in one piece. Loose components may be removed separately. Controls and electrical equipment may be removed from the equipment and handled separately. Large units, such as motor driven pumps, may be dismantled and motors handled separately. Do not use a cutting torch to separate the Owner's equipment or material. Salvaged piping shall be taken apart at flanges or fittings and removed in sections.

2.00 PRODUCTS

2.01 MATERIALS

- A. New materials and equipment for patching and extending work shall meet the requirements of the individual Sections in these Contract Documents. For materials not addressed in these documents, materials used shall meet or exceed the dimensions and quality of the existing work.

3.00 EXECUTION

3.01 SITE CLEARING

- A. Perform site clearing to the limits indicated on the Drawings. Scrape the Site, removing brush, trees, weeds and trash. Haul debris away from the Site to an approved site as it accumulates.
- B. Grub out tree and brush roots within the limits of buildings, parking lots, driveways and other structures. Remove rock out-croppings and boulders from any area within the limits of grading or structures. Remove roots and backfill any excavation resulting from tree removal with suitable soil for final grading plan.
- C. Trees not located within the construction limits, or otherwise indicated for removal, shall remain in place. Visit the Site with the Engineer or Owner and identify those trees that are to remain. Mark all other trees with yellow paint to indicate removal. Protect remaining trees during construction. Wrap the tree trunks with 2 x 4 timbers if construction equipment must operate in close proximity to them.
- D. Contractor to tag all trees over 12" in diameter and coordinate removal with SRA.
- E. Provide dust control as needed or requested by the Owner.

3.02 UNDERGROUND PIPING

- A. Contractor shall be responsible for obtaining location of underground utilities at the Site. Arrange for all applicable utility companies to accurately locate underground piping and set color-coded flags along the pipe route. Investigate utility company's records to ascertain depths and sizes of piping and other ancillary features.
- B. In the event that exact location of piping cannot be obtained, dig test holes as necessary to establish location of piping. Contractor shall not use mechanical digging machines within 6 feet of any active buried piping. For a distance of 4 feet on either side of buried piping, all digging shall be by hand excavation. If the piping is not active, or is to be abandoned or removed, any form of excavation may be used. Any existing active piping that is damaged

during demolition will be repaired to new condition by the Contractor at no additional cost to the Owner.

3.03 BACKFILLING

- A. Backfill cavities resulting from demolition. Fill cavities occurring within the limits of buildings, structures, or pavements in accordance with the requirements of other Sections of the Specifications. Backfill and compact cavities outside the construction limits to the same density as the surrounding earth. No testing is required for backfill outside the limits of new construction.

3.04 CLEANING AND REPAIR

- A. Clean and repair existing materials and equipment which remain or are to be reused.

END OF SECTION

03 11 00 CONCRETE FORMING

1.00 GENERAL

1.01 WORK INCLUDED

- A. Furnish material and labor to form, tie, brace and support wet concrete, reinforcing steel and embedded items until the concrete has developed sufficient strength to remove forms.

1.02 QUALITY ASSURANCE

- A. Design Criteria: Forms shall be designed for the pressure exerted by a liquid weighing 150 pounds per cubic foot. The rate of placing the concrete, the temperature of the concrete, and all other pertinent factors shall be taken into consideration when determining the depth of the equivalent liquid. An additional design live load of 50 pounds per square foot shall be used on horizontal surfaces.
- B. Alignment Control:
 - 1. True alignment of walls and other vertical surfaces having straight lines or rectangular shapes shall be controlled and checked by the following procedures:
 - a. Forming shall be arranged with provisions for adjusting the horizontal alignment of a form, after the form has been filled with concrete to grade, using wedges, turn buckles, or other adjustment methods. Establish a transit line or other reference so that adjustments can be made to an established line while the concrete in the top of the form is still plastic.
 - b. Adjusting facilities shall be at intervals which permit adjustments to a straight line. Concrete shall not be placed until adequate adjusting facilities are in place.
- C. Tolerances: Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

1.03 STANDARDS

- A. The applicable provisions of the following standards shall apply as if written here in their entirety:

- 1. American Concrete Institute (ACI) Specifications:

ACI 117	Specifications for Tolerances for Concrete Construction and Materials
ACI 301	Specifications for Structural Concrete
ACI 318	Building Code Requirements for Structural Concrete

- 2. American Institute of Steel Construction (AISC) Publication:
 - a. AISC Manual of Steel Construction.
- 3. American Iron and Steel Institute (AISI) Publication:
 - a. AISI Cold Formed Steel Design Manual.

- 4. American Plywood Association (APA) Standards:
 - a. APA Design/Construction Guide: Concrete Forming.

1.04 DELIVERY AND STORAGE

- A. Lumber for forms shall be stacked neatly on platforms raised above ground.

1.05 JOB CONDITIONS

- A. The Contractor shall notify the Engineer upon completion of various portions of the work required for placing concrete so that compliance with the plans and specifications may be monitored. The Engineer will authorize the Contractor to proceed with the placement after this has been completed and corrections, if required, have been made.
- B. In hot weather, both sides of the face forms may be required to be treated with oil to prevent warping and to secure tight joints.

2.00 PRODUCTS

2.01 MATERIALS

- A. Lumber: Properly seasoned and of good quality; free from loose or unsound knots, knot holes, twists, shakes, decay, splits, and other imperfections which would affect its strength or impair the finished surface of the concrete.
 - 1. Refer to Section 03 30 00 "Cast-In-Place Concrete" and the drawings for finish requirements.
- B. Fiber Board Form Lining: Hardboard finished smooth on one side; minimum thickness of 3/16 inch thoroughly wet with water at least 12 hours before using.
- C. Plywood Form Lining: Conforming to APA HDO; exterior exposure waterproof adhesive, 3/8 inch thick.
- D. Form Oil: Light, clear oil; shall not discolor or injuriously affect the concrete surface, subsequent coatings, or delay or impair curing operations.

2.02 FABRICATIONS

- A. Lumber: Lumber for facing or sheathing shall be surfaced on at least one side and two edges, and sized to uniform thickness. Lumber of nominal 1-inch thickness or plywood of 3/4-inch thickness shall be permitted for general use on structures, if backed by a sufficient number of studs and wales.
- B. Special Form Lumber:
 - 1. Molding for chamfer strips or other uses shall be made of redwood, cypress, or pine materials of a grade that will not split when nailed, and which can be maintained to a true line without warping. The form shall be mill cut and dressed on all faces. Fillet forms at sharp corners, both inside and outside and at edges, with triangular chamfer strips at all non-contiguous edges exposed to view. Thoroughly oil chamfer strips before installation on forms.

2. Construct forms for railings and ornamental work to standards equivalent to first class mill work.
 3. All moldings, panel work, and bevel strips shall be straight and true with neatly mitered joints, and designed so that the finished work shall be true, sharp and clean cut.
- C. Forms:
1. Forms shall be built mortar tight and of material sufficient in strength to prevent bulging between supports.
 2. Reused forms or form lumber shall be maintained clean and in good condition as to accuracy, shape, strength, rigidity, tightness, and smoothness of surface.
 3. All forms shall be so constructed as to permit removal without damage to the concrete. Exercise special care in framing forms for copings, offsets, railing and ornamental work, so that there will be no damage to the concrete when the forms are removed.
- D. 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.
- E. Metal Forms:
1. The specifications for "Forms" regarding design, mortar tightness, filleted corners, beveled projections, bracing, alignment, removal, re use, oiling, and wetting shall apply equally to metal forms.
 2. The metal used for forms shall be of such thickness that the forms will remain true to shape. Bolt and rivet heads on the facing sides shall be countersunk. Clamps, pins, or other connecting devices shall be designed to hold the forms rigidly together and to allow removal without injury to the concrete.
 3. Metal forms which do not present a smooth surface or line up properly shall not be used. Exercise special care to keep metal free from rust, grease, or other foreign material that discolors the concrete.
- F. Form Linings:
1. Timber forms for exposed concrete surfaces which are to be given a rubbed finish shall be face-lined with an approved type of form lining material.
 2. If plywood is used for form lining, it shall be made with waterproof adhesive and have a minimum thickness of 3/4 inch. It shall preferably be oiled at the mill and then re-oiled or lacquered on the job before using.
 3. If fiber board is used, apply water to the screen side on the board. Stack the boards screen side to screen side. Use the smooth hard face as the contact surface of the form. Such surfaces may be formed with 3/4-inch thick plywood made with waterproof adhesive if backed with adequate studs and wales. The greatest strength of the outer plies should be at right angles to the studding. In this case, form lining will not be required.

4. Carefully align edges and faces of adjacent panels and fill the joints between panels with patching plaster or cold water putty to prevent leakage. Lightly sand with No. 0 sandpaper to make the joints smooth.
 5. Forms which are reused shall have all unused form tie holes filled and smoothed as specified above.
- G. 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.
- H. Form Ties:
1. Metal form ties shall be used to hold forms in place and to provide easy metal removal. The use of wire for ties shall not be permitted.
 2. Leave no metal or other material within 1-1/2 inches of the surface, when removing form tie assemblies which are used inside the forms to hold the forms in correct alignment. The assembly shall provide cone-shaped depressions in the concrete surface at least 1 inch in diameter and 1-1/2 inches deep to allow filling and patching. Such devices, when removed, shall leave a smooth depression in the concrete surface without undue injury to the surface from chipping or spalling.
 3. Burning off rods, bolts, or ties shall not be permitted.
 4. Metal ties shall be held in place by devices attached to wales. Each device shall be capable of developing the strength of the tie.
 5. Metal and wooden spreaders which are separate from the forms shall be wired to top of form and shall be entirely removed as the concrete is placed.
 6. In the construction of basement or water bearing walls, the portion of a single rod tie that is to remain in the concrete shall be provided with a tightly fitted washer at midpoint to control seepage. Multi-rod ties do not require washers. The use of form ties which are tapered or encased in paper or other material to allow the removal of complete tie, and which leave a hole through the concrete structure, shall not be permitted.
- I. Falsework:
1. Falsework shall be designed and constructed so that no excessive settlement or deformation occurs. Falsework shall provide necessary rigidity.
 2. Timber used in falsework centering shall be sound, in good condition and free from defects which impair its strength.
 3. Steel members shall be of adequate strength and shape for the intended purpose.
 4. Timber piling used in falsework may be of any wood species which satisfactorily withstands driving and which adequately supports the superimposed load.
 5. When sills or timber grillages are used to support falsework columns, unless founded on solid rock, shale or other hard materials, place them in excavated pits. Backfill to prevent the softening of the supporting material from form drip or from rains that may

occur during the construction process. Sills or grillages shall be of ample size to support the superimposed load without settlement.

6. Falsework not founded on a satisfactory spread footing shall be supported on piling, which shall be driven to a bearing capacity to support the superimposed load without settlement.

3.00 EXECUTION

3.01 PREPARATION

- A. Before placing concrete, ensure that embedded items are correctly, firmly and securely fastened into place. Embedded items shall be thoroughly clean and free of oil and other foreign material. Anchor bolts shall be set to the correct location, alignment and elevation by the use of suitable anchor bolt templates.

3.02 INSTALLATION

A. Pre-Placement:

1. During the elapsed time between building the forms and placing the concrete, maintain the forms to eliminate warping and shrinking.
2. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
 - a. For concrete surfaces exposed to view: Class A, 1/8 inch.
 - b. For concrete surfaces to receive a rubbed finish: Class A, 1/8 inch.
 - c. For concrete surfaces to receive plaster, stucco or wainscoting: Class B, 1/4 inch.
 - d. For concrete surfaces not exposed to view: Class D, 1 inch.
3. Construct forms tight enough to prevent loss of concrete mortar.
4. 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.
5. Do not use rust-stained steel form-facing material.
6. 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.
7. Treat the facing of forms with suitable form oil before concrete is placed. Apply oil before the reinforcement is placed. Wet form surfaces which will come in contact with the concrete immediately before the concrete is placed.
8. At the time of placing concrete, the forms shall be clean and entirely free from all chips, dirt, sawdust, and other extraneous matter at the time. Forms for slab, beam and girder construction shall not have tie wire cuttings, nails or any other matter which would mar

the appearance of the finished construction. Clean forms and keep them free of foreign matter during concrete placement.

- B. Where aluminum anchors, aluminum shapes, or aluminum electrical conduits are embedded in concrete, paint aluminum contact surfaces with zinc rich primer. Allow the paint to thoroughly dry before placing the aluminum in contact with the concrete.
- C. Placement:
1. Set and maintain forms to the lines designated, until the concrete is sufficiently hardened to permit form removal. If, at any stage of the work, the forms show signs of bulging or sagging, immediately remove that portion of the concrete causing this condition. If necessary, reset the forms and securely brace against further movement.
 2. Provide adequate cleanout openings where access to the bottom of the forms is not otherwise readily attainable.
 3. Chamfer exterior corners and edges of permanently exposed concrete.
 4. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
 5. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement. Carefully and accurately place and support reinforcement in concrete structures.
- D. Removal: Remove forms so that the underlying concrete surface is not marred or damaged in any way. Forms shall not be removed until the concrete has attained sufficient strength to safely carry the dead load, but in no case less than the number of curing days set forth in the following table:

Forms	Curing Days
Forms for concrete of minor structural load carrying importance	1 day
Forms for walls, columns, sides of drilled shafts, massive structural components and other members not resisting a bending moment during curing	1 day
Forms and falsework under slabs, beams and girders where deflections due to dead load moment may exist (for spans ≤ 10 feet)	7 days
Forms and falsework under slabs, beams and girders where deflections due to dead load moment may exist (for spans > 10 feet and ≤ 20 feet)	14 days
Forms and falsework under slabs, beams and girders where deflections due to dead load moment may exist (for spans > 20 feet)	21 days

- E. Reuse:
1. 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.
 2. 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 Owner's Representative.

F. Shores and Reshores:

1. Comply with ACI 318, ACI 301, and recommendations in ACI 347R for design, installation, and removal of shoring and re-shoring.
 - a. Plan sequence of removal of shores and re-shore to avoid damage to concrete. Locate and provide adequate re-shoring to support construction without excessive stress or deflection.

END OF SECTION

03 20 00 CONCRETE REINFORCING

1.00 GENERAL

1.01 DESCRIPTION

- A. This work shall consist of furnishing reinforcing steel, bar supports, welding, tools, supplies, equipment and services, and placing of concrete reinforcement for cast in place concrete.
- B. Related work specified elsewhere
 - 1. Quality Control - Section 01 40 00
 - 2. Concrete Formwork - Section 03 30 00
 - 3. Cast-In-Place Concrete - Section 03 30 00
 - 4. Concrete Unit Masonry - Section 04 22 00

1.02 QUALITY ASSURANCE

- A. Publications of the following organizations form a part of this specification to the extent indicated by reference in this specification
 - 1. ACI 301 Specifications for Concrete Buildings
 - 2. ACI 315 Manual of Standard Practice for Detailing Reinforced Concrete Structures
 - 3. ACI 318 American Concrete Institute Building Code Requirements for Reinforced Concrete
 - 4. ACI 347 Recommended Practice for Concrete Forms
 - 5. ASTM A 82 Cold Drawn Steel Wire for Concrete Reinforcement
 - 6. ASTM A 185 Welded Steel Wire Fabric for Concrete Reinforcement
 - 7. ASTM A 497 Welded Deformed Steel Wire Fabric for Concrete Reinforcement
 - 8. ASTM A 615 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
 - 9. ASTM A 616 Rail-Steel Deformed and Plain Bars for Concrete Reinforcement
 - 10. ASTM A 617 Axle-Steel Deformed and Plain Bars for Concrete Reinforcement
 - 11. CRSI Manual of Standard Practice
 - 12. CRSI Placing Reinforcing Bars
 - 13. CRSI Reinforcement Anchorages and Splices
 - 14. AWS D1.4 Structural Welding Code – Reinforcing Steel American Welding Society
- B. Mill test reports

A certified copy of mill test on each heat of reinforcing steel delivered showing physical and chemical analysis shall be provided as specified on drawings.

C. Surface condition

1. Metal Reinforcement at the time concrete is placed shall be free from mud, oil, or other nonmetallic coatings that adversely affect bonding capacity.
2. Metal reinforcement, except prestressing steel, with rust, mill scale, or a combination of both shall be considered as satisfactory, provided the minimum dimensions, including height of deformations and weight of a hand wire brushed test specimen, are not less than the applicable ASTM specification requirements.

D. Standard practice

All requirements of concrete reinforcement not covered in these specifications or on the structural drawings shall be in accordance with Manual of Standard Practice, as published by the Concrete Reinforcing Steel Institute.

1. All hooks shall conform to bent dimensions defined as standard hooks in Manual of Standard Practice, as published by the Concrete Reinforcing Steel Institute, unless otherwise shown on the structural drawings.
2. Reinforcing bars shall not be bent or straightened in a manner that will injure the material.
3. Reinforcing bars shall conform accurately to the dimensions shown on the structural drawings and within the fabricating tolerances shown in Manual of Standard Practices, as published by the Concrete Reinforcing Steel Institute.

1.03 SUBMITTALS

The Contractor shall submit placing drawings and bar lists in accordance with Section 01 30 00 of this specification and the latest revision of Manual of Standard Practice for Detailing Reinforced Concrete Structures (ACI 315), as published by the American Concrete Institute. Obtain reviews and acceptance of placing drawings before starting fabrication.

A. Include, but not limited to, the following:

1. Complete bar schedule, bar details, and erection drawings to conform to ACI SP-66.
2. Drawing with each type of bent bar marked with identification mark. Straight bars shall have mark number or be identified by size and length.
3. Erection drawings shall be clear, easily legible, and to a minimum scale of :
 - a. 1/4 inch = 1 foot.
 - b. 1/8 inch = 1 foot if bars in each face are shown in separate views.
4. Size and location of all openings.
5. Concrete protective cover.
6. Grade of steel.
7. Lap splice lengths.
8. Mechanical splice product specification and data.

1.04 DELIVERY AND STORAGE

Deliver reinforcement to job site properly tagged and ready to set. Store above ground surface on platforms, skids, or other supports.

2.0 PRODUCTS

2.01 MATERIALS

A. Reinforcing Steel

1. All reinforcing bars, except column spirals, shall be deformed as defined in ASTM specifications.
2. All reinforcing bars, unless noted on the structural drawings, shall be Grade 60 as defined in the American Society for Testing and Materials, Specifications for Steel Bars for Concrete Reinforcement (A 615).
3. Spiral reinforcing steel shall be fabricated from cold drawn wire (ASTM A 82) or hot rolled plain or deformed bars conforming to ASTM A 615, Grade 60 or ASTM A 706.
4. Welded smooth wire fabric shall conform to ASTM A 185 Welded Steel Wire Fabric for Concrete Reinforcement.
 - i. WWR Yield Strength: Provide minimum yield strength of 75,000 psi (515 MPa).
 - ii. Welded wire reinforcement shall be manufactured from foreign or domestic steel.
 - iii. Wire Spacing and Size: Provide wire spacing and size, as calculated to maintain the specified area of steel as indicated on the contract drawings.
 - iv. Wire used in the manufacturing of welded wire reinforcement shall conform to ASTM A82.
 - v. Welded Wire Reinforcement shall be furnished in flat sheets or fabricated into bent sheets as indicated in the contract documents.
5. Welded deformed wire fabric shall conform to ASTM A 497 Welded Deformed Steel Wire Fabric for Concrete Reinforcement. (ACI Building Code limits the wire spacing to 16 in. maximum).

B. Fabrication of Bars

1. Fabricate with cold bends conforming to the recommended dimensions shown in ACI 318.
2. Fabricate bars according to the tolerances given in ACI 301, Chapter 5.
3. Field fabrication will not be allowed.
4. Attach metal or plastic tags with identifying mark or length corresponding to mark number or length on Drawing. Straight bars shall have mark number or size and length. Bent bars shall have mark number.

C. Tie wire

The tie wire used shall be black annealed wire, 16.5 gauge or heavier.

D. Reinforcing bar supports

Bar supports shall conform to the Bar Support Specifications contained in Manual of Standard Practice, as published by the Concrete Reinforcement Steel Institute.

1. Conform to ACI SP-66 and the CRSI Manual of Standard Practice.
2. Plastic or Wire Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during concrete placement and construction loading conditions. Items shall conform to industry practice as described in the Wire Reinforcement Institute's, "Manual of Standard Practice" or "TF 702 – Supporting Welded Wire Reinforcement".
3. Provide all spacers, bolsters, chairs, ties, and other devices necessary to properly space, place, support, and fasten steel reinforcement in place during the concrete placement.
4. Metal accessories shall be plastic-coated where legs will be exposed in finished concrete surfaces.
5. Do not use rocks, broken bricks, wood blocks, or concrete fragments for support of steel reinforcement.

3.00 EXECUTION

3.01 PLACING REINFORCING STEEL

- A. The placement of bars shall conform to the recommended practices in Placing Reinforcing Bars, as published by the Concrete Reinforcing Steel Institute.
- B. Bars shall be securely tied to prevent displacement during the concreting operation and all dowels must be wired in place before depositing concrete.
- C. When required, welding of reinforcing steels shall conform to AWS D1.4.
- D. All splices not indicated on the contract documents shall be subject to acceptance. Mechanical connectors for reinforcing bars may be used subject to acceptance.
- E. All splicing of bars, concrete cover, placing tolerances and bar spacings shall conform to Building Code Requirements for Reinforced Concrete (ACI 318, as published by the American Concrete Institute) and to recommended practices in Reinforcement Anchorages and Splices by the Concrete Reinforcing Steel Institute.
- F. The use of bar supports shall conform to CRSI Specifications for Placing Bar Supports, except as noted on contract drawings. Unless otherwise indicated all reinforcement supports shall have compressive strength equal to the compressive strength concrete being placed.
- G. Placing bars on layers of fresh concrete as the work progresses and adjusting bars during the placing of concrete shall not be permitted.
- H. Welded Wire Mesh or Fabric:
 1. Place supports to secure welded wire reinforcement against displacement caused by construction loads or placing of concrete. Concrete blocks (dobies) shall be used for supporting welded wire reinforcement in footings and slab-on-grades. For other concrete work, metal or plastic supports, hangers, or spacers maybe used. Layers of welded wire reinforcement shall be separated by chairs or bolsters. Stones, non-approved concrete chunks, wood blocks, bricks, etc., shall not be used to support reinforcement.

2. Place welded wire reinforcement as per the structural plans and details, or in the absence of information on the plans and details, as required to obtain at least minimum coverages for concrete protection.
3. Do not displace or damage vapor barrier.
4. Accommodate placement of formed openings.
5. Welded wire reinforcement sheets shall have side lap and end laps as called for on the shop drawings. Laps shall be calculated in accordance with ACI 318 code.

END OF SECTION

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03 21 00 REINFORCING STEEL

1.00 GENERAL

1.01 WORK INCLUDED

- A. Furnish labor and reinforcing materials required to cut, bend, tie, splice, place and support the reinforcement in the material grades, sizes, quantities and locations specified.

1.02 QUALITY ASSURANCE

A. Tolerances:

1. Reinforcing shall be placed where specified, with the following maximum tolerances, plus or minus:
 - a. Concrete Cover: 1/4 inch.
 - b. Reinforcing Bar Spacing: 1/4 inch in 12 inches.

1.03 SUBMITTALS

A. Submittals shall be in accordance with the Contract Documents and shall include:

1. Shop Drawings:
 - a. Reinforcing bar layout drawing with bar lists clearly marked and referenced to the Drawings. Include:
 - 1). Material, grade, bar schedules, stirrup spacing, bent bar diagrams, arrangement, and supports of concrete reinforcing.
 - 2). Additional reinforcing required for openings through concrete structures.
2. Record Data: Manufacturers' literature for specified products.
3. Certified Test Reports:
 - a. Certification of steel quality, size, grade and manufacturer's origin.

1.04 STANDARDS

A. The applicable provisions of the following standards shall apply as if written here in their entirety:

1. ASTM International (ASTM) Standards:

ASTM A1064	Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM A615	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

2. American Concrete Institute (ACI) Publications:

ACI 301	Specification for Structural Concrete
ACI SP-66	ACI Detailing Manual

ACI 318	Building Code Requirements for Structural Concrete
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3. Concrete Reinforcing Steel Institute (CRSI) Publications:

CRSI	Manual of Standard Practice
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1.05 DELIVERY AND STORAGE

- A. Store reinforcement above the surface of the ground upon platform skids or other supports. Protect from mechanical and chemical injury and surface deterioration caused by exposure to conditions producing rust. When placed in the Work, reinforcement shall be free from dirt, scale, dust, paint, oil and other foreign material. Tag and store reinforcement for ease of correlation with Shop Drawings.

1.06 JOB CONDITIONS

- A. Proposed deviations from reinforcing indicated on the Drawings or Specifications shall be approved in writing by the Engineer prior to fabrication.
- B. Lap lengths shall be of the length shown on the Drawings or noted in lap and embedment table, and shall be in compliance with ACI 318.
- C. Specified cover for reinforcing shall be maintained throughout construction. Bars shall be cut to lengths necessary to allow for proper clearances. Cover of concrete shall be measured from face of forms to outside face of reinforcement.
- D. Stirrups shall be hooked.

2.00 PRODUCTS

2.01 MATERIALS

- A. Steel Reinforcing Bars: Billet-Steel bars for concrete reinforcement conforming to ASTM A615; Grade 60, deformed, with minimum yield strength of 60,000 psi. Steel reinforcing bars shall be produced in the United States of America.
- B. Welded Wire Reinforcement: Cold-drawn steel wire conforming to ASTM A1064; flat sheets fabricated in accordance with ASTM A1064.
- C. Joint Dowel Bars: Plain-steel bars, ASTM A615/A615M, Grade 60. Cut bars true to length with ends square and free of burrs.
- D. Epoxy-Coated Joint Dowel Bars: ASTM A775/A775M; with ASTM A615/A615M, Grade 60, plain-steel bars.
- E. Supports (Chairs): Bar supports shall be of the proper type for the intended use.
 - 1. Exposed Surface: CRSI Class 1 – Maximum Protection – uniform high density polyethylene (plastic) or fiberglass reinforced plastic (FRP). Plastic protected wire bar supports are not allowed.
 - 2. Unexposed Surface: CRSI Class 3 – No Protection.
- F. Spacers: Precast mortar blocks with a 28-day compressive strength that is greater than the specified concrete strength in which the blocks are being placed. Additionally:

1. Cure a minimum of 4 days.
 2. Blocks shall be in the form of a frustum positioned such that its size increases away from the formed surface. The surface placed adjacent to the forms shall not exceed 2-1/2 x 2-1/2 inches or 3 inches in diameter.
 3. Blocks shall be accurately cast to the thickness required and the surface to be placed adjacent to the forms shall be a true plane free of surface imperfections.
 4. Wires ties for securing reinforcement shall be embedded in the block.
- G. Mechanical Splices:
1. Mechanical splices shall develop at least 125 percent of the reinforcement yield strength.
 2. Threaded coupler shall utilize a metal coupling sleeve with internal threads.
- H. Zinc Repair Material: ASTM A780, zinc-based solder, paint containing zinc dust, or sprayed zinc.

3.00 EXECUTION

3.01 FABRICATION

- A. Reinforcing bars shall be bent cold by machine to shapes indicated on the Drawings; true to shapes indicated; irregularities in bending shall be cause for rejection. Unless otherwise noted, all hook and bend details and tolerances shall conform to the requirements of ACI SP-66 and ACI 318.
1. Fabricate reinforcement to provide lapped connections, bends and transitions in reinforcement as required for continuity of the typical reinforcement specified on the Drawings.
 2. Unless otherwise detailed, intersecting wall and/or beam reinforcement shall extend to the far face and terminate in a standard hook. Reinforcement at the outside face of corners shall be continuous or provide lap splices at each side of the corner.

3.02 PREPARATION

- A. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials.
- B. 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 reinforcement.

3.03 INSTALLATION

- A. General: Place the reinforcement carefully and accurately in the concrete structures. Rigidly tie and support the reinforcement. Welding of any type of reinforcement shall not be permitted.
- B. Splices:
1. Splice reinforcement only as indicated on the Drawings or as approved by the Engineer prior to fabrication. Splices shall preferably occur at points of minimum stress.

2. Lap Splice: Lengths shall be as indicated on the Drawings. Rigidly wire the bars at all splices. Overlap sheets of wire fabric sufficiently to maintain a uniform strength and securely fasten.
 3. Mechanical Splice: Threaded coupler, installed in accordance with the manufacturer's instructions and recommendations. The splice device shall develop at least 125 percent of the specified yield strength of the reinforcement.
 4. Welding of reinforcing steel splices shall not be permitted.
- C. Placement:
1. Place reinforcement, as indicated on the Drawings with the specified tolerances. Hold securely in place during the placing of the concrete. The minimum clear distance between bars shall be per ACI 318 unless noted otherwise. Always pass vertical stirrups around the main tension members and securely attach thereto. Wire reinforcing together at a sufficient number of intersections to produce a sound, sturdy mat or cage of reinforcement that will maintain the reinforcement in correct positions when the concrete is placed.
 2. Hold the reinforcing steel in concrete slabs firmly in place with wire supports or "chairs." Sizing and spacing of the chairs shall be sufficient to properly support the steel, and shall be in accordance with CRSI Publications "Manual of Standard Practice in."
 3. Space the reinforcing steel in concrete walls the proper distance from the face of the forms, as indicated on the Drawings:
 - a. For wall surfaces exposed to view, use chairs.
 - b. For wall surfaces not exposed to view, use chairs or precast mortar blocks.
 4. Where reinforcing conflicts with location of anchor bolts, inserts, etc., submit prompt notifications so that revisions can be made before concrete is placed. No cutting of reinforcing shall be permitted without the prior approval of the Engineer.
 5. Welded wire shall be fabricated flat sheets, in longest practical lengths. Lap joints one mesh. Do not locate end laps over beams of continuous structures or midway between supporting beams. Offset end laps of adjacent widths to prevent continuous lap. Fasten ends and sides of welded wire fabric at 48 inches O.C. with tie wire.
 6. Reinforcing shall extend through construction joints.
 7. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

3.04 FIELD QUALITY CONTROL

- A. Concrete shall not be placed until the Engineer has observed the final placing of the reinforcing steel, and has given permission to place concrete.

END OF SECTION

03 30 00 CAST-IN-PLACE CONCRETE

1.00 GENERAL

1.01 SUMMARY

- A. Furnish labor, materials, mixing and transporting equipment and incidentals necessary to proportion, mix, transport, place, consolidate, finish, and cure concrete in the structure.

1.02 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and silica fume; subject to compliance with requirements.

1.03 SUBMITTALS

- A. Submittals shall be in accordance with Section 01 33 00 "Document Management" and shall include:

- 1. Shop Drawings:

- a. Mix Design: For each mix design, provide documentation using field test data or trial mixture data in accordance with ACI 301, which includes average strength documentation using either field strength test data or trial mixtures.
 - b. Submit a schedule to the Owner's representative which shows the sequence of concrete placements.

- 2. Certified Test Reports:

- a. Materials used in the mix design and which will be used during production of concrete for the Project.
 - b. Water: Verification that all potable mix water and curing water sources do not exceed the non-potable water limits listed in ASTM C1602 Table 2.
 - c. Aggregate, conforming to ASTM C33, including the test reports for soundness and abrasion resistance.
 - d. Aggregate:
 - 1). Verification that aggregate is not "potentially reactive" per ASTM C1260.
 - 2). Or a cement chemical analysis indicating that the total alkali content is acceptable per Paragraph 2.02.A.
 - e. 7-day and 28-day compressive strength tests results.
 - f. If the sum total of chlorides in mix water and aggregates exceeds 80 percent of the specified limit for hardened concrete, then prior to use of concrete, test mix design to verify acceptable chloride ion concentrations in accordance with ASTM C1218.

- 3. Record Data:

- a. Manufacturer's literature on specified materials.

- b. Documentation indicating conformance with ASTM C94 requirements.
 - 1). Concrete delivery tickets in accordance ASTM C94.
- c. Documentation of supplier's National Ready Mixed Concrete Association certification.

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:
 - 1. A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C94 requirements for production facilities and equipment.
 - 2. Manufacturer must be certified according to the National Ready Mixed Concrete Association's Certification of Ready Mixed Concrete Production Facilities.
- C. Testing Agency Qualifications:
 - 1. An independent testing agency, acceptable to authorities having jurisdiction and the Engineer, qualified according to ASTM C1077 and ASTM E329 to conduct the testing indicated.
 - 2. 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.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver cement in bulk or bags which are plainly marked with the brand and manufacturer's name. Immediately upon receipt, store cement in a dry, weather-tight, and properly ventilated structure which excludes moisture. Storage facilities shall permit easy access for inspection and identification. Cement not stored in accordance with the requirements shall not be used.
- B. Sufficient cement shall be in storage to complete placement of concrete started. In order that cement may not become unduly aged after delivery, maintain records of delivery dates. Use cement which has been stored at the Site for 60 days or more before using cement of lesser age. No cement shall be used which is lumped, caked, stored more than 90 days, or whose temperature exceeds 170 F.

1.06 STANDARDS

- A. Mixing, sampling, placing, curing and testing of concrete, and the materials used shall be in compliance with the latest revisions of the following standards, unless otherwise noted in the Contract Documents. The Contractor shall maintain one copy of each of the applicable standards at the construction field office.

1. ASTM International (ASTM) Standards:

ASTM Standards	
ASTM C31	Standard Practice for of Making and Curing Concrete Test Specimens in the Field
ASTM C33	Standard Specification for Concrete Aggregates
ASTM C39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C42	Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C94	Standard Specification of Ready Mixed Concrete
ASTM C109	Standard Test Method for Compressive Strength of Hydraulic Cement Mortars
ASTM C125	Standard Terminology Relating to Concrete and Concrete Aggregates
ASTM C138	Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
ASTM C143	Standard Test Method for Slump of Hydraulic Cement Concrete
ASTM C150	Standard Specification for Portland Cement
ASTM C171	Standard Specification for Sheet Materials for Curing Concrete
ASTM C172	Standard Practice for Sampling Freshly Mixed Concrete
ASTM C173	Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C191	Standard Test Method for Time of Setting of Hydraulic Cement by Vicat Needle
ASTM C192	Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM C231	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260	Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C290	Standard Specification for Elastomeric Joint Sealants
ASTM C309	Standard Specification for Liquid Membrane Forming Compounds for Curing Concrete
ASTM C494	Standard Specification for Chemical Admixtures for Concrete
ASTM C579	Standard Test Methods for Compressive Strength of Chemical Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes
ASTM C580	Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes
ASTM C595	Standard Specification for Blended Hydraulic Cements
ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

ASTM Standards	
ASTM C827	Standard Test Method for Change in Height at Early Stages of Cylindrical Specimens of Cementitious Mixtures
ASTM C845	Standard Specification for Expansive Hydraulic Cement
ASTM C881	Standard Specification for Epoxy Resin Base Bonding Systems for Concrete
ASTM C1116	Standard Specification for Fiber-Reinforced Concrete
ASTM C1218	Standard Test Method for Water-Soluble Chloride in Mortar and Concrete
ASTM C1240	Standard Specification for Silica Fume used in Cementitious Mixtures
ASTM C1260	Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C1602	Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete
ASTM D1751	Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D1752	Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D2240	Standard Test Method for Rubber Property Durometer Hardness
ASTM E96	Standard Test Methods for Water Vapor Transmission of Materials

2. American Concrete Institute (ACI) Standards:

ACI Standards	
ACI 211.1	Standard Practice for Selecting Proportions for Normal, Heavy-weight, and Mass Concrete
ACI 301	Specification for Structural Concrete
ACI 305.1	Specification for Hot Weather Concreting
ACI 306.1	Standard Specification for Cold Weather Concreting
ACI 308.1	Specification for Curing Concrete
ACI 318	Building Code Requirements for Structural Concrete

3. Concrete Plant Manufacturers Bureau (CPMB) Standards:

a. Concrete Plant Standards.

2.00 PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
 2. Products: Subject to compliance with requirements, provide one of the products specified.
 3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 4. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 CONCRETE MATERIALS

- A. Cementitious Material; General: If the fine and/or coarse aggregates test "Potentially Reactive", in accordance with ASTM C1260, then a low alkali cementitious material shall be used. A low alkali cementitious material shall be such that, the Sodium Oxide Equivalent ($\text{Na}_2\text{O}_{\text{eq}}$) shall not exceed 0.6 percent of the total cementitious material content.
- B. Cement; Type:
1. Type I or I/II Portland cement, conforming to ASTM C150; used for all concrete, unless noted otherwise.
- C. Supplementary Cementitious Materials (SCM):
1. Fly Ash/Pozzolans: Conforming to ASTM C618, Class F fly ash; used in all classes of concrete. If fly ash is not available then provide a straight cement mix.
- D. Coarse Aggregate:
1. Crushed stone or gravel conforming to ASTM C33, in the gradation size specified.
 - a. Class: Severe weathering region, but not less than 3S.
 - b. Class: Moderate weathering region, but not less than 3M.
 - c. Class: Negligible weathering region, but not less than 1N.
 - d. Aggregate shall have a coefficient of thermal expansion (CoTE) of 4.5 microstrain per degree Fahrenheit.
 2. For gradation size number 467, a maximum aggregate size of 1-1/2 inches is:

Sieve Size	Percent Retained	Percent Passing
2"	0	100
1-1/2"	0-5	95-100
3/4"	30-65	35-70

Sieve Size	Percent Retained	Percent Passing
3/8"	70-90	10-30
No. 4	95-100	0-5

3. For gradation size number 57, the maximum aggregate size of 1 inch is:

Sieve Size	Percent Retained	Percent Passing
1-1/2"	0	100
1"	0-5	95-100
1/2"	40-75	25-60
No. 4	90-100	0-10
No. 8	95-100	0-5

4. For gradation size number 67, the maximum aggregate size of 3/4 inch is:

Sieve Size	Percent Retained	Percent Passing
1"	0	100
3/4"	0-10	90-100
3/8"	45-80	20-55
No. 4	90-100	10-10
No. 8	90-100	0-5

5. For gradation size number 8, the maximum aggregate size of 3/8 inch is:

Sieve Size	Percent Retained	Percent Passing
1"	0	100
3/8"	0-15	85-100
No. 4	70-90	10-30
No. 8	90-100	0-10
No. 16	95-100	0-5

E. Fine Aggregate:

1. Washed and screened natural sands or sands manufactured by crushing stones; conforming to ASTM C33. The gradation in ASTM C33 for air entrained concrete is:

Sieve Size	Percent Retained	Percent Passing
3/8"	0	100
#4	0-5	95-100
#8	0-20	80-100
#16	15-50	50-85
#30	40-75	25-60

Sieve Size	Percent Retained	Percent Passing
#50	70-90	10-30

2. Fine aggregate shall have not more than 45 percent retained between any two consecutive sieves. Its fineness modulus, as defined in ASTM C125, shall be not less than 2.3 nor more than 3.1.
- F. Normal-Weight Aggregate for Slab-on-Grade: ASTM C33, combined gradations as follows:
1. 8 to 18 percent for 1-1/2 inch stone.
 2. 8 to 22 percent for 3/4-inch or 1-inch stone.
 3. 8 to 15 percent for #30 and #50 sieve.
 4. 0 to 4 percent on top size sieve.
 5. 1-1/2 to 5 percent on the #100 sieve.
 6. Nominal Maximum Aggregate Size: 1 inch.
- G. Water: Potable and complying with ASTM C1602.

2.03 ADMIXTURES

- A. Measure and dose admixtures in accordance with manufacturer's recommendations.
- B. Air Entraining Admixture: Conforming to ASTM C260.
- C. Water Reducing Admixtures: Conforming to ASTM C494; Types A or D.
- D. Set Retarding Admixtures: Conforming to ASTM C494; Types B and D.
- E. Water Reducing Admixtures, High Range (HRWR): High Range Water Reducer shall comply with ASTM C494, Type F or G. HRWR shall be added to the concrete mix at the concrete batch plant. HRWR may not be added at placement site except to redose a batch and only after approval of the HRWR manufacturer. The high range water reducing admixture shall be able to maintain the plasticity range without significant loss of slump or rise in concrete temperature for 2 hours. Other admixtures may only be used with the HRWR if approved by the HRWR manufacturer. A representative of the HRWR manufacturer shall be present during any large placement, placement of slabs, or during times of unusual circumstance which may require changes to the product formulation.
1. Manufacturers:
 - a. GCP Applied Technologies.
 - b. Master Builders Solutions US LLC.
 - c. Sika Corporation.
- F. 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. Products:
 - a. MasterLife CI 222; Master Builders Solutions US LLC.

- b. DCI or DCI S, GCP Applied Technologies, Inc.
- c. FerroGard-901; Sika Corporation.
- d. Approved equal.

2.04 CURING MATERIALS

- A. Water: Potable and complying with ASTM C1602 .
- B. Absorbent Material: AASHTO M182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd. dry.
- C. Sheet Curing Material: Conforming to ASTM C171.
 - 1. Waterproof paper.
 - 2. Polyethylene film.
 - 3. White burlap - polyethylene film.
- D. Membrane Curing Compounds: Membrane curing compound conforming to ASTM C309; applied according to the manufacturer's recommendations. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 1, Class B, 18 to 22 percent solids.
 - 1. Products:
 - a. Diamond Clear VOX; Euclid Chemical Co.
 - b. Lambco Glazecote 30; Lambert Corporation.
 - c. Dress & Seal; Laticrete International, Inc.
 - d. Vocomp-20; W.R. Meadows, Inc.
 - e. Cure & Seal 250E; Nox-Crete Products Group, Kinsman Corporation.
 - f. Starseal 0800; Vexcon Chemicals, Inc.
 - g. Approved equal.
- E. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C1315, Type 1, Class A.
 - 1. Products:
 - a. Polyseal WB-15; ChemMasters.
 - b. UV Safe Seal; Lambert Corporation.
 - c. Lumiseal Plus; Laticrete International, Inc.
 - d. MasterKure CC 1315 WB; Master Builders Solutions US LLC.
 - e. Vocomp-30; W.R. Meadows, Inc.
 - f. Vexcon Starseal 1315; Vexcon Chemicals, Inc.
 - g. Approved equal.
- F. Finishing Aid: Spraying material designed to form a monomolecular film on fresh concrete that reduces the rate of evaporation of surface moisture prior to finishing. This material is not a curing compound. Concrete must be cured as specified.

1. MasterKure ER 50; Master Builders Solutions US LLC.
2. Approved equal.

2.05 RELATED MATERIALS

A. Expansion and Isolation Joint Filler:

1. Water retaining structures: ASTM D1752, Type I or II.
2. Non-water retaining structures: ASTM D1751; or ASTM D1752, Type I or II.
3. Thickness as indicated on the Drawings.

B. Expansion and Isolation Joint Sealant:

1. Non-water retaining structures: ASTM C920, Type S or M, Grade P or NS as applicable, Class 35, Use T, UV resistance.
2. Backing material for sealant shall be a rod of diameter and composition recommended by the sealant manufacturer.

C. Bonding Agent: Water-based epoxy modified, with integral corrosion inhibitor. Install according to the manufacturer's recommendations.

1. Sika Armathec 110 EpoCem; Sika Corporation.
2. MasterEmaco P 124; Master Builders Solutions US LLC.
3. Approved equal.

2.06 REPAIR MATERIALS

A. Structural Concrete Repair Material: Low-shrink, non-slump, non-metallic, quick setting patching mortar; as approved by the manufacturer for each application and applied accordance with the manufacturer's recommendations.

1. Products:
 - a. Five Star Structural Concrete; Five Star Products, Inc.
 - b. SikaTop 123; Sika Corporation.
 - c. SikaTop 122; Sika Corporation.
 - d. MasterEmaco N 425; Master Builders Solutions US LLC.
 - e. Approved equal.

B. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.

3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
 4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C109/C109M.
- C. Repair Topping: Traffic-bearing, cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch.
1. Cement Binder: ASTM C150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C219.
 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
 4. Compressive Strength: Not less than 5700 psi at 28 days when tested according to ASTM C109/C109M.

2.07 CONCRETE MIXTURES

A. Design Criteria:

1. Provide a mix design for each concrete application indicated. This may necessitate multiple mix designs for each class of concrete depending on HRWR, entrained air, and other requirements.
2. All Concrete shall be normal weight concrete composed of Portland cement, fine aggregate, coarse aggregate, admixtures, and water, as specified.
3. ACI 211.1 shall be the basis for selecting the proportions for concrete made with aggregates of normal and high density and of workability suitable for usual cast in place structures.
4. The workability of any mix shall be as required for the specific placing conditions and the method of placement. The concrete shall have the ability to be worked readily into corners and around reinforcing steel without the segregation of materials or the collection of free water on the surface. Compliance with specified slump limitations shall not necessarily designate a satisfactory mix.
5. In no case shall the amount of coarse material produce harshness in placing or honeycombing in the structure, when forms are removed. The maximum amount of coarse aggregate (dry loose volume) per cubic foot of finished concrete shall not exceed 0.82 cubic feet.
6. In calculating water-cement ratio: The water content shall include the amount of water batched or to be added later, plus the free water in the aggregate, and minus the water content at SSD conditions.
7. No allowance shall be made for the evaporation of water after batching. If additional water is required to obtain the desired slump, a compensating amount of cement shall also be added. In no case shall the maximum water cement ratio exceed the specified maximum or that of the approved mix design.

8. Air Entrainment: Provide the percent air entrainment in each concrete mix design as recommended by ACI 318:
 - a. Exposure Class: F1, unless otherwise specified/restricted:
 - 1). Do not provide air-entrainment in drilled shafts unless placed underwater.
 - 2). Do not provide air-entrainment and entrapped air shall not exceed 3 percent for the following applications:
 - a). Interior slabs.
 - b). Slabs on composite metal decks.
9. Maximum water-soluble chloride ion content in concrete, by percent weight of concrete, shall not exceed ACI 318] Exposure Class C2.
10. When job conditions dictate, water-reducing and set-controlling admixtures may be used. Only specified admixtures shall be used. Admixtures shall be batched at the batch plant.
11. High Range Water Reducer (HRWR): Provide HRWR in mix designs for the following specified applications:
 - a. Drilled shafts, footings, walls, columns, and beams.
 - b. Interior of building curbs which are not cast monolithically with slabs.
 - c. Precast concrete.
 - d. Exception: Do not provide HRWR in slabs and pavement (a water reducer is permitted provided performance requirements are met).
12. If fly ash is to be used in place of cement, no more than 25 percent of the cement may be replaced.
13. Use silica fume where indicated. The trial mix shall be in accordance with this Section and the silica fume manufacturer.
 - a. Single source throughout the Project.
 - b. Added to the mix at a rate of 10 percent of cement content. No reduction in cement content shall be allowed, but it may be included when determining the water-cement ratio.
 - c. Mix shall contain high range water reducer and air-entraining admixtures.
14. Concrete shall be capable of developing two-thirds of the required 28-day compressive strength in 7 days.
15. Shrinkage Limits: All concrete used in the following structures shall have a shrinkage limit of 0.04 percent at 28 days in accordance with ASTM C157.

- B. Concrete Classifications: Refer to Structural Notes on drawings.
- C. Concrete Usage: Refer to Structural Notes on drawings.
- D. Required Average Compressive Strength:
 - 1. All concrete is required to have an average compressive strength greater than the specified strength. The required average compressive strength shall be established according to the requirements of ACI 301.
 - 2. Standard Deviation: Calculate a standard deviation and establish the required average compressive strength (f_{cr}') in accordance with ACI 301. If field test records are not available, select the required average strength from ACI 301.
- E. Documentation of Required Average Compressive Strength:
 - 1. Documentation indicating the proposed concrete proportions will produce an average compressive strength equal to or greater than f_{cr}' . Documentation shall consist of field strength records or trial mixture.
 - 2. Field Strength Test Records: Document field strength test records according to ACI 301, which is partially restated here:
 - a. If field test data are available and represent a single group of at least 10 consecutive strength tests for one mixture, using the same materials, under the same conditions, and encompassing a period of not less than 45 days, verify that the average of the field test results equals or exceeds f_{cr}' .
 - b. If the field test data represent two groups of strength tests for two mixtures, plot the average strength of each group versus the water-cementitious materials ratio of the corresponding mixture proportions and interpolate between them to establish the required mixture proportions for f_{cr}' .
 - 3. Trial Mixtures:
 - a. Establish trial mixture proportions according to ACI 301, which is partially restated here:
 - 1). Make at least three trial mixtures complying with performance and design requirements. Each trial mixture shall have a different cementitious material content. Select water-cementitious materials ratios that will produce a range of compressive strengths encompassing f_{cr}' .
 - 2). Submit a plot of a curve showing the relationship between water-cementitious materials ratio and compressive strength.
 - 3). Establish mixture proportions so that the maximum water-cementitious materials ratio is not exceeded when the slump is at the maximum specified.
 - b. Trial mixtures shall be designed, sampled, and tested by an independent testing laboratory, retained and paid by the Contractor and approved by the Owner.
 - c. Provide 7-day and 28-day strengths test results.

4. Revisions to concrete mixtures:

- a. When less than 15 compressive strength tests results for a given class of concrete are available from the current Project:
 - 1). If any of the following criteria are met, take immediate steps to increase average compressive strength of the concrete.
 - a). A 7-day compressive strength test result multiplied by 1.5 falls below the required 28-day compressive strength.
 - b). A 28-day compressive strength test result is deemed not satisfactory.
- b. When at least 15 compressive strength test results for a given class of concrete become available from the current Project:
 - 1). Calculate the actual average compressive strength, standard deviation and required average compressive strength using the previous 15 consecutive strength tests. Submit results in graphical form with each 28-day test result for that class of concrete.
 - 2). If any of the following criteria are met, take immediate steps to increase average compressive strength of the concrete.
 - a). A 7-day compressive strength test result multiplied by the average job-to-date ratio of 7-day to 28-day compressive strength falls below the required 28-day compressive strength.
 - b). A 28-day compressive strength test result is deemed not satisfactory.
 - c). The average compressive strength falls below the required average compressive strength.
- c. When revisions to the mix design are required, notify the Engineer in writing of the corrective actions taken.

2.08 OFF-SITE BATCH PLANT

- A. Batch plants shall be an established concrete batching facility meeting the requirements of the Concrete Plant Standards of the Concrete Plant Manufacturers Bureau.

2.09 CONCRETE MIXING

- A. Mixers may be stationary, truck, or paving mixers of approved design. They shall be capable of combining the materials into a uniform mixture and of discharging without mixture segregation. Stationary and paving mixers shall be provided with an acceptable device to lock the discharge mechanism until the required mixing time has elapsed. The mixers or mixing plant shall include a device for automatically counting the total number of batches of concrete mixed. The mixers shall be operated at the drum or mixing blade speed designated by the manufacturer on the name plate.
- B. The mixing time for stationary mixers shall be based upon the mixer's ability to produce uniform concrete throughout the batch and from batch to batch. For guidance purposes, the manufacturer's recommendations, or 1 minute for 1 cubic yard plus 1/4 minute for each

additional cubic yard may be used. Final mixing time shall be based on mixer performance. Mixers shall not be charged in excess of the capacity specified by the manufacturer.

- C. When a stationary mixer is used for partial mixing of the concrete (shrink mixed), the stationary mixing time may be reduced to the minimum necessary to intermingle the ingredients (about 30 seconds).
- D. When a truck mixer is used, either for complete mixing (transit-mixed) or to finish the partial mixing in a stationary mixer and in the absence of uniformity test data, each batch of concrete shall be mixed not less than 70 nor more than 100 revolutions of the drum, at the rate of rotation designated by the manufacturer of the equipment as mixing speed. If the batch is at least 1/2 cubic yard less than the rated capacity, in the absence of uniformity test data, the number of revolutions at mixing speed may be reduced to no less than 50. Additional mixing shall be performed at the speed designated by the manufacturer of the equipment as agitating speed. When necessary for proper control of the concrete, mixing of transit-mixed concrete shall not be permitted until the truck mixer is at the Site of the concrete placement. Truck mixers shall be equipped with accurate revolution counters.
- E. Paving mixers may be either single compartment drum or multiple compartment drum type. A sled or box of suitable size shall be attached to the mixer under the bucket to catch any concrete spillage that may occur when the mixer is discharging concrete into the bucket. Multiple compartment drum paving mixers shall be properly synchronized. The mixing time shall be determined by time required to transfer the concrete between compartments of the drum.
- F. Vehicles used in transporting materials from the batching plant to the paving mixers shall have bodies or compartments of adequate capacity to carry the materials and to deliver each batch, separated and intact, to the mixer. Cement shall be transported from the batching plant to the mixers in separate compartments which are equipped with windproof and rain proof covers.

3.00 EXECUTION

3.01 PREPARATION

- A. Notify the Owner's representative upon completion of various portions of the work required for placing concrete, so that inspection may be made as early as possible. Keep the Owner's representative informed of the anticipated concrete placing schedules.
- B. All items, including lines and grades, forms, waterstops, reinforcing, inserts, piping, electrical, plumbing and the Contractor's concreting materials and equipment shall be in compliance with the Contract Documents before proceeding.
- C. Do not place any concrete until formwork and the placing reinforcement in that unit is complete. Place no concrete before the completion of all adjacent operations which might prove detrimental to the concrete.
- D. Brilliantly light the Site so that all operations are plainly visible when concrete mixing, placing, and finishing, continues after daylight. Whenever possible, concrete finishing shall be completed in daylight hours.
- E. When placing concrete, the forms shall be clean and entirely free from all chips, dirt, sawdust and other extraneous matter. Forms for slab, beam and girder construction shall

not have tie wire cuttings, nails, or any other matter which would mar the appearance of the finished construction. Clean forms and keep them free of any foreign matter during concrete placing.

- F. The concrete shall be mixed in quantities required for immediate use. Any concrete which is not in place within the time limits specified shall not be used. Concrete shall not be re-tempered.
- G. Concrete shall not be placed if impending weather conditions would impair the quality of the finished Work.
- H. Unless otherwise provided, the following requirements shall govern the time sequence on which construction operations shall be carried.
 - 1. Forms for walls or columns shall not be erected on concrete footings until the concrete in the footing has cured for at least 2 curing days. Concrete may be placed in a wall or column as soon as the forms and reinforcing steel placements are approved.
 - 2. Steel beams or forms and falsework for superstructures shall not be erected on ground-supported concrete substructures until the substructure concrete has cured for at least 4 curing days.
 - 3. Falsework required for superstructures shall not be erected until the substructure has cured for 4 curing days, and shall not be removed until allowed for by Section 03 11 00 "Concrete Forming."

3.02 EMBEDDED ITEMS

- A. Where aluminum anchors, aluminum shapes, or aluminum electrical conduits are embedded in concrete, paint aluminum contact surfaces with zinc rich primer. Allow the paint to thoroughly dry before placing the aluminum in contact with the concrete.
- B. 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 JOINTS

- A. Expansion Joints and Devices:
 - 1. Workmanship: Exercise careful workmanship in joint construction to separate the concrete sections by an open joint or by the joint materials, and make the joints true to the outline indicated.
 - 2. Expansion Joints: Construct expansion joints and devices to provide expansion and contraction. Construct joints which are to be left open or filled with poured joint material with forms which are adaptable for loosening or early removal. In order to avoid jamming by the expansion action of the concrete and the consequent likelihood of injuring adjacent concrete, remove or loosen these forms as soon as possible after the concrete has initially set. Make provisions for loosening the forms to permit free concrete expansion without requiring full removal.

3. Armored Joints: Carefully construct armored joints to avoid defective anchorage of the steel and porous or honeycombed concrete adjacent to same. Anchor pre-molded materials to the concrete on one side of the joint with approved adhesive. Anchor so that the material does not fall out of the joint.
- B. Construction Joints:
1. Construction joints are formed by placing plastic concrete in direct contact with concrete which has attained its initial set. When concrete is specified as monolithic, the term shall be interpreted as the manner and sequence of concrete placement so that construction joints do not occur.
 2. Additional horizontal and vertical construction joints, when submitted and approved by the Engineer, may have an impact on reinforcing details. Revise reinforcing details to reflect additional joints.
 3. Unless otherwise provided, construction joints shall be square and normal to the forms. Provide bulkheads in the forms for all joints except horizontal joints.
 4. Clean horizontal construction joints for receiving the succeeding lift using air water cutting. The surface shall be exposed sound, clean aggregate with a 1/4 inch amplitude. After cutting, wash the surface until there is no trace of cloudiness in the wash water.
 5. In areas where air water cutting cannot be satisfactorily accomplished, or in areas where it is undesirable to disturb the surface of the concrete before it has hardened, prepare the surface for receiving the next lift by wet sand blasting to immediately remove all laitance and unsound concrete prior to placing of the next lift. Thoroughly wash the surface of the concrete after sand blasting to remove all loose material.
 6. Provide construction joints with concrete keyways, reinforcing steel dowels, and waterstops where indicated on the Drawings. The method of forming keys in keyed joints shall permit the easy removal of forms without chipping, breaking, or damaging the concrete.
 7. Construction joint layout unless otherwise indicated on the Drawings:
 - a. Maximum horizontal spacing of construction joints shall be 45 feet.
 - b. Maximum vertical spacing of construction joints shall be 15 feet.
- C. Control Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness, spaced at not more than 15 feet on center, and as follows:
1. Tooled Joints: Form control joints after initial floating by tooling/grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 2. Sawed Joints: Form control joints with early entry dry-cut power saws within 2 hours of finishing operations. Cut 1/8-inch 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.
- E. Hardened Concrete: Where new concrete or grout is to be placed in contact with existing or recently hardened concrete, texture the existing or recently hardened surface by chipping or other means so that an irregular surface having a height variance of not less than 1/4 inch is created. The existing or recently hardened concrete shall then be coated with a bonding agent and new concrete or grout placed.

3.04 CONCRETE PLACEMENT

A. Cold Weather:

1. If air temperature has fallen to, or is expected to fall below 40 F during the protection period (a minimum of 48 hours but not less than that required by ACI 306.1), then cold weather concreting shall be performed in accordance with ACI 306.1.
2. In cases where the temperature drops below 40 F after the concreting operations have been started, sufficient canvas and framework or other type of housing shall be furnished to enclose and protect the structure, in accordance with the requirements of ACI 306.1. Sufficient heating apparatus to provide heat shall be supplied, and heating source and protection from combustion gas shall be in accordance with ACI 306.1. The concrete shall be protected when placed under all weather conditions. Should concrete placed under such conditions prove unsatisfactory, remove and replace the concrete at no cost to the Owner.
3. When the air temperature is above 30 F:
 - a. The minimum concrete temperature at the time of mixing shall be 60 F unless other requirements of ACI 306.1 are met, which may allow for a lower mix temperature.
 - b. The minimum concrete temperature at the time of placement and during the protection period shall be 55 F unless other requirements of ACI 306.1 are met, which may allow for a lower temperature.
4. The means used to heat a concrete mix shall be in accordance with ACI 306.1.
5. Salts, chemicals, or other foreign materials shall not be mixed with the concrete to preventing freezing. Calcium chloride is not permitted.

B. Hot Weather:

1. Hot weather is defined as any combination of high air temperature, low relative humidity, and wind velocity that impairs the quality of the concrete. Hot weather concreting shall be in accordance with ACI 305.1. Concrete shall be placed in the forms without the addition of any more water than that required by the design (slump). No excess water shall be added on the concrete surface for finishing. Control of initial set of the concrete and extending the time for finishing operations may be accomplished with the use of approved water reducing and set retarding admixture, as specified.

2. Maximum time intervals between the addition of mixing water and/or cement to the batch, and the placing of concrete in the forms shall not exceed the following (excluding HRWR admixture use):

Concrete Temperature	Maximum Time from Water Batch to Placement
Non-Agitated Concrete	
Up to 80 F	30 Minutes
Over 80 F	15 Minutes
Agitated Concrete	
Up to 75 F	90 Minutes
75 F to 89 F	60 Minutes

- a. The use of an approved set-retarding admixture will permit the extension of the above time maximums by 30 minutes, for agitated concrete only.
 - b. The use of an approved high range water reducing (HRWR) or hydration-controlling admixture will allow placement time extensions as determined by the manufacturer.
 3. The maximum temperature of fresh concrete at time of discharge shall not exceed 95 F. The temperatures of the mixing water shall be reduced by the use of chilled water or ice.
 4. The maximum temperature of fresh concrete with high range water reducing admixture shall not exceed 100 F at time of discharge.
 5. Under extreme heat, wind, or humidity conditions, concreting operations may be suspended if the quality of the concrete being placed is not acceptable.
- C. Handling and Transporting:
1. Delivery tickets shall be required for each batch and shall be in accordance with ASTM C94. Each delivery ticket must show plainly the amount of water, in gallons that can be added to the mixer truck at the Site without exceeding the maximum water cement ratio approved for that mix design. Amount of water added must be in proportion to contents of truck.
 2. Arrange and use chutes, troughs, or pipes as aids in placing concrete so that the ingredients of the concrete are not segregated. They shall be steel or steel lined. When steep slopes are necessary, equip the chutes with baffles or make in short lengths that reverse the direction of movement. Extend open troughs and chutes, if necessary, inside the forms or through holes left in the forms. Terminate the ends of these chutes in vertical downspouts.
 3. Keep chutes, troughs, and pipes clean and free from coatings of hardened concrete by thoroughly flushing with water before and after placement. Discharge water used for flushing away from the concrete in place.
 4. Use pumping equipment that has sufficient capacity so that:
 - a. Discharge of pump concrete does not result in segregation.

b. Modification of accepted concrete mixture is not required.

5. Carting or wheeling concrete batches on completed concrete floor slab shall not be permitted until the slab has aged at least 4 curing days. Unless pneumatic tired carts are used, wheel the carts on timber planking so that the loads and impact are distributed over the slab. Curing operations shall not be interrupted for the purpose of wheeling concrete over finished slabs.

D. Depositing:

1. The method and manner of placing shall prevent segregation or separation of the aggregate or the displacement of the reinforcement. Use drop chutes or tremies as necessary.
2. Free Fall: Concrete shall not be allowed to free fall more than 10 feet when HRWR admixture is used or 5 feet without the use of HRWR. Free falling concrete shall avoid striking reinforcing during placement. Placement of concrete for heights exceeding the free fall limit shall be placed using a tremie.
 - a. Concrete shall not be allowed to free fall through water. Place as indicated below.
3. Prevent the splattering of forms and reinforcing bars if the splattered concrete will dry or harden before incorporation into the mass.
4. Fill each part of the forms by directly depositing concrete as near its final position as possible. Work the concrete under and around the reinforcement bars. Depositing large quantities at one point in the forms, then running or working it along the forms shall not be permitted.
 - a. Place required sections in one continuous operation to avoid additional cold joints. Each layer shall be fluid and concrete shall not have taken initial set when a new layer is placed upon it. Not more than 1 hour shall elapse between the placing of successive concrete layers in any portion of the structures included in continuous placement.
5. Place in continuous horizontal layers with a depth of from 1 to 3 feet. If excessive bleeding causes water to form on the surface of the concrete in tall forms, revise mix design to reduce the bleeding.
6. In tall walls, place the concrete to a point about 1 foot below the top of the wall and allow to settle for 1 hour. Resume and complete concreting before set occurs.
7. For slopes greater than 2 percent, start concrete placement at low end and proceed upslope.
8. After the concrete has taken initial set, the forms shall not be jarred. No force or load shall be placed upon projecting reinforcement.

E. Consolidating:

1. Compact each layer of concrete and flush the mortar to the surface of the forms by continuous-working mechanical vibrators. Apply the vibrator to the concrete immediately after deposit. Move vibrator throughout the layer of the newly placed concrete, several inches into the plastic layer below. Thoroughly work the concrete around the reinforcement, embedded fixtures and into the corners and angles of the forms until it is well-compacted.

2. Mechanical vibrators shall not be operated so that they penetrate or disturb previously placed layers which are partially set or hardened. They shall not be used to aid the flow of concrete laterally. The vibration shall be of sufficient duration to completely compact and embed reinforcement and fixtures, but not to an extent causing segregation.
3. Keep vibrators constantly moving in the concrete and apply vertically at points uniformly spaced, not farther apart than the radius over which the vibrator is visibly effective. The vibrator shall not be held in one location longer than required to produce a liquified appearance on the surface.
4. When submerged in concrete, internal vibrators shall maintain a frequency of not less than 6000 impulses per minute for heads with diameters greater than 5 inches and 10,000 impulses for smaller vibrator heads. The vibration intensity (amplitude) shall be sufficient to produce satisfactory consolidation.
 - a. Vibrator head shall be sufficiently small to allow placement between reinforcing steel.
 - b. Provide at least one standby vibrator.
 - c. Check vibrators intended for regular service or standby service prior to concreting operations.

F. Placement in Water:

1. Deposit concrete in water only when dry conditions cannot be obtained. The forms, cofferdams, or caissons shall be sufficiently tight to prevent any water flowing through the space where concrete is to be deposited. Pumping of water shall not be permitted while the concrete is being placed, nor until it has set for at least 36 hours.
2. Carefully place the concrete using a tremie, closed bottom dumping bucket, or another approved method which does not permit the concrete to fall through the water without protection. The concrete shall not be disturbed after being deposited. Regulate depositing to maintain horizontal surfaces.
3. When a tremie is used, it shall consist of a tube constructed in sections having water-tight connections. The means of supporting the tremie shall permit the movement of the discharge end over the entire top surface of the work, and shall allow the tremie to be rapidly lowered to retard the flow. The number of times it is necessary to shift the location of the tremie shall be held to a minimum for any continuous placement of concrete. During the placing of concrete, keep the tremie tube full to the bottom of the hopper. When a batch is dumped into the hopper, slightly raise the tremie, but not out of the concrete at the bottom, until the batch discharges to the level of the bottom of the hopper. Stop the flow by lowering the tremie. Continue placing operations until the work is completed.
4. When concrete is placed by means of the bottom dump bucket, the bucket shall have a capacity of not less than 1/2 cubic yard. Lower the bucket gradually and carefully until it rests upon the concrete already placed. Raise it very slowly during the discharge travel to maintain still water at the point of discharge and to avoid agitating the mixture.
5. Use a sump or other approved method to channel displaced fluid and concrete away from the shaft excavation. Recover slurry and dispose of it as approved. Do not discharge displaced fluids into or in close proximity to streams or other bodies of water.

G. Placement in Slabs:

1. Allow concrete in columns, walls and deep beams or girders to stand for at least 1 hour to permit full settlement from consolidation, before concrete is placed for slabs they are to support. Haunches are considered as part of the slab and shall be placed integrally with them.
2. When monolithic slabs are placed in strips, the widths of the strips, unless otherwise specified or indicated, shall insure that concrete in any one strip is not allowed to lie in place for more than 1 hour before the adjacent strips are placed.
3. Immediately before placing concrete, thoroughly dampen the subgrade to receive concrete to prevent moisture absorption from the concrete.
4. As soon as concrete placing is complete for a slab section of sufficient width to permit finishing operations, level the concrete, strike off, tamp and screed. The screed shall be of a design adaptable to the use intended, shall have provision for vertical adjustment and shall be sufficiently rigid to hold true to shape during use.
5. The initial strike off shall leave the concrete surface at an elevation slightly above grade so that, when consolidation and finishing operations are completed, the surface of the slab is at grade elevation.
6. Continue tamping and screeding operations until the concrete is properly consolidated and free of surface voids. Bring the surface to a smooth, true alignment using longitudinal screeding, floating, belting, and/or other methods.
7. When used, templates shall be of a design which permits early removal so satisfactory finishing at and adjacent to the template is achieved.
8. While the concrete is still plastic, straighten the surface as required to achieve specified flatness requirements. Remove high spots and fill depressions with fresh concrete and re-float. Continue to check during the final finishing operation, until the surface is true to grade and free of depressions, high spots, voids, or rough spots.
9. Where floor drains are shown in slabs and sloping the slab is not indicated, slope slab to drain on a grade of 1/16 inch per foot. The thickness of slab at floor drain shall be the thickness of slab as indicated on the Drawings.

H. Placement in Foundations: Place concrete in deep foundations so that segregation of the aggregates or displacement of the reinforcement is avoided. Provide suitable chutes or vertical pipes. When footings can be placed in dry foundation pits without the use of cofferdams or caissons, forms may be omitted and the entire excavation filled with concrete to the elevation of the top of footing. The placing of concrete bases above mud slab is permitted after the forms are free from water and the seal course cleaned. Execute necessary pumping or bailing during concreting from a suitable sump located outside the forms.

I. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on the Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates of manufacturer furnishing machines and equipment.

3.05 FINISHING FORMED SURFACES

- A. Forms for walls, columns, and sides of beams and girders shall be removed as specified in Section 03 11 00 "Concrete Forming." Patch, repair, finish, and clean concrete after form removal. Finish concrete not more than 7 days after form removal. Cure concrete as finishing progresses.
- B. Air voids, for all types of finishes, are defects and shall be removed by rubbing or patching.
- C. Finish Schedule:

Type of Finish	Location
No Finish	Surfaces which are not visible from the inside or outside of the completed structure, are more than 12" below finish grade, and where a coating/membrane/drainage board will not be installed
Smooth Finish	Surfaces exposed to view, areas below to a point 12" below grade, and where a coating/membrane/drainage board will be installed.

- D. No Finish: Patch tie holes. Repair defects larger than 1-1/2 inches in diameter or 1/2 inch in deep. Remove projections larger than 1 inch.
- E. Smooth Finish: The form facing material shall produce a smooth, uniform texture on the concrete. Patch tie holes. Repair defects larger than 3/4 inch wide or 1/2 inch deep. Remove projections flush with the adjacent surface.

3.06 FINISHING FLOORS AND SLABS

- A. General: Screed, restraigten, and finish concrete surfaces. Do not wet concrete surfaces.
- B. Finish slabs, platforms, and steps monolithically and apply as indicated on the Drawings and the following schedule of finishes:

Type of Finish	Location
Float Finish	Top of walls, vault top slabs not subject to pedestrian foot traffic.
Broom Finish	Exterior concrete platforms and steps.

- 1. Float Finish: Finish surfaces using a float to a true, even plane with no coarse aggregate visible. In the initial floating, while the concrete is plastic, use sufficient pressure on the float to bring excess moisture to the surface for removal. Apply a final "light float" finish to the surface as the concrete hardens. The surface shall have a uniform granular texture and shall meet the straightness requirements.

- a. Finish surfaces to the following tolerances, measured within 24 hours according to ASTM E1155/E1155M for a randomly trafficked floor surface:
- b. Finish and measure surface so gap at any point between concrete surface and an unlevleed freestanding 10-foot long straightedge, resting on two high spots and placed anywhere on the surface, does not exceed the following:
 - 1). 1/4 inch.
 - 2). 3/16 inch.
 - 3). 1/8 inch.
- 2. Trowel and Fine-Broom Finish: Apply a partial trowel finish, stopping after second troweling. Immediately after second troweling, and when concrete is still plastic, slightly scarify surface with a fine broom.
- 3. Broom Finish: Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with the Engineer before application.
 - a. After broadcasting and tamping, apply float finish.
 - b. After curing, lightly work surface with a steel wire brush or an abrasive stone, and water to expose slip-resistive aggregate.
- C. Give sidewalks a brush finish, unless noted otherwise. Score sidewalks at a spacing equal to the width of the walk and edge on each side using a tool with a radius of approximately 1/4 inch.

Note to Specifier: Typically delete option below unless required by the Project.

3.07 MISCELLANEOUS CONCRETE ITEMS

A. Normal Shrinkage Grouting:

- 1. Prior to grout application, thoroughly clean the surface of all foreign matter. Roughen concrete surface to CSP 4 and wet as required for a saturate surface dry condition (SSD). Set forms in place; tight and securely anchored to prevent the loss of grout.
- 2. The necessary materials and tools shall be on hand before starting grouting operations.
- 3. After preparing surface and immediately prior to grouting, provide scrub coat of grout material. Do not allow scrub coat to dry prior to placing grout.
- 4. After mixing, quickly and continuously place the grout to avoid overworking, segregation and breaking down of the initial set. Mix and place the grout where indicated on the Drawings. Cure grout using wet curing method for concrete. Grout shall receive a trowel finish, unless otherwise noted.

B. Non-Shrink Grout:

- 1. Obtain field technical assistance from the grout manufacturer, as required, to ensure that grout mixing and installation comply with the manufacturer's recommendations and procedures.

2. Roughen concrete surface as required by the manufacturer, but not less than CSP 4. Saturate the surface to achieve an SSD condition. Baseplates shall be free of oil, grease, laitance and other foreign substances.
 - a. Epoxy Grout: Surface shall be dry as recommended by the manufacturer.
3. Place grout according to the manufacturer's directions so that spaces and cavities below the bottom of the baseplates are completely filled. Provide forms where structural components of the baseplates do not confine the grout. Trowel finish the non-shrink grout where the edge of the grout is exposed to view and after the grout has reached its initial set. Cut off the exposed edges of the grout at a 45-degree angle to the baseplate, bedplate, member, or piece of equipment.
4. Wet cure a minimum of 3 days, but not less than that recommended by the manufacturer.
 - a. Epoxy Grout: Dry curing is acceptable if recommended by the manufacturer.
5. Use epoxy non-shrink grout under all machinery, pumps, equipment, and where chemicals are present that would abate cementitious non-shrink grouts.

3.08 CONCRETE CURING AND PROTECTION

- A. General: Begin curing of concrete immediately after completion of finishing activities for unformed concrete and immediately after removal of forms from formed concrete. Apply curing method without staining, marring, or damaging concrete surfaces. Where pedestrian traffic is unavoidable, provide suitable walkways to protect the curing material and the concrete surface from damage. Unless a particular curing method is specified, select the appropriate curing method from the curing options indicated.
- B. Length of Curing Period:
 1. Curing Day: A day on which the ambient temperature is above 50 deg. F for at least 18 hours.
 2. Curing Period: 7 consecutive curing days.
 3. Extended Curing Period: When curing day requirements are not met, then extend the curing period by one day for each day not in compliance. Extend curing up a maximum total of 14 consecutive days.
- C. Wet Curing with Absorbent Material:
 1. Cover concrete surfaces with absorbent material and hold it in contact with concrete surface. Provide a minimum 8-inch lap of adjacent material section edges.
 2. Apply water to absorbent material and saturate. Maintain saturated condition for curing period – do not allow absorbent material to dry.
 3. Do not use wet curing if curing water will be subject to freezing during the curing period.
- D. Sheet Curing: Cover concrete surfaces with sheets and hold in contact with concrete surface. Apply in accordance with manufacturer recommendations, which includes placement, patching holes, and tape joints per manufacturer recommendations.

E. Membrane Curing:

1. Cover the surface of the concrete with a continuous, uniform film. Application shall be in accordance with manufacturer recommendations. Prevent overspray as necessary to meet project requirements.
2. Do not allow foot traffic on surface in accordance with manufacturer recommendations.
3. Repair film if damaged within the curing period.
4. Unless preapproved, do not use membrane curing on surfaces that:
 - a. Receive concrete topping, terrazzo, paint, floor hardener, or other finish.
 - b. Are specified to have a rubbed finish.

F. Protection: During and after curing period, protect concrete surfaces from damage, marring, or staining by construction activities.

3.09 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. 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. If the surface of the concrete is bulged, uneven, or shows honeycombing or form marks, which in the Engineer's opinion cannot be repaired satisfactorily, remove and replace the entire section.
 2. Patch honeycomb and minor defects in all concrete surfaces with structural concrete repair material. Cut back each defective area with a pneumatic chipping tool as deep as the defect extends, but in no case less than 1/2 inch. Prepare the existing concrete and apply repair material according to the manufacturer's recommendations. Finish the surface of the patches to match finish on surrounding concrete.
 3. Immediately after form removal, cut out honeycombs, rock pockets, and voids to expose solid concrete but not less than 1-inch 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 repair material before bonding agent has dried.
- C. 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, pop outs, honeycombs, rock pockets, crazing and cracks in excess of 0.01-inch 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 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 inch 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 inch 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-inch 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 72 hours.
- D. Perform structural repairs of concrete, subject to Engineer's approval, using epoxy adhesive and patching mortar.
- E. Repair materials and installation not specified above may be used, subject to Engineer's approval.

3.10 FIELD QUALITY CONTROL

A. Testing:

1. General:

- a. Tests shall be required throughout the Work to monitor the quality of concrete. Samples shall be taken in accordance with ASTM C172.
- b. Engineer may waive these requirements on concrete placements of 10 cubic yards or less. However, evidence shall be furnished showing a design mix which meets the Specifications.
- c. Unless noted otherwise, testing of the materials, ready mix, transit mix, or central plant concrete will be by an independent testing agency. The independent testing agency will be approved by the Owner and paid by the Contractor. A summary of all tests performed will be available. No concrete shall be placed without a representative present at either the plant or at the Site.
- d. Unless the Owner's laboratory is on the Site, provide housing for the curing and storage of test specimens and equipment.

2. Slump Test: Slump tests, in accordance with ASTM C143, shall be used to indicate the workability and consistency of the concrete mix from batch to batch. Generally, a slump test shall be made at the start of operations each day, at regular intervals throughout a working day, and at any time when the appearance of the concrete suggests a change in uniformity.
3. Air Content Test: Tests for the concrete's air content shall be made in accordance with ASTM C231 or ASTM C173, at the point of delivery of concrete, prior to placing in forms. The test shall be made frequently to monitor a proper air content uniform from batch to batch.
4. Temperature Test: Test for the concrete's temperature in accordance with ASTM C1064 and as follows: the temperature of the concrete to be placed shall be taken with a thermometer immediately before placement, with the point of measurement being in the chute or bucket. Temperature test shall be performed for each truck. Record temperatures on batch ticket.
5. Compression Test:
 - a. Compression test specimens shall be 6-by-12-inch concrete cylinders made and cured in accordance with ASTM C31. If the maximum aggregate size is no larger than 1 inch, 4-by-8-inch concrete cylinders are acceptable. No fewer than two 6-by-12-inch or three 4-by-8-inch specimens shall be made for each test Sample. Samples shall be taken at a minimum of every 50 cubic yards of concrete for each class placed. At least one set of test specimens per day shall be made for each class of concrete used that day. Specimens shall be cured under laboratory conditions specified in ASTM C31. Additional concrete cylinders may be required for curing on the job under actual job curing conditions. These Samples could be required when:
 - 1). There is a possibility of the air temperature surrounding the concrete falling below 40 F, or rising above 90 F.
 - 2). The curing procedure may need to be improved and/or lengthened.
 - 3). It is necessary to determine when the structure may be put into service.
 - b. Compression strength tests shall be made on the laboratory-cured and job-cured concrete cylinders at 7 and 28 days, in accordance with ASTM C39. The value of each test result shall be the average compressive strength of all of the cylinders in the test Sample. All cylinders within a test Sample shall be taken at the same time from the same batch of concrete. For the 28-day cylinders, the strength level shall be satisfactory if the averages of all sets of three consecutive strength test results exceed the required design compressive strength, and no individual strength test result falls below the required compressive strength by more than 500 psi.
6. High Early Strength Concrete Test: When Type "III" High Early Strength Portland cement is used instead of Type "I" Portland cement, the minimum allowable 28-day strength for Type "I" Portland cement concrete shall be at 7 days. The ages at time of test for Type "III" shall be 3 days and 7 days, instead of 7 days and 28 days, respectively, for Type "I."
7. Failure to Meet Requirements:
 - a. Should the 7-day strengths shown by the test specimens fall below the required values, additional curing shall be performed on those portions of the structures

represented by the test specimens at the Contractor's expense. Test cores shall be obtained and tested in accordance with ASTM C42. If additional curing does not give the strength required, the Owner reserves the right to require strengthening, replacement of those substandard portions of the structure, or additional testing, at the Contractor's expense.

- b. Upon receipt of the Contractor's written request, substandard concrete work may be reexamined in place by nondestructive testing methods or core Samples, in accordance with ACI 301. The services of an independent testing laboratory shall be retained and all expenses paid without compensation from the Owner. Laboratory results shall be evaluated by the Engineer, who shall make the final decision on acceptability of the concrete in question. Core Sample holes shall be repaired.
 - c. 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.
 - d. 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 C42 or by other methods as directed by Engineer.
- B. The Owner may withhold payment for any section of concrete which does not meet the requirements of the Specifications. Withheld payment shall be based upon the unit prices established for concrete and reinforcing steel. Payment shall be withheld until the unacceptable concrete has been refinished, removed and replaced or otherwise brought into conformance with the Specifications.
- C. PVC/TPER/PE Waterstops: Waterstops shall be observed by the Owner's representative prior to concrete placement. Unacceptable splicing defects include:
- 1. Misalignment of center bulb, ribs, and end bulbs greater than 1/16 inch.
 - 2. Bond failure at joint deeper than 1/16 inch.
 - 3. Misalignment which reduces waterstop cross-section more than 15 percent.
 - 4. Bubble or visible porosity in the weld.
 - 5. Visible signs of splice separation when a cooled splice is bent by hand at a sharp angle.
 - 6. Charred or burnt material.

END OF SECTION

Concrete Mix Design

Project Name: _____
FNI Project Number: _____
Project Location: _____
Owner: _____
General Contractor: _____
Mix Number / Class: _____

A. Mix Design:

Cement = _____ lb/yd³
Fly Ash = _____ lb/yd³
Other Cementitious Material:
_____ = _____ lb/yd³
Fine Aggregate = _____ lb/yd³
Coarse Aggregate = _____ lb/yd³
Water = _____ lb/yd³
Water Reducing Admixture = _____ oz/yd³
High Range Water Reducer = _____ oz/yd³
Air Entraining Admixture = _____ oz/yd³
Other Admixture:
_____ = _____ oz/yd³
Slump = _____ inches
Gross Weight = _____ lb/yd³
Air Content = _____ percent
Water/Cement Ratio = _____

B. Materials:

	Source	ASTM	Type	Remarks
Cement				
Fly Ash				
Other Cementitious Material: _____				
Fine Aggregate				
Coarse Aggregate				
Water				
Water Reducer				
High Range Water Reducer				
Air Entraining				

	Source	ASTM	Type	Remarks
Other Admixture: _____				

C. Determination of Average Strength Required (f_{cr}'):

1. Test Records Available:

A. Summary of Test Records (Provide Supporting Documentation):

Test Group No.	No. of Consecutive Tests	Specified Strength (psi)	Standard Deviation (psi)
Average Standard Deviation:			

B. Standard Deviation Modification Factor (ACI 30 1, Table 4.2.3.3.a): ____.

C. Standard Deviation Used: ____.

D. Average Compressive Strength Required: ____.

2. Test Records Not Available:

A. Average Compressive Strength Required (ACI 30 1, Table 4.2.3.3.b, if required): ____.

D. Documentation of Required Average Compressive Strength (Check One):

1. Field Strength:

a. Field Strength Test Records (ACI 30 1, Table 4.2.3.3.a): _____. *Complete Attachment A.

2. Trial Mixtures:

a. Trial Mixtures (ACI 301, Table 4.2.3.3.b, if required): _____. *Complete Attachment B.

I, _____ certify that the above information is correct and all gradations, cement certifications, and test results are located at our place of business for review by the Engineer.

Name: _____ Date: _____

Title: _____

Company: _____

Address: _____

Attachment A

Documentation of Required Average Strength – Field Strength Records

(ACI 301, 4.2.3.4.a)

A. Summary of Test Records (Provide Supporting Documentation):

Test Record No.	No. of Tests in Record	Duration of Record (days)	Water-Cementitious Materials Ratio	Average Strength (psi)

B. Interpolation used? _____.

1. Provide an interpolation calculation or plot of strength versus proportions.

C. Submit the following data for each mix:

1. Brand, type, and amount of cement.
2. Brand, type, and amount of each admixture.
3. Source of each material used.
4. Amount of water.
5. Proportions of each aggregate material per cubic yard.
6. Gross weight per cubic yard.
7. Measured slump.
8. Measured air content.
9. Results of consecutive strength tests.

END OF ATTACHEMENT A

Attachment B

Documentation of Required Average Strength – Trial Mixtures (ACI 301, 4.2.3.4.b)

A. Summary of Test Record(s):

Trial Mix No.	7-Day Tests		28-Day Tests		Water-Cementitious Materials Ratio	Slump (in)	Air Content (percent)	Temperature (F)
	No. of Test Cylinders	Strength (psi)	No. of Test Cylinders	Strength (psi)				

B. Maximum water-cementitious materials ratio _____.

1. Provide an interpolation calculation or plot of strength versus water-cementitious materials ratio.

C. Submit the following data for each mix:

1. Brand, type, and amount of cement.
2. Brand, type, and amount of each admixture.
3. Amount of water used in trial mixes.
4. Proportions of each aggregate material per cubic yard.
5. Gross weight per cubic yard.
6. Measured slump.
7. Measured air content.
8. Compressive strength developed at 7 days and 28 days, from not less than three test cylinders cast for each 7-day and 28-day test.

END OF ATTACHMENT B

03 30 00 CAST-IN-PLACE CONCRETE

1.00 GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install cast-in-place concrete for structural building frame, slabs on fill or grade, and other concrete components associated with the building; include:
 - 1. Floors and slabs on fill on vapor retarder.
 - 2. Concrete Walls
 - 3. Concrete Footings
 - 4. Floor toppings.

1.2 REFERENCES

- A. ACI 301 - Specifications for Structural Concrete for Buildings.
- B. ACI 305 - Hot Weather Concreting.
- C. ACI 306 - Cold Weather Concreting.
- D. ACI 318 - Building Code Requirements for Reinforced Concrete.
- E. ASTM C33 - Concrete Aggregates.
- F. ASTM C94 - Ready-Mixed Concrete.
- G. ASTM C260 - Air-Entraining Admixtures for Concrete.
- H. ASTM C494 - Chemical Admixtures for Concrete.
- I. ASTM D1751 - Preformed Expansion Joint Filler for Concrete Paving and Construction (Non-extruding and Resilient Structural Bituminous Types).

1.3 SUBMITTALS

- A. Manufacturer's Literature: Submit for review, manufacturer's specifications and installation instructions for each item of proprietary material used, showing compliance with these specifications.
- B. Design Mixes: Submit for review, design with support material and mix design of the test results and manufacturer's data.
- C. Shop drawings for reinforcement detailing fabricating, bending, and placing concrete reinforcement. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures" showing bar schedules, stirrup spacing, bent bar diagrams, and arrangement of concrete reinforcement. Include special reinforcing required for openings through concrete structures. Include all special reinforcement on elevation drawn at a scale of not less than 1/4" to 1'-0".

- D. Placing Schedule: Submit concrete placement plans and schedule; include location and details of construction joints and waterstops.
- E. Certification: Certification that tensile splitting strength meets or exceeds specified requirements for reinforced concrete.
- F. Refer to Sections 03 10 00, 03 20 00, and 03 35 00 for additional submittal requirements.

1.4 QUALITY ASSURANCE

- A. Perform work in accordance with ACI 301 and ACI 318.
- B. Obtain materials from same source throughout the Work.
- C. Quality assurance for all cast-in-place concrete is specified in Section 01 40 00, Concrete Testing and Inspection.

2.00 PRODUCTS

2.1 MIX DESIGN

- A. Employ concrete mix designer familiar with local construction conditions and materials to design concrete mixes. The concrete mix designer shall be different than the technical agency retained by the Owner for quality control testing.
- B. Prior to the formulation of design mixes, the Contractor shall review with the concrete mix designer responsible for their preparation, requirements relative to slump, seasonal variation of admixtures and anticipated job use conditions.
- C. Separate design mixes are required for each anticipated and/or actual change in type of mix materials including admixtures, change in proportion of basic materials, change in slump limits and change in pumped concrete requirements.
- D. Mix designs are to be formulated with ample lead time (6 weeks) to allow testing and verification of the design as hereinafter specified so that mixes can be reviewed by A/E prior to job use.
- E. Mix designs reviewed by A/E are to be in file in the Contractor's field office prior to pouring concrete.
- F. Requirements of Mix Designer:
 - 1. List design mixes required, stating where each applies.
 - 2. Design the concrete mixes subject to the controls specified under Paragraph 2.6, Proportioning, including adjustments for seasonality.
 - 3. Verify the adequacy of the design mix for compressive strength in accordance with ACI 301, Method 1 or Method 2 as hereinafter modified:

- a. Method 1: Compression test cylinders shall be made and tested in accordance with appropriate ASTM procedures to substantiate an average compressive strength as specified in Paragraph 2.6, Proportioning.
 - b. Method 2: Appropriate field test data for concrete made with the same ingredients may be used. Thirty (30) or more consecutive strength test results of mixes with the same materials and proportions used in similar construction and climatic conditions within the past year shall be used to indicate performance in strength shall be as specified in Paragraph 2.6, Proportioning.
- 4. Adjust mix designs that prove unsatisfactory in use, subject to A/E's review. Concrete that does not consistently exhibit the specified control characteristics will be considered unsatisfactory.
- G. Submit for A/E's Review
 - 1. List of mixes.
 - 2. Mix proportions.
 - 3. Proposed adjustments for seasonality.
 - 4. Test results and/or mill certificates showing that the mix proportions and materials comply with the performance characteristics specified.
 - 5. Manufacturer's data, or independent test results if required by A/E, showing that the lightweight concrete complies with the specification regarding shrinkage, split cylinder strength, and modulus of elasticity.

2.2 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150; modified as follows:
 - 1. Alkali content; maximum 0.6 percent or certify that no alkali reactivity is produced with the proposed cement-aggregate combinations (ASTM C227).
 - 2. Type I unless noted.
 - 3. Type II where noted.
 - 4. Type III at Contractor's option to Type I - subject to A/E's review.
- B. Aggregate: ASTM C33 (modified grading) for normal weight concrete and ASTM C 330 for structural light weight concrete. Native stone. Artificial or natural sand. For concrete strengths greater than or equal to 5,000 psi use sharp angular crushed stone.
- C. Mixing Water: Drinkable, tasteless, and odorless.

2.3 FORM MATERIALS

Forms for Exposed Finish Concrete: Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on drawings.

Use overlaid plywood complying with U.S. Product Standard PS-1 "A-C or B-B High Density Overlaid Concrete Form," Class I.

Use plywood complying with U.S. Product Standard PS-1 "B-B (Concrete Form) Plywood," Class I, Exterior Grade or better, mill-oiled and edge-sealed, with each piece bearing legible inspection trademark.

Forms for Unexposed Finish Concrete: Plywood, lumber, metal, or another acceptable material. Provide lumber dressed on at least two edges and one side for tight fit.

Form Release Agent: Provide commercial formulation form release agent with a maximum of 350 mg/l volatile organic compounds (VOCs) that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

Form Ties: Factory-fabricated, adjustable-length, removable or snap-off metal form ties designed to prevent form deflection and to prevent spalling of concrete upon removal. Provide units that will leave no metal closer than 1-1/2 inches to the plane of the exposed concrete surface.

Provide ties that, when removed, will leave holes not larger than 1 inch in diameter in the concrete surface.

2.4 REINFORCING MATERIALS

Reinforcing Bars: ASTM A 615, Grade 60, deformed.

Steel Wire: ASTM A 82, plain, cold-drawn steel.

Welded Wire Fabric: ASTM A 185, welded steel wire fabric.

Supports for Reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire bar-type supports complying with CRSI specifications.

For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.

For exposed-to-view concrete surfaces where legs of supports are in contact with forms, provide supports with legs that are protected by plastic (CRSI, Class 1) or stainless steel (CRSI, Class 2).

2.5 ADMIXTURES

- A. Air-Entraining: ASTM C260.
- B. Water Reducing (Plasticizing): ASTM C494 Type A.
- C. Water Reducing (Retarding): ASTM C494 Type D.
- D. Water Reducing (Accelerating): ASTM C494 Type E.
- E. Calcium Chloride: Strictly prohibited.

2.6 ACCESSORIES

- A. Vapor Retarder: 10-mil thick clear polyethylene film. Type recommended for below grade application.
- B. Grout
 - 1. Bearing Plates: Non-shrink per CRD C588, non-metallic for exposed grout, "Masterflow 713" (Master builders), "Euco N.S." (The Euclid Chemical Co.), "Five Star Grout" (U.S. Grout Corp.) or "Sono Grout" (Sonneborn-Contech.)
 - 2. Structural Repair: As specified.
 - 3. Drypack: Zero slump, cement-sand mix, proportion determined by trial to produce 7000 psi at 28 days.
- B. Joint Filler: Bitumine impregnated fiber type, 1/2-inch thick; ASTM D1751.

2.7 PROPORTIONING

- A. Proportion the materials to produce job-use concrete of the type and strength indicated, subject to the following controls.
- B. Strength and Durability:
 - 1. Structural Concrete:
 - a. Water reducing (plasticizer) admixture required.
 - b. Trial Mix: Average compressive strength shall be determined by ACI 301, Method 1 with a minimum of 1200 psi greater than the specified f'c or by Method 2 where the average strength exceeds the specified strength f'c by at least:
 - 1. 400 psi if standard deviation is less than 300 psi.
 - 2. 550 psi if standard deviation is less than 300 psi to 400 psi.
 - 3. 770 psi if standard deviation is less than 400 psi to 500 psi.
 - 4. 900 psi if standard deviation is less than 500 psi to 600 psi.
 - 5. 1,200 psi if standard deviation is greater than 600 psi.
 - c. Minimum Cement Content (Portland Cement plus Fly Ash)
 - 1. 3,000 psi Concrete - 5 bags/cubic yard.
 - 2. 3,500 psi Concrete - 5½ bags/cubic yard.
 - 3. 4,000 psi Concrete - 6 bags/cubic yard.
 - d. For pumped concrete, increase minimum cement content as required to maintain equivalent water/cement ratios to those required for all strengths of non-pumped concrete.
 - 2. Exterior Exposed Concrete:
 - a. Air entrainment and water reducing admixtures as required.
 - b. Minimum cement - 5 1/2 bag/cubic yard.
 - c. Maximum water - 5 1/2 gallon bag.
- C. Aggregates
 - 1. ASTM C33.
 - 2. Maximum Size 467 for general use.
 - a. Size 57 for columns, beams, and slabs.
 - b. Size 7 or Size 67 for tight pours.

- c. Minimum 15 percent passing No. 50 sieve.
 - d. Minimum 3 percent passing No. 10 sieve.
 - e. Fineness Modulus, Sand: Minimum 2.5, maximum 3.
- D. Consistency: Plastic and workable with cohesiveness sufficient to prevent segregation with maximum slump as hereinafter specified.
- E. Admixtures:
 - 1. Water Reducing (Plasticizing): Follow the manufacturer's recommendations.
 - 2. Air entraining: Limit air content as follows:
 - a. Exposed normal weight concrete - minimum 4 percent, maximum 7 percent.
 - b. Lightweight concrete - minimum 4 percent, maximum 6 percent.
 - 3. Accelerators: Only as accepted by A/E.
 - 4. Retarders: Only as accepted by A/E.
 - 5. Splitting Tensile Strength (fct): Minimum as follows for given strength (f'c):
 - a. 3,000 psi, fct = 370 psi.
 - b. 4,000 psi, fct = 425 psi.
 - 6. Modulus of Elasticity: Minimum E = 2,400,000 psi (secant modulus at 0.3 f'c).
 - 7. Drying Shrinkage: Maximum .06 percent at age 1 year or .035 percent at 28 days ASTM.
 - 8. Natural Sand: (ASTM C33) is to be substituted for lightweight fines.
- F. Apply one of the following Curing Compounds to the concrete foundation and floor slabs per the manufacturer's specifications and installation requirements. Any substitution shall meet ASTM C 309 and shall be confirmed by the structural engineer.
 - 1. W.R. Grace Sealtight 1100
- G. Pumped Concrete:
 - 1. Aggregates:
 - a. Maximum Size: One-third the maximum opening in either the pump or the pipeline, whichever is smaller.
 - b. Grading: As close as possible to the middle of the ASTM C33 or C330 grading range.
 - c. Fine Aggregate Fineness Modulus (FM): 2.40 to 3.00 with 15 to 20 percent passing the No. 50 sieve and 5 to 10 percent passing the No. 200 sieve.
 - d. Daily Variation in FM: 0.20 from the value used in selecting proportions.
 - 2. Admixtures
 - a. Air Content: Minimum 3 percent, maximum 5 percent.
 - b. Pumping Aids: As required to produce a pumpable mix with sufficient strength.
 - c. Accelerators: Not to be used with pumped concrete.

2.8 MIXING CONCRETE

- A. Site Mixed Concrete: Mix concrete by a mechanical batch type mixing plant with adequate facilities for accurate measurement and control of each material entering mixer and for changing proportions to conform to varying conditions of work. Provide for adequate inspection at all times. Obtain approval for plant and its location.
 - 1. Batching Unit: Provide with the following:
 - a. Weighing Unit: For each type material to show scale load at convenient stages of weighing operation. When directed, check weighing units in A/E's presence; when required, adjust before further use.
 - b. Water Mechanism: Tight, with valves interlocked so that discharge valves cannot be opened before filling valve is fully closed; fit with graduated gauge.
 - 2. Mixing Unit
 - a. Mixing Speed: Do not charge mixers over rated capacity or operate above rated speed. Excessive mixing, requiring addition of water to preserve required consistency is not permitted. Discharge entire batch before recharging.
 - b. Mixing Time: Measure from instant water is introduced into drum containing solids. Introduce all mixing water before one-fourth of mixing time has elapsed; mixing time 1 1/2 minutes or until mass is uniform and homogeneous. Capacity of mixer to be such that it will handle one or more full sack batches.
- B. Ready Mixed Concrete: ASTM C94 Alternative No. 1 for controlled mixes.
- C. Concrete will be considered unacceptable if it undergoes initial set or if not deposited within 90 minutes of the time the water is introduced.
- D. Adding water to unworkable concrete at delivery end is not permitted unless:
 - 1. A/E accepts procedure and observes additions of water.
 - 2. Workability without exceeding maximum slump can be attained with the site-addition of not more than 1 gallon/cubic yard of concrete mixed for 30 seconds/cubic yard.
- E. Admixtures introduced at the site are to be added separately, in solution form, and with additional mixing time at the rate of 30 seconds/cubic yard or a minimum of 1 1/2 minutes.
- F. Slump
 - 1. 4 inches plus or minus 1 inch for normal weight at point of deposit.
 - 2. 4 inches plus or minus 1 inch for normal weight pumped concrete at the point of deposit, 5 inch maximum at the pump.

3.00 EXECUTION

3.1 EXAMINATION

- A. Verify anchors, seats, plates, reinforcement, and other items to be cast into concrete are accurately placed, held securely, and will not cause hardship in placing concrete.

3.2 PREPARATION

- A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent. Apply bonding agent in accordance with manufacturer's instructions.
- B. At locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels, and pack solid with non-shrink grout.
- C. Install vapor retarder under interior slabs on fill. Lap joints minimum 6 inches and seal. Do not disturb or damage vapor retarder while placing concrete. Repair damaged vapor retarder.

3.3 FORMS

General: Design, erect, support, brace, and maintain formwork to support vertical, lateral, static, and dynamic loads that might be applied until concrete structure can support such loads. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position. Maintain formwork construction tolerances and surface irregularities complying with the following ACI 347 limits:

Provide Class A tolerances for concrete surfaces exposed to view.

Provide Class C tolerances for other concrete surfaces.

Design forms and falsework to include assumed values of live load, dead load, weight of moving equipment operated on formwork, concrete mix, height of concrete drop, vibrator frequency, ambient temperature, foundation pressures, stresses, lateral stability, and other factors pertinent to safety of the structure during construction.

Construction loads, including reshoring loads, on in-place construction shall at no time exceed the live load for which the in-place construction was designed. If the contractor is uncertain about the design live loads, it shall be his responsibility to obtain these from the Architect/Engineer.

Construct forms to sizes, shapes, lines, and dimensions shown and to obtain accurate alignment, location, grades, level, and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in the Work. Use selected materials to obtain required finishes. Solidly butt joints and provide backup at joints to prevent cement paste from leaking.

Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, recesses, and the like for easy removal.

Provide temporary openings for clean-outs and inspections where interior area of formwork is inaccessible before and during concrete placement. Securely brace temporary openings and set tightly to forms to prevent losing concrete mortar. Locate temporary openings in forms at inconspicuous locations.

Chamfer exposed corners and edges as indicated, using wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

Forms for Exposed Concrete: Drill forms to suit ties used and to prevent leakage of concrete mortar around tie holes. Do not splinter forms by driving ties through improperly prepared holes.

Do not use metal cover plates for patching holes or defects in forms.

Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.

Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before placing concrete. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

3.4 PLACING REINFORCEMENT

General: Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars," for details and methods of reinforcement placement and supports and as specified.

Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that reduce or destroy bond with concrete.

Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as approved by Architect.

Provide sufficient numbers of supports and of strength to carry the reinforcement. Do not place reinforcing bars more than 2 inches beyond the last leg of any continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.

Place reinforcement to maintain minimum coverages as indicated for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

Space reinforcing bars to comply with ACI 318-83, Section 7.6. Reinforcing bars may be relocated as necessary to avoid interference with other reinforcement, conduit, or other embedded items. However, if any reinforcing bar is moved a distance exceeding one bar diameter or the specified placing tolerance, the resulting rearrangement of the reinforcement will be subject to acceptance by the Architect/Engineer.

Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least two full mesh and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.5 JOINTS

Construction Joints: Locate and install construction joints so they do not impair strength or appearance of the structure, as acceptable to Architect/Engineer.

Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints except as indicated otherwise. Do not continue reinforcement through sides of strip placements.

Use bonding agent on existing concrete surfaces that will be joined with fresh concrete.

Waterstops: Provide waterstops in construction joints as indicated. Install waterstops to form continuous diaphragm in each joint. Support and protect exposed waterstops during progress of Work. Field-fabricate joints in waterstops according to manufacturer's printed instructions.

3.6 INSTALLING EMBEDDED ITEMS

General: Set and build into formwork anchorage devices and other embedded items required for other work that is attached to or supported by cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached.

Anchor bolts shall be set with securely fastened templates, and the threaded area shall be protected from concrete laitance.

Where conduit, pipe, or other items are to be embedded in concrete beams, slabs, or columns, they shall be placed not closer than the diameter of the largest of the adjacent items and with a net reduction in the concrete area (of a 12 inch wide strip in slabs) not in excess of 9% without prior approval of the Engineer. The location of such embedded items shall generally be at the middle or centroid of the member.

Forms for Slabs: Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and contours in finished surfaces. Provide and secure units to support screed strips using strike-off templates or compacting-type screeds.

3.7 PREPARING FORM SURFACES

General: Coat contact surfaces of forms with an approved, nonresidual, low-VOC, form-coating compound before placing reinforcement.

Do not allow excess form-coating material to accumulate in forms or come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply according to manufacturer's instructions.

Coat steel forms with a nonstaining, rust-preventative material. Rust-stained steel formwork is not acceptable.

3.8 PLACING CONCRETE

- A. Notify A/E minimum 24 hours prior to commencement of concreting operations.
- B. Place concrete in accordance with ACI 301.
- C. Wet all exposed subgrade, masonry filler units, precast concrete, previously poured concrete, and uncoated wood forms immediately prior to pouring (except during freezing temperatures).
- D. Do not pour concrete in freestanding water, over ice, or on frozen sub-grade.
- E. 24 hours time must elapse between adjacent slab pours.
- F. Deposit concrete within 5 feet of its final position in uniform layers not exceeding 18 inches deep with no more than 30 minutes time lapse between layers.
- G. Consolidate the concrete to maximum density using internal vibration (use external vibration only as a supplement). Work the concrete around and under reinforcing and into corners.
- H. Mechanical Vibrators: Minimum frequency - 7,000 rpm. Insert and withdraw vertically drawing out entrapped air and excess water.
- I. Ensure reinforcement, inserts, embedded parts, formed joints are not disturbed during concrete pavement.
- J. Maintain concrete cover around reinforcing as follows:

Item	Coverage (inches)
Footings and Concrete Formed Against Earth	3
Slabs on Fill	2

- K. Place concrete continuously between predetermined construction and control joints. Do not break or interrupt successive pours such that cold joints occur.
- L. Place floor slabs on fill in lanes indicated on Drawings.
- M. Construction Joints: Locate construction joints as detailed or to limit the size of pour units as follows: Slabs-On-Ground: Maximum 20,000 square feet.
- N. Saw cut control joints at an optimum time after finishing. Use 3/16 inch thick blade, cutting one-third into depth of slab thickness.
- O. Separate exterior slabs on fill from vertical surfaces with joint filler. Extend joint filler from bottom of slab to within 1/8 inch of finished slab surface.
- P. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify A/E upon discovery.

3.9 FINISHING

Rough-Formed Finish: Provide a rough-formed finish on formed concrete surfaces not exposed to view in the finished Work or concealed by other construction. This is the concrete surface having texture imparted by form-facing material used, with tie holes and defective areas repaired and patched, and fins and other projections exceeding 1/4 inch in height rubbed down or chipped off.

Smooth-Formed Finish: Provide a smooth-formed finish on formed concrete surfaces exposed to view or to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, painting, or another similar system. This is an as-cast concrete surface obtained with selected form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch defective areas with fins and other projections completely removed and smoothed.

Smooth-Rubbed Finish: Provide smooth-rubbed finish on scheduled concrete surfaces that have received smooth-formed finish treatment not later than 1 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.

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.

MONOLITHIC SLAB FINISHES

Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as specified; slab surfaces to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand-bed terrazzo; and where indicated.

After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating, using float blades or float shoes only, when surface water has disappeared, or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats or by hand-floating if area is small or inaccessible to power units. Finish surfaces to tolerances of F(F) 18 (floor flatness) and F(L) 15 (floor levelness) measured according to ASTM E 1155. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.

Trowel Finish: Apply a trowel finish to monolithic slab surfaces exposed to view and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or another thin film-finish coating system.

After floating, begin first trowel-finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface.

Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and finish surfaces to tolerances of F(F) 20 (floor flatness) and F(L) 17 (floor levelness) measured according to ASTM E 1155 and not exceeding 1/8 inch in 10 feet when tested with a 10 foot straight edge. Grind smooth any surface defects that would telegraph through applied floor covering system.

Trowel and Fine Broom Finish: Where ceramic or quarry tile is to be installed with thin-set mortar, apply a trowel finish as specified, then immediately follow by slightly scarifying the surface with a fine broom.

Nonslip Broom Finish: Apply a nonslip broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.

Immediately after float finishing, slightly roughen concrete surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect/Engineer before application.

Chemical-Hardener Finish: On concrete floors which remain exposed and as directed apply chemical-hardener finish to interior concrete floors. Apply liquid chemical-hardener after complete curing and drying of the concrete surface. Dilute liquid hardener with water (parts of hardener/water as follows), and apply in 3 coats; first coat, 1/3-strength; second coat, 1/2-strength; third coat, 2/3-strength. Evenly apply each coat, and allow 24 hours for drying between coats.

Apply proprietary chemical hardeners, in accordance with manufacturer's printed instructions.

After final coat of chemical-hardener solution is applied and dried, remove surplus hardener by scrubbing and mopping with water.

3.10 PATCHING

- A. Notify A/E immediately upon removal of forms.
- B. Patch imperfections.

3.11 DEFECTIVE CONCRETE

- A. Concrete that does not satisfy the performance requirements of this specification is to be removed and replaced if repair cannot be accomplished to A/E's satisfaction.
- B. Structural Repair: The long term strength, elasticity, and continuity characteristics of the entire structural element and/or frame must be accounted for if repair is attempted.
 - 1. Use expansive cements, and epoxy type bonding agents to produce repair materials with strength, elasticity, and durability characteristics compatible with the parent material being repaired.
 - 2. Submit a procedural outline of proposed repair work including a description of materials, preparations, shoring, and protection for A/E's review.
 - 3. A/E will review repair procedures before they are attempted.

3.12 FIELD QUALITY CONTROL

- A. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

3.13 PROTECTION

- A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

3.14 COLD WEATHER PROTECTION

- A. ACI 306; the methods of protection used for cold weather concreting are to be reviewed with A/E. Sufficient protection material is to be on the job site in advance of the time when mean daily temperatures are expected to drop below 40 degrees F. Provide strong and secure weather protection around the building for at least one story above and one story below the floor being concreted to prevent infiltration of wind. Submit to A/E for review details and materials of the temperatures in the range between 50 degrees F and:
 - 1. Heated Concrete Temperature:
 - a. Maximum 100 degrees F in mixer.
 - b. Maximum 90 degrees F leaving mixer.
 - 2. Accelerators:
 - a. Review with A/E.
 - b. Calcium Chloride: Shall not be used.
 - 3. Concrete made with hydrothermally or vacuum-saturated lightweight aggregate shall be allowed to air dry for two weeks after the initial curing period. During the initial curing period, as well as the drying period, the concrete temperature shall be maintained above 50 degrees F.

3.15 HOT WEATHER PROTECTION

- A. ACI 305; when air temperature or form temperature exceeds 100 degrees F control concreting as follows:
 - 1. Cool forms to a maximum 80 degrees F.
 - 2. Cool concrete to a maximum 70 degrees F leaving the mixer.
 - 3. 50 lbs. ice = 6 gallons mixing water (maximum per cubic yard).
 - 4. Adjust concrete mix to retard set with retarding admixture or Type II cement.

3.16 CURING

- G. Retain moisture and maintain reasonably constant temperature in freshly poured concrete for the duration of the curing period.
- H. Curing Period Duration: Starting at time of deposit: Concrete with Type I Cement, five days.

- I. Concrete Surface Curing Temperature
 - 1. Minimum 50 degrees F, maximum 90 degrees F.
 - 2. Rate of Change: Maximum plus or minus 5 degrees F per hour.
- J. Apply Curing and Sealing Compound to the concrete foundation and floor slabs per the manufacturer's specifications and installation requirements, except for at areas to receive moveable carpet squares.
- K. Moisture Retention: By any of the following, except as otherwise specified.
 - 1. Moist Cure: Roll-out waterproof covering (equivalent to ASTM C171) or use burlap, frequently wetted (except during freezing temperatures).
 - 2. Chemical Curing Agents: Curing compound conforming to FS IT-C-800A, 30 percent solids minimum and/or ASTM C309.

3.17 QUALITY CONTROL TESTING DURING CONSTRUCTION

- A. Sampling: ASTM C 172, except modified for slump to comply with ASTM C 94.
 - 1. Slump: ASTM C 143. One test at point of discharge for each day's pour of each type of concrete, and additional tests if concrete consistency changes.
 - 2. Air content: ASTM C 173 or ASTM C 231 for normal weight concrete. One test for each day's pour of each type of air-entrained concrete.
 - 3. Air content: One test for each day's pour of each type of air-entrained concrete.
 - 4. Concrete temperature:
 - a. Test hourly when air temperature is 90 degrees F or above.
 - b. Test each time a set of compression test specimens are made.
 - 5. Compression test specimen: ASTM C 31. One set of four standard cylinders for each compressive strength test.
- B. Compressive Strength Tests: ASTM C 39. One set for each day's pour of each concrete class exceeding 5 cubic yards.
 - 1. Test one additional set of cylinders for each 75 cubic yards over and above the first 25 cubic yards of each class of concrete placed in any one day.
 - 2. Test one specimen at 7 days, two at 28 days, and retain one from each set for later testing, if required.
 - 3. When frequency of testing would otherwise provide fewer than 5 strength tests for a given class of concrete, conduct testing from at least 5 randomly selected batches, or from each batch if fewer than 5 are used.
 - 4. When strength of field-cured specimens is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.
 - 5. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength, and no individual strength test result fails below specified compressive strength by more than 500 psi.
- C. Test Results: Laboratory shall report test results in writing to A/E and contractor within 24 hours of test.

1. Compressive strength test reports shall contain the minimum following data:
 - a. Project identification name and number.
 - b. Name of concrete testing service.
 - c. Date of concrete placement.
 - d. Concrete type and class.
 - e. Location of concrete batch in structure.
 - f. Design compressive strength at 28 days.
 - g. Concrete mix proportions and materials.
 - h. Compressive breaking strength and type of break for both 7-days tests and 28-day tests.
2. Nondestructive testing: Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.
3. Additional tests: The testing service shall make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by A/E.
 - a. Testing service may conduct tests of cored cylinders, complying with ASTM C 42, or by other methods as directed.
 - b. Cost of additional testing shall be borne by the contractor when unacceptable concrete has been verified.

END OF SECTION

04 10 00-A MORTAR AND MASONRY GROUT

1.00 GENERAL

0.01 SECTION INCLUDES

- A. Mortar and grout for masonry.

0.02 SUBMITTALS

- A. Include design mix, indicate the Proportion or Property specification of ASTM C270 used, required environmental conditions, and admixture limitations.
- B. Samples: Submit two samples of mortar, illustrating mortar color and color range.
- C. Reports for Information:
 - 1. Submit reports on mortar indicating conformance of mortar to property requirements of ASTM C270 and test and evaluation reports to ASTM C780.
 - 2. Submit reports on grout indicating conformance of component grout materials to requirements of ASTM C476 and test and evaluation reports to ASTM C1019.
- D. Manufacturer's Certificate for Information: Certify that products meet or exceed specified requirements.

0.03 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 530 and ACI 530.1.

0.04 DELIVERY, STORAGE, AND HANDLING

- A. Maintain packaged materials clean, dry, and protected against dampness, freezing, and foreign matter.

0.05 ENVIRONMENTAL REQUIREMENTS

- A. Maintain materials and surrounding air temperature to minimum 45 degrees F prior to, during, and 48 hours after completion of masonry work.
- B. Maintain materials and surrounding air temperature to maximum 90 degrees F prior to, during, and 48 hours after completion of masonry work.

2.00 PRODUCTS

0.06 MATERIALS

- C. Portland Cement: ASTM C150, Type I, gray color.
- D. Mortar Aggregate: ASTM C144, standard masonry type.
- E. Hydrated Lime: ASTM C207, Type S.
- F. Grout Course Aggregate: ASTM C404.
- G. Grouts Fine Aggregate: Sand.
- H. Water: Clean and potable.

0.07 MORTAR MIXES

- A. Mortar for Non-Load Bearing Walls and Partitions: ASTM C270, Type M or S using the Property specification.
- B. Mortar for Engineered Masonry: ATM C270 Type M or S using the property specification.

0.08 MORTAR MIXING

- A. Thoroughly mix mortar ingredients in accordance with ASTM C270 in quantities needed for immediate use.
- B. Maintain sand uniformly damp immediately before the mixing process.
- C. Do not use anti-freeze compounds to lower the freezing point of mortar.
- D. If water is lost by evaporation, re-temper only within two hours of mixing.
- E. Use mortar within two hours after mixing at temperatures of 90 degrees F, or two-and-one-half hours at temperatures under 45 degrees F.

0.09 GROUT MIXES

- A. Bond Beams, Lintels and Engineered Masonry: 3,000 psi strength at 28 days; 8-10 inches slump; mixed in accordance with ASTM C476 Fine and course grout.

0.010 GROUT MIXING

- A. Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C476 Fine grout.
- B. Do not use anti-freeze compounds to lower the freezing point of grout.

0.011 MIX TESTS

- A. Testing of Mortar Mix: In accordance with ASTM C270.
- B. Testing of Grout Mix: In accordance with ASTM C1019 for compressive strength, and slump.

3.00 EXECUTION

0.012 EXAMINATION

- C. Request inspection of spaces to be grouted.

0.013 PREPARATION

- A. Plug clean-out holes with concrete masonry units. Brace masonry for wet grout pressure.

0.014 INSTALLATION

- A. Install mortar in accordance with ASTM C270. Install grout in accordance with ASTM C476.
- B. Work grout into masonry and cavities to eliminate voids.
- C. Do not install grout in lifts greater than 16 inches without consolidating grout by rodding.
- D. Remove excess mortar from grout spaces.

0.015 FIELD QUALITY CONTROL

- A. Test and evaluate mortar in accordance with ASTM C780.
- B. Test and evaluate grout in accordance with ASTM C1019.

0.016 SCHEDULES

- A. Stone Veneer, at Concrete Haunches and retaining walls:
 - 1. Type S mortar, recessed joints (dry-stack look)

2. White, Dark grey and buff color options to be selected by Architect.

END OF SECTION

04 22 00 CONCRETE UNIT MASONRY

1.00 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Concrete masonry units
 - 2. Mortar and grout.
 - 3. Reinforcing steel.
 - 4. Miscellaneous masonry accessories.

1.2 DEFINITIONS

- A. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For the following:
 - 1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
- C. Samples for Verification: For each type and color of the following:
 - 1. Accessories embedded in masonry.

1.4 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each type and size of the following:
 - 1. Masonry units.
 - a. Include data on material properties.
 - 2. Cementitious materials. Include brand, type, and name of manufacturer.
 - 3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
 - 4. Grout mixes. Include description of type and proportions of ingredients.
 - 5. Metal accessories.
- B. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.5 QUALITY ASSURANCE

- A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.
- C. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.
- D. Preconstruction Testing Service: Engage a qualified independent testing agency to perform the following preconstruction testing:
 - 1. Concrete Masonry Unit Test: For each concrete masonry unit indicated, per ASTM C 140.

2. Prism Test: For each type of wall construction indicated, per ASTM C 1314.
3. Mortar Test: For mortar properties per ASTM C 270.
4. Grout Test: For compressive strength per ASTM C 1019.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.7 PROJECT CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
 1. Extend cover a minimum of 24 inches (600 mm) down both sides of walls and hold cover securely in place.
- B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 2. Protect sills, ledges, and projections from mortar droppings.
 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.

2.2 CONCRETE MASONRY UNITS

- A. Integral Water Repellent: Provide units made with integral water repellent for exposed units.
 - 1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested according to ASTM E 514 as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive, with test period extended to 24 hours, shall show no visible water or leaks on the back of test specimen.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) ACM Chemistries, Inc.; RainBloc.
 - 2) BASF Aktiengesellschaft; Rheopel Plus.
 - 3) Grace Construction Products, W. R. Grace & Co. - Conn.; Dry-Block.
- B. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
 - 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
 - 2. Provide square-edged units for outside corners unless otherwise indicated.
- C. CMUs: ASTM C 90.
 - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2000 psi.
 - 2. Density Classification: Normal weight.
 - 3. Size (Width): Manufactured to the following dimensions:
 - a. 6 inches (152 mm) nominal; 5-5/8 inches (143 mm) actual.
 - b. 8 inches (200 mm) nominal; 7-5/8 inches (194 mm) actual.
 - c. 12 inches (300 mm) nominal; 11-1/4 inches (281 mm) actual.
 - 4. Exposed Faces: Manufacturer's standard color and texture, unless otherwise indicated.
 - a. Where units are to receive a direct application of plaster, provide textured-face units made with gap-graded aggregates.
 - b. Where units are to be left exposed, provide color and texture matching the range represented by Architect's sample.

2.3 MORTAR MATERIALS

- A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- B. Hydrated Lime: ASTM C 207, Type S.

- C. Portland Cement-Lime Mix: Packaged blend of portland cement complying with ASTM C 150, Type I or Type III, and hydrated lime complying with ASTM C 207.
 - 1. Utilize factory preblended mortar and grout mixes from manufacturers capable of providing computer controlled products including batch information relating to the approximate weights of each individual raw material utilized in the mixtures. Use of field prepared mortar and grout mixes that incorporate damp loose aggregate is prohibited.
 - 2. Basis of Design Products: SPEC MIX® Materials as manufactured by Texas Industries (TXI), Dallas, TX.
 - D. Aggregate for Mortar: ASTM C 144.
 - 1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
 - 2. For joints less than 1/4 inch (6 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.
 - 3. White-Mortar Aggregates: Natural white sand or crushed white stone.
 - E. Aggregate for Grout: ASTM C 404.
 - F. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Euclid Chemical Company (The); Accelguard 80.
 - b. Grace Construction Products, W. R. Grace & Co. - Conn.; Morset.
 - c. Sonneborn Products, BASF Aktiengesellschaft; Trimix-NCA.
 - G. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with concrete masonry units, containing integral water repellent by same manufacturer.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ACM Chemistries, Inc.; RainBloc for Mortar.
 - b. BASF Aktiengesellschaft; Rheopel Mortar Admixture.
 - c. Grace Construction Products, W. R. Grace & Co. - Conn.; Dry-Block Mortar Admixture.
 - H. Water: Potable.
- 2.4 REINFORCEMENT
- A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60 (Grade 420).
 - B. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.
 - 1. Exterior Walls: Hot-dip galvanized, carbon steel.
 - 2. Wire Size for Side Rods: 0.148-inch (3.77-mm) diameter.
 - 3. Wire Size for Cross Rods: 0.148-inch (3.77-mm) diameter.
 - 4. Wire Size for Veneer Ties: 0.148-inch (3.77-mm) diameter.
 - 5. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches (407 mm) o.c.
 - 6. Provide in lengths of not less than 10 feet (3 m), with prefabricated corner and tee units.
 - C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.

2.5 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene or urethane.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 or PVC, complying with ASTM D 2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).
- D. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and hold reinforcing bars in center of cells. Units are formed from 0.148-inch (3.77-mm) steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dayton Superior Corporation, Dur-O-Wal Division; D/A 810, D/A 812 or D/A 817.
 - b. Heckmann Building Products Inc.; No. 376 Rebar Positioner.
 - c. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
 - d. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.

2.6 MASONRY CLEANERS

- A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Diedrich Technologies, Inc.
 - b. EaCo Chem, Inc.
 - c. ProSoCo, Inc.

2.7 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
 - 1. Do not use calcium chloride in mortar or grout.
 - 2. Add cold-weather admixture (if used) at the same rate for all mortar, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in the form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification.
 - 1. Extended-Life Mortar for Unit Masonry: Mortar complying with ASTM C 1142 may be used instead of mortar specified above, at Contractor's option.
 - 2. Limit cementitious materials in mortar for exterior and reinforced masonry to portland cement and lime.

3. For masonry below grade, in contact with earth, and where indicated, use Type M.
 4. For reinforced masonry and where indicated, use Type S.
 5. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type S.
- D. Grout for Unit Masonry: Comply with ASTM C 476.
1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 5 of ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
 2. Provide grout with a slump of 8 to 11 inches (200 to 280 mm) as measured according to ASTM C 143.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
1. Verify that foundations are within tolerances specified.
 2. Verify that reinforcing dowels are properly placed.
 3. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.
- B. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- C. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
1. Mix units from several pallets or cubes as they are placed.

3.3 TOLERANCES

- A. Dimensions and Locations of Elements:
1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch (12 mm) or minus 1/4 inch (6 mm).
 2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch (12 mm).
 3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch (6 mm) in a story height or 1/2 inch (12 mm) total.
- B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2 inch (12 mm) maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2 inch (12 mm) maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2 inch (12 mm) maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2 inch (12 mm) maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch (1.5 mm) except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm); do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm).
2. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm).
3. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch (1.5 mm) from one masonry unit to the next.

3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond to match existing; do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.
- C. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- E. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

- F. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.
- G. Fill cores in hollow CMUs with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

3.5 MORTAR BEDDING AND JOINTING

- A. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- B. Set trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.
 - 1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
 - 2. Allow cleaned surfaces to dry before setting.
 - 3. Wet joint surfaces thoroughly before applying mortar.
- C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.6 MASONRY JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).
 - 1. Space reinforcement not more than 16 inches (406 mm) o.c.
 - 2. Space reinforcement not more than 16 inches (203 mm) o.c. in foundation walls.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.
- E. Cut and bend reinforcing units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.7 CONTROL AND EXPANSION JOINTS

- A. General: Install control and expansion joint materials in unit masonry where indicated and not to exceed 20-feet on center and 10-feet from corners. Build-in related items as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry using one of the following methods:
 - 1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
 - 2. Install preformed control-joint gaskets designed to fit standard sash block.

3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.

3.8 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
 1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
 1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
 2. Limit height of vertical grout pours to not more than 60 inches (1520 mm).

3.9 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.
- B. Inspections: Level 1 special inspections according to the "International Building Code."
 1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
- C. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.
- D. Grout will be sampled and tested for compressive strength per ASTM C 1019.
- E. Concrete Masonry Unit Tests: For each type of concrete masonry unit indicated, units will be tested according to ASTM C 140.
- F. Prism-Test Method: For each type of wall construction indicated, masonry prisms will be tested per ASTM C 1314, and as follows:
 1. Prepare 1 set of prisms for testing at 7 days and 1 set for testing at 28 days.

3.10 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 - 3. Protect adjacent nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
 - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
 - 5. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

3.11 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

END OF SECTION

04 80 00-A MASONRY ASSEMBLIES

1.00 GENERAL

1.01 SUMMARY

- A. Provide unit masonry construction:

1. Veneer Stone.

1.02 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Samples: Submit two representative samples of each material specified indicating visual characteristics and finish. Include range of samples if variation of finish is anticipated. Samples to provide include alternate rock blends as requested by the Architect.

1.03 QUALITY ASSURANCE

- A. Mock-Ups: Provide 4'-0" wide x 4'-0" high mock-up to demonstrate quality of workmanship.
- B. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

2.00 PRODUCTS

2.01 MATERIALS

- A. Veneer Stone

1. Product: Natural Stone
2. Provider: Minick Materials, or approved equal
 - a. Minick Materials, Contact: Hunter Bohannon, phone: 405-301-0025, hbohannon@minickmaterials.com
3. Color: Moss Rock
4. Size and Shape: Material shall be machine split four edges, 4 inch depth +/- 1/2 inch, full dimensional with random widths and lengths. The bedface is to be exposed.
 - a. 20% of area to be Moss Rock Squared – larger stones
 - b. 80% of area to be Moss Rock – smaller stones
5. Pattern: Dry stack look with tight, recessed mortar joints.
6. Material shall conform to ASTM C 568 with the following properties:
 - a. Maximum absorption rate of 3 percent when tested in accordance with ASTM C97.
 - b. Minimum density of 2560 kg/m³ when tested in accordance with ASTM C97.
 - c. Minimum compressive strength of 55 Mpa when tested in accordance with ASTM C170.
 - d. Minimum flexural strength of 8.27 Mpa when tested in accordance with ASTM C880.

B. Reinforcing Steel:

1. Reinforcing Bars: ASTM A 615, Grade 60
2. Sizes: as indicated on the drawings

C. Ties and Anchors:

1. DA 990 - Corrugated Wall Ties (where concrete and stone have 3/8" mortared gap)
 - a. Hot galv./mill galv./stainless steel
 - b. Standard 7/8 inch width and 6-3/4 inch length.

D. Masonry Accessories:

1. Thru Wall Flashing: Fiberweb 300 reinforced mylar with 2" fiberweb joint tape.
2. Preformed control joint gaskets.
3. Bond breaker strips.
4. Open head-joint weeps.

3.00 EXECUTION

3.01 INSTALLATION

A. Installation of Masonry Assemblies:

1. Comply with PCA Recommended Practices for Laying Concrete Block and NCMA TEK Bulletins.
2. Sawcut units when required. Maintain uniform joint width. Provide full bed, head and collar joints except at weepholes.
3. Space wall ties @ 16" o.c. vertically and 24" o.c. horizontally.
4. Provide weeps @ max. 32" o.c. where there is a wall cavity.
5. Coordinate installation of flashings.
6. Provide expansion and control joints in accordance with NCMA recommendations and as shown on the drawings.
7. Remove and replace damaged units.
8. Clean concrete masonry with detergent masonry cleaner, Sure Klean 600 or approved equal.
9. Apply water repellent in accordance with manufacturer's written instructions.

END OF SECTION

05 12 00 STRUCTURAL STEEL FRAMING

1.00 General

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Structural steel.
 - 2. Prefabricated building columns.
 - 3. Grout.
- B. Related Sections:
 - 1. Section 01 40 00 "Quality Requirements" for independent testing agency procedures and administrative requirements.

1.3 REFERENCES

- A. American Society of Testing and Materials (ASTM)
- B. AISC - Code of Standard Practice - Manual of Steel Construction - Allowable Stress Design (ASD).
- C. American Welding Society (AWS)
 - D1.1 Structural Welding Code - Steel

1.4 DEFINITIONS

- A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.5 PERFORMANCE REQUIREMENTS

- A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator to withstand loads indicated and comply with other information and restrictions indicated.
 - 1. Select and complete connections using structural details indicated and AISC 360.
 - 2. Design connections not detailed on Drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State of the project.
- B. Moment Connections: Type FR, fully restrained.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

- B. Shop Drawings: Show fabrication of structural-steel components.
 - 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 - 2. Include embedment drawings.
 - 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
 - 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
 - 5. Identify demand critical welds.
- C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for each welded joint whether prequalified or qualified by testing, including the following:
 - 1. Power source (constant current or constant voltage).
 - 2. Electrode manufacturer and trade name, for demand critical welds.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer, fabricator, professional engineer, and testing agency.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- D. Mill test reports for structural steel, including chemical and physical properties.
- E. Product Test Reports: For the following:
 - 1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 - 2. Direct-tension indicators.
 - 3. Tension-control, high-strength bolt-nut-washer assemblies.
 - 4. Shear stud connectors.
 - 5. Shop primers.
 - 6. Nonshrink grout.
- F. Source quality-control reports.

1.8 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.
- B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category ACSE.
- C. Codes and Standards: Comply with provisions of the following, except as otherwise indicated:
 - 1. AISC "Code of Standard Practice for Steel Buildings and Bridges" with paragraph 4.2.1 modified by deletion of the following sentence:
This approval constitutes the owner's acceptance of all responsibility for the design adequacy of any detail configuration of connections developed by the fabricator as a part of his preparation of these shop drawings."

2. AISC "Specifications for Structural Steel Buildings" including the "Commentary", later referred to as "AISC Specifications".
 3. "Specifications for Structural Joints using ASTM A325 or A490 Bolts" approved by the Research Council on Structural Connections.
 4. AWS D1.1
 5. ASTM A6
- D. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."
- E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.
- F. Comply with applicable provisions of the following specifications and documents:
1. AISC 303.
 2. AISC 341 and AISC 341s1.
 3. AISC 360.
 4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- G. Preinstallation Conference: Conduct conference at Project site.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

1.10 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A 992/A 992M or ASTM A 572/A 572M, Grade 50.
- B. Channels, M, & S-Shapes: ASTM A 992 or A 572, Grade 50.
- C. Angles: ASTM A36, Grade 36.
- D. Bars & Plates : ASTM A 572, Grade 50.
- E. Corrosion-Resisting Structural-Steel Shapes, Plates, and Bars: ASTM A 588/A 588M, Grade 50.
- F. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.
- G. Corrosion-Resisting Cold-Formed Hollow Structural Sections: ASTM A 847/A 847M, structural tubing.
- H. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.
- I. Steel Castings: ASTM A 216/A 216M, Grade WCB with supplementary requirement S11.
- J. Steel Forgings: ASTM A 668/A 668M.
- K. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 Type 1, heavy-hex steel structural bolts. (Typical bolt to be used for steel-to-steel connection on this project)
- B. High-Strength Bolts, Nuts, and Washers: ASTM A 490 Type 1, heavy-hex steel structural bolts. (May not be used on this project unless called out on specific details or sections.)
- C. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B. Minimum yield strength shall be 50 ksi.
- D. Anchor Rods and Anchor Bolts: ASTM F 1554, Grade 55, weldable, straight, headed or with nut and washer at ends.
 - 1. Nuts: ASTM A 563 hex carbon steel.
 - 2. Plate Washers: ASTM A 36/A 36M carbon steel.
 - 3. Washers: ASTM F 436, Type 1, hardened carbon steel.
 - 4. Finish: Plain
- E. Threaded Rods: A 572/A 572M, Grade 50.
 - 1. Nuts: ASTM A 563 hex carbon steel.
 - 2. Washers: ASTM F 436, Type 1, hardened carbon steel.
 - 3. Finish: Plain
- F. Clevises and Turnbuckles: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1035.
- G. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1030.

- H. Sleeve Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1018.

2.3 PRIMER

- A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Primer: Comply with Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."
- C. Galvanizing Repair Paint: ASTM A 780.

2.4 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.5 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.
 - 1. Camber structural-steel members where indicated.
 - 2. Fabricate beams with rolling camber up.
 - 3. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
 - 4. Mark and match-mark materials for field assembly.
 - 5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 - 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
- C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted.
- F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.
- G. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural steel. Straighten as required to provide uniform, square, and true members in completed wall framing.
- H. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel framing members.
 - 1. Cut, drill, or punch holes perpendicular to steel surfaces
 - 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.

3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.6 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A325 or A 490 Bolts" for type of bolt and type of joint specified.
 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.7 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
 2. Surfaces to be field welded.
 3. Surfaces to be high-strength bolted with slip-critical connections.
 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
 5. Galvanized surfaces.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
 1. SSPC-SP 2, "Hand Tool Cleaning."
 2. SSPC-SP 3, "Power Tool Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.
- D. Painting: Prepare steel and apply a one-coat, nonasphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils (0.038 mm).

2.8 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.
 1. Fill vent and drain holes that will be exposed in the finished Work unless they will function as weep holes, by plugging with zinc solder and filing off smooth.
 2. Galvanize lintels, shelf angles, and welded door frames attached to structural-steel frame and located in exterior walls.
 3. Galvanize any structural steel exposed to the environment, or outside of the building envelope.

2.9 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.
 - 1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
- C. Bolted Connections: Shop-bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - 1. Ultrasonic Inspection: ASTM E 164.
- E. In addition to visual inspection, shop-welded shear connectors will be tested and inspected according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
 - 1. Bend tests will be performed if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
 - 2. Tests will be conducted on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1/D1.1M.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with steel Erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 - 1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.
 - 1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

- B. Base Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Weld plate washers to top of baseplate.
 - 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 - 4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.
 - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection unless approved by Engineer. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.
- H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 - 2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
 - 3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.
- B. Bolted Connections: Bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Welded Connections: Field welds will be visually inspected according to AWS D1.1/D1.1M.
 - 1. In addition to visual inspection, field welds will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - a. Ultrasonic Inspection: ASTM E 164.
- D. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
 - 1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
 - 2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1/D1.1M.
- E. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.6 REPAIRS AND PROTECTION

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780.
- B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
- C. Touchup Painting: Cleaning and touchup painting are specified in Section 09 91 13 "Exterior Painting" Section 09 91 23 "Interior Painting."

END OF SECTION

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05 50 00 METAL FABRICATIONS

1.00 GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Steel elevator pit ladder.
 - 2. Support angles for elevator door sills.
 - 3. Elevator sump pit grate.
 - 4. Loose bearing and leveling plates.
 - 5. Steel weld plates and angles for casting into concrete not specified in other Sections.
 - 6. Loose steel lintels.
 - 7. Shelf and relieving angles.
 - 8. Partial-height partition supports.
 - 9. Steel framing and supports for mechanical and electrical equipment.
 - 10. Steel framing and supports for applications where framing and supports are not specified in other Sections.
 - 11. Metal angle corner guards.
 - 12. Metal edgings.
 - 13. Miscellaneous metal trim.
 - 14. Metal floor plate and supports.
 - 15. Pipe bollards.
 - 16. Decorative bollard for push button control.
- B. Related Sections include the following:
 - 1. Division 05 Section "Metal Stairs."
 - 2. Division 05 Section "Pipe and Tube Railings."
 - 3. Division 05 Section "Decorative Metal Railings."
 - 4. Division 06 Section "Rough Carpentry."
 - 5. Division 06 "Interior Architectural Woodwork" for steel supports for countertops.

1.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance of Ladders: Provide ladders capable of withstanding the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.
- B. Thermal Movements: Provide exterior metal fabrications that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.3 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Partial-height partition supports.

2. Nonslip aggregates and nonslip-aggregate surface finishes.
 3. Paint products.
 4. Grout.
- B. Shop Drawings: Detail fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
1. Provide templates for anchors and bolts specified for installation under other Sections.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding Certificates: Copies of certificates for welding procedures and personnel.
- B. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm experienced in producing metal fabrications 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. Metal Bar Grating Standards: Comply with applicable requirements of the following:
1. Non-Heavy-Duty Metal Bar Gratings: Comply with NAAMM MBG 531, "Metal Bar Grating Manual for Steel, Stainless Steel, and Aluminum Gratings and Stair Treads."
- C. Welding: Qualify procedures and personnel according to the following:
1. AWS D1.1, "Structural Welding Code--Steel."
 2. AWS D1.3, "Structural Welding Code--Sheet Steel."
 3. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Where metal fabrications are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
 2. Provide allowance for trimming and fitting at site.

1.7 COORDINATION

- A. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be

embedded in concrete or masonry. Deliver such items to Project site in time for installation.

- B. Coordinate installation of steel weld plates and angles for casting into concrete that are specified in this Section but required for work of another Section. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide metal bar grating products by one of the following:
 - 1. Alabama Metal Industries Corporation.
 - 2. All American Grating, Inc.
 - 3. Barnett/Bates Corp.
 - 4. IKG Industries; a Harsco Company.
 - 5. Ohio Gratings, Inc.
 - 6. Seidelhuber Metal Products, Inc.

2.2 METALS, GENERAL

- A. Metal Surfaces, General: For metal fabrications exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

2.3 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- C. Wire Rod for Grating Crossbars: ASTM A 510 (ASTM A 510M).
- D. Steel Tubing: Cold-formed steel tubing complying with ASTM A 500.
- E. Steel Pipe: ASTM A 53, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.
- F. Stainless-Steel Sheet, Strip, and Plate: ASTM A 240/A 240M or ASTM A 666, Type 304.
- G. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.
- H. Partial-Height Partition Supports: Manufactured minimum 14 gage steel tube and 3/8-inch thick steel base plate assembly, of height required to brace less than full-height, free-standing gypsum board partitions, with pre-punched holes for attachment or anchorage to concrete subfloor substrate.
 - 1. Acceptable Products:
 - a. NoFlex Corporation, Huntington Beach, CA.
 - b. "R-15" bank rail support post as manufactured by RACO.
- I. Malleable-Iron Castings: ASTM A 47, Grade 32510(ASTM A 47M, Grade 22010).

- J. Gray-Iron Castings: ASTM A 48, Class 30(ASTM A 48M, Class 200), unless another class is indicated or required by structural loads.
- K. Cast-in-Place Anchors in Concrete: Anchors of type indicated below, fabricated from corrosion-resistant materials capable of sustaining, without failure, the load imposed within a safety factor of 4, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
 - 1. Threaded or wedge type; galvanized ferrous castings, either ASTM A 47(ASTM A 47M) malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized per ASTM A 153/A 153M.
- L. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

2.4 NONFERROUS METALS

- A. Aluminum Plate and Sheet: ASTM B 209 (ASTM B 209M), Alloy 6061-T6.
- B. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.

2.5 FASTENERS

- A. General: Provide Type 304 or 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, where built into exterior walls. Select fasteners for type, grade, and class required.
- B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
- C. Anchor Bolts: ASTM F 1554, Grade 36.
 - 1. Provide hot-dip or mechanically deposited, zinc-coated anchor bolts where item being fastened is indicated to be galvanized.
- D. Eyebolts: ASTM A 489.
- E. Machine Screws: ASME B18.6.3 (ASME B18.6.7M).
- F. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).
- G. Wood Screws: Flat head, carbon steel, ASME B18.6.1.
- H. Plain Washers: Round, carbon steel, ASME B18.22.1 (ASME B18.22M).
- I. Lock Washers: Helical, spring type, carbon steel, ASME B18.21.1 (ASME B18.21.2M).
- J. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
 - 1. Material: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.
- K. Toggle Bolts: FS FF-B-588, tumble-wing type, class and style as needed.

2.6 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with performance requirements in FS TT-P-664; selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.
- C. Zinc-Rich Shop Primer for Ferrous Metal: Organic zinc-rich primer, complying with SSPC-Paint 20 and compatible with topcoat.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Carbozinc 621; Carboline Company.
 - b. Aquapon Zinc-Rich Primer 97-670; PPG Industries, Inc.
 - c. Series 90-97 - Tneme-Zinc; Tnemec Company, Inc.
- D. Galvanizing Repair Paint: High-zinc-dust-content paint for regalanizing welds in steel, complying with SSPC-Paint 20.
- E. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers, or cold-applied asphalt emulsion complying with ASTM D 1187.
- F. Nonshrink, Metallic Grout: Factory-packaged, ferrous-aggregate grout complying with ASTM C 1107, specifically recommended by manufacturer for heavy-duty loading applications.
- G. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- H. Concrete Materials and Properties: Comply with requirements in Division 03 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa), unless otherwise indicated.

2.7 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Shear and punch metals cleanly and accurately. Remove burrs.
- C. Ease exposed edges to a radius of approximately 1/32 inch (1 mm), unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.

4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- E. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- F. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- G. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.
- H. Allow for thermal movement resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening up of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- I. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.
- J. Remove sharp or rough areas on exposed traffic surfaces.
- K. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.

2.8 STEEL LADDERS

- A. General: Fabricate ladders for locations shown, with dimensions, spacings, details, and anchorages as indicated.
 1. Comply with ANSI A14.3, unless otherwise indicated.
 2. For elevator pit ladders, comply with ASME A17.1.
- B. Siderails: Continuous, 1/2-by-2-1/2-inch (12-by-64-mm) steel flat bars, with eased edges, spaced 18 inches (457 mm) apart.
- C. Bar Rungs: 3/4-inch-(19-mm-) diameter steel bars, spaced 12 inches (300 mm) o.c.
- D. Fit rungs in centerline of side rails; plug-weld and grind smooth on outer rail faces.
- E. Support each ladder at top and bottom and not more than 60 inches (1500 mm) o.c. with welded or bolted steel brackets. Size brackets to support design loads specified in ANSI A14.3.
- F. Provide nonslip surfaces on top of each rung by coating with abrasive material metallurgically bonded to rung by a proprietary process.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Mebac; IKG Borden.
 - b. SLIP-NOT; W. S. Molnar Company.
- G. Galvanize ladders, including brackets and fasteners, in the following locations:

1. Exterior.
2. Interior, where indicated.

2.9 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
- B. Prime plates with zinc-rich primer.

2.10 LOOSE STEEL LINTELS

- A. Fabricate loose structural-steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated.
- B. Weld adjoining members together to form a single unit where indicated.
- C. Size loose lintels to provide bearing length at each side of openings equal to one-twelfth of clear span, but not less than 8 inches (200 mm), unless otherwise indicated.
- D. Galvanize all loose steel lintels located in exterior walls.

2.11 SHELF ANGLES

- A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch (19-mm) bolts, spaced not more than 6 inches (150 mm) from ends and 24 inches (600 mm) o.c., unless otherwise indicated.
- B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete. Align expansion joints in angles with indicated control and expansion joints in cavity-wall exterior wythe.
- C. Galvanize all shelf angles to be installed in exterior walls.
- D. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

2.12 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with not less than two integrally welded steel strap anchors for embedding in concrete.

2.13 ELEVATOR SUMP PIT GRATING

- A. Fabricate grating sections in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Form from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.

- C. Metal Bar-Grating: Form elevator sump pit cover to configurations shown from metal bar grating; fabricate to comply with NAAMM MBG 531, "Metal Bar Grating Manual."
 - 1. Fabricate from welded steel grating with 1-1/4-by-3/16-inch (32-by-5-mm) bearing bars at 15/16 inch (24 mm) o.c. and crossbars at 4 inches (100 mm) o.c., NAAMM designation: W-15-4 (1-1/4 x 3/16) STEEL.
 - 2. Surface: Serrated.
 - 3. Finish: Galvanized.
- D. Removable Grating Sections: Fabricate with banding bars attached by welding to entire perimeter of each section. Include anchors and fasteners of type indicated or, if not indicated, as recommended by manufacturer for attaching to supports.
- E. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space the anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.
- F. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.
 - 1. Edge-band openings in grating that interrupt four or more bearing bars with bars of same size and material as bearing bars.
- G. Frames and Supports for Metal Gratings: Fabricate from metal shapes, plates, and bars of welded construction to sizes, shapes, and profiles indicated and as necessary to receive gratings. Miter and weld connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.

2.14 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports that are not a part of structural-steel framework as necessary to complete the Work.
- B. Fabricate units from structural-steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.
 - 1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors 1-1/4 inches (32 mm) wide by 1/4 inch (6 mm) thick by 8 inches (200 mm) long at 24 inches (600 mm) o.c., unless otherwise indicated.
 - 2. Furnish inserts if units must be installed after concrete is placed.
- C. Galvanize miscellaneous framing and supports where indicated.

2.15 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from structural-steel shapes, plates, and bars of profiles shown with continuously welded joints, and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work. Provide anchors, welded to trim, for embedding in concrete or masonry construction, spaced not more than 6 inches (150 mm) from each end, 6 inches (150 mm) from corners, and 24 inches (600 mm) o.c., unless otherwise indicated.

- C. Galvanize miscellaneous steel trim in the following locations:
 - 1. Exterior.
 - 2. Interior, where indicated.

2.16 BOLLARDS

- A. Fabricate pipe bollards from Schedule 40 steel pipe.
 - 1. Cap bollards with 1/4-inch- (6.4-mm-) thick steel plate.
- B. Fabricate decorative square bollards from extruded aluminum.
 - 1. Provide necessary cutouts for push-button controls and hole for wire.

2.17 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.

2.18 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:
 - 1. ASTM A 123, for galvanizing steel and iron products.
 - 2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.
- B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface-preparation specifications and environmental exposure conditions of installed metal fabrications:
 - 1. Exteriors (SSPC Zone 1B): SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 2. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."
- C. Ladders in Elevator Pits: Provide zinc-rich primer.
- D. Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1," for shop painting.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2.19 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal fabrications to in-place construction. Include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. Protection of Dissimilar Materials: When dissimilar materials come in contact, provide bituminous paint protective coating. Conditions include, but are not limited to:
 - 1. Ferrous metal to aluminum.
 - 2. Ferrous metal or aluminum in contact with concrete.
 - 3. Steel to copper.

3.2 SETTING BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
 - 1. Use nonshrink grout, either metallic or nonmetallic, in concealed locations where not exposed to moisture; use nonshrink, nonmetallic grout in exposed locations, unless otherwise indicated.
 - 2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.3 INSTALLING METAL BAR GRATINGS

- A. General: Install gratings to comply with recommendations of referenced metal bar grating standards that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
- C. Attach removable units to supporting members with type and size of clips and fasteners indicated or, if not indicated, as recommended by grating manufacturer for type of installation conditions shown.

3.4 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings, if any.

3.5 INSTALLING PIPE BOLLARDS

- A. Bollards with Footings: Anchor bollards in place with concrete footings. Center and align bollards in holes 3 inches (75 mm) above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.
- B. Fill bollards solidly with concrete, mounding top surface to shed water.
 - 1. Do not fill removable bollards with concrete.

3.6 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 09 Section "Painting."
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION

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05 52 13 PIPE AND TUBE RAILINGS

1.00 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Steel pipe and tube handrails and railings.
- B. Related sections include the following:
 - 1. Division 05 Section "Metal Stairs" for steel tube railings associated with metal stairs.
 - 2. Division 06 Section "Miscellaneous Rough Carpentry" for wood blocking for anchoring railings.
 - 3. Division 09 Section "Non-Structural Metal Framing" for metal backing for anchoring railings.

1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design railings, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
 - 1. Steel: 72 percent of minimum yield strength.
- C. Structural Performance: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Handrails and Top Rails of Guards:
 - a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
 - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 - 2. Infill of Guards:
 - a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
 - b. Infill load and other loads need not be assumed to act concurrently.
- D. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.3 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Grout, anchoring cement, and paint products.
- B. Shop Drawings: Show fabrication and installation of handrails and railings. Include plans, elevations, sections, component details, and attachments to other Work.

1.4 INFORMATIONAL SUBMITTALS

- A. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- B. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- C. Welding certificates.
- D. Product Test Reports: From a qualified testing agency indicating products comply with requirements, based on comprehensive testing of current products.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of handrail and railing through one source from a single manufacturer.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. 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 handrails and railings that are similar to those indicated for this Project in material, design, and extent.
- D. Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.
- E. NAAMM Stair Railing Standard: Comply with NAAMM AMP 521, "Pipe Railing Systems Manual," for class of stair designated in Section 05 51 00, and for railing system joint construction designated below by reference to NOMMA standard, unless more stringent requirements are indicated.
 - 1. Type 2, unless otherwise indicated.

1.6 STORAGE

- A. Store handrails and railings in a dry, well-ventilated, weather-tight place.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify handrail and railing dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.8 COORDINATION AND SCHEDULING

- A. Coordinate installation of anchorages for handrails and railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves,

concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

- B. Schedule installation so handrails and railings are mounted only on completed walls. Do not support temporarily by any means that does not satisfy structural performance requirements.

2.00 - PRODUCTS

2.1 METALS

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without pitting, seam marks, roller marks, rolled trade names, stains, discolorations, blemishes, or other imperfections.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.
- C. Steel and Iron: Provide steel and iron in the form indicated, complying with the following requirements:
 - 1. Steel Pipe: ASTM A 53; finish, type, and weight class as follows:
 - a. Black finish, unless otherwise indicated.
 - b. Type F, or Type S, Grade A, standard weight (Schedule 40), unless another grade and weight are required by structural loads.
 - 2. Steel Tubing: Cold-formed steel tubing, ASTM A 500, Grade A, unless another grade is required by structural loads.
 - 3. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
 - 4. Iron Castings: Malleable iron complying with ASTM A 47, Grade 32510(ASTM A 47M, Grade 22010).
- D. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails, unless otherwise indicated.

2.2 FASTENERS

- A. General: Provide the following:
 - 1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5 for zinc coating.
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
- C. Fasteners for Interconnecting Railing Components:
 - 1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.
 - 2. Provide Phillips flat-head machine screws for exposed fasteners unless otherwise indicated.

- D. Post-Installed Anchors: Torque-controlled expansion anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
 - 1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.

2.3 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with performance requirements in FS TT-P-664, selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.
- C. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- D. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

2.4 FABRICATION

- A. General: Fabricate handrails and railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Assemble handrails and railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Form changes in direction of railing members as follows:
 - 1. As detailed.
- D. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail and railing components.
- E. Welded Connections: Fabricate handrails and railings for connecting members by welding. Cope components at perpendicular and skew connections to provide close fit, or use fittings designed for this purpose. Weld connections continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.

3. Remove flux immediately.
 4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- F. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect handrail and railing members to other work, unless otherwise indicated.
 - G. Provide inserts and other anchorage devices for connecting handrails and railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by handrails and railings. Coordinate anchorage devices with supporting structure.
 - H. For railing posts set in concrete, provide preset sleeves of steel not less than 6 inches (150 mm) long with inside dimensions not less than 1/2 inch (12 mm) greater than outside dimensions of post, and steel plate forming bottom closure.
 - I. Shear and punch metals cleanly and accurately. Remove burrs from exposed cut edges.
 - J. Ease exposed edges to a radius of approximately 1/32 inch (1 mm), unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.
 - K. Cut, reinforce, drill, and tap components, as indicated, to receive finish hardware, screws, and similar items.
 - L. Provide weep holes or another means to drain entrapped water in hollow sections of handrail and railing members that are exposed to exterior or to moisture from condensation or other sources.
 - M. Fabricate joints that will be exposed to weather in a watertight manner.
 - N. Close exposed ends of handrail and railing members with prefabricated end fittings.
 - O. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated. Close ends of returns, unless clearance between end of railing and wall is 1/4 inch (6 mm) or less.
 - P. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.
 - Q. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.
- 2.5 FINISHES, GENERAL
- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

2.6 STEEL FINISHES

- A. Fill vent and drain holes that will be exposed in finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- B. For non-galvanized steel handrails and railings, provide non-galvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors to be embedded in exterior concrete or masonry.
- C. Preparation for Shop Priming – Non-Galvanized: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface-preparation specifications and environmental exposure conditions of installed handrails and railings:
 - 1. Interiors (SSPC Zone 1A): SSPC-SP 7, "Brush-off Blast Cleaning."
- D. Apply shop primer to prepared surfaces of handrail and railing components, unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.
 - 1. Stripe paint edges, corners, crevices, bolts, and welds.

3 - EXECUTION

3.1 EXAMINATION

- A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required to install handrails and railings. Set handrails and railings accurately in location, alignment, and elevation; measured from established lines and levels and free from rack.
 - 1. Do not weld, cut, or abrade surfaces of handrail and railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 - 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
 - 3. Align rails so variations from level for horizontal members and from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (5 mm in 3 m).
- C. Adjust handrails and railings before anchoring to ensure matching alignment at abutting joints. Space posts at interval indicated, but not less than that required by structural loads.
- D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing handrails and railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

- A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

3.4 ANCHORING POSTS

- A. Form or core-drill holes (no core drilling in composite slab) not less than 5 inches (125 mm) deep and 3/4 inch (20 mm) larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with the following anchoring material, mixed and placed to comply with anchoring material manufacturer's written instructions:
 - 1. Nonshrink, nonmetallic grout or anchoring cement.
- B. Cover anchorage joint with flange of same metal as post, attached to post as follows:
 - 1. Welded to post after placing anchoring material.
- C. Leave anchorage joint exposed; wipe off surplus anchoring material; and leave 1/8-inch(3-mm) build-up, sloped away from post.
- D. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
 - 1. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.

3.5 ANCHORING RAILING ENDS

- A. Anchor railing ends into concrete and masonry with round flanges connected to railing ends and anchored into wall construction with postinstalled anchors and bolts.
- B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces.
 - 1. Weld flanges to railing ends.

3.6 ATTACHING HANDRAILS TO WALLS

- A. Attach handrails to wall with wall brackets. Provide bracket with 1-1/2-inch (38-mm) clearance from inside face of handrail and finished wall surface.
- B. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- C. Secure wall brackets to building construction as follows:
 - 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
 - 2. For hollow masonry anchorage, use toggle bolts.
 - 3. For steel-framed gypsum board assemblies, fasten brackets directly to steel framing or concealed reinforcements using self-tapping screws of size and type required to support structural loads.

3.7 CLEANING

- A. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 9 Section "Painting."

3.8 PROTECTION

- A. Protect finishes of handrails and railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at the time of Substantial Completion.
- B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION

06 10 00 ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Structural floor, wall, and roof framing.
 - 2. Wall and roof sheathing.
 - 3. Subfloor sheathing.
 - 4. Curbs, cants, and blocking.
- B. Related Sections:
 - 1. Section 03 30 00 – Cast-in-place Concrete.
 - 2. Section 06 17 53 – Shop Fabricated Wood Trusses

1.2 REFERENCES

- A. American Forest & Paper Association
- B. American Wood Council
- C. ALSC (American Lumber Standards Committee) - Softwood Lumber Standards.
- D. APA (American Plywood Association).
- E. AWWA (American Wood Preservers Association) C1 - All Timber Products - Preservative Treatment by Pressure Process
- F. NFPA (National Forest Products Association).
- G. SPIB (Southern Pine Inspection Bureau).

1.3 QUALITY ASSURANCE

- A. Mill and Producers Mark: Each piece of lumber and plywood shall be gradestamped indicating type, grade, mill, and grading agency certified by the Board of Review of the American Lumber Standards Committee. Mark shall appear on unfinished surface, or ends of pieces with finished surfaces.
- B. Pressure Preservative Treated Material: Accredited agency quality mark on each piece of wood indicating treatment.
- C. Fire-Retardant Treated Material: Accredited testing agency mark on each piece of wood indicating compliance with the fire hazard classification.

1.4 DELIVERY, STORAGE, AND PROTECTION

- A. Keep materials dry during delivery. Store materials 6 inches minimum above ground surface. Protect against exposure to weather and contact with damp or wet surfaces. Stack lumber and plywood, and provide air circulation between stacks.

- B. Cover stored materials until ready for use for protection from moisture. Place and anchor covering in a manner which will assure good ventilation under the covering.

PART 2 - PRODUCTS

2.1 LUMBER MATERIALS

- A. Refer to framing drawings for specific member design
- B. Lumber Grading Rules: NFPA and SPIB.
- C. Beam Framing: Southern Pine or, Douglas Fir, Larch species, No. 2 grade, 19 percent maximum moisture content.
- D. Joist Framing: Southern Pine or, Douglas Fir, Larch species, No. 2 grade, 19 percent maximum moisture content.
- E. Rafter Framing: Southern Pine or, Douglas Fir, Larch species, No. 2 grade, 19 percent maximum moisture content.
- F. Studding: Southern Pine or, Douglas Fir, Larch species, grading per sheet S1.1, 19 percent maximum moisture content.

2.2 PLYWOOD MATERIALS

- A. Sloped Roof Sheathing: APA Rated Sheathing, 19/32" Span Rating 40/20; Exposure Durability 1; unsanded
- B. Wall Sheathing: APA Rated Sheathing, 15/32" Span Rating 32/16; Exposure Durability 1; unsanded.
- C. Floor and Flat Roof Plywood Underlayment: APA Rated Underlayment, 23/32" Span Rating 48/24; Exposure Durability 1; sanded.

2.3 ORIENTED STRAND BOARD MATERIALS

- A. Sloped Roof Sheathing: APA Oriented Strand Board, set with waterproof resin binder; 19/32" Span Rating 40/20; Exposure Durability 1; unsanded faces.
- B. Wall Sheathing: APA Oriented Strand Board set with waterproof resin binder; 15/32" Span Rating 32/16; Exposure Durability 1; unsanded faces.
- C. Floor and Flat Roof Underlayment: APA Oriented Strand Board set with waterproof resin binder; 23/32" Span Rating 48/24; Exposure Durability 1; sanded.

2.4 PRESERVATIVE TREATMENT

- A. Treat lumber and plywood where indicated and as specified. Comply with applicable AWPA U1 Standards and quality control and inspection requirements.
- B. Fasteners and anchoring devices to be used with wood treated with waterbourne preservatives shall be hot-dipped galvanized or stainless steel if the wood will be exposed to moisture.
- C. Complete fabrication of items to be treated to the greatest extent possible prior to treatment. Where items must be cut after treatment, coat cut

surfaces with heavy brush coat of the same chemical used for treatment or other solution recommended by AWP Standards for the treatment.

- D. Inspect wood after treating and drying. Discard warped or twisted items.
- E. Wood Treatment: Compatible with galvanized metal connector plates, unless other compatible protective finish for connector plates is approved by the Director for use with approved treatment.
 - 1. Preservative Treatment: Category UC3A for Exterior Construction above Ground; coated and exposed to rapid water runoff.
 - 2. Preservative Treatment: Category UC3B for Exterior Construction above Ground; uncoated and exposed to poor water runoff.
 - 3. Nailers, blocking, cants, shim stock, and similar members used in conjunction with roofing (including related flashings, trim and vapor barrier), coping, and waterproofing.
 - 4. Nailers, blocking, furring, stripping, and similar concealed members in contact with exterior masonry and concrete (including interior wythe of exterior walls), and all sills for framing.
 - 5. Wood items indicated or scheduled on the Drawings to be preservative treated.
- F. Wood Treatment: Compatible with galvanized metal connector plates, unless other compatible protective finish for connector plates is approved by the Director for use with approved treatment.
 - 1. Preservative Treatment: Category UC4A for Ground Contact or Freshwater; Non-critical components.

2.5 FIRE-RETARDANT TREATMENT

- A. Furnish "FR-S" lumber where indicated, complying with AWP U1 Standards for pressure impregnation with fire-retardant chemicals to achieve a flamespread rating of 25 or less, when tested in accordance with UL Test 723, ASTM E 84 or NFPA Test 255.
- B. WATERBASE PAINTS OR FINISHES SHOULD NOT BE USED ON CONVENTIONAL FR-S WOOD.
 - 1. Where treated items are indicated to receive a transparent or paint finish, use a fire-retardant treatment which will not bleed through or adversely affect bond of finish.
 - 2. Provide UL label or identifying mark on each piece of fire-retardant lumber.
 - 3. Redry treated items to a maximum moisture content of 19 percent after treatment.

2.6 ACCESSORIES

- A. Fasteners: Hot dipped or electro galvanized steel for high humidity and treated wood locations. Corrosion resistance shall also be as follows:
 - 1. For Exterior (Open) Locations: Metal connectors and fasteners located in open areas shall be either stainless steel and meet ASTM A167; hot-

dip galvanized after fabrication and meet ASTM A123 or ASTM A153; hot-dip galvanized or galvanized prior to fabrication and meet ASTM A653; hot-dip galvanized or electrogalvanized in accordance with ASTM A641; mechanically deposited zinc coatings in accordance with ASTM B695; or electrodeposited zinc coatings in accordance with ASTM B633. Open areas shall include: 1. Porches 2. Open Decks 3. Carports 4. Exterior wall coverings 5. Roof coverings 6. Metal ties for stone and masonry veneer 7. Anchors for securing mechanical equipment to structures 8. Roof vent and louver attachments 9. Skylight attachments 10. Impact protective systems, such as shutters

2. For Vented or Enclosed Areas. Metal connectors and fasteners located in vented or enclosed areas may meet the requirements of Section 2.6/A/1, or shall be epoxy-coated in accordance with ASTM A899. Vented or enclosed areas shall include: 1. Attics 2. Exterior wall stud cavities 3. Window and door attachments 4. Roof sheathing 5. Wall sheathing
 3. Conditioned Areas. Metal connectors and fasteners located in conditioned areas (heated and cooled living areas) are not required to be corrosion resistant.
- B. Structural Framing Connectors and Joist Hangers: Hot dipped galvanized steel, sized to suit framing conditions, manufactured by Simpson.
 - C. Anchors: Toggle bolt type for anchorage to hollow masonry, expansion shield and lag bolt type for anchorage to solid masonry or concrete, bolts or ballistic fasteners for anchorages to steel.
 - D. Spacer panel clips: Install mid-span of each sheet.
 - E. Subfloor Glue: Waterproof, air cure type, cartridge dispensed, adhesive conforming to ASTM D 3498 "ADHESIVES FOR FIELD-GLUEING PLYWOOD TO LUMBER FRAMING FOR FLOOR SYSTEMS"
 - F. Drywall Screws: Bugle head, steel, power driven type, length 3 times thickness of sheathing.
 - G. Building Paper: No. 15 asphalt felt.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Examine substrate and supporting structure on which rough carpentry is to be installed for defects that will adversely affect the execution and quality of the Work. Do not proceed with installation until unsatisfactory conditions are corrected

3.2 INSTALLATION – GENERAL

- A. Do not use units of material with defects which impair the quality of the Work and units which are too small to fabricate the Work with minimum joints or with optimum joint arrangement.

- B. Install Work accurately to required lines and levels with members plumb and true, accurately cut and fitted and securely fastened. Closely fit rough carpentry to other associated construction.
- C. Securely attach carpentry Work to substrates by anchoring and fastening as indicated or, if not indicated, as required by the referenced standards. Select fasteners of size that will not penetrate through members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; predrill as required. Set nail heads in exposed Work which is to be painted or stained and fill resulting holes.
- D. Treated Wood: Apply heavy brush coat of treatment material to field cut surfaces. (Not required for pressure treated wood materials)

3.3 WOOD FRAMING

- A. Install framing members of nominal sizes indicated or of units built-up to dimensions indicated, on spacings shown. Unless otherwise indicated, comply with the recommendations of the AFPA "Manual for Wood Frame Construction". Construct required openings for installation of related work. Do not splice structural members between supports.
- B. Anchor and nail members as indicated. If not indicated, comply with the "Recommended Nailing Schedule - Table 1" of the "Manual for Wood Frame Construction" and other applicable recommendations of the AFPA.
- C. Install miscellaneous blocking and framing indicated and as required for attachment and support of facing materials, fixtures, specialty items, and trim.
- D. Erect wood framing members level and plumb. Place horizontal members laid flat, crown side up. Construct framing members full length without splices.
- E. Make provisions for erection loads, and for sufficient temporary bracing to maintain structure safe, plumb, and in true alignment until completion of erection and installation of permanent bracing.
- F. Double or triple members at openings as required by design. Space short studs over and under opening to stud spacing.
- G. Construct double joist headers at floor and ceiling openings. Construct double joists under wall studding.
- H. Bridge joists in excess of 8 ft span or as detailed, at mid-span members. Fit solid bridging at ends of members.
- I. Place full width continuous sill flashings under framed walls on cementitious foundations. Lap flashing joint 4 inch.
- J. Construct load bearing framing and curb members full length without splices.
- K. Curb roof openings except where prefabricated curbs are provided. Form corners by alternating lapping side members.
- L. Coordinate curb installation with installation of decking and support of deck openings, roofing vapor retardant, and parapet construction.
- M. Coordinate installation of wood decking, glue laminated structural units, and prefabricated wood trusses.

3.4 SHEATHING

- A. Secure roof sheathing perpendicular to framing members with ends staggered. Secure sheet edges over firm bearing. Use sheathing clips between sheets between roof framing members.
- B. Secure wall sheathing horizontally perpendicular to wall studs, with ends staggered, over firm bearing.
- C. Place weather resistant barrier over wall sheathing, weather lap joints.
- D. Secure subfloor perpendicular to floor framing with end joints staggered. Secure sheet edges over firm bearing. Attach floor sheathing with subfloor glue and nails.
- E. Install plywood two span minimum continuous.
- F. Install telephone and electrical panel back boards with plywood sheathing material where required. Size the back board by 12 inches beyond size of electrical panel.
- G. Comply with printed installation requirements of the APA Design/ Construction Guide, Residential & Commercial for plywood application required, unless otherwise indicated.
- H. Plywood and OSB Underlayment: Install underlayment just prior to installation of finish flooring. Stagger end joints between panels in relation to each other and stagger all joints in relation to substrate jointing. Allow 1/32 inch space between panel ends and edges for expansion. Fasten in accordance with APA recommendations. Prior to installation of finish flooring, patch damaged areas wider than 1/16 inch. Set nails 1/16 inch, but do not fill. Sand rough areas smooth and uneven joints flush

3.5 BLOCKING, CURBS, AND CANTS

- A. Construct curb [and cants] members of single pieces per location.
- B. Curb all roof openings except where prefabricated curbs are provided. Form corners by lapping side members alternately.
- C. Coordinate work with installation of decking and support of decking at openings.

3.6 TOLERANCES

- A. Framing Members: 1/4 inch from true position, maximum.
- B. Surface Flatness of Floor: 1/4 inch in 10 feet maximum, and 1/2 inch in 30 feet maximum.

END OF SECTION

06 11 00-A WOOD FRAMING

1.00 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof framing.
2. Roof sheathing.
3. Blocking.
4. Cedar ceiling boards.

B. Related Sections:

1. Section 03 30 00-A: Cast-in-place Concrete.
2. Section 06 18 50-A: Structural Glue Laminated Timbers

1.2 REFERENCES

- A. ALSC (American Lumber Standards Committee) - Softwood Lumber Standards.
- B. APA (American Plywood Association).
- C. AWWA (American Wood Preservers Association) C1 - All Timber Products - Preservative Treatment by Pressure Process
- D. NFPA (National Forest Products Association).
- E. SPIB (Southern Pine Inspection Bureau).

1.3 QUALITY ASSURANCE

A. Perform Work in accordance with the following agencies:

1. Lumber Grading Agency: Certified by ALSC.
2. Plywood Grading Agency: Certified by APA.

1.4 DELIVERY, STORAGE, AND PROTECTION

- A. Protect trusses from warping or other distortion by stacking in vertical position, braced to resist movement.
- B. Cover stored material until use.

PART 2 PRODUCTS

2.1 LUMBER MATERIALS

- A. Refer to framing drawings for specific member design.
- B. Lumber Grading Rules: NFPA and SPIB.
- C. Beam Framing: Southern Pine, Douglas Fir, Larch species, No. 2 grade, 19 percent maximum moisture content.
- D. Joist Framing: Southern Pine, Douglas Fir, Larch species, No. 2 grade, 19 percent maximum moisture content.
- E. Studding: Southern Pine, Douglas Fir, Larch species, stud grade, 19 percent maximum moisture content.

2.2 PLYWOOD MATERIALS

- A. Roof Sheathing: APA Rated Sheathing with radiant barrier on one side, Span Rating 24/16. Use radiant barrier on roof deck where deck is not exposed to view.
 - 1. Louisiana-Pacific TechShield
 - 2. Approved equal.

2.3 ACCESSORIES

- A. Fasteners: Hot dipped or electro galvanized steel for high humidity and treated wood locations, unfinished steel elsewhere.
- B. Structural Framing Connectors and Joist Hangers: Hot dipped galvanized steel, sized to suit framing conditions, manufactured by Simpson.
- C. Anchors: Toggle bolt type for anchorage to hollow masonry, expansion shield and lag bolt type for anchorage to solid masonry or concrete, bolts or ballistic fasteners for anchorages to steel.
- D. Spacer panel clips: Install mid-span of each sheet.
- E. Building Paper:
 - 1. Self adhered bituminous membrane over roof sheathing.

PART 3 EXECUTION

3.1 FRAMING

- A. Erect wood framing members level and plumb – or at angles and spacing as indicated on drawings. Place horizontal members laid flat, crown side up. Construct framing members full length without splices.
- B. Make provisions for erection loads, and for sufficient temporary bracing to maintain structure safe, plumb, and in true alignment until completion of erection and installation of permanent bracing.
- C. Bridge joists in excess of 8 ft span or as detailed, at mid-span members. Fit solid bridging at ends of members.
- D. Construct load bearing framing and curb members full length without splices.
- E. Coordinate installation of wood decking, glue laminated structural units, and wood soffit.

3.2 SHEATHING

- A. Secure roof sheathing as indicated on structural drawings. Secure sheet edges over firm bearing. Use sheathing clips between sheets between roof framing members.
- B. Install plywood to two spans continuous.

3.3 BLOCKING, CURBS, AND CANTS

- A. Coordinate work with installation of decking and support of decking as required.

3.4 TOLERANCES

- A. Framing Members: 1/4 inch from true position, maximum.

END OF SECTION

06 18 00 GLUE LAMINATED STRUCTURAL UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Glue laminated wood beams and headers.
- B. Steel hardware and attachment brackets.

1.2 RELATED SECTIONS

- A. Section 061000 - Framing and Sheathing: Roof sheathing, floor decking.
- B. Section 099000 - Painting: Field finishing.

1.3 REFERENCES

- A. AITC (American Institute of Timber Construction).
- B. ANSI A190.1 - Structural Glued Laminated Timber.
- C. AITC 109 – 2007 for Exterior Glulam Beams

1.4 DESIGN REQUIREMENTS

- A. Design and laminate members to AITC 117 standard drawings.
- B. Provide member sizes and allowable strengths as shown on the Structural Notes and Drawings.

1.5 SUBMITTALS

- A. Product Data: Provide technical data on wood preservative materials, application technique and resultant performance information.
- B. Shop Drawings: Indicate framing system, sizes and spacing of members, loads and cambers, bearing and anchor details, bridging and bracing, and framed openings.

1.6 QUALITY ASSURANCE

- A. Manufacturer/Fabricator Qualifications: Company specializing in manufacture of glue laminated structural units with three years experience, and certified by AITC in accordance with ANSI A190.1.
- B. Erector Qualifications: Company specializing in erection of this Work with five years experience.

1.7 DELIVERY, STORAGE, AND PROTECTION

- A. Protect members to AITC requirements for individually wrapped.

- B. Leave individual wrapping in place until finishing occurs.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. American Laminators, Inc.
- B. Boozer Laminated Beam Company, Inc.
- C. Anthony Forest Products.
- D. Unidalla Laminated Products.
- E. Unit Structures, Inc.
- F. Structural Wood Components

2.2 FABRICATION

- A. Fabricate glue laminated structural members in accordance with AITC Architectural grade.
- B. Verify dimensions and site conditions prior to fabrication.
- C. Cut and fit members accurately to length to achieve tight joint fit.
- D. Fabricate member with camber built in.
- E. Do not splice or join members in locations other than those indicated without permission.
- F. Fabricate steel hardware and connections with joints neatly fitted, welded, and ground smooth.
- G. After end trimming, seal with penetrating sealer in accordance with AITC requirements.
- H. Field Finishing of Members: Specified in Section 09900.
- I. Use pressure treated exterior grade woods and glues for any glulam members exposed to the weather or on the exterior of the building, per AITC 109, use Category UC3 "Exterior Construction Above Ground".

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that supports are ready to receive units.
- B. Verify sufficient end bearing area.

3.2 PREPARATION

- A. Coordinate placement of bearing and support items.

3.3 ERECTION

- A. Lift members using protective straps to prevent visible damage.
- B. Set structural members level and plumb, in correct positions or sloped where indicated.
- C. Provide temporary bracing and anchorage to hold members in place until permanently secured.
- D. Fit members together accurately without trimming, cutting, or other unauthorized modification.
- E. Swab and seal the interior wood surfaces of field drilled holes in members with primer.

3.4 TOLERANCES

- A. Framing Members: 1/2-inch maximum from true position.

END OF SECTION

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07 10 00-A DAMPPROOFING AND WATERPROOFING

1.00 GENERAL

1.1 SECTION INCLUDES

- A. Dampproofing of above grade concrete haunches
- B. Flexible flashing
- C. Base flashing at masonry

1.2 REFERENCES

- A. ASTM D-570 – Water Absorption
- B. ASTM E-96 - Test Methods for Water Transmission of Materials
- C. ASTM D-751 Hydrostatic Head Test
- D. ASTM D-779 Water Resistance
- E. ASTM D-828

1.3 SUBMITTALS

- A. Product Data: Provide data indicating material characteristics, performance criteria, and limitations.
- B. Manufacturer's Installation Instructions for Information: Indicate preparation and installation requirements, techniques.

1.4 SEQUENCING

- A. Sequence Work to permit installation of materials in conjunction with other retardant materials and seals
- B. Do not install water protection membrane until items penetrating it are in place.

2.00 PRODUCTS

2.1 WATERPROOFING MATERIALS

A. MANUFACTURERS

- 1. BASF Hydrocide 700
- 2. Approved Equal

B. COMPONENTS

- 1. Membrane: 70 mil. self adhering laminated rubberized asphalt and polyethylene sheets. 3 feet wide.
- 2. Liquid Membrane: Compatible product from sheet membrane manufacturer for detailing.
- 3. Mastic: Compatible product from sheet membrane manufacturer for sealing termination points

2.2 FLEXIBLE FLASHING MATERIALS

A. MANUFACTURERS

- 1. DuPont FlexWrap

- 2. Approved equal
- B. COMPONENTS
 - 1. Cold applied water based emulsified asphalt damproofing and vapor retarder.
 - 2. Long fiber reinforced for trowel application.
- 2.3 MASONRY BASE FLASHING
 - A. MANUFACTURERS
 - 1. Dupont Through-Wall Flashing
 - 2. Approved Equal
 - B. COMPONENTS
 - 1. Membrane: 40 mil. adhered membrane with integral drip edge.
 - 2. Reference Standards: ASTM E-2112(standard).
 - 3. Water Vapor Permeance: Less than .30 perms (standard); ASTM E-96.
 - 4. Water Resistance: 24 hours (standard); ASTM D-779
 - C. Accessories:
 - 1. Sealant – DuPont Commercial Sealant
 - 2. Preformed Corners
 - 3. End Dams
 - 4. Weep – wick type
- 2.4 THROUGH-WALL FLASHING
 - A. MANUFACTURERS
 - 1. Dupont Through-Wall Flashing
 - 2. Approved Equal
 - B. COMPONENTS
 - 1. Membrane: 40 mil. adhered membrane with integral drip edge.
 - 2. Reference Standards: ASTM E-2112(standard).
 - 3. Water Vapor Permeance: Less than .30 perms (standard); ASTM E-96.
 - 4. Water Resistance: 24 hours (standard); ASTM D-779
 - C. Accessories:
 - 1. Sealant – DuPont Commercial Sealant
 - 2. Preformed Corners
 - 3. End Dams
 - 4. DuPont Flashing Tape – 20 mil polypropylene film

3.00 EXECUTION

3.1 PREPARATION

- A. Surface should be free of oil, grease, dirt, laitance and loose material. Dry surfaces must be dampened with water and kept damp until application.
- B. Notify Contractor of any defects in substrate.

3.2 INSTALLATION - DAMPROOFING

- A. Apply Hydrocide 700 with a trowel.
- B. Apply 1/8" thick coat.
- C. Apply 1 coat, carrying the coating in and around all joints, grooves, and slots, following all reveals.
- D. Allow to set.

3.3 INSTALLATION – FLEXIBLE FLASHING

- A. Install flashing between top of concrete haunches and steel saddles.

3.4 INSTALLATION OF MASONRY BASE FLASHING

- A. Apply membrane in accordance with manufacturer's recommendations, laid smooth without folds or bunches of material. Form inside and outside corners as directed in instructions.
 - 1. Seam Overlap: As recommended by flashing manufacturer for specific flashing material and application indicated.
 - 2. Sealing: Seal edges and items projecting through vapor retarders and vapor barriers.
- B. Inspect and repair flashing prior to application of finish material over flashing; tape tears, perforations and similar damage.

END OF SECTION

07 41 00 PREFORMED METAL ROOFING

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide sheet metal roofing.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
- C. Samples: Submit two representative samples of each material specified indicating visual characteristics and finish. Include range samples if variation of finish is anticipated.

1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Sheet Metal Roofing:
 - 1. Manufacturers: MBCI, CAP-SEAM; Berridge Manufacturing or approved equal.
 - 2. Seam Type: Architectural Standing-seam flat panel, 2" minimum.
 - a. Panel color as selected by Architect.
 - 3. Metal: Hot-Dipped Galvanized.
 - a. Standard: ASTM A446-85 Grade C G90 Coating A525-86 24 Gauge core steel.
 - 4. Finish: Kynar 500 Fluoropolymer coating
 - a. Strippable film shall be applied to the top side of the painted coil to protect the finish during fabrication, shipping and field handling. This strippable film must be removed before installation.
- B. Auxiliary Materials:
 - 1. Provide components required for a complete panel system, including trim, closures, clips, gaskets, fillers, and similar items. Match materials and finish of preformed panels.
 - 2. Rosin-sized building paper.
 - 3. Asphalt saturated organic felt underlayment.
 - 4. Polyethylene underlayment.
 - 5. Rubberized asphalt underlayment.
 - 6. Bituminous isolation coating.
 - 7. Batten bars and strips.
 - 8. Ice & Water Shield roofing underlayment.

2.2 FABRICATION

- A. Panels shall have 16" on-center seam spacing with a seam height of 1".
- B. Snap-on seams shall be 1" in height and shall contain a Weather Seal.

- C. Concealed anchor clips shall be spaced as required to meet uplift loads (maximum of 24" on center).
 - D. When required, Panel assembly shall bear Underwriter's Laboratories Label UL90, pursuant to Construction Number 296 and applicable Fire Ratings.
 - E. Certification shall be submitted, based on independent testing laboratory, indicating no measurable water penetration or air leakage beyond allowable tolerances through the system when tested in accordance with ASTM E-331-86 and E-283-84.
 - F. Fabricate and finish panels and accessories at the factory to the greatest extent possible, by the manufacturer's standard procedures and processes. Comply with indicated profiles and dimensional requirements.
 - G. Metal Gauge: Fabricate panels and accessories with not less than 26-gauge steel sheet.
- H. Provide all panels full length. Seaming joints at midspans shall not be allowed.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with SMACNA Sheet Metal Manual recommendations. Comply with accessory manufacturers' instructions and recommendations. Coordinate installation with roofing system to ensure weathertight performance.
- B. Anchor securely to structure to withstand inward and outward loads.
- C. Isolate dissimilar metals to prevent galvanic corrosion.
- D. Clean and grease, finger marks or stains from the panels per manufacturer's recommendations.
- E. Provide prefinished trim, caps, flashings, and special shapes as shown on plans and as required for complete installation.

END OF SECTION

07 62 00-A SHEET METAL FLASHING AND TRIM

1.00 GENERAL

0.1 SECTION INCLUDES

- A. Flashings and counter flashings, and fabricated sheet metal items, as indicated on drawings.
- B. Accessories

0.2 DESIGN REQUIREMENTS

- A. Sheet Metal Flashings: Conform to the following criteria of SMACNA Architectural Sheet Metal Manual.
 - 1. Coping: SMACNA, Detail Figure 4-12B similar
 - 2. Roof Penetration Flashing: SMACNA Figure 4-19A.

0.3 QUALITY ASSURANCE

- A. Fabricator and Installer Qualifications: Company specializing in sheet metal work with 5 years documented experience.

0.4 DELIVERY, STORAGE, AND PROTECTION

- A. Stack material to prevent twisting, bending, and abrasion. Provide ventilation. Slope metal sheets to ensure drainage.
- B. Prevent contact with materials which may cause discoloration or staining.

2.00 PRODUCTS

0.5 SHEET MATERIALS

- C. Concealed locations - Galvanized Steel: ASTM A526/A526M, G90 zinc coating; 24 gage thick steel.
- B. Exposed locations – Kynar 500 / Hylar 5000 Prefinished Steel: 24 gauge thick, color to be selected by Architect.

2.2 ACCESSORIES

- A. Fasteners: Galvanized steel or same material and finish as flashing metal, with soft neoprene washers.
- B. Primer: Zinc molybdate or galvanized iron type
- C. Protective Backing Paint: FS TT-C-494, Bituminous
- D. Sealant: Type A specified in Section 07900
- E. Plastic Cement: ASTM D4586, Type I
- F. Solder: ASTM B32; 50/50 type

2.3 FABRICATION

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- B. Fabricate cleats of type sheet metal; same material as sheet, minimum 2 inches wide, interlocking with sheet.
- C. Form pieces in longest possible lengths.
- D. Hem exposed edges on underside 1/2 inch; miter and seam corners.

- E. Form material with flat lock seams, except where otherwise indicated. At moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
- F. Fabricate corners from one piece with minimum 18 inch long legs; solder for rigidity, seal with sealant.
- G. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.
- H. Seal metal joints.

3.00 EXECUTION

2.4 EXAMINATION

- I. Verify existing conditions before starting work.
- J. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set and nailing strips located.
- K. Verify roofing termination and base flashings are in place, sealed, and secure.

2.5 PREPARATION

- A. Install starter and edge strips, and cleats before starting installation.
- B. Paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil.

2.6 INSTALLATION

- A. Secure flashings in place using concealed fasteners. Use exposed fasteners only where permitted.
- B. Apply plastic cement compound between metal flashings and felt flashings.
- C. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- D. Seal metal joints watertight.
- E. Solder metal joints for full metal surface contact. After soldering, wash metal clean with neutralizing solution and rinse with water.
- F. Seal metal joints watertight.

2.7 FIELD QUALITY CONTROL

- A. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

2.8 SCHEDULE

- A. Flashings associated roofing including ridge, eave, rake, as required by roofing manufacturer for roofing system.
- B. Counter flashings at roofing terminations (over roofing base flashings)
- C. Roofing penetration flashings, for pipes and equipment supports.
- D. All flashings that are visible shall be prefinished or painted to match adjacent materials as approved by the Architect.

END OF SECTION

07 90 00-A JOINT SEALERS

1.00 GENERAL

1.01 SUMMARY

- A. Provide caulking and sealant as shown on the Drawings, specified herein, and not specified elsewhere. In general, seal all openings indicated on Drawings and other locations requiring sealant to seal visually and against infiltration from air or moisture, including but not limited to:
 - 1. Expansion and control joints in concrete paving and sidewalks.
 - 2. Masonry control joints.
 - 3. Isolation joints between structure and other elements.
 - 4. Joints at penetrations of ceilings or decks by piping and other service equipment.
 - 5. Joints between items of equipment and other construction.
 - 6. Open joints between dissimilar materials as required to close and conceal jointing of the work.
 - 7. Other joints as indicated.

1.02 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Samples: Submit two representative samples of each material specified indicating visual characteristics and finish. Include range samples if variation of finish is anticipated.
 - 1. Include manufacturer's full range of color and finish options if additional selection is required.

1.03 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Field-Constructed Mock-Ups: Each joint type.

2.00 PRODUCTS

2.01 MATERIALS

- A. Manufacturers:
 - 1. Pecora Corp.
 - 2. Sika Corp.
 - 3. Dow Chemical
 - 4. Tremco
 - 5. Sonneborn Building Products
 - 6. Approved Substitute.

B. Acceptable Materials:

1. Exterior: Two component polyurethane, FS TT-S0027E, Type II, Class A, non-sag. Verify that sealant is compatible with exterior coating & finish.
2. Primer: As recommended by sealant manufacturer.
3. Concrete sidewalks and interior slabs: Two component self-leveling polyurethane, FS TT-S0027E, Type I, Class A, pourable.
4. Colors: As selected from manufacturer's standard colors.

C. Auxiliary Materials:

1. Plastic foam joint fillers.
2. Elastomeric tubing backer rods.
3. Bond breaker tape.

3.00 EXECUTION

3.01 INSTALLATION

- A. Examine substrate and report unsatisfactory conditions in writing. Beginning work means acceptance of substrates.
- B. Provide sealants in colors as selected from manufacturer's standards.
- C. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections. Clean and prime joints, and install bond breakers, backer rods and sealant as recommended by manufacturers.
- D. Depth shall equal width up to 1/2" wide; depth shall equal 1/2 width for joints over 1/2" wide.
- E. Cure and protect sealants as directed by manufacturers. Replace or restore damaged sealants. Clean adjacent surfaces to remove spillage.

END OF SECTION

09 80 00-A SPECIAL COATINGS

1.00 GENERAL

1.1 SECTION INCLUDES

- A. Anti-Graffiti coatings for masonry surfaces.

1.2 SYSTEM DESCRIPTION

- A. Finish Materials: Conform to applicable code for flame/fuel/smoke rating requirements.
- B. Code Approval: Materials shall be approved by local codes for type of application

1.3 SUBMITTALS

- A. Product Data: Manufacturer's literature including application instructions, material composition, test data, etc. for material being considered.
- B. Certification of compliance with local codes.

1.4 QUALITY ASSURANCE

- A. Provide products from one manufacturer unless noted specifically otherwise.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store and apply materials in environmental conditions required by manufacturer's instructions.

2.00 PRODUCTS

2.1 Anti-graffiti Coating

- A. Prosoco, "Sure Klean Weather Seal" Blok-Guard & Graffiti Control.
- B. Approved equal.

3.00 EXECUTION

3.1 EXAMINATION

- A. Verify that substrate conditions are ready to receive work.
- B. Measure moisture content of porous surfaces using an electronic moisture meter.
- C. Correct minor defects and clean surfaces that affect work of this Section.
- D. Surface preparation shall be in accordance with manufacturer's instructions.

3.2 APPLICATION

- A. Mix and thin materials in accordance with manufacturer's printed instructions.
- B. Apply materials at specified film thickness by method recommended by manufacturer.
- C. Allow each coat to dry thoroughly before re-coating.
- D. Make finish coats smooth, uniform in color, and free of brush marks, laps, runs, dry spray, over-spray and skipped or missed areas.

3.3 ADJUSTING

- A. Request acceptance of each coat before applying succeeding coats.
- B. Touch-up and repair all work that is not acceptable to A/E and request final acceptance.

3.5 COATING SCHEDULE

A. Anti-Graffiti Coating

1. Apply to all masonry surfaces
2. Apply coating according to manufacturer's instructions for each type of surface material

3.6 CLEANING

- A. Remove paint splatters from surfaces not scheduled for paintings.
- B. Repair damage to coating or surfaces caused by painting or cleaning operations.
- C. Remove debris from job site and leave storage areas clean.

END OF SECTION

09 90 00-A PAINTING

1.00 GENERAL

1.1 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints, stains, and other coatings.

1.2 DEFINITIONS

- A. Conform to ASTM D16 for interpretation of terms used in this section.

1.3 SUBMITTALS

- A. Product Data: Provide data on all finishing products. Provide documents that indicate the quality level within the manufacturer's product line.
- B. Manufacturer's Instructions for Information: Indicate special surface preparation procedures and substrate conditions requiring special attention.
- C. Maintenance Data: Submit data on cleaning, touch-up, and repair of painted and coated surfaces.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Applicator Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.

1.5 REGULATORY REQUIREMENTS

- A. Conform to applicable code for flame and smoke rating requirements for products and finishes.

1.6 DELIVERY, STORAGE, AND PROTECTION

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.
- C. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.
- D. Minimum Application Temperature for Varnish and Epoxy Finishes: 65 degrees F for interior or exterior, unless required otherwise by manufacturer's instructions.

- E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

1.8 PROJECT CONDITIONS

- A. Sequence application to the following:
 - 1. Do not apply finish coats until paintable sealant is applied.
 - 2. Back prime wood trim before installation of trim.

2.00 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers - Paint
 - 1. Sherwin Williams.
 - 2. Approved Equal
- B. Manufacturers - Stain
 - 1. PPG Industries, Pittsburgh Paints.
 - 2. The Sherwin-Williams Company.
 - 3. Benjamin Moore and Co.
 - 4. ICI/Devoe and Raynolds Co.
 - 5. ICI/The Glidden Company.
 - 6. Pratt and Lambert.
- C. Manufacturers - Primer Sealers
 - 1. Sherwin Williams
 - 2. Approved equal.

2.2 QUALITY LEVEL

- A. Paint - Refer to Section 09970 Coating Systems for Steel
- B. Stain – Equal to Sherwin Williams WoodScapes.
- C. Wood Conditioner – Equal to Zinsser SealCoat.

2.3 MATERIALS

- A. Coatings: Ready mixed, except field catalyzed coatings. Prepare pigments:
 - 1. To a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating.
 - 2. For good flow and brushing properties.
 - 3. Capable of drying or curing free of streaks or sags.
 - 4. Paints and coatings shall be the manufacturer's medium quality product.
- B. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve the finishes specified; commercial quality.
- C. Patching Materials: Latex filler.
- D. Fastener Head Cover Materials: Latex filler.

2.4 FINISHES

- A. Refer to schedule at end of section for surface finish.

3.00 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting Work.
- B. Verify that surfaces and substrate conditions are ready to receive Work as instructed by the product manufacturer.
- C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- D. Test shop applied primer for compatibility with subsequent cover materials.
- E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 - 1. Concrete and Concrete Unit Masonry: 12 percent.
 - 2. Interior Wood: 15 percent, measured in accordance with ASTM D4442.
 - 3. Exterior Wood: 15 percent, measured in accordance with ASTM D4442.

3.2 PREPARATION

- A. Surface Appurtenances: Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.
- B. Surfaces: Correct defects and clean surfaces which affect work of this section.
- C. Marks: Seal with shellac those which may bleed through surface finishes.
- D. Impervious Surfaces: Remove mildew by scrubbing with solution of tri-sodium phosphate and bleach. Rinse with clean water and allow surfaces to dry.
- E. Galvanized Surfaces: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.
- F. Concrete and Unit Masonry Surfaces Scheduled to Receive Paint Finish: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.
- G. Uncoated Steel and Iron Surfaces: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Spot prime paint after repairs.
- H. Shop Primed Steel Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.
- I. Exterior Wood Scheduled to Receive Stain Finish: Remove dust, grit, and foreign matter. Seal knots, pitch streaks, and sappy sections. Apply Zinnser SealCoat to raw wood prior to stain. Fill nail holes with tinted exterior calking compound after seal coat has been applied.

- J. Wood Doors Scheduled for Painting: Seal wood door top and bottom edge surfaces with clear sealer.
- K. Metal Doors Scheduled for Painting: Prime metal door top and bottom edge surfaces.

3.3 APPLICATION

- A. Apply products in accordance with manufacturer's instructions.
- B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before the next coat is applied.
- C. Apply each coat to uniform appearance. Apply each coat of paint slightly darker than preceding coat unless otherwise approved.
- D. Sand wood and metal surfaces lightly between coats to achieve the required finish.
- E. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying the next coat.
- F. Where clear finishes are required, tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.

3.4 FIELD QUALITY CONTROL

- A. Inspect and test questionable coated areas.

3.5 CLEANING

- A. Collect waste material which may constitute a fire hazard, placed in closed metal containers, and remove daily from site.

3.6 SCHEDULE - SHOP PRIMED ITEMS FOR SITE FINISHING

- A. Metal Fabrications (Section 05500): Exposed surfaces of steel plates, fasteners, saddles, gutters, downspouts.

3.7 SCHEDULE - EXTERIOR SURFACES

- A. Wood - Stained
 - 1. One coat Zinnser SealCoat wood conditioner
 - 2. Alkyd Oil based primer
 - 3. Two coats stain per manufacturers' instructions.
- B. Steel - Shop Primed
 - 1. Refer to Section 09970 Coating Systems for Steel
- C. Steel - Galvanized
 - 1. Refer to Section 09970 Coating Systems for Steel

END OF SECTION

09 97 00-A COATING SYSTEMS FOR STEEL

1.00 GENERAL

1.1 SECTION INCLUDES

- A. Coating systems for exposed steel

1.2 RELATED SECTIONS

- A. Section 05500 – Metal Fabrications

1.3 REFERENCES

- A. ASTM D 16 - Terminology Relating to Paint, Varnish, Lacquer, and Related Products.
- B. SSPC-SP 1 - Solvent Cleaning.
- C. SSPC-SP 2 - Hand Tool Cleaning.
- D. SSPC-SP 3 - Power Tool Cleaning.
- E. SSPC-SP 6/NACE 3 - Commercial Blast Cleaning.

1.4 DEFINITIONS

- A. Definitions of Painting Terms: ASTM D 16, unless otherwise specified.
- B. Dry Film Thickness (DFT): Thickness of a coat of paint in fully cured state measured in mils (1/1000 inch).

1.5 SUBMITTALS

- A. Product Data: Submit manufacturer's product data for each coating, including generic description, complete technical data, surface preparation, and application instructions.
- B. Color Samples: Submit manufacturer's color samples showing full range of standard colors.
- C. Manufacturer's Quality Assurance: Submit manufacturer's certification that coatings comply with specified requirements and are suitable for intended application.
- D. Warranty: Submit manufacturer's standard warranty.

1.6 QUALITY ASSURANCE

- A. Manufacturer's Qualifications:
 - 1. Specialize in manufacture of coatings with a minimum of 10 years successful experience.
 - 2. Able to demonstrate successful performance on comparable projects.
 - 3. Single Source Responsibility: Coatings and coating application accessories shall be products of a single manufacturer.
- B. Applicator's Qualifications:
 - 1. Experienced in application of specified coatings for a minimum of 5 years on projects of similar size and complexity to this Work.
 - 2. Applicator's Personnel: Employ persons trained for application of specified coatings.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying:
 - 1. Coating or material name.
 - 2. Manufacturer.
 - 3. Color name and number.
 - 4. Batch or lot number.
 - 5. Date of manufacture.
 - 6. Mixing and thinning instructions.
- B. Storage:
 - 1. Store materials in a clean dry area and within temperature range in accordance with manufacturer's instructions.
 - 2. Keep containers sealed until ready for use.
 - 3. Do not use materials beyond manufacturer's shelf life limits.
- C. Handling: Protect materials during handling and application to prevent damage or contamination.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Weather:
 - 1. Air and Surface Temperatures: Prepare surfaces and apply and cure coatings within air and surface temperature range in accordance with manufacturer's instructions.
 - 2. Surface Temperature: Minimum of 5 degrees F (3 degrees C) above dew point.
 - 3. Relative Humidity: Prepare surfaces and apply and cure coatings within relative humidity range in accordance with manufacturer's instructions.
 - 4. Precipitation: Do not prepare surfaces or apply coatings in rain, snow, fog, or mist.
 - 5. Wind: Do not spray coatings if wind velocity is above manufacturer's limit.
- B. Ventilation: Provide ventilation during coating evaporation stage in confined or enclosed areas in accordance with manufacturer's instructions.
- C. Dust and Contaminants:
 - 1. Schedule coating work to avoid excessive dust and airborne contaminants.
 - 2. Protect work areas from excessive dust and airborne contaminants during coating application and curing.

2.00 PRODUCTS

2.1 MANUFACTURER

- A. Sherwin Williams
- B. Approved equal.

2.2 COATING SYSTEMS FOR EXTERIOR STEEL

- A. Frequent Public Contact, Chemical or UV Exposure:
 - 1. System Type: epoxy/urethane.
 - 2. Surface Preparation: SSPC-SP 6/NACE 3.
 - 3. First Coat: Macropoxy 646 Fast Cure Epoxy
 - 4. Intermediate Coat: Acrolon 218 HS Polyurethane
 - 5. Field Finish Coat: Acrolon 218 HS Polyurethane
 - 6. Finish Color: As selected by Architect from manufacturer's standard colors.

3.00 EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions under which coating systems are to be applied. Notify Architect of areas or conditions not acceptable. Do not begin surface preparation or application until unacceptable areas or conditions have been corrected.

3.2 PROTECTION OF SURFACES NOT SCHEDULED TO BE COATED

- A. Protect surrounding areas and surfaces not scheduled to be coated from damage during surface preparation and application of coatings.
- B. Immediately remove coatings that fall on surrounding areas and surfaces not scheduled to be coated.

3.3 SURFACE PREPARATION OF STEEL

- A. Prepare steel surfaces in accordance with manufacturer's instructions.
- B. Touch-up primer on all surfaces. Ensure that all surfaces that are inaccessible after completed construction are thoroughly coated.
- C. Fabrication Defects:
 - 1. Correct steel and fabrication defects revealed by surface preparation.
 - 2. Remove weld spatter and slag.
 - 3. Round sharp edges and corners of welds to a smooth contour.
 - 4. Smooth weld undercuts and recesses.
 - 5. Grind down porous welds to pinhole-free metal.
 - 6. Remove weld flux from surface.
- D. Ensure surfaces are dry.
 - 1. Interior Steel Surfaces, Mild Exposure: Remove visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter in accordance with SSPC-SP 2 or SP 3.
 - 2. Interior Steel Surfaces, Moderate to Severe Exposure: Remove visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter in accordance with SSPC-SP 6/NACE 3.

3. Exterior Steel Surfaces: Remove visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter in accordance with SSPC-SP 6/NACE 3.
4. Totally Spray-Applied Shop Coating Systems for Steel: Remove visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter in accordance with SSPC-SP 6/NACE 3.
5. Abrasive Blast-Cleaned or Chemically Stripped Surfaces: Coat abrasive blast-cleaned surfaces with primer before visible rust forms on surface. Do not leave blast-cleaned surfaces uncoated for more than 8 hours.
6. Shop Primer: Prepare shop or field primer to receive field coat in accordance with manufacturer's instructions.

3.4 SURFACE PREPARATION OF GALVANIZED STEEL AND NONFERROUS METAL

- A. Prepare galvanized steel and nonferrous metal surfaces in accordance with manufacturer's instructions. Surface preparation recommendations will vary depending on substrate and exposure conditions.

3.5 APPLICATION

- A. Apply coatings in accordance with manufacturer's instructions.
- B. Mix and thin coatings, including multi-component materials, in accordance with manufacturer's instructions.
- C. Keep containers closed when not in use to avoid contamination.
- D. Do not use mixed coatings beyond pot life limits.
- E. Use application equipment, tools, pressure settings, and techniques in accordance with manufacturer's instructions.
- F. Uniformly apply coatings at spreading rate required to achieve specified DFT.
- G. Apply coatings to be free of film characteristics or defects that would adversely affect performance or appearance of coating systems.
- H. Stripe paint with brush critical locations on steel such as welds, corners, and edges using specified primer.

3.6 REPAIR

- A. Materials and Surfaces Not Scheduled To Be Coated: Repair or replace damaged materials and surfaces not scheduled to be coated.
- B. Damaged Coatings: Touch-up or repair damaged coatings. Touch-up of minor damage shall be acceptable where result is not visibly different from adjacent surfaces. Recoat entire surface where touch-up result is visibly different, either in sheen, texture, or color.
- C. Coating Defects: Repair in accordance with manufacturer's instructions coatings that exhibit film characteristics or defects that would adversely affect performance or appearance of coating systems.

3.7 CLEANING

- A. Remove temporary coverings and protection of surrounding areas and surfaces.

3.8 PROTECTION OF COATING SYSTEMS

- A. Protect surfaces of coating systems from damage during construction.

3.9 SCHEDULE

- A. Apply coating to all exterior exposed primed steel elements
- B. Colors: As selected by Architect and Owner.

END OF SECTION

26 00 00 BASIC ELECTRICAL REQUIREMENTS

1.00 GENERAL

1.01 WORK INCLUDED

- A. General Requirements specifically applicable to Division 26.
- B. The Contractor shall be responsible for:
 - 1. The work included consists of furnishing all materials, supplies, equipment and tools, and performing all labor and services necessary for installation of a completely functional power, lighting, and signaling systems. Complete systems in accordance with the intent of Contract Documents.
 - 2. Coordinating the details of facility equipment and construction for all Specification Divisions, which affect the work covered under this Division.
 - 3. Furnishing and installing all incidental items not actually shown or specified, but which are required by good practice to provide complete functional systems.
 - 4. Temporary power service and lighting for construction. Coordinating all shutdown dates and schedules with Owner's Representative and obtain all work-permits required by Owner.
- C. Intent of Drawings:
 - 1. The Drawings are necessarily diagrammatic by their nature, and are not intended to show every connection in detail or every device or raceway in its exact location, unless specifically dimensioned. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the work in order to avoid interference between the various phases of work. The Contractor shall be responsible for the proper routing of raceway, subject to prior review by the Owner and Engineer. Work shall be organized and laid out so that it will be concealed below grade, in poles, in electrical equipment enclosures, in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. All work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.
 - 2. The intent of the Drawings is to establish the type of systems and functions, but not to set forth each item essential to the functioning of the system. The drawings and specifications are cooperative, and work or materials called for in one and not mentioned in the other shall be provided. Review pertinent drawings and adjust the work to conditions shown. In case of doubt as to work intended, or where discrepancies occur between drawings, specifications, and actual conditions, immediately notify the Architect/Engineer and the Owner's representative, and propose a resolution.

1.02 RELATED WORK

- A. This Section shall be used in conjunction with the following other specifications and related Contract Documents to establish the total general requirements for the project electrical systems and equipment.
 - 1. Division 01 Sections included in the project specifications.
 - 2. The contract.

1.03 DESIGN CRITERIA

- A. Equipment and devices to be installed outdoors or in enclosures where the temperatures are not controlled shall be capable of continuous operation under such conditions per manufacturer's requirements.
- B. Compliance by the Contractor with the provisions of this Specification does not relieve him of the responsibilities of furnishing equipment and materials of proper design, mechanically and electrically suited to meet operating guarantees at the specified service conditions.
- C. Electrical components shall be UL listed and labeled.

1.04 REFERENCE CODES AND STANDARDS, REGULATORY REQUIREMENTS

- A. Standards of the following organizations as well as those listed in Division 01, may be referenced in the specification. Unless noted otherwise, references are to standards or codes current at the time of bidding.
 - 1. International Building Code
 - 2. Texas Department of Licensing and Regulation, TAS
 - 3. Americans with Disability Act (ADA)
 - 4. Association of Edison Illuminating Companies (AEIC)
 - 5. American National Standards Institute (ANSI)
 - 6. Institute of Electrical and Electronics Engineers (IEEE)
 - 7. Insulated Cable Engineers Association (ICEA)
 - 8. International Energy Conservation Code (IECC)
 - 9. National Electrical Code (NEC)
 - 10. National Electrical Manufacturers Association (NEMA)
 - 11. National Electrical Safety Code
 - 12. National Fire Protection Association (NFPA)
 - a. NFPA 70
 - b. NFPA 101
 - 13. Underwriters' Laboratories (UL)
 - 14. ASHRAE/IES 90.1 – Energy Standard for Buildings Except Low-Rise Residential Buildings
 - 15. International Energy Conservation Code (IECC) 2009 Edition
- B. Work, materials and equipment must comply with the latest rules and regulations of the following.
 - 1. National Electrical Code (NEC)
 - 2. National Electrical Safety Code
 - 3. Occupational Safety and Health Act (OSHA)
 - 4. Americans with Disability Act (ADA)
 - 5. American Society for Testing and Materials (ASTM)
 - 6. Applicable state and federal codes, ordinances and regulations
- C. Discrepancies. The drawings and specifications are intended to comply with listed codes, ordinances, regulations and standards. Where discrepancies occur, immediately notify the Owner's representative in writing and ask for an interpretation. Should installed materials or workmanship fail to comply, the Contractor is responsible for correcting the improper installation. Additionally, where sizes, capacities, or other such features are required in excess of minimum code or standards requirements, provide those specified or shown.

- D. Contractor shall obtain permits and arrange inspections required by codes applicable to this Section and shall submit written evidence to the Owner and Engineer that the required permits, inspections and code requirements have been secured.

1.05 SUBMITTALS

- A. Submit the following in addition to and in accordance with the requirements of Division 01 for submittal requirement.
 - 1. Include inspection and permit certificates and certificates of final inspection and acceptance from the authority having jurisdiction.
 - 2. Manufacturer's standardized schematic diagrams and catalog cuts shall not be acceptable unless applicable portions of it are clearly indicated and non-applicable portions clearly deleted or crossed out.
 - 3. All schematic, connection and/or interconnection diagrams shall be in accordance with the latest edition of NEMA.
 - 4. Provide submittals as required by individual specification Section.
- B. Provide the following with each submittal:
 - 1. Catalog cuts with manufacturer's name clearly indicated. Applicable portions shall be circled and non-applicable portions shall be crossed out.
 - 2. Line-by-line specification review by equipment manufacturer and contractor with any exceptions explicitly defined.
- C. Equipment Layout Drawing: 1/8-inch scale minimum drawings indicating electrical equipment locations. Dimensions for housekeeping pads should be indicated on these drawings. Indicate routing of conduit 2 inches and over on these drawings. Indicate all exposed conduits regardless of size.
- D. Within the specified time window after award of contract, submit list of equipment and materials to be furnished.
 - 1. Itemize equipment and material by specification Section number; include manufacturer and identifying model or catalog numbers.
 - 2. Replace rejected items with an acceptable item within 2 weeks after notification of rejection.
 - 3. If a satisfactory replacement is not submitted within a two-week period, owner will notify contractor as to equipment manufacturer or type and make or material to be furnished. Provide designated items at no additional cost to owner.
- E. As-Built Record Drawings: The Contractor shall maintain a master set of As-Built Record Drawings that show changes and any other deviations from the drawings. The markups must be made as the changes are done. At the conclusion of the job, these As-Built Record Drawings shall be transferred to AutoCad electronic files, in a format acceptable to the Owner, and shall be complete and delivered to the Owner's Representative prior to final acceptance. Refer to 013100 Project Administration for other requirements.

1.06 SAFETY

- A. The Contractor shall follow the safety procedures in addition to, and in accordance with, the requirements of Project Safety Manual (PSM).
 - 1. The Contractors shall be responsible for training all personnel under their employ in areas concerning safe work habits and construction safety. The Contractor shall continually inform personnel on hazards particular to this project and update the information as the project progresses.
 - 2. The Contractor shall secure all electrical rooms, to limit access, prior to energizing any switchgear and shall control access during the project after energization. The Contractor shall post and maintain warning and caution signage in areas where work is ongoing near energized equipment. The Contractor shall cover all energized live parts when work is not being done in the equipment. This includes lunch and breaks.
 - 3. The Contractor shall strictly enforce OSHA lock out/tag out procedures. Initial infractions shall result in a warning; a second infraction shall result in the removal of the workman and his foreman from the site. Continued infractions shall result in removal of the Contractor from the site.

1.07 SHORING AND EQUIPMENT SUPPORTS

- A. The Contractor shall provide all permanent and temporary shoring, anchoring, and bracing required to make all parts absolutely stable and rigid; even when such shoring, anchoring, and bracing are not explicitly called for.
- B. The Contractor shall adequately support all freestanding panels, switchgear, switchboard, enclosures, and other equipment. This shall include bolting to the floor or solid structural steel to prevent tipping. Install free-standing electrical equipment on 4" thick concrete housekeeping pads that are provided by others. Under no condition shall equipment be fastened to non-rigid building steel (i.e., removable platform steel gratings, handrails, etc.).
- C. The Contractor shall provide racks and supports, independently mounted at structure, to support electrical equipment and systems supplied and installed under this contract. At no time shall the Contractor mount or suspend equipment from other disciplines' supports.

1.08 TEMPORARY POWER REQUIREMENTS

- A. Provide power distribution system sufficient to accommodate construction operations requiring power, use of power tools, electrical heating, lighting, and start-up/testing of permanent electric-powered equipment prior to its permanent connection to electrical system. Provide proper overload protection. Ground fault circuit interrupters (GFCI) are to be used on all 120-volt, single-phase, 15 and 20 amp receptacle outlets where portable tools and equipment are used. Ground fault circuit interrupters shall be tested weekly by the Contractor.
- B. Temporary power feeders shall originate from a distribution panel. The conductors shall be multi-conductor cord or cable per NEC for hard and extra-hard service multi-conductor cord.
- C. Branch circuits shall originate in an approved receptacle or panelboard. The conductors shall be multi-conductor cord or cable per NEC for hard and extra-hard service multi-conductor cord. Each branch circuit shall have a separate equipment grounding conductor.

- D. All receptacles shall be of the grounding type and electrically connected to the grounding conductor.
- E. Provide temporary lighting by factory-assembled lighting strings or by manually-assembled units. All lamps for general lighting shall be protected from accidental contact or breakage. Protection shall be provided by installing the lights a minimum of 7 feet from the work surface or by lamp holders with guards. Branch circuits supplying temporary lighting shall not supply any other load. Provide sufficient temporary lighting to ensure proper workmanship by combined use of day lighting, general lighting, and portable plug-in task lighting. Comply with OSHA required foot-candle levels and submit plan for approval by the owner.
- F. For temporary wiring, suitable fencing, barriers, or other effective means shall be provided to prevent access of anyone other than authorized and qualified personnel.
- G. Temporary power cords shall be kept off the ground or floor. The Contractor shall provide temporary supports as required to keep temporary cords off the ground or floor.

1.09 SUBSTITUTION OF MATERIALS AND EQUIPMENT

- A. Refer to Uniform General Conditions and Supplementary General Conditions for substitution of materials and equipment.
- B. The intent of the Drawings and/or Specifications is neither to limit products to any particular manufacturer nor to discriminate against an "APPROVED EQUAL" product as produced by another manufacturer. Some proprietary products are mentioned to set a definite standard for acceptance and to serve as a reference in comparison with other products. When a manufacturer's name appears in these Specifications, it is not to be construed that the manufacturer is unconditionally acceptable as a provider of equipment for this project. The successful manufacturer or supplier shall meet all of the provisions of the appropriate specification(s).
- C. The specified products have been used in preparing the Drawings and Specifications and thus establish minimum qualities with which substitutes must at least equal to be considered acceptable. The burden of proof of equality rests with the Contractor. The decision of the designer is final.
- D. When requested by the Architect/Engineer, the Contractor shall provide a sample of the proposed substitute item. In some cases, samples of both the specified item and the proposed item shall be provided for comparison purposes.
- E. Timeliness: The burden of timeliness in the complete cycle of submittal data, shop Drawings, and sample processing is on the Contractor. The Contractor shall allow a minimum of six (6) weeks time frame for review of each submission by the office of the design discipline involved after receipt of such submissions by that design discipline. The Contractor is responsible for allowing sufficient time in the construction schedule to cover the aforementioned cycles of data processing, including time for all resubmittal cycles on unacceptable materials, equipment, etc. covered by the data submitted. Construction delays and/or lack of timeliness in the above regard are the responsibility of the Contractor and will not be considered in any request for scheduled construction time extensions and/or additional costs to the Owner.

- F. All equipment installed on this project shall have local representation; local factory authorized service, and a local stock of repair parts.
- G. Acceptance of materials and equipment will be based on manufacturer's published data and will be tentative subject to the submission of complete shop Drawings indicating compliance with the contract documents and that adequate and acceptable clearances for entry, servicing, and maintenance will exist. Acceptance of materials and equipment under this provision shall not be construed as authorizing any deviations from the Specifications, unless the attention of the Architect/Engineer has been directed in writing to the specific deviations. Data submitted shall not contain unrelated information unless all pertinent information is properly identified.
- H. Certification: The Contractor shall carefully examine all data forwarded for approval and shall sign a certificate to the effect that the data has been carefully checked and found to be correct with respect to dimensions and available space and that the equipment complies with all requirements of the Specifications.
- I. Physical Size of Equipment: Space is critical; therefore, equipment of larger sizes than shown, even though of specified manufacturer, will not be acceptable unless it can be demonstrated that ample space exists for proper installation, operation, and maintenance.
- J. Should a substitution be accepted, and should the substitute material prove defective, or otherwise unsatisfactory for the service intended within the guarantee period, this material or equipment shall be replaced with the material or equipment specified at no additional cost to the Owner.

1.10 COMMISSIONING

- A. Commissioning of a system or systems specified in this section is part of the construction process. Documentation and testing of these systems, as well as training of the TCCD operation and maintenance personnel, is required in cooperation with the TCCD Project Manager and the Commissioning Authority. Project Closeout is dependent on successful completion of all commissioning procedures, documentation, and issue closure. Refer to Section 019113, Commissioning, for detailed commissioning requirements.

2.00 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. Materials and Equipment: Labeled and/or listed as acceptable to the authority having jurisdiction as suitable for the use intended. Materials shall be of a standard industrial quality if no specifications or specific model numbers are given.
- B. Where two or more units of the same class of material are required, provide products of a single manufacturer. Component parts of materials or equipment need not be products of the same manufacturer.
- C. All materials shall be new and unused.
- D. Provide non-metallic material in corrosive areas or as otherwise specified.

3.00 EXECUTION

3.01 WORKMANSHIP

- A. Install work in compliance with NEC latest edition.
- B. Install material and equipment in accordance with manufacturers' instructions. Provide calibrated torque wrenches and screwdrivers and tighten all terminals, lugs, and bus joints using it.
- C. Comply with startup procedures as defined by Construction Manager and Owner.
- D. Arrange electrical work in a neat, well-organized manner. Do not block future connection points of electrical service. Install all electrical work parallel or perpendicular to building lines unless noted otherwise, properly supported with purpose-designed apparatus, in a neat manner.
- E. Apply, install, connect, erect, use, clean, adjust, and condition materials and equipment as recommended by the manufacturers in their published literature.
- F. Make opening through masonry and concrete by core drilling in acceptable locations. Restore openings to original condition to match remaining surrounding materials.

3.02 SERVICE CONTINUITY

- A. Maintain continuity of electric service to all functioning portions of process or buildings during the hours of normal use. Phase construction work to accommodate Owner's occupancy requirements.
- B. Arrange temporary outages for cutover work with the Owner. Keep the outages to a minimum number and minimum length of time.
- C. All service outages shall be requested in writing a minimum of two weeks prior to the date. Owner reserves the right to postpone shutdowns up to 24 hours prior to the shutdown at no additional cost. Outage requests shall include a schedule of the work to be performed and the time requirements.
- D. The Contractor shall obtain all appropriate Owner permits for working in equipment.

3.03 HAZARDOUS LOCATIONS

- A. Equipment, wiring, devices, and other components located within hazardous areas to be of appropriate type per NFPA requirements.
- B. Ground exposed non-current carrying parts of entire electrical system in hazardous areas, in accordance with NEC and as instructed by Owner.

3.04 SLEEVES AND SEALS

- A. Provide sealing and/or fire stopping where electrical system passes through walls, ceilings, and floors. Seals shall be watertight and/or fire rated as applicable.

3.05 CONSTRUCTION REVIEW

- A. The Engineer or Owner's representative will review and observe installation work to ensure compliance by the Contractor with requirements of the Contract Documents.
- B. Review, observation, assistance, and actions by the Engineer or Owner's representative shall not be construed as undertaking supervisory control of the work or of methods and means employed by the Contractor. The review and observation activities shall not relieve the Contractor from the responsibilities of these Contract Documents.
- C. The fact that the Engineer or Owner's representative do not make early discovery of faulty or omitted work shall not bar the Engineer or Owner's representative from subsequently rejecting this work and insisting that the Contractor make the necessary corrections.
- D. Regardless of when discovery and rejection are made, and regardless of when the Contractor is ordered to correct such work, the Contractor shall have no claim against the Engineer or Owner's representative for an increase in the Contract price, or for any payment on account of increased cost, damage, or loss.

3.06 WARRANTY

- A. Provide warranties in accordance with the requirements of Uniform General and Supplementary Conditions (UGC).

3.07 FUNCTIONAL PERFORMANCE AND INTEGRATED SYSTEMS TESTING

- A. Functional Performance & Integrated Systems Testing is part of the Commissioning Process. Functional Performance & Integrated Systems Testing shall be performed by the contractor and witnessed and documented by the Commissioning Authority. Refer to Section 019113, Commissioning, for functional performance and integrated systems testing and commissioning requirements.

3.08 TRAINING

- A. Training of the TCCD operation and maintenance personnel is required. Provide competent, factory authorized personnel to provide instruction to TCCD operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. The instruction shall be scheduled in coordination with the TCCD Project Manager after submission and approval of formal training plans. Refer to Section 019113, Commissioning, for contractor training requirements.

END OF SECTION

26 05 00 BASIC ELECTRICAL MATERIALS AND METHODS

1.00 GENERAL

1.01 WORK INCLUDED

- A. Hinged cover enclosures and cabinets
- B. Contactors
- C. Control relays
- D. Push buttons, and selector switches
- E. Terminal blocks and accessories
- F. Penetration sealing systems (fire stops)

1.02 APPLICABLE CODES AND STANDARDS

- A. NFPA 70, National Electrical Code (latest edition)
- B. American National Standard C2, National Electrical Safety Code, (latest edition)
- C. Applicable publications of NEMA, ANSI, IEEE, and ICEA
- D. Underwriters Laboratories, Inc. Standards (UL)
- E. Federal, city, state, and local codes and regulations having jurisdiction
- F. OSHA requirements
- G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)
- H. NEMA WD 1 – General-Purpose Wiring Devices
- I. UL 98 - Enclosed Switches

1.03 INTENT

- A. This Section is not, and shall not be interpreted to be, a complete listing of all materials or equipment that is Contractor furnished and erected. It is intended to clarify and further define the Contractor scope of work, procurement, and responsibilities for those incidental materials that are not specified by other specifications, but important to a complete and operational system.
- B. The Contractor shall furnish all equipment and materials, whether or not specified in other Sections of specification and on drawings, for installation and connection required to place equipment into satisfactory operating service. The Contractor shall review the Drawings and specifications for clarification of his responsibility in the handling and installation of equipment and material. Where applicable, and not in contradiction with the Drawings and specifications, the Contractor shall install and connect the equipment in accordance with the manufacturer's recommendations and instructions.
- C. All materials and equipment shall be of types and manufacturer specified wherever practical. Should materials or equipment so specified be unattainable, the Contractor shall submit the description and manufacturer's literature, reason for substitution request, and

shall secure the approval of the Engineer before substitution of other material or equipment is purchased. This Section establishes performance requirements and the quality of equipment acceptable for use and shall in no way be construed to limit procurement from other manufacturer.

1.04 SUBMITTALS

- A. Provide submittals in addition and in accordance with Section 260000, Basic Electrical Requirements, and Division 01 for submittal requirement.
- B. Submit manufacturer's literature and specification data sheets for each type of basic material, which is applicable to the project.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Provide factory-wrapped waterproof flexible barrier material for covering materials, where applicable, to protect against physical damage in transit. Damaged materials shall be removed from project site.
- B. In their factory-furnished coverings, store materials in a clean, dry indoor space, which provides protection against the weather.

2.00 PRODUCTS

2.01 ENCLOSURES AND CABINETS

- A. Enclosures and cabinets for all Contractor furnished electrical equipment and devices shall be suitable for the location and environmental conditions and shall be of the NEMA type as shown in Table 1. Exceptions shall be as specifically designated on the Drawings.

Table 1 Enclosures		
Location	Environment	Enclosure Type
Indoor Utility	Dry, subject to dust, falling dirt and dripping non-corrosive liquids	NEMA 12
Indoor	Clean, Dry	NEMA 1
Outdoor	Subject to windblown dust and rain, splashing water, and hose-directed water	NEMA 4
Indoor	Wet, subject to hose-directed water	NEMA 4
Outdoor	Subject to falling rain, sleet, and external ice formation	NEMA 3R
Indoor or Outdoor	Subject to corrosion, windblown dust and rain, splashing water and hose-directed water	NEMA 4X

- B. Enclosures shall have the following properties:
 - 1. Hinged Cover Enclosures: NEMA 250.
 - a. Type 1: Steel.
 - b. Type 4: Steel with gasket door, rain tight.
 - c. Type 4X: Stainless steel.
 - d. Type 12: Steel with gasketed door, dust-tight.
- C. Finish: Exterior, manufacturer's standard gray enamel finish; interior, white enamel finish.
- D. Covers: Continuous hinge, held closed by flush latch operable by hasp and staple for padlock. Where required for NEMA ratings, gaskets shall be neoprene rubber.
- E. Interior Panel for Mounting Terminal Blocks or Electrical Components: 14-gauge steel, white enamel finish.
- F. Provide protective pocket inside front cover with schematic diagram, connection diagram, and layout drawing of control wiring and components within enclosure.
- G. Forced Ventilation: Where indicated, provide 115V single-phase fan motor, filtered with air plenum, finger guard, and stainless steel grille. Washable aluminum filter, accessible for cleaning from outside the enclosure; 20,000-hour continuous operation without lubrication or service. Provide matching exhaust grille assembly. Mount fan in lower side corner, exhaust grille in opposite upper side corner.

2.02 CONTACTORS

- A. Acceptable Manufacturers
 - 1. Square D or approved equal.
- B. Contactors: NEMA ICS 2; electrically held or mechanically held as indicated on Drawings. Two-wire control for electrically held contactors and three-wire control for mechanically held contactors.
- C. Enclosure: NEMA 1 unless indicated otherwise on Drawings.
- D. Control Transformer: Provide when indicated on Drawings or as required even if not indicated on drawings. Minimum capacity shall be 100 VA. Provide primary and secondary fuse protection.
- E. Coil operating voltage; 110 volts, 60 Hz or as per drawings.
- F. Size: NEMA ICS 2; size as shown or as required.
- G. Contacts: Ampacity as indicated on Drawings; 600 Volts, 60 Hz. (minimum 30A).
- H. Provide solderless pressure wire terminals on bus terminals suitable for mounting in panelboard as indicated on Drawings.

2.03 CONTROL RELAYS

- A. Acceptable Manufacturers
 - 1. General Electric Type CR120A

2. Cutler-Hammer Type M-300
 3. Square D Company
 4. Allen-Bradley
 5. Other manufacturers equal in design and function will be considered upon A/E approval following substitution procedure in 260000 and Division 01 for substitution requirement.
- B. Provide magnetic control relays, NEMA Class A: A300 (300 volts, 10 amps continuous, 7,200 VA make, 720 VA break), industrial control type with field-convertible contacts, and meeting the requirements of NEMA ICS 2.
 - C. Where time delay relays are specified or required, unless otherwise noted, provide magnetic control relays with a solid-state timer attachment adjustable from 0.2 to 60 seconds (minimum) or with range as indicated. Provide with field convertible from ON delay to OFF delay and vice versa.
 - D. Where latching (mechanically held) relays or motor thermal detector relays are specified or required, provide magnetic control relays with mechanical latch attachment with unlatching coil and coil clearing contacts.

2.04 PUSH BUTTONS, AND SELECTOR SWITCHES

- A. Acceptable Manufacturers
 1. Allen-Bradley
 2. Square D
 3. Cutler Hammer
 4. Siemens
 5. Other manufacturers equal in design and function will be considered upon A/E approval following substitution procedure in 260000 and Division 01 for substitution requirement.
- B. For non-hazardous, indoor, dry locations, including control panels, and individual stations, provide heavy duty, NEMA 13, oil tight type pushbuttons, indicating lights, selector switches, and stations for these devices.
- C. For non hazardous, outdoor, or normally wet locations, or where otherwise indicated, provide heavy duty corrosion resistant, NEMA 4, watertight type pushbuttons, indicating lights, or selector switches mounted in NEMA 4 watertight enclosures. Provide special gasketing required to make complete station watertight.
- D. For hazardous locations, provide control station listed by UL for Class I, Divisions 01 and 02, Groups C and D; Class II, Division 01 and 02, Groups E, F, and G. Specific type shall be in accordance with area classification.
- E. Provide devices meeting the requirements of NEMA ICS 2, and having individual, extra large nameplates indicating their specific function. Provide push-button stations with laminated plastic nameplates indicating the drive they control. Provide contacts with NEMA designation rating A600. Install provisions for locking pushbuttons and selector switches in

the OFF position wherever lockout provisions are indicated. Nameplates shall be as specified in Section 260553.

- F. Utilize selector switches having standard operating levers. All indicating lights shall be LED type, push-to-test type. Provide ON or START pushbuttons colored black. Provide OFF or STOP pushbuttons colored red.

2.05 TERMINAL BLOCKS AND ACCESSORIES

A. Signal And Control Terminals

- 1. Acceptable Manufacturers
 - a. Phoenix Contact
 - b. Buchanan
 - c. Weidmüller
 - d. Entrelec
 - e. Other manufacturers equal in design and function will be considered upon A/E approval following substitution procedure in 230000 and Division 01 for substitution requirement.
- 1. Signal and Control Terminals: Modular construction type, DIN 46 277/3 channel mounted; screw clamp compression connectors, rated 300 volts. Minimum terminal width of 0.24-inch, capable of holding two No. 12 or two No. 14 AWG conductors in each connector. Terminal identification numbers shall be thermoset characters (black) on a white background. Provide 25 percent spare terminals.

B. Power Terminals

- 1. Acceptable Manufacturers
 - a. Buchanan
 - b. Ilsco
 - c. Square D Company
 - d. Burndy
 - e. Other manufacturers equal in design and function will be considered upon A/E approval following substitution procedure in 260000 and Division 01 for substitution requirement.
- 2. Power Terminals: Unit construction type, closed-back type, with tubular pressure screw connectors, rated 600 volts, size as required. Provide 25 percent spare terminals.

2.06 PENETRATION SEALING SYSTEMS (FIRE STOPS)

- A. Provide penetration sealing where conduit, cable tray, etc. pass through rated walls, ceilings, and floors. See Section 078413, Fire Stopping, and Section 079200, Joint Sealants, for sealing requirements and systems.

2.07 UL LISTING

- A. All equipment and materials shall be new and conform to the requirements of this Section. All equipment and materials shall be UL listed, and shall bear their label whenever standards have been established and level service is regularly furnished. All equipment and materials shall be of the best grade of their respective kind for the purpose.

3.00 EXECUTION

3.01 FABRICATION - CONTROL ENCLOSURES AND CABINETS

- A. Shop assemble enclosures and cabinets housing terminal blocks or electrical components in accordance with NEMA ICS 6.

3.02 INSTALLATION - ENCLOSURES AND CABINETS

- A. Install cabinets and enclosures plumb; anchor securely to wall and structural supports at each corner, minimum. Direct attachment to dry wall is not permitted.
- B. Provide accessory feet for freestanding equipment enclosures.
- C. Install trim plumb.

3.03 ERECTION OF EQUIPMENT

- A. Manufacturer's Installation Instructions: Where furnished or called for by the manufacturer equipment manufacturer's installation instructions shall be considered a part of this specification and fully complied with. Where the Contractor damages the finishing coat of paint in existing or completed areas, he shall refinish with matching paint.
- B. Mounting: Equipment and control devices shall be supported independent of conduit connections. Panels or cabinets shall be mounted on metal frame supports independently of equipment. Control devices and metal enclosures shall be bolted or welded to steel channel or steel plate. All electrical equipment and devices not covered by the above, such as miscellaneous switches, thermostats, duct switches, temperature switches, floats, photoelectrical devices, and similar electrical devices shall be located and set as suitable for the application. Where control panels are provided as part of the equipment racks mounted on the floor, they shall be provided to support conduits and flexible connections to control panels.

3.04 COORDINATION

- A. Exact location of all electrical equipment, devices and fixtures shall be determined in field by contractor and verified by Engineer's field representative prior to installation.

END OF SECTION

26 05 12 ELECTRICAL TESTING AND LOAD BALANCING

1.00 GENERAL

1.01 WORK INCLUDED

- A. Perform test, balance, final adjustment, etc., and record data for electrical work as described herein.

1.02 SUBMITTALS

- A. Submit data record forms for approval before conducting any tests or making final adjustments, torquing, balancing, etc.

2.00 PRODUCTS

Not used.

3.00 EXECUTION

3.01 TESTING

- A. 600V Conductors:
 - 1. Megger test feeder conductors at 600 volts dc. Record value for each feeder conductor. Conductors which test below 50 megohms shall be replaced. Retest new conductors and record data.
 - 2. Perform continuity test on all feeder and branch circuit conductors.
 - 3. Torque all feeder and branch circuit connections and terminations to manufacturer's recommended values.
- B. Medium Voltage Conductors:
 - 1. VLF test all medium voltage conductors. Record value for each conductor. Replace any conductors that do not pass per manufacture recommendations.
- C. Grounding:
 - 1. Measure and record ground resistance from system neutral connection at service entrance to ground reference point using suitable ground testing equipment. Resistance shall not exceed 2 ohms.
 - 2. Test continuity and bonding of raceway systems, enclosures, etc.
 - 3. Record data for each test.
- D. Control Wiring:
 - 1. Test for proper connection before energization of equipment. System shall be completely tested to verify proper operation.
- E. Panelboards:
 - 1. Test insulation resistance for each panelboard and switchboard bus, component, connecting supply, feeder, and control circuit.

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard and panelboard.
 4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- F. Manual Transfer Switches:
1. Acceptance Test: The extent of testing will be at the discretion of the Architect/Engineer. The manufacturer shall certify that the settings are adjusted properly and all control and power wiring is per specification.
 2. Operational and functional demonstration.
- 3.02 DEVICE TRIP SETTINGS
- A. Equipment manufacturer field service personnel shall adjust and set all devices in accordance with approved results of "System Coordination and Analysis".
- 3.03 BUS TORQUING
- A. All bolted bus connections shall be made using a torque wrench.
- B. Bus and lug connections in panelboards shall be in accordance with manufacturer's specifications.
- 3.04 LOAD/VOLTAGE DATA
- A. Record amperage of each phase and neutral in each panelboard.
- B. Record voltage line-to-neutral and line-to-line of all phases in each panelboard and switchboard. Record each reading.
- 3.05 MECHANICAL ADJUSTMENT
- A. Adjust all operating mechanisms of electrical equipment for free mechanical movement.
- 3.06 3RD PARTY QUALITY & CERTIFICATION TESTING & CX WITNESSING
- A. Coordinate with the Commissioning Authority for scheduling and witnessing of 3rd party quality and certification testing. All 3rd party quality and certification testing reports are to be provided to the Commissioning Authority. Refer to Section 019113, Commissioning.

END OF SECTION

26 05 13 MEDIUM VOLTAGE CABLES

1.00 GENERAL

1.01 DESCRIPTION OF WORK

- A. The extent of medium voltage cable work is indicated by drawings and by the requirements of this Section.

1.02 REFERENCES

- A. AEIC CS6-96 – Specifications for Ethylene Propylene Rubber Insulated Shielded Power Cables Rated 69 kV
- B. ASTM B8-04 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
- C. ICEA S-93-639/NEMA WC74 – Shielded Power Cables Rated 5 – 46 kV
- D. ICEA S-97-682 – Utility Shield Power Cables Rated 5 - 46 kV
- E. IEEE 48 – Standard Test Procedures and Requirements for Alternating-Current Cable Terminations 2.5 kV through 765 kV
- F. UL 1072 – Medium-Voltage Power Cables
- G. IEEE 400 – Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems

1.03 QUALITY ASSURANCE

- A. Manufacturer shall be a firm specializing in manufacturing medium voltage cable and accessories with minimum ten years documented experience.
- B. Installer shall be a firm with at least five years of successful installation experience on projects with electrical work similar to that required for this project.
- C. NEC Compliance: Comply with the National Electrical Code (NFPA 70) as applicable to construction and installation of electrical cable, and terminations required for this project.
- D. Product Delivery, Storage Handling:
 - 1. Provide factory wrapped waterproof flexible barrier materials for covering cable on wooden reels. Cable ends shall be properly sealed to prevent water propagation.
 - 2. Store cable in factory finished covering and in clean, dry place which provides protection against weather.

1.04 SUBMITTALS

- A. Provide submittals in accordance with and in addition to Section 26 00 00, Basic Electrical Requirements, and Division 01 for submittal requirement.
- B. Submit evidence documenting manufacturer's ten-year experience in medium voltage cable and accessories manufacturing. Submit manufacturer's data on electrical cable and terminations.

- C. Submit a list of previous work evidencing at least five years' experience in medium voltage cable installation of similar type.
- D. Submit name and experience record of each person to be engaged in medium voltage cable work. Only those persons accepted by the Owner will be permitted to engage in medium voltage cable work.
- E. Submit three copies of cable manufacturers' certified test report prior to installation of cable.
- F. Submit original and two copies of certified field test report.

2.00 PRODUCTS

2.01 CABLE (MEDIUM VOLTAGE)

- A. Provide cable and terminations of manufacturer's standard materials as indicated by published product information designed and constructed as recommended by the manufacturer and as required by the application.
- B. Power cable shall be single conductor copper, ethylene propylene rubber insulated, 133% insulation level with copper tape shielding and overall sunlight resistant PVC jacket. Cable shall conform to ICEA S-93-639, ICEA S-97-682, AEIC CS6-96, UL 1072, and shall be UL listed as Type MV-105. Voltage ratings and conductor sizes shall be as shown on the drawings.
- C. Cable reel shall bear a tag containing name of manufacturer, UL label, cable type and year and month of manufacture. Cable shall be imprinted with name of manufacturer, UL label, cable type and year and month of manufacture.
- D. Cable to be furnished in continuous length and shall be free of kinks and defects at time of delivery to jobsite.
- E. Provide XHHW stranded copper ground conductor in each conduit with phase conductors. Size for ground conductor shall be as shown on the Drawings.
- F. Medium voltage terminations shall be as follows:
 - 1. Elbow Terminators:
 - a. 200 ampere, loadbreak, equal to Elastimold Type 273LR series with shield terminator with appropriate shield adapt kit.
 - b. 600 ampere, equal to Elastimold with shield terminator and appropriate shield adapt kit.
 - c. Shall be compatible with switchgear and cable being installed.
- G. Electrical tapes shall be equal to those manufactured by 3M as follows:
 - 1. Fire Retardant Electric Arc Proofing: Scotch 77
 - 2. Glass Cloth: Scotch 69
 - 3. Self-fusing Silicone Rubber: Scotch 70
 - 4. Vinyl Plastic: Scotch 88

3.00 EXECUTION

3.01 INSPECTION

- A. Examine areas and conditions under which medium voltage cable terminations are to be installed and notify the Architect/Engineer in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install medium voltage cable and terminations as indicated in accordance with the manufacturer's written instructions, the applicable requirements of NEC and the National Electrical Contractors Association's "Standard of Installation", and in accordance with recognized industry practices to ensure that products serve the intended functions.
- B. Conduit shall be swabbed to ensure debris free. Rubber duct swabs shall be sized to conduit used. Do not exceed cable pulling tensions and bending radius recommended cable manufacturer.
- C. Cable lubricant used on pulls shall be appropriate type or as specified by cable manufacturer. All conduits shall be pre-lubricated with lubricant placed in each conduit ahead of a rubber duct swab and pulled in just before each cable pull.
- D. Ground cable shield at each termination.
- E. Medium Voltage Cable Identification:
 - 1. Identify cables as to phase and circuit at each accessible location such as manholes, pull boxes, switchgear, and pad mounted transformers. Identification to be accomplished by means of plastic tags permanently affixed to cable embossed in letters no less than 1/2" high.
 - 2. Arrange tags such that they can be read without moving cables.
- F. Fireproof exposed medium voltage cable at manholes, switchgear, vaults, pull boxes and pad mounted transformers as follows:
 - 1. Apply one half-lapped wrap of fire retardant electric arc proofing tape over exposed areas of cable extended one inch into ducts.
 - 2. Secure ends of fireproofing tape with two wraps of glass cloth tape.
- G. Where cable terminates in a stress cone, wrap exposed insulation with half-lapped layer of self-fusing silicone tape applied without stretch. Secure ends of silicone tape with vinyl plastic tape to prevent ravel.
- H. Damaged cable jacket and/or insulation will be cause for rejection of cable. Do not install cable if jacket is damaged in any way. No kinks are permitted and the bends are to be kept in accordance with the minimums recommended by the manufacturer. Pull cables directly into the duct from the coil or reel on which they are received. Cable shall not be pulled off and laid on the ground prior to installation. Make pulls in one direction.

- I. Splices are not permitted for new pulls. Contractor shall pull all cables in continuous lengths unless splices are specified by the Engineer. Splices are permitted only where indicated on the Drawings. The installer shall be a trained and certified technician for such special installation with appropriate splicing kit and materials.
- J. Provide cable lengths with liberal allowances for slack for terminating. If pulling grips are used, sufficient excess cable shall be allowed so that damage due to the pulling grips can be removed prior to terminating. Use rubber tape to seal cable ends. Cable shall not be pulled with the ends open. Where cable requires more than one pull, the Contractor shall lay down new 6-mil PVC plastic sheathing on the ground in the lay down area. The cable shall not be dragged across this surface, but will be permitted to be laid on the surface between pulls. Cable ends shall be moisture proofed at all times until terminations are installed.
- K. Provide pull-in guides, cable feeders or draw-in protectors to prevent damage to the cable at the duct mouths. Pull cable by grips on the conductors with proper taping of the insulation to prevent pushback. Short lengths may be pulled with cable grips around the entire group; however, care should be taken to ensure equal distribution of tension and any damaged ends must be cut off and discarded before terminating the cable.
- L. Stop pulling instantly if undue tension occurs. Lubricant shall be used to facilitate pulling and shall be compatible with the type of cable used.
- M. Identify individual phases of each power circuit at points near each end of the cables. Before connections are made at cable terminals, check by ringing out or talking over each conductor by means of a portable hand telephone set. Identify circuits before terminal connections are made by one of the methods specified above.

END OF SECTION

26 05 18 ELECTRICAL CONNECTIONS TO EQUIPMENT

1.00 GENERAL

1.01 WORK INCLUDED

- A. The extent of electrical connections to equipment is indicated on the drawings and in schedules, in other Divisions of the specifications, and by the requirements of this section, and is hereby defined to include (but not necessarily limited to) connections for providing electrical power to equipment.
- B. The types of electrical connections specified in this section include, but are not necessarily limited to, the following:
 - 1. Miscellaneous equipment

1.02 SUBMITTALS

- A. Submit manufacturer's product data on materials to be used on project.

2.00 PRODUCTS

2.01 MATERIALS AND COMPONENTS

- A. For each electrical connection indicated, provide a complete assembly of materials, including but not necessarily limited to the following:
 - 1. Pressure connectors
 - 2. Terminals (lugs)
 - 3. Electrical insulating tape
 - 4. Heat shrinkable tubing
 - 5. Cable ties
 - 6. Solderless wire nuts
 - 7. Conductors
- B. Furnish materials and components in compliance with equipment manufacturer's recommendations for the intended application.

3.00 EXECUTION

3.01 INSTALLATION OF ELECTRICAL CONNECTIONS

- A. Install electrical connections as indicated, in accordance with recognized industry practices to ensure that products serve the intended functions.
- B. Connect electrical power supply conductors to equipment conductors in accordance with other sections of the specifications and in accordance with equipment manufacturer's written instructions and wiring diagrams. Wherever possible, match conductors of the electrical connection for proper interface between the electrical supply and the installed equipment.
 - 1. Cover splices with electrical insulation equivalent to, or of a higher rating, than insulation on the conductors being spliced.

2. Prepare cables wires and, by cutting and stripping covering armor, jacket, and insulation properly to ensure a uniform and neat appearance where cables and wires are terminated.
 3. Trim cables and wires to be as short as practicable and arrange routing to facilitate inspection, testing and maintenance.
- C. Provide conduit for connections in accordance with other sections of the specifications.
- D. Coordinate installation of electrical connections to the equipment with equipment installation work and as follows:
1. Make electrical connections to equipment furnished under other sections of the Contract Documents.
 2. Furnish wiring, conduit, outlet boxes, disconnect switches, etc., as required for same throughout the project.
 3. Check the General Construction, Civil, Landscape, Landscape, etc. drawings and specifications and determine the amount of required wiring for final connections.
 4. Verify locations, horsepower, voltages, etc., of all such equipment as the work progresses.
 5. Advise the Architect/Engineer immediately, for clarification, if an apparent conflict arises in control wiring, power wiring, etc.
- E. Due to manufacturer's changes or substitutions, equipment furnished under the mechanical and other sections of the specifications may require different rough-in and power requirements than indicated on the plans. Secure detailed drawings from the Contractor furnishing the equipment, to determine actual rough-in locations, and conduit and conductor requirements to assure a proper and workmanlike installation.
- 3.02 FINAL CONNECTIONS FOR EQUIPMENT FURNISHED BY OWNER OR UNDER OTHER SECTIONS OF THE CONTRACT DOCUMENTS
- A. SEWAGE EJECTOR UNIT: It is the Contractor's responsibility to obtain the submittal data for sewage ejector equipment, check the data, and provide required electrical, including conduit and conductors, circuit breakers, fuses, disconnects, etc., to accommodate changes or variations in the drawings and/or specifications.
- B. SUMP PUMPS: It is the Contractor's responsibility to obtain the submittal data for sump pump equipment, check the data, and provide required electrical, including conduit and conductors, circuit breakers, fuses, disconnects, etc., to accommodate changes or variations in the drawings and/or specifications.
- C. OTHER EQUIPMENT AND SYSTEMS: It is the Contractor's responsibility to obtain the submittal data for other equipment and systems, check the data, and provide required electrical, including conduit and conductors, circuit breakers, fuses, disconnects, etc., to accommodate changes or variations in the drawings and/or specifications.

END OF SECTION

26 05 19 CABLE, WIRE AND CONNECTORS, 600 VOLT

1.00 GENERAL

1.01 WORK INCLUDED

- A. Building wire.
 - 1. Power distribution circuitry.
 - 2. Control system circuitry.
 - 3. Lighting circuitry.
 - 4. Appliance and equipment circuitry.
 - 5. Motor-branch circuitry.
 - 6. Outdoors lighting and power.
 - 7. Other systems circuitry as designated.
- B. Cable.
- C. Wiring connections and terminations.

1.02 REFERENCES

- A. NEMA WC 3 - Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
- B. NEMA WC 5 - Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
- C. ANSI/UL 83 – Thermoplastic-Insulated Wire and Cables
- D. NFPA 70 – National Electrical Code, latest edition
- E. NEFA – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- F. Where application of National Electrical Code, trade association standards or publications appears to be in conflict with the requirements of this Section, the Architect/Engineer shall be asked for an interpretation.

1.03 SUBMITTALS

- A. Provide submittals in accordance with and in addition to Section 260000, Basic Electrical Requirements, and Division 01 for submittal requirement.
- B. Submit manufacturer's literature and specification data sheets for each item of cable, wire and connectors.
- C. Qualification of cable and wire manufacturer: Company specializing in manufacturing products specified in this Section with minimum ten years experience.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Provide factory-wrapped waterproof flexible barrier material for covering wire and cable wood reels, where applicable; and weather resistant fiberboard containers for factory packaging of cable, wire and connectors, to protect against physical damage in transit. Damaged cable, wire or connectors shall be removed from project site.
- B. Store cable, wire and connectors in a clean, dry indoor space in their factory-furnished coverings, which provides protection against the weather.

2.00 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Generally, cable, wire and connectors shall be of manufacturer's standard materials, as indicated by published product information.
- B. Provide factory-fabricated wire of the size, rating, material and type as indicated for each service. Where not indicated, provide proper selection as required to comply with installation requirements and with NEC standards. The minimum size wire to be used for power, control or lighting circuits shall be #12 copper with insulation as noted below.
- C. If more than three phase conductors are installed in a single raceway, the conductors shall be derated in accordance with the National Electrical Code. Increase wire size so that resulting ampacity, after derating factor is applied, is equal to or greater than ampacity of conductor specified.
- D. The conductors of wires and cables shall be of copper (tinned where specified), and have conductivity in accordance with the standardization rules of the IEEE. The conductor and each strand shall be round and free of kinks and defects. Provide aluminum conductors as noted on drawings for feeders rated 100 amps and larger.
- E. Grounding conductors, where insulated, shall be colored solid green or identified with green color as required by the NEC. Conductors intended as a neutral shall be colored solid white, or identified as required by the NEC. All motor or equipment power wiring shall be colored according to Section 260553, Electrical Identification.
- F. Use compression lugs for all wiring termination's, except on breakers or terminal strips in panel boards.

2.02 BUILDING WIRE

- A. Thermoplastic-insulated Building Wire: NEMA WC 5.
- B. Rubber-insulated Building Wire: NEMA WC 3.
- C. Branch Circuits 10 AWG and Smaller: 98% conductivity copper, soft-drawn, solid conductor, 600 volt insulation, THHN/THWN. Use XHHW "USE" conductors where installed in conduit underground.
- D. Service, Feeders and Branch Circuits 8 AWG and Larger: 98% conductivity copper, soft-drawn, stranded conductor, 600 volt insulation, THHN/THWN. Use XHHW "USE" conductors where installed in conduit underground.

2.03 REMOTE CONTROL AND SIGNAL CABLE

A. 600 Volt Insulation Control Cable for Class 1 Remote Control and Signal Circuits, Type TC:

1. Individual Conductors: 12 AWG, stranded copper, XHHW insulation. Rated 90 degrees C dry, 75 degrees C wet, color-coded per ICEA Method 1 plus one green equipment grounding conductor.
2. Assembly: Bundle wrapped with cable tape and covered with an overall PVC jacket. Cable shall pass IEEE-1202 vertical tray ribbon-burner flame test (210,000 BTU) VW-1.

B. Instrumentation Cable

1. 300 Volt Instrumentation Cable, Multiple Pairs, Overall Shield, Type PLTC:

- a. Individual Conductors: 18 AWG, stranded, tinned copper, flame retardant polyethylene or PVC insulated, rated 105 degrees C, black and white numerically printed and coded pairs.
- b. Assembly: Individual twisted pairs having a 100 percent coverage aluminum-polyester shield and 20 AWG stranded tinned copper drain wire. Conductor bundle shall be shielded with 100 percent coverage overall aluminum-polyester shield complete with 20 AWG drain wire. All group shields completely isolated from each other. Bundle wrapped with cable tape and covered with an overall flame retardant PVC jacket. Cable shall pass IEEE-383 vertical tray flame test (70,000 BTU) UL1581.

2.04 WIRING CONNECTIONS AND TERMINATIONS

A. Provide factory-fabricated, metal connectors of the size, rating, material, type and class as indicated for each service. Where not indicated, provide proper selection as required to comply with installation requirements and with NEC standards. Select from only following types, classes, kinds and styles.

1. Type:
 - a. Solderless pressure connectors.
 - b. Crimp.
 - c. Threaded.
 - d. Insulated spring wire connectors with plastic caps for 10 AWG and smaller.
2. Class:
 - a. Insulated.
3. Material:
 - a. Copper (for CU to CU connection).
4. Style: Pigtail connector.
 - a. Parallel and tee connectors equal to ILSCO and GTA and GTT with ILSCO insulating cover. Parallel and tee connections shall be used only where specifically detailed. (Split bolt type connectors are not permitted.)
5. Pigtail Adaptors

- B. Terminate and splice #6 AWG and larger conductors with high conductivity, wrought copper, color-keyed compression connectors. Where three (3) or more conductors are installed in wiring gutter, utilize a screw-type power distribution block.
- C. Connect and splice #8 AWG and smaller conductors with self-insulating, wire nut connectors.
- D. Install listed watertight connectors for wire and cable splices made in hand holes, manholes, and below grade.
- E. Install appropriately sized cable limiters (at both terminations) where two (2) or more sets of parallel conductors are required.

3.00 EXECUTION

3.01 INSPECTION

- A. Installer must examine the areas and conditions under which cable, wire and connectors are to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Inspect wire and cable for physical damage. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.02 GENERAL WIRING METHODS

- A. Install electrical cable, wire and connectors as indicated, in accordance with the manufacturer's written instructions, the applicable requirements of NEC and the National Electrical Contractors Association's "Standard of Installation", and as required to ensure that products serve the intended functions.
- B. Coordinate cable and wire installation work with electrical raceway and equipment installation work, as necessary for proper interface. Do not install the conductors until raceway system is complete and properly cleaned.
- C. Conductors shall be selected on the basis of their purpose and UL listing. Generally, use Types THWN and THHN in building interiors and other dry locations. Outdoors and underground in raceways, use Type XHHW "USE". Conductors subject to abrasion, such as in lighting poles, shall be Type THWN or THHN.
- D. No conductor smaller than No. 12 wire shall be used for lighting purposes. In the case of "home runs" over 60' in length (130' for 277 volt) no conductor smaller than a No. 10 wire shall be used. Conductor sizes shown on drawings are minimum and shall be increased as necessary to comply with voltage drop restrictions specified herein. The sizing of all wire except remote control wire shall be accomplished in the case of both feeder and branch circuits by conforming to the following provisions.
 - 1. 120/240 Volt Branch Circuits: The voltage drop in the case of 120/240 volt circuits shall not exceed 2.0% at maximum load and 70.0% power factor.
- E. Separate neutral conductor shall be provided for each 120V single-phase circuit, same size as phase conductors. Do not share neutrals between any two or more 120 volt circuits.
- F. Remote control wires shall be no smaller than No. 14 conductors. Control wires shall be run in separate conduits. Departures from the sizes so determined shall be made only in those cases in which the National Electrical Code requires the use of larger conductors. The sizes

as determined from these tables shall be regarded as the acceptable minimum under all other circumstances. In no case, however, shall there be a voltage drop greater than that specified in any feeder or branch circuit. The Contractor may, if he deems it necessary or advisable, use larger sized conductors than those shown. Under no circumstances, however, shall the Contractor use any conductors sized in a manner which does not conform to the above mentioned tables without having first secured the written approval of the Owner's duly authorized representative.

- G. Exposed wire and cable is not permitted. All wire and cable shall be installed in conduit.
- H. Splice branch circuits only in accessible junction or outlet boxes. Control cable shall never be spliced except the final connection to field devices. Where terminations of cables that are installed under this Section are to be made by others, provide pigtail of adequate length for neat, trained and bundles connections, minimum 5 feet at each location, unless noted otherwise on drawings.
- I. Wiring within an Enclosure: Contractor shall bundle ac and dc wiring separately within an enclosure. The Contractor shall utilize panel wireways when they are provided. Where wireways are not provided the Contractor shall neatly tag, bundle wires and secure to sub-panel at a minimum of every three inches with T&B Type TC5355 heavy duty mounting bases.
- J. Do not bend any conductor either permanently or temporarily during installation to radii less than four times the outer diameter of 600-volt insulated conductors.

3.03 WIRING INSTALLATION IN RACEWAYS

- A. Wire and cable shall be pulled into clean dry conduit. Do not exceed manufacturer's recommended values for maximum pulling tension and sidewall pressure.
- B. Pull conductors together where more than one is being installed in a raceway.
- C. Use UL listed pulling compound or lubricant, when necessary; compound must not deteriorate conductor and insulation.
- D. Do not use a pulling means, including fish tape, cable or rope, which can damage the raceway.
- E. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.
- F. Place an equal number of conductors for each phase of a circuit in same raceway.
- G. Provide separate conduit or raceway for line and load conductors of motor starters, safety disconnect switches, and similar devices. Those devices shall not share the same raceway.
- H. All conduits shall contain a green equipment grounding conductor. Conduit, wireways, or boxes shall not be used as the equipment grounding conductor.

3.04 CABLE INSTALLATION

- A. Provide protection for exposed cables where subject to damage during construction. Do not install cable before the completion of raceway system.

- B. Cable above ceilings shall be in conduit or raceways. Cables, conduits and raceways shall not be laid on ceiling tiles or strapped to ceiling wire.
- C. Use suitable cable fittings and connectors.
- D. It shall be the Contractor's responsibility to accurately measure all cable runs before the cable is cut. The Contractor shall furnish all tools and equipment, have sufficient properly trained personnel and shall exercise necessary care to ensure that the cable is not damaged during installation. Cable found to be damaged before installation shall not be installed. Cable damage during installation shall be removed and replaced. Repairs to cables can only be done with written permission from the Owner's Representative and only under special circumstances.
- E. Each cable entering an enclosure shall have its conductors bundled together and identified with the cable number. All groups of conductors within an enclosure shall be shaped and formed to provide a neat appearance to facilitate future additions or rework. All control conductors shall be numbered and shall be labeled at each termination with this number, using markers designed for the application.
- F. Instrument Cable: Instrument cable shall be installed in conduit. They shall not be spliced at any point. The shields and drain wires of shielded signal cables shall be grounded only at one point as indicated on the Drawings.

3.05 WIRING CONNECTIONS AND TERMINATIONS

- A. Install splices, taps and terminations, which have equivalent-or-better mechanical strength and insulation as the conductor. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.
- B. Keep conductor splices and taps accessible and to a minimum, and in junction boxes only. Control circuit conductors shall terminate at terminal blocks only. Do not splice below grade or in outdoor pull boxes.
- C. Use splice, tap and termination connectors, which are compatible with the conductor material.
- D. Thoroughly clean wires before installing lugs and connectors.
- E. Terminate spare conductors with electrical tape and label as spare. Do not energize.
- F. Power and Lighting Circuits: Use solderless pressure connectors with insulating covers for copper wire splices and taps, 4 AWG and larger. For 8 AWG and smaller, use insulated spring wire connectors with plastic caps on lighting and receptacle circuits.
- G. Connections for all wire sizes in motor terminal boxes where the motor leads are furnished with crimped-on lugs shall be made by installing ring type compression terminals on the motor branch circuit ends and then bolting the proper pairs of lugs together. First one layer of No. 33 scotch tape reversed (sticky side out), then a layer of rubber tape, then two layers of No. 33 half-lapped.
- H. Identify conductors per Section 260553 - Electrical Identification.

3.06 FIELD QUALITY CONTROL

- A. Torque test conductor connections and terminations to manufacturer's recommended values.
- B. Perform continuity test on all power and equipment branch circuit conductors. Verify proper phasing connections.
- C. Conductors in vertical conduits or raceways shall be supported in the manner set forth in the appropriate section of the latest revision of the National Electrical Code. Lighting fixtures shall not be used for raceways for circuits other than parallel wiring of fixtures.
- D. Conductors may be run in parallel as shown on drawings, provided all paralleled conductors are the same size, length, and type of insulation. They shall be so arranged and terminated as to ensure equal division of the total current between all conductors involved.

3.07 TESTING AND ACCEPTANCE

- A. Before final acceptance, the Contractor shall make voltage, insulation, and load tests, necessary to demonstrate to the Owner's representative the satisfactory installation and proper performance of all circuits.
- B. Test feeder conductors clear of faults. Insulation-resistance test shall be conducted per NETA – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems. Test results below 50 megohms shall be cause for rejection of the wiring installation. Replace and retest all such rejected conductor.
- C. At the completion of this project, the Contractor shall provide for the Owner three (3) complete and finally corrected sets of working drawings. These sets of working drawings shall be new, unused and in good condition, and shall include the nature, destination, path, size and type of wire and all other characteristics for complete identification of each and every conduit and circuit.
- D. 3rd Party Quality & Certification Testing & Cx Witnessing: Coordinate with the Commissioning Authority for scheduling and witnessing of 3rd party quality and certification testing. All 3rd party quality and certification testing reports are to be provided to the Commissioning Authority. Refer to Section 019113, Commissioning.

END OF SECTION

26 05 26 GROUNDING

1.00 GENERAL

1.01 WORK INCLUDED

- A. Power system grounding.
- B. Communication system grounding.
- C. Electrical equipment and raceway grounding and bonding.

1.02 REFERENCES

- A. NFPA 70 – National Electrical Code, latest edition
- B. ANSI/UL 467 – Electrical Grounding and Bonding Equipment
- C. ANSI/IEEE STD 142 – Recommended Practice for Grounding of Industrial and Commercial Power Systems
- D. IEEE 81 – Guide for Measuring Earth Receptivity, Ground Impedance and earth Surface Potential of a ground System
- E. IEEE 1100 – Recommended Practice for Powering and Grounding Sensitive Electronic Equipment
- F. ANSI/TIA/EIA 607 – Commercial Building Grounding and Bonding Requirements for Telecommunications

1.03 SYSTEM DESCRIPTION

- A. Ground the electrical service system neutral at service entrance equipment to grounding electrodes. Electrical systems that are grounded shall be connected to earth in a manner that will limit the voltage imposed by lightning, line surges, or unintentional contact with higher-voltage lines and that will stabilize the voltage to earth during normal operations. Concrete encased electrodes shall be connected as the most effective grounding electrodes. Provide a completely grounded system in accordance with Article 250 of the NEC.
- B. Ground each separately-derived system neutral to separate ground buses that are installed in nearest electrical rooms. Standby or emergency generators are separately derived systems if the neutral is bonded to the generator frame and if there is no direct connection of the generator neutral conductor to the service neutral conductor.
- C. Bond together system neutrals, service equipment enclosures, exposed non-current carrying metal parts of electrical equipment, metal raceway systems, cable sheath, ground bus in electrical equipment enclosures, metal frame of the building or structure, ground ring, grounding conductor in raceways and cables, receptacle ground connectors, metal underground water pipe, and plumbing systems.
- D. Bonding jumpers shall be installed around non-metal fittings or insulating joints to ensure electrical continuity. Bonding shall be provided where necessary to ensure electrical continuity and the capacity to conduct safely any fault current likely to be imposed.

- E. Supplementary Grounding Electrode: Use minimum of three driven ground rods in main service equipment area, effectively grounded metal frame of the building and minimum of 20 feet No. 4 bare copper wire embedded in concrete foundation.

1.04 SUBMITTALS

- A. Provide submittals in accordance with and in addition to Section 260000, Basic Electrical Requirements, and Division 01 for submittal requirement.

1.05 COMMISSIONING

- A. Commissioning of a system or systems specified in this section is part of the construction process. Documentation and testing of these systems, as well as training of the maintenance personnel, is required in cooperation with SRA Project Manager and the Commissioning Authority. Project Closeout is dependent on successful completion of all commissioning procedures, documentation, and issue closure. Refer to Section 019113, Commissioning, for detailed commissioning requirements.

2.00 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. Grounding system components shall be as required to comply with the design and construction of the system indicated. Components shall be as indicated in manufacturer's submittal data.
- B. Ground conductors shall be stranded tinned, annealed copper cable of the sizes indicated on drawings. Bond grounding conductors at both ends of metallic conduit.
- C. Grounding clips shall be Steel City Type G, or equal.
- D. Ground Rods shall be copper-encased steel, 3/4" diameter, minimum length 10 feet.
- E. Conductors in contact with soil shall be insulated and suitable for direct burial, except ground ring shall be bare.

3.00 EXECUTION

3.01 INSTALLATION

- A. Install ground system as indicated, in accordance with the applicable requirements of the National Electrical Code and the National Electrical Contractors Association's "Standard of Installation".
- B. Install grounding conductors continuous, without splice or connection, between equipment and grounding electrodes. Install test wells at all ground rods.
- C. In feeder and branch circuits, provide a separate, insulated equipment grounding conductor. Terminate each end on a grounding lug, bus, or bushing.
- D. Connect grounding electrode conductors to metal water pipe where metal pipe is available and accessible using suitable ground clamp. Make connections to flanged piping at street side of flange. Provide bonding jumper around water meter.

- E. Install fusion welded ground connectors where they are concealed or inaccessible.
- F. Ground each outlet by the use of an approved grounding clip attached to the junction box in such a position to be readily inspected on removal of the cover plate; or by the use of an approved grounding yoke type receptacle.
- G. No strap grounding clamps shall be used; connections requiring bolting shall be made up with monel metal bolts, washers and nuts. Connections shall be made only after surfaces have been cleaned, or ground to expose virgin metal.
- H. Install external ground wire on liquid tight flexible metal conduit with grounding bushings.
- I. Conductor connections shall be made by means of solderless connectors such as serrated bolted clamps or split bolt and nut type connectors.
- J. The neutral of each transformer shall be bonded to system ground at one point only. This point shall be ahead of the first secondary protective device.
- K. Connect grounding conductors to ground rods at the upper end of the rod with the end of the rod and the connection points below finished grade. Below grade connection shall be exothermic-welded type connectors as manufactured by Cadweld, Thermoweld.
- L. Provide grounding and bonding at pad-mounted transformer and portable generator location.

3.02 FIELD QUALITY CONTROL

- A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.
- B. Measure ground resistance from system neutral connection at service entrance to convenient ground reference point using suitable ground testing equipment. Resistance shall not exceed 2 ohms. Provide additional ground rod as required until resistance reading is 2 ohms or less.

3.03 FUNCTIONAL PERFORMANCE AND INTEGRATED SYSTEMS TESTING

- A. Functional Performance & Integrated Systems Testing is part of the Commissioning Process. Functional Performance & Integrated Systems Testing shall be performed by the contractor and witnessed and documented by the Commissioning Authority. Refer to Section 019113, Commissioning, for functional performance and integrated systems testing and commissioning requirements.

END OF SECTION

26 05 29 SECURING AND SUPPORTING METHODS

1.00 GENERAL

1.01 WORK INCLUDED

- A. Raceway, cable tray, and equipment supports.
- B. Fastening hardware.
- C. Coordinate location of concrete equipment pads.

1.02 QUALITY ASSURANCE

- A. Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry. Support systems shall be sized adequately to support an additional 25% for future loads

1.03 SUBMITTALS

- A. Provide submittals in accordance with and in addition to Section 260000, Basic Electrical Requirements, and Division 01.

2.00 PRODUCTS

2.01 MATERIAL

- A. Support Channel:
 - 1. All non-corrosive locations: Hot-dip galvanized steel.
 - 2. Corrosive locations: Nonmetallic fiberglass.
- B. Hardware:
 - 1. All non-corrosive locations: Hot-dip galvanized steel.
 - 2. Corrosive locations: Stainless steel threaded rod, attachments and fasteners shall be used with fiberglass supports.
- C. Threaded Rod: Used for rack support from structure above; 1/4-inch minimum diameter.

2.02 CONDUIT ANCHORING

- A. Conduit shall be securely anchored with split ring hangers, conduit straps, or other devices specifically designed for the purpose. Wire ties and spring clips are specifically not permitted. Do not support conduits from ceiling support wires.

3.00 EXECUTION

3.01 INSTALLATION

- A. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using precast insert system, expansion anchors, or beam clamps. Do not use spring steel clips and clamps. Provide necessary calculations to select proper support materials for

electrical equipment, raceway, and cable tray supports. Provide cable tray supports for cable tray filled to 125 percent capacity per NEC.

- B. Install hangers, anchors, sleeves and seals as indicated, in accordance with manufacturer's written instructions and with recognized industry practices to insure supporting devices comply with requirements. Comply with requirements of NEC for installation of supporting devices. Install supports with spacing in compliance with NEC requirements.
- C. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors in solid masonry walls; or concrete surfaces; sheet metal screws in sheet metal studs; and wood screws in wood construction.
- D. Do not fasten supports to piping, ductwork, mechanical equipment, or conduit.
- E. Do not use powder actuated anchors without written permission from the Engineer.
- F. Do not drill structural steel members without written permission from the Structural Engineer.
- G. Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.
- H. Bridge studs top and bottom with channels to support recessed mounted cabinets and panelboards in stud walls.
- I. Install surface mounted cabinets and panelboards with a minimum of four anchors. Provide strut channel supports to stand cabinet 1-5/8 inches off wall. Utilize "Post Bases" where support channel is attached to structural floor.
- J. Provide extra care in supporting PVC conduit to protect it from potential damage.
- K. Use fiberglass for nonmetallic raceway systems supports in areas subject to corrosives.
- L. Conduit supports shall have at a minimum, the bottom support member constructed of double strut. This horizontal member shall be double-nutted, and the supporting all-thread rod shall be trimmed to one inch below lowest nut.
- M. Coordinate with other electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work.
- N. Install freestanding electrical equipment on 4-inch concrete pads. Pad shall be a minimum four inches larger than equipment. No crevices shall be left around the pads. Equipment includes but not limited to the following:
 - 1. Transfer switches
- O. Do not anchor supports to columns. Where panelboards, cables, or conduits are routed on the face of a column provide "column hugging" channel supports.

3.02 TOUCH-UP

- A. Touch-up all scratches on securing and supporting system, and paint the ends of channel after cutting with an approved zinc chromate or 90 percent zinc paint.

END OF SECTION

26 05 33 RACEWAYS, CONDUITS AND BOXES

1.00 GENERAL

1.01 WORK INCLUDED

- A. Raceways:
 - 1. Wireways.
- B. Conduit:
 - 1. Rigid metal conduit and fittings (RGS).
 - 2. Electrical metallic tubing and fittings (EMT).
 - 3. Liquid-tight flexible metal conduit and fittings.
 - 4. Non-metallic conduit and fittings (underground use only).
- C. Boxes:
 - 1. Wall and ceiling outlet boxes.
 - 2. Pull and junction boxes.

1.02 REFERENCES

- A. NFPA 70 – National Electrical Code, latest edition
- B. ANSI C80.1 - Rigid Steel Conduit, Zinc-Coated
- C. ANSI C80.3 - Electrical Metallic Tubing, Zinc-Coated
- D. ANSI/NEMA FB 1 - Fittings and Supports for Conduit and Cable Assemblies
- E. EMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing
- F. ANSI/NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports
- G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)
- H. ANSI/NEMA TC 2 – Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80)
- I. ANSI/UL 1 – Flexible Metal Conduit
- J. ANSI/UL 360 – Liquid-tight Flexible Steel Conduit
- K. ANSI/UL 467 – Electrical Grounding and Bonding Equipment
- L. ANSI/UL 651 – Schedule 40 and 80 Rigid PVC Conduit (underground use only)
- M. ANSI/UL 797 – Electrical Metal Tubing
- N. ANSI/UL 870 – Wireways, Auxiliary Gutters and Fittings
- O. UL 6 – Rigid Metal Conduit
- P. ANSI/UL 498 – Attachment Plugs and Receptacles
- Q. ANSI/UL 943 – Ground Fault Circuit Interrupters

1.03 SUBMITTALS

- A. Provide submittals in accordance with and in addition to Section 260000, Basic Electrical Requirements, and Division 01 for submittal requirements.
- B. Shop drawings consisting of a complete list of equipment and materials, which will be used for the project, including manufacturer's descriptive and technical literature, catalog cuts and installation instructions.
- C. Sealing/fire stopping materials and details.
- D. Submit detailed shop drawing for Owner and Structural Engineer approval showing all conduits 2" and larger, all exposed conduits in finished areas regardless of size, and all conduits embedded in concrete structure regardless of size.
- E. Submit cable pulling tension and sidewall pressure calculations for all service, site, and feeder conduits.

1.04 STORAGE AND HANDLING

- A. Handle materials carefully to avoid damage, breaking, denting and scoring. Damaged equipment or materials shall not be installed.
- B. Store materials in a clean dry space and protected from the weather.

2.00 PRODUCTS

2.01 WIREWAYS

- A. Wireways shall be of steel construction general purpose for indoor spaces and rain tight for outdoor applications with knockouts.
- B. Submit proposed site and location for approval. Use wireways only where acceptable to Owner and Engineer.
- C. Cover shall be hinged or screw applied as indicated on Drawings. Rain tight wireways shall be provided with full gasketing.
- D. Fittings shall be so constructed to continue the "lay-in" feature through the entire installation.
- E. Provide all sheet metal parts with a rust inhibiting phosphatizing primer coating and finished in gray enamel. All hardware shall be cadmium plated to prevent corrosion.

2.02 CONDUIT AND FITTINGS

- A. Conduit and fittings for all electrical systems on this project shall include the following:
 - 1. Service entrance
 - 2. Electrical power and lighting feeders
 - 3. Electrical power and lighting circuits
 - 4. Other electrical systems

- B. For each electrical wireway system indicated, provide a complete assembly of conduit, tubing or duct with fittings including, but not necessarily limited to, connectors, nipples, couplings, locknuts, bushings, expansion fittings, other components and accessories as needed to form a complete system of the same type indicated.
- C. Conduit fittings shall be designed and approved for the specific use intended. Conduit fittings, including flexible, shall have insulated throats or bushings. Rigid conduits shall have insulated bushings, unless grounding bushings are required by N.E.C. Article 250. Grounding bushings shall have insulated throats.
- D. Rigid and intermediate metal conduit shall be hot-dipped galvanized. Fittings shall be threaded type. Expansion fittings shall be OZ Type DX.
- E. Electrical metallic tubing shall be galvanized. Fittings shall be all steel compression type. Expansion fittings shall be OZ Type TX.
- F. Malleable metal fittings are not acceptable.
- G. Liquid-tight flexible conduit and fittings shall consist of single strip, continuous, flexible interlocked, double-wrapped steel, galvanized inside and outside, forming smooth internal wiring channel with liquid-tight covering of flexible polyvinyl chloride (PVC). It shall be furnished with a sealing O-ring where entering an enclosure subject to moisture. Where O-Rings are used, ground type bushings shall be used in the box or enclosure.
- H. Nonmetallic conduit and fittings shall be suitable for temperature rating of conductor but not less than 90°C. Nonmetallic conduit and fittings shall be molded of high impact PVC compound having noncombustible, nonmagnetic, non-corrosive and chemical resistant properties and shall be of the same manufacturer. Solvent cement shall be of the same manufacturer as the conduit and shall be of the brush-on type. Spray solvents are prohibited. PVC coated metallic fittings shall not be permitted for PVC conduit connections.
- I. ENT is not acceptable.
- J. Provide strain relief fittings as manufactured by OZ for cables in vertical raceways.
- K. Crimp or set-screw type fittings are not acceptable.
- L. Minimum conduit size shall be 3/4 inch.
- M. Rigid steel conduit shall be taped where in contact with concrete.

2.03 WALL AND CEILING OUTLET BOXES

- A. Galvanized steel interior outlet wiring boxes of the type, shape and size, including depth of box, to suit each respective location and installation; constructed with stamped knockouts in back and sides, and with threaded holes with screws for securing box covers or wiring devices.
 - 1. Outlet box accessories as required for each installation, including mounting brackets, wallboard hangers, extension rings, fixture studs, cable clamps and metal straps for supporting outlet boxes, compatible with outlet boxes, compatible with outlet boxes being used and meeting requirements of individual situations.

2. Provide multi-gang outlets of single box design. Sectional boxes are not acceptable. Provide outlet boxes of sufficient volume to accommodate the number of conductors entering the box in accordance with the requirements of NEC, and not less than 1 ½ inch deep unless shallower boxes are required by structural conditions and are approved by the A/E.
- B. Provide deep type cast metal weatherproof exterior outlet wiring boxes of the type, shape and size, including depth of box, with threaded conduit ends, cast metal face plate with spring-hinged waterproof cap suitably configured for each application, including face plate gasket and fasteners. Outlets exposed to rain shall be equipped with cast metal in-use cover.
- C. Outlet boxes in poured concrete shall be plenum type without any holes and with reset knockouts. Where extension rings are used to offset conduit between wall reinforcing steel, joint between extension ring and box shall be sealed to prevent concrete from entering box during pour.
- D. Provide 4-inch octagonal ceiling outlet boxes.
- E. Surface mounted outlet boxes in interior locations shall be threaded cast type.

2.04 PULL AND JUNCTION BOXES

- A. Boxes shall be galvanized sheet metal conforming to ANSI/NEMA OS 1 with screw-on cover and welded seams, stainless steel nuts, bolts, screws and washers.
- B. Boxes larger than 24 inches in any dimension shall be panelboard code gauge galvanized steel with hinged cover.
- C. Boxes shall be sized in accordance with NEC.
- D. Provide cast-in-place or pre-cast concrete handholes/pull boxes as per design for underground installations. Cast-in-place and pre-cast boxes shall be provided with reinforcing bars, traffic rated, tamper proof cover.

3.00 EXECUTION

3.01 INSTALLATION - CONDUIT

- A. Install products as indicated, in accordance with the applicable requirements of NEC, NEMA and the National Electrical Contractors Association's "Standard of Installation".
- B. Cut conduit square using a saw or pipe cutter. De-burr cut ends. Joints in steel conduit must be painted with T&B Kopr shield and drawn up tight. Threads for rigid metal conduit and IMC shall be deep and clean. Running threads shall not be used. Wipe plastic conduit clean and dry before joining. Apply full, even coat of cement with brush to entire area that will be inserted into fitting. Let joint cure for 20 minutes minimum. Spray type of cement is not acceptable. Install raceway and conduit system from point of origin in outlets shown, complete with support assemblies including all necessary hangers, beam clamps, hanger rods, turnbuckles, bracing, rolls, clips angles, through bolts, brackets, saddles, nuts, bolts, washers, offsets, pull boxes, junction boxes and fittings to ensure a complete functional raceway system. Where vertical drops of conduit are made to equipment in open space, the vertical conduit shall be rigidly supported from racks supported on the floor.

- C. Raceway and conduit system shall be installed parallel and perpendicular to building lines unless indicated otherwise on the drawings.
- D. Install rigid wall hot-dipped galvanized steel conduit or hot-dipped galvanized intermediate metal conduit for service entrance, feeders, wall or floor penetrations, mechanical rooms, electrical rooms, exposed interior locations, exposed outdoor locations, damp locations or any location as per design drawing. The following exceptions permitted:
 - 1. EMT
 - a. In sizes up to and including 4 inch, may be used inside dry locations where concealed above accessible ceilings or in dry wall partitions. EMT may not be used outside, in electrical equipment enclosures, in concrete, underground, in under floor spaces, in masonry walls, in locations likely to be damp, in electrical and mechanical rooms, or where exposed.
 - 2. PVC (underground use only)
 - a. Install PVC schedule 40 conduit where direct buried in earth. Stub-ups shall be long sweep fiberglass.
 - b. Encased in concrete as noted.
 - 3. Liquid-tight
 - a. Install liquid-tight flexible metal conduit for connections to rotating, vibrating, moving or movable equipment, including dry-type transformers. Install external ground wire on flexible conduit with grounding bushings. Maximum length shall be 6 feet minimum of 2 feet.
- E. Install conduits parallel and supported/ anchored with split ring hangers, conduit straps or other devices specifically designed for the purpose. No raceways or boxes shall be supported using wire. Arrange conduit to maintain headroom and present a neat appearance. Conduit routes shall follow the contour of the surface it is routed on. Route exposed conduit and tray above accessible ceilings parallel and perpendicular to walls and adjacent piping. Maintain 12-inch clearance between conduit and heat sources, such as flues and heating appliances. Wire ties or "wrap lock" are not permitted to support or secure conduit system. Fasten conduit with the following material:
 - 1. Wood screws on wood
 - 2. Toggle bolts on hollow masonry
 - 3. Bolts and expansion anchors in concrete or brick
 - 4. Machine screws, threaded rods and clamps on steel
 - 5. Conduit clips on steel joists.
- F. Install conduits outside of building lines at a minimum depth of 24 inches below finished grade, except main service entrance conduits shall be minimum 36" below grade. Provide additional depth as required to maintain required separation and avoid obstructions. Maintain twelve inches earth or two inches concrete separation between electrical conduits and other services or utilities underground.

- G. Encase all plastic service entrance conduits and conduits and medium voltage conduits. In addition, provide concrete encasement for underground raceways in locations prescribed in the NEC and in locations subject to damage.
- H. Provide red dye for top of concrete encasement of all medium voltage conduits and secondary service entrance duct banks.
- I. Allow minimum 6" clearance from heat sources.
- J. Ducts in concrete encased ductbanks shall be independently supported by interlocking module spacers by Formex or equal. Spacers shall provide 3 inches separation between adjacent ducts. Spacers shall be installed at 5 feet maximum intervals.
- K. A watertight tapered plug shall be furnished and installed in unused duct openings. Terminators shall be poured-in-place.
- L. Install underground conduits with sealing glands equal to OZ Type FSK exterior to the conduit and OZ type CSB, or equal internally at the point where conduits enter the building to prevent water seepage into the building.
- M. Fittings shall be approved for grounding purposes or shall be jumpered with copper grounding conductors of appropriate ampacity. Leave termination of such jumpers exposed.
- N. Install conduit concealed in structures, enclosures or below grade. Exposed conduits permitted only as specifically noted and approved by Owner.
- O. Avoid moisture traps where possible; where unavoidable, provide junction box with drain fitting at conduit low point.
- P. Use suitable conduit caps to protect installed conduit against entrance of dirt and moisture if cable or wire are not installed immediate after conduit run. Tape covering conduit ends is not acceptable.
- Q. Provide 200 lb. nylon cord full length in empty conduit.
- R. Install no more than the equivalent of three 90-degree bends between boxes. Where four 90 degree bends are required, prior approval by the Engineer is required. Use conduit bodies to make sharp changes in direction, as around beams. Conduit bodies shall be readily accessible and sized for the cables installed. Running or rolling offsets are not approved. Use factory long radius elbows for bends in conduit larger than 2-inch size. Field bending of elbows for bends in conduit larger than 2" is acceptable, however each bend will be inspected by Owner and shall be replaced if not acceptable. All parallel bends shall be concentric.
- S. Pull string shall be provided full length in conduit designated for future use.

3.02 INSTALLATION - WIREWAYS

- A. Bolt wireways to steel channels fastened to the wall or in self-supporting structure. Install level.
- B. Gasket each joint in oil-tight wireway.
- C. Mount rain tight wireway for exterior installation in horizontal position only.

3.03 INSTALLATION - BOXES

- A. Provide electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance.
- B. Provide outlet box accessories as required for each installation, including mounting brackets, wallboard hangers, extension rings, fixture studs, cable clamps and metal straps for supporting outlet boxes, compatible with outlet boxes being used and meeting requirements of individual situations.
- C. Electrical box locations shown on Contract Drawings are approximate unless dimensioned. Verify location of outlets prior to rough-in.
- D. Allow minimum 6" clearance from heat sources.
- E. Locate and install boxes to allow access, minimum 12 inches above ceiling except where space dimensions do not allow.
- F. Secure boxes rigidly to the substrate upon which they are being mounted, or solidly imbed boxes in concrete or masonry. Do not support junction boxes from the raceway systems. Boxes shall not be permitted to move laterally.
- G. Provide knockout plugs for unused openings.
- H. Outlet boxes in plaster partitions shall be "shallow-type" set flush in wall so there is at least 5/8 inch plaster covering back of box.
- I. Outlet boxes for switch shall not be used as junction boxes.
- J. In inaccessible ceiling areas, position outlets and junction boxes within 6 inches of recessed luminaire, to be accessible through luminaire ceiling opening.
- K. Outlet boxes supporting fixtures shall be securely anchored in place in an approved manner. Support outlet boxes and fixtures in acoustic ceiling areas from building structures, not from acoustic ceilings. Lighting fixture outlets shall be coordinated with mechanical and architectural equipment and elements to eliminate conflicts and provide a workable neat installation.

3.04 WALL AND FLOOR PENETRATIONS

- A. Core drilling shall be approved in writing by the Structural Engineer prior to execution.

END OF SECTION

26 05 53 ELECTRICAL IDENTIFICATION

1.00 GENERAL

1.01 WORK INCLUDED

- A. Nameplates and tape labels
- B. Wire and cable markers
- C. Conduit color coding and labeling

1.02 REFERENCES

- A. NFPA 70 – National Electrical Code (latest edition)

1.03 SUBMITTALS

- A. Provide submittals in accordance with and in addition to Section 260000, Basic Electrical Requirements, and Division 01 for submittal requirement.
 - 1. Furnish nameplate identification schedules listing equipment type and nameplate data with letter sizes and nameplate material.

2.00 PRODUCTS

2.01 MATERIALS

- A. Equipment Nameplates:
 - 1. For normal power electrical equipment, provide engraved three-layer laminated plastic nameplates, engraved white letters on a black background.
 - 2. For other systems, provide engraved three-layer laminated plastic nameplates with color to match enclosure color with white letters.
- B. Underground Warning Tape
 - 1. Manufactured polyethylene material and unaffected by acids and alkalines.
 - 2. 3.5 mils thick and 6 inches wide.
 - 3. Tensile strength of 1,750 psi lengthwise.
 - 4. Printing on tape shall include an identification note BURIED ELECTRIC LINE, and a caution note CAUTION. Repeat identification and caution notes over full length of tape. Provide with black letters on a red background.
- C. Conductor Color Tape and Heat Shrink:
 - 1. Colored vinyl electrical tape shall be applied perpendicular to the long dimension of the cable or conductor.
 - 2. In applications utilizing tray cable, heat shrinkable tubing shall be used to obtain the proper color coding for the length of the conductor in the cabinet or enclosure. Variations to the cable color coding due to standard types of wire or cables are not acceptable.

- D. Warning labels: Provide warning labels with black lettering on red background with a minimum of 1/2" lettering.
- E. Tape Labels: Embossed adhesive tape, with minimum 1/4-inch letters for labeling receptacles, switches, control device stations, junction and pull boxes and manual motor starter units, etc.
- F. White letters on black background for normal power.
- G. Receptacle cover plate Circuit Labels: Black engraved letters 1/4" high. Include circuit number on receptacle cover plate.
- H. J-Box and Pull Box Labels: Black stenciled letters 1/4" high. Adhesive back tapes may be used if a clear tape is applied over the label for protection.

3.00 EXECUTION

3.01 INSTALLATION

- A. Degrease and clean surfaces to receive nameplates or tape labels.
- B. Install nameplates parallel to equipment lines.
- C. Secure plastic nameplates to equipment fronts using screws or rivets. Use of adhesives shall be per Owner's approval. Secure nameplate to outside face of flush mounted panelboard doors in finished locations.

3.02 WIRE IDENTIFICATION

- A. Provide wire markers on each conductor in panelboard gutters, pull boxes, outlet and junction boxes, and at load connection. Identify with branch circuit or feeder number for power and lighting circuits. Label control wire with number as indicated on schematic and interconnection diagrams or equipment manufacturer's shop drawings for control wiring.
- B. Conductors for power circuits to be identified per the following schedule.

System Voltage	
Conductor	240/120V
Phase A	Black
Phase B	Red
Neutral	White
Grounding	Green
IG	Green w/Yellow

3.03 NAMEPLATE ENGRAVING SCHEDULE

- A. Provide nameplates of minimum letter height as scheduled below. Nameplates shall be same as equipment names indicated on the Drawings.
- B. Individual Circuit Breakers in Distribution Panelboards, Disconnect Switches, Motor Starters, and Contactors: 1/4-inch; identify source to device and the load it serves, including location.
- C. Transformers: 3/8-inch; identify equipment designation. 1/4-inch; identify primary and secondary voltages, primary source, and secondary load and location.

- D. Automatic and Manual Transfer Switches: 3/8-inch; white letters and red background; identify equipment designation 1/4-inch; identify voltage rating, normal source, standby source and load served including location.
- E. Panelboards: 3/8-inch; identify equipment designation. 1/4 -inch; identify source, voltage and bus rating.

3.04 SWITCHGEAR LABEL

- A. Switchgear shall be labeled to include arc-flash labels, personal protective equipment (PPE) and other information as required by NEC 110.16 and as described in the standards and guidelines referenced in FPN Nos. 1 and 2.

3.05 PULL AND JUNCTION BOX COVER LABEL

- A. Identify circuit numbers and voltage on pull boxes and junction box covers.

END OF SECTION

26 05 73 SYSTEM COORDINATION AND ANALYSIS

1.00 GENERAL

1.01 WORK INCLUDED

- A. Provide a complete analysis of the operation of the electrical power system under overcurrent and short circuit conditions (L-G, L-L and 3Ø bolted fault).
- B. Provide complete arc-flash study and equipment labeling.

1.02 SUBMITTALS

- A. Analysis shall be performed by one of the following:
 - 1. Coordinated Power Systems - Hales Corner, Wisconsin
 - 2. Square D Systems Coordination Group
 - 3. Cutler-Hammer/Westinghouse
 - 4. Siemens
- B. Submit a preliminary analysis of the system for approval prior to a release for fabrication of electrical equipment.
- C. Submit final analysis of the system prior to the installation or energization of equipment.

1.03 REFERENCED STANDARDS

- A. The analysis of overcurrent operation shall be based on IEEE "Overcurrent Protective Device Coordination by Computer".
- B. The analysis of short circuit current operation shall be based on IEEE "Procedure for Determining Maximum Short Circuit Value in Electrical Distribution Systems".

2.00 PRODUCTS

Not used.

3.00 EXECUTION

3.01 SCOPE OF ANALYSIS

- A. The analysis shall be comprehensive from PMH switchgear through oil-filled pad mounted transformers through the distribution system to the last overcurrent device serving equipment or outlets. Include recommended fuse type/rating in PMH to serve pad mounted transformer.
- B. The contribution of all motors one horsepower and larger shall be included.
- C. Where operation from one or more sources is possible, all operating configurations shall be analyzed.

3.02 BASIS OF COMPUTATION

- A. Computation shall be based on infinite bus method, except that actual fault values shall be used for arc-flash study.
- B. Device characteristics and equipment impedances shall be obtained in writing from the equipment supplier.
- C. The preliminary analysis shall be based on the Contractor's estimation of feeder types and lengths and the proposed equipment characteristics.
- D. The final analysis shall be based on the equipment and materials actually installed at the project. Conductor and raceway type, lengths, and characteristics shall be supplied by the Contractor on the actual materials and routings to be installed.

3.03 RESULTS

- A. The overcurrent device coordination analysis shall present a graphic representation of the required time-current settings for every protective device in the system and a tabular listing for equipment calibration. All devices which are not able to be fully selectively coordinated shall be noted along with recommended action.
- B. The short circuit analysis shall list the phase and ground fault current available at each switchgear, switchboard and panelboard bus in the system, and define whether each device in the system is adequately rated for the duty imposed. Contractor shall furnish equipment with AIC rating which exceeds maximum available fault current regardless of rating specified on drawings. Equipment ratings on drawings are minimum AIC duty and shall not be reduced.
- C. Series rating is not permitted.
- D. Label switchgear based on results of arc-flash study.

END OF SECTION

26 09 23 LIGHTING CONTROL DEVICES

1.00 GENERAL

1.01 SUMMARY

A. This Section includes the following lighting control devices:

1. Lighting contactors and enclosures.
2. HOA switches.

1.02 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.
- C. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.03 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

2.00 PRODUCTS

2.01 LIGHTING CONTACTORS AND HOA SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Allen-Bradley/Rockwell Automation
 2. ASCO Power Technologies
 3. GE Industrial Systems
 4. Square D
- B. Description: Electrically operated and mechanically held, combination type with nonfused disconnect, complying with NEMA ICS 2 and UL 508.
1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
 2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
 3. Enclosure: Comply with NEMA 250.
 4. Provide with control and pilot devices as required, matching the NEMA type specified for the enclosure.

- 5. Minimum contactor rating of 30 amps.
- 6. Provide auxiliary relays as required.
- C. HOA switches shall be heavy duty, key operated, installed in hinged cover of contactor enclosure.

2.02 LIGHTING CONTROLS

- A. Refer to drawings for control requirements.
- B. Time clocks and photocells shall be equal to Paragon or Tork. Time clocks shall have battery backup and shall be astronomic type. Photocells shall be adjustable.

3.00 EXECUTION

3.01 CONTACTOR INSTALLATION

- A. Mount lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.02 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Operational Test: Verify operation of each lighting zone.
- B. Lighting control devices that fail tests and inspections are defective work.

3.03 FUNCTIONAL TESTING

- A. Lighting control manufacturer shall provide functional testing in accordance with IECC.

END OF SECTION

26 12 13 PAD MOUNTED TRANSFORMERS (LIQUID FILLED)

1.00 GENERAL

1.01 WORK INCLUDED

- A. Outdoor liquid filled pad mounted transformers (medium voltage).

1.02 RELATED WORK

- A. Section 26 05 26 – Grounding

1.03 REFERENCES

- A. IEEE C57.12.00 - General Requirements for Liquid-Immersed Distribution, Power and Regulating Transformers
- B. ANSI C57.12.10 – Requirements for Transformers 230 kV and Below
- C. IEEE C57.12.70 – Terminal Markings and Connections for Distribution and Power Transformers
- D. IEEE C57.12.90 - Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers
- E. IEEE C57.98 – Guide for Transformer Impulse Tests
- F. IEEE C57.109 – Guide for Liquid Immersed Transformer Through-Fault-Current Duration
- G. IEEE C57.111 – Guide for Acceptance of Silicon Insulating Fluid and Its Maintenance in Transformers
- H. IEEE C57.121 – Guide for Acceptance and Maintenance of Less Flammable Hydrocarbon Fluid in Transformers
- I. NEMA TR1: Transformers, Regulators, and Reactors
- J. DoE 10 CFR Part 432 - Minimum Requirements
- K. Install in accordance with manufacturer's recommendations and specifications.

1.04 SUBMITTALS

- A. Provide submittals in accordance with and in addition to Section 26 00 00, Basic Electrical Requirements, and Division 01 for submittal requirement.
 - 1. Outline dimensions including plan and elevation views, base plan, and conduit entry opening dimensions.
 - 2. Support points, locations of all accessories, bushings, and terminal compartments.
 - 3. Transformer diagrammatic nameplate (each unit) including manufacturer, primary voltage and connections, secondary voltage and connections, rated KVA, number of phases, number and percent taps, frequency and percent impedance.
 - 4. Location for floor channels, anchor bolts, drain valve, and ground pads.
 - 5. Total weight of unit (transformer and filling liquid).

6. Transformer winding temperature rise.
 7. Filling liquid capacity in gallons.
 8. Bill of material showing components, ratings, and part numbers.
 9. Product descriptive literature including standard factory tests for each unit, and options for similar units.
 10. Short-circuit withstand capacities.
 11. Indicate quantity of conductors that can be terminated on each secondary spade terminal.
 12. Indicate quantity of 4" conduits that can be stubbed up within secondary compartment.
 13. Submit dimensioned drawings of transformers, including support points, lifting eyes and brackets.
- B. Submit the following information as a complete set in 3-ring binder after fabrication, assembly, delivery, installation, and field testing. Deliver to Owner no later than the training included in the contract.
1. Operation and Maintenance manual.
 2. Maintenance schedule for the first cycle of scheduled maintenance, not less than 12 months.
 3. Spare parts list, renewable parts list, and consumable list.
 4. As-built drawings including final fabrication drawings of items specified in 1.4, this Section.
- C. Certified test reports.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Store in a clean dry location.
- B. Handle transformers using only lifting eyes and brackets provided for handling purposes. Protect units against damage from rain, sleet, or snow if handled in inclement weather.

2.00 PRODUCTS

2.01 COMPARTMENTAL – TYPE, PAD MOUNTED TRANSFORMERS

- A. Secondary bushing heights shall not exceed height of existing pad mounted transformer being replaced. Verify on site prior to bid.
- B. Transformers shall be equipped with an air filled terminal compartment on the high voltage side, and an air filled terminal compartment on the low voltage side.
- C. The ratings of each transformer shall be as follows:
 1. KVA Rating: As indicated on drawings.
 2. Temp. Rise: The average temperature rise of the windings measured by the resistance method shall be 65°C when the transformer is operated at rated KVA output in a 40° C ambient, without loss of life expectancy.

3. Impedance: 5.75% or per drawings.
 4. H. Voltage: 7,200V and as listed in attached Table.
 5. H.V. BIL: 125 KV for 7,200 volt primary
 6. H.V. Taps: 2 - 2-1/2% full capacity above and below rated voltage
 7. L. Voltage: 124/240 volt single phase
 8. L.V. BIL: 30 KV
 9. Transformer efficiency must meet or exceed new Department of Energy DOE-2016 minimum standards.
 10. Transformers 500 kVA and larger must utilize amorphous metal core technology.
- D. The units shall be filled with Envirotemp FR3 listed less-flammable biodegradable fluid by Cargill with no detectable level of PCB, less than 1 ppm. Manufacturer's recommendations for application of this fluid must be followed. The insulating liquid shall be shipped in the tank of the transformer.
 - E. The sealed transformer tanks shall be provided with a dry nitrogen blanket of recommended pressure per manufacturer's tank ratings. List fill pressure.
 - F. The transformers shall be designed to carry short time emergency overloads in accordance with ANSI standards. Duration and magnitude of designed short circuit withstand capability shall be as outlined in IEEE C57.12.00.
 - G. The 24,940 VAC transformers shall be equipped with internal fuse holders accessible from the hand hole. The fuses shall be internal expulsion fuse with isolation link technology. The ratings of the fuse and isolation link shall be specified for the specific transformer size and listed with the submittals.
 - H. The transformers shall be U.L. listed.
 - I. Transformer features and accessories shall include:
 1. De-energized tap changer with cover mounted, externally operated, pad lockable handle;
 2. Combination drain and filter valve and sampling device;
 3. 1" filling plug and filter press connection in cover;
 4. Top liquid thermometer (dial type);
 5. Magnetic liquid level gauge;
 6. Pressure vacuum gauge;
 7. Provision for lifting;
 8. Provision for jacking on tank or base;
 9. Base for skidding or rolling in two directions;
 10. Automatic pressure relief device that automatically reseals after operation;
 11. Ground pad;
 12. Instruction and diagrammatic nameplate;

13. Welded-on main tank cover and bolted with gasket hand hole in cover.
- J. Windings shall be wound with copper conductors.
- K. The main transformer tank and attached components shall be designed to withstand pressures of 15 PSI without permanent deformation. Construction shall be from carbon steel plate reinforced with external sidewall braces. All seams and joints shall be continuously welded.
- L. Each radiator assembly shall be individually welded and receive a quality control pressurized check for leaks. The entire tank assembly shall receive a similar leak test before tanking.
- M. Outdoor units shall be painted olive green, Munsell 7GY3.29/1.5 Super Durabake II to match S&C PMH switchgear.
- N. High and low voltage compartments shall be located side-by-side separated by a steel barrier. When facing the transformer, the low voltage compartment shall be on the right. Terminal compartments shall be full height, air filled with individual doors. The high voltage door fastenings shall not be accessible until the low voltage door has been opened. The low voltage door shall have a 3 point latching mechanism with a cabinet handle having provisions for a single padlock and penta head bolt. The doors shall be equipped with lift-off type stainless steel hinges and door stops to hold the doors open when working in the compartments. The front sill of the compartment shall be removable to allow the transformer to be rolled or skidded into position over conduit stubs. ANSI tank grounding provisions shall be furnished in each compartment.
- O. High voltage terminations and equipment shall be dead front and conform to ANSI C57.12.26 requirements. Provide universal type 200 Amp bushing wells for use with feedthrough load break inserts 15 kV elbow terminators and parking stands for mounting accessory equipment on 7.2 kV primary transformers. Bushing wells shall be capable of being externally clamped.
- P. Provide one (1) 17.00MCOV, 15 kV class dead front metal oxide varistor elbow arresters for placement in the high voltage compartment for 7.2 kV primary transformers, #273ESA-21.
- Q. Low voltage bushings shall be molded epoxy and provided with blade type spade terminals with NEMA standard hole spacing arranged for vertical take-off. The low voltage neutral shall be an insulated bushing grounded to the transformer tank by a removable grounding strap.
- R. Manufacturer shall perform the following tests on all transformers:
1. Resistance measurements of all windings on the rated voltage connection and at the tap extremes.
 2. Ratio tests on the rated voltage connection and on all tap connections.
 3. Polarity and phase-relation tests on the rated voltage connections.
 4. No-load loss at rated voltage on the rated voltage connection.
 5. Exciting current at rated voltage on the rated voltage connection.
 6. Impedance and load loss at rated current on the rated voltage connection and on the tap extremes.
 7. Applied potential tests.

8. Induced potential tests.
9. Temperature Test:
10. Furnish temperature tests for each size and type transformer. Certified tests of a similar unit of identical size and type will be acceptable.
11. All tests shall be conducted in accordance with the latest revision of ANSI C57.12.90 and NEMA TR2.
12. Furnish manufacturer's certified test report.
13. Audible sound level shall comply with NEMA TR1.

2.02 ACCEPTABLE MANUFACTURERS:

- A. ABB
- B. Cooper
- C. Schneider Electric – Square D

3.00 EXECUTION

3.01 EXAMINATION

- A. Verify that pads are ready to receive work.
- B. Verify field measurements are as shown on Drawings and as indicated by manufacturer's shop drawings.
- C. Verify that required utilities are available, in proper location, and ready for use.
- D. Beginning of installation means installer accepts conditions.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install safety labels to NEMA requirements.

3.03 ADDITIONAL LABELLING

- A. Clearly mark (using traditional red and black and/or yellow paint) the inside cover of the 7.2 kV compartment with the following:
 1. 7.2 kV Primary Voltage
 2. Electrocution symbol
- B. Clearly mark (using stenciled block numbers and letters with white paint) the lower, exterior portion of the transformer cover with the following:
 1. Transformer Name (i.e. "TRANSFORMER STP-1")
 2. 7.2 kV

3.04 FIELD QUALITY CONTROL

- A. Check for damage and tight connections prior to energizing transformers. Check primary, secondary, and ground connections.
- B. Clean and inspect bushings.
- C. Inspect bushing clamps and gaskets.
- D. Inspect cover and handhole gasket seals.
- E. Inspect tap change seals.
- F. Check fluid leaks and external damage to radiators.
- G. Check liquid level.
- H. Check accessory devices for condition and proper operation.
- I. Measure primary and secondary voltages and make appropriate tap adjustments within zero to two percent of rated voltage at no load.
- J. Check phase rotation and make appropriate changes in connection to match phase rotation between units connected in secondary-selective schemes.
- K. Insulation resistance test: Megger transformer windings high to low and ground, low to high and ground, and high and low to ground.
- L. Perform turns ratio test.
- M. Field test reports shall be forwarded to the Owner.

END OF SECTION

26 13 00 PMH-7 SWITCHGEAR (MEDIUM VOLTAGE)

1.00 GENERAL

1.01 SUBMITTALS

- A. Submit manufacturer's product data.
- B. Submit dimensioned drawings of PME-11 switchgear showing accurately scaled basic units.

1.02 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver switchgear in factory fabricated water resistant wrapping.
- B. Maintain factory wrapping or provide an additional heavy canvas or plastic cover.
- C. Store switchgear in a clean and dry space and protected from weather.
- D. Handle switchgear carefully to avoid damage to material components, enclosure and finish.

2.00 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. S&C Electric Company.

2.02 SWITCHGEAR CONSTRUCTION

- A. Enclosure shall be tamper-resistant, free-standing with provisions for bottom cable entrance and exits. Roof shall be undercoated and bottom shall be equipped with gasket.
- B. An internal steel-enclosed compartment shall encase the interrupter switches and fuses for electrical isolation and protection from contamination. The compartment shall have a galvanized steel sheet floor to exclude foliage and animals. The floor shall have screened drain vents to allow drainage if the enclosure is flooded. The top of this compartment shall be gasketed to provide sealing with the enclosure roof.
- C. Base spacer, if any, shall be such that it matches existing cable termination height.
- D. Provide barriers for fuses and as required for BIL rating. Provide copper bus.
- E. Source circuit switches shall be 600 Amp with external handle for three-pole live switching.
- F. Load circuit switches shall be 200 Amp hook-stick operated for live switching.
- G. Complete assembly shall be constructed in accordance with minimum construction specifications of the switch and fuse manufacturer to provide adequate electrical clearances and adequate space for fuse handling, cable pulling and cable terminations. Bus shall be copper.
- H. Provide provisions to store spare fuses in each fuse compartment door.
- I. Interrupter switch and fuse mounting insulators and main bus supports shall be of a cycloaliphatic epoxy resin system or electrical grade porcelain with characteristics to ensure non-tracking properties and adequate leakage distance that withstand the stresses

associated with the short circuit rating of the switchgear, including proper allowances for transient conditions.

- J. Provide ground connection pad in each bay. Each individual ground connection, one per bay, to have short circuit current capability consistent with the short circuit rating of integrated assembly.
- K. Finish in inaccessible areas shall have phosphatizing bath and iron oxide zinc-rich anti-corrosion primer to ensure that all surfaces are protected.
- L. A conductive zinc coating shall be applied to interior and exterior surfaces to furnish cathodic protection for the steel, promote neutralization of atmospheric contaminants, improve finished covering at sharp edges and retard underfilm propagation of rust. The intermediate coat to be epoxy ester primer. Final coat shall be olive green Super Durabake II.
- M. Each phase at all switch terminals shall have an elbow mounted arrester.
- N. Ratings: The ratings for the integrated switchgear assembly shall be as follows:

Nominal Voltage Class	14.4 KV
Maximum Design Voltage	17.0 KV
Basic Impulse Level	95 KV
Main Bus	600 Amperes Continuous
Short Circuit	25,000 Amperes RMS Symmetrical

- O. Interrupter switches and interrupter switches with power fuses shall have a two-time duty-cycle fault-closing rating equal to or greater than the short circuit rating of the switchgear assembly. Switches shall have a single blade per phase for circuit closing including fault closing, continuous current carrying and circuit interrupting. Switches incorporating secondary flipper type interrupter blades are not acceptable.
- P. Interrupter switches intended for manual operation shall be operated by means of an externally mounted, removable handle.
- Q. Termination compartments for switches shall have bushings, and termination compartments for fuses shall have bushing wells to permit connection of elbows. The bushings and bushing wells shall be mounted on the interior walls at a minimum height of 33 inches above the enclosure base. Each termination compartment for a switch shall be equipped with a viewing window to allow visual inspection of interrupter switch blades to allow positive verification of switch position. Each termination compartment for a set of fuses shall be equipped with a set of viewing windows to allow visual inspection of blown-fuse indicators.
- R. Bushings and bushing wells shall conform to ANSI/IEEE Standard 386 and shall be of a cycloaliphatic epoxy resin.
- S. Fuse mountings shall be enclosed in an inner steel compartment and shall be provided with bushing wells rated 200 amperes continuous for elbow connection. Each fuse mounting shall be an integral part of a fuse handling mechanism that does not allow access to the fuse until the elbow for that fuse has been disconnected. To access a fuse it shall be necessary to disconnect the elbow for that fuse and move it to the appropriate parking stand. Actuate a mechanical interlock to unlock the fuse-access panel. Unlatch and then pivot the fuse-access panel to electrically isolate the fuse so that it can be removed from the fuse mounting with a

shotgun stick. To protect the fuse-handling mechanism from corrosion, all mechanism parts shall be painted or made of corrosion-resistant materials, or otherwise be protected from corrosion. All latches and pivots shall be stainless steel or zinc-nickel-plated steel with nylon or plastic bushings.

- T. Cable guides shall be provided in each termination compartment for a set of fuses, to prevent cables from interfering with rotation of the fuse-access panel.

2.03 MEDIUM VOLTAGE FUSES

- A. Furnish SME-20 standard speed fuse refills for metal enclosed switchgear as manufactured by S&C Electric Company.
- B. Fuses shall be capable of detecting and interrupting faults down to the minimum melting current with line-to-line or line-to-ground voltage across the fuse and capable of handling the full range of transient recovery voltage associated with these faults.
- C. Fuses shall have minimum melting time-current characteristics accurate to within plus or minus 10 percent.
- D. Fuses shall be non-aging and non-damageable so that it is unnecessary to replace unblown fuses in single phase or three phase installations where one or more of the fuses have blown.
- E. Furnish three spare fuses of each size and type used on project.
- F. Provide fuse sizes per drawings.

2.04 ACCESSORIES

- A. Mounting provisions shall be provided for fault indicators in each switch compartment.
 - 1. Provide one set of fault indicators for each phase for all switch compartments.
 - 2. Fault indicators shall be automatic reset type designed for single phase application, Power Delivery Products Model #29-6115-3F0-24.

3.00 EXECUTION

3.01 INSPECTION

- A. Installer shall examine the areas and conditions under which switchgear is to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Touch-up scratched or marred surfaces to match-original finish.
- B. Install nameplate on front door of the switch cubicle. In addition, a "Danger High Voltage" sign shall be mounted on all doors providing access to high voltage.

END OF SECTION

26 24 16 PANELBOARDS

1.00 GENERAL

1.01 WORK INCLUDED

- A. Distribution panelboards.
- B. Branch circuit panelboards.

1.02 REFERENCES

- A. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
- B. NAME KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- C. NEMA PB 1 - Panelboards.
- D. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
- E. NEMA PB 1.2 - Application Guide for Ground-fault Protective Devices for Equipment.
- F. NEMA AB 3 - Molded Case Breakers and Their Application
- G. ANSI/UL 67 - Electric Panelboards
- H. ANSI/UL 50 - Cabinets and Boxes
- I. ANSI/UL 508 - Industrial Control Equipment

1.03 SUBMITTALS

- A. Provide submittals in accordance with and in addition to Section 260000, Basic Electrical Requirements, and Division 01 for submittal requirement.
- B. Submit dimensioned drawings showing size, circuit breaker arrangement and equipment ratings including, but not limited to, voltage, main bus ampacity, integrated short circuit ampere rating, and temperature rating of circuit breaker terminations.
- C. Submit 1/4" scale drawing of each electrical room, electrical enclosure, and other rooms with electrical equipment to demonstrate that all equipment being submitted will fit in the space and all clearances are obtained. This drawing must be included with the submittal for equipment specified in this section.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver distribution panelboards in factory-fabricated water-resistant wrapping.
- B. Handle panelboards carefully to avoid damage to material component, enclosure and finish.
- C. Store in a clean, dry space and protected from the weather.

2.00 PRODUCTS

2.01 ACCEPTABLE MANUFACTURER

- A. Square D
- B. Siemens
- C. Eaton

2.02 PANELBOARD CONSTRUCTION

- A. General: Provide flush or surface mounted, circuit breaker type distribution or branch circuit panelboards with electrical ratings and configurations, as indicated on the drawings and schedules. Load center type of panelboards are not acceptable.
- B. Enclosure:
 - 1. Enclosure shall be proper NEMA type as indicated.
 - 2. NEMA 1 (Indoors)
 - a. Back box shall be galvanized steel for flush mounted branch circuit panelboards. Back box shall have gray enamel electro-deposited finish over cleaned phosphatized steel for all other type panelboards.
 - b. Provide panelboard fronts with door-in-door cover.
 - 3. Construct cabinet in accordance with UL 50. Use not less than 16-gauge galvanized sheet steel, with all cut edge galvanized. Provide a minimum 4-inch gutter wiring space on each side. Provide large gutter where required to accommodate the size and quantity of conductors to be terminated in the panel, and where required by code.
 - 4. Exterior and interior steel surfaces shall be cleaned and finished with gray enamel over rust inhibiting phosphatized coating. Color shall be ANSI 61 gray.
 - 5. Doors shall be equipped with flush-type combination catch and key lock. All locks shall be keyed alike.
 - 6. Branch circuit panelboards shall be 5-3/4-inches deep.
 - 7. A directory holder with heavy plastic plate, metal frame, and index card shall be mounted inside of each door.
 - 8. Reinforce enclosure and securely support bus bars and overcurrent devices to prevent vibration and breakage in handling.
 - 9. Rating: Minimum integrated short-circuit rating, voltage and current rating as shown on drawings.
 - 10. Labeling: The Contractor shall furnish and install engraved, laminated plastic nameplates on the trim per Section 260553, Electrical Identification
- C. Bus:
 - 1. Provide panelboards with copper rounded edge phase, neutral and ground buses, rated full capacity as scheduled on drawings. Buses shall be full-length and braced for the maximum available fault current as shown on drawings.

2. Phase bussing shall be stacked front-to-back, A-B.
3. The neutral and ground bus bars shall have termination locations for each of the individual feeders and the lugs sized appropriately. In addition, space shall be provided to terminate the neutrals and grounds in two feeders equal to the largest size circuit breaker that can be installed in the panelboard. The ground bus shall be mounted in the panelboard, opposite the incoming line and neutral lugs and shall be accessible to allow easy installation of bolts, nuts and lock washers used to attach ground lugs. The neutral and ground buses in branch circuit panelboards shall have spaces to terminate 42 neutral and 42 ground wires.
4. All lugs for phase, neutral, and ground buses shall be tin-plated copper.

2.03 SWITCHING AND OVERCURRENT PROTECTIVE DEVICES

- A. Provide molded case circuit breakers with manufacturer's standard construction, bolt on type, with integral inverse time delay thermal and instantaneous magnetic trip in each pole. Circuit breakers shall be constructed using glass reinforced polyester insulating material providing superior dielectric strength. Provide circuit breakers UL listed as Type HACR for air-conditioning equipment branch circuits.
- B. Circuit breakers shall have an over center, trip-free, toggle operating mechanism that will provide a quick-make, quick-break contact action.
- C. Provide handle padlock attachments on circuit breakers where required. Device shall be capable of accepting a single padlock. All circuit breakers shall be capable of being individually padlocked in the off position.
- D. The circuit breakers shall be connected to the bus by means of solidly bolted connection. In multi-pole breakers, the phase connections on the bussing shall be made simultaneously without additional connectors or jumpers. Multi-pole breakers shall be two or three pole as specified. Handle ties are not permitted. The circuit breaker shall have common tripping for all poles.
- E. All circuit breakers shall be provided with visible ON and OFF indications.
- F. Provide AFCI or GFCI breakers where required by NEC or AHJ.
- G. Breakers for lighting circuits shall be UL listed type SWD, for switching duty.
- H. Breakers serving mechanical equipment shall be HACR rated, if required by the specific application.
- I. Breaker voltage and trip rating shall be per drawings. Breaker faceplate shall indicate UL certificate standards with applicable voltage systems and corresponding short current rating as per drawings.
- J. Molded Case Circuit Breakers:
 1. Breakers 400 ampere frame and less shall be manufacturer's standard industrial construction, bolt-on type, integral inverse time delay thermal and instantaneous magnetic trip. Breakers 225 ampere through 400 ampere shall have continuously adjustable magnetic pick-ups of approximately five to ten times trip rating. Provide solid-state trip units where necessary to provide coordination and as necessary to compensate for dry type transformer inrush.

2. Breakers 600 ampere frame and above shall be equipped with solid-state trip complete with built-in current transformers, and solid-state trip unit.

2.04 SURGE PROTECTION

- A. Each panel shall be equipped with stand-alone surge-protective device adjacent to panel. Include 3-pole breaker in panelboard and conduit/conductors to surge protective device. Breaker and conduit/conductors shall be size as recommended by manufacturer. Breaker may not be shown on Panel Schedule but shall be provided.
- B. ABB Current Technology.
 1. SL3(kA rating)(voltage)(configuration)MN(feed)M4EF2 Building Services, MSB's, Large separately derived sources. Requires HPI cable set from OCP device.
 2. CGP-(kA rating)(voltage) other code required or where layered protection is recommended.

2.05 DEVICE FEATURES, SIZES AND RATINGS

- A. In accordance with coordination study and arc-flash study, provide all "recommended" and "required" device features, sizes and ratings at no additional cost including but not limited to:
 1. NEC arc-energy reduction.
 2. Emergency branch coordination.
 3. Other protection or coordination issues.

3.00 EXECUTION

3.01 INSTALLATION

- A. Install panelboards in accordance with manufacturer's written instructions and the applicable requirements of the NEC, NEMA, ANSI and the National Electrical Contractors Association's "Standard of Installation".
- B. Anchor enclosed firmly to walls and structural surfaces, ensuring that they are permanently and mechanically secured. Direct attachment to dry wall is not permitted. Freestanding panelboards shall be installed on a concrete housekeeping pad with anchors per manufacturer's recommendation.
- C. Mounting Height:
 1. Distribution Panelboards: Such that highest operating handle is no greater than 79 inches above finished floor.
 2. Branch Circuit Panelboards: Such that highest operating handle is no greater than 79 inches above finished floor.
 3. Where panelboards occur in groups, the tops shall be aligned if it can be done without exceeding items 1 and 2 above.
- D. Install panelboards plumb. Adjust trim to cover all openings. Seal all conduit openings and cap all used knockout holes.

- E. Provide blank plates for unused open spaces in panelboards. Keep the front door closed after work to protect from damage, dirt, and debris at all times.
- F. Install identification nameplates in accordance with Section 260553, Electrical Identification.

3.02 FIELD QUALITY CONTROL

- A. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers and lugs.

3.03 PANELBOARD SCHEDULE

- A. The Contractor shall provide engraved, laminated plastic nameplates for circuit identification as indicated on the Drawings for distribution panelboards.
- B. The Contractor shall fill the index directory inside the front door of branch circuit panelboards identifying each circuit as shown on Panel Schedule drawings. Where changes are made, the schedule shall reflect the changes. At the end of the job, these schedules shall reflect as-built record conditions.

END OF SECTION

26 27 26 WIRING DEVICES AND FLOOR BOXES

1.00 GENERAL

1.01 WORK INCLUDED

- A. Wiring Devices:
 - 1. Wall switches.
 - 2. Receptacles.
 - 3. Device plates and box covers.
 - 4. Lighting controls (Refer to Section 260935 for additional information)

1.02 REFERENCES

- A. Americans with Disabilities Act (ADA)
- B. ANSI/NEMA OS 1- Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
- C. ANSI/UL 20 – General Use Snap Switches.
- D. ANSI/UL 498 – Attachment Plugs and Receptacles.
- E. ANSI/UL 943 – Ground Fault Circuit Interrupters.
- F. NEMA 250 – Enclosures for Electrical Equipment (1000 Volts maximum).
- G. NEMA WD 1 – General-Purpose Wiring Devices.
- H. NEMA WD 5 - Specific-Purpose Wiring Devices.
- I. Texas Accessibility Standards. (TAS)

1.03 SUBMITTALS

- A. Provide submittals in and Division 01 for submittal requirement.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Deliver wiring devices individually wrapped in factory-fabricated containers.
- B. Handle wiring devices carefully to avoid damage, breaking and scoring.
- C. Store in a clean dry space and protected from the weather.

2.00 PRODUCTS

2.01 GENERAL

- A. Provide factory fabricated wiring devices in the type and electrical rating for the service indicated. Where type and grade are not indicated, provide proper selection to correspond with branch circuit wiring and overcurrent protection. Attachment of wires to devices shall be by screw pressure under the head of binding screws. Arrangements depending on spring pressure or tension are not acceptable. All binding screws shall be brass or bronze.

B. Device color:

1. Switches and receptacles on normal power shall be color as selected by Owner.
2. Key operated switches shall be gray.

2.02 WALL SWITCHES

A. Acceptable manufacturers

1. Hubbell
2. Leviton
3. Pass and Seymour
4. Approved equal

B. Material

1. Wall switches for lighting circuits and motor loads under 1/3 hp shall be AC general use snap switch with toggle handle, 20 amperes and 120/277 volt AC with number of poles as required; Arrow-Hart 1990 Series.
2. Pilot light type shall be equipped with red toggle handle (glow when on), 20 amperes and 120/277 volt AC with number of poles as required; Arrow-Hart 1990PL Series.
3. Key operated switches shall be Gray, 20 amperes and 120/277 volt AC with number of poles as required key all locks alike. Furnish keys compatible with key switch, quantity as directed by Owner, minimum of ten copies; Arrow-Hart 1990L Series.
4. A listed manual switch having a horsepower rating not less than the rating of the motor and marked "Suitable as Motor Disconnect" shall be permitted to serve as disconnect means for stationary motor of 2 horsepower or less.
5. Switch terminal screws or connectors shall be designed to accommodate No. 10 solid conductor.

2.03 RECEPTACLES

A. Acceptable manufacturers

1. Hubbell
2. Leviton
3. Pass and Seymour
4. Approved equal

B. Material

1. Dedicated circuit and convenience duplex receptacles shall be rated 20 amperes, 125 volt AC; Arrow-Hart 5362 Series.
2. GFCI receptacles shall be rated 20 amperes, 125 volt with integral ground fault current interrupter; Arrow-Hart GF5342 Series.
3. Receptacles within 6'-0" of sink or wet area shall be GFI type.

4. All receptacles in restrooms and outdoors shall be GFI type.
5. Specific-use receptacles shall have volts, amps, poles and NEMA configuration as noted on drawings.
6. Heavy-duty lock-blade receptacles shall be NEMA WD5 heavy-duty specification grade.
7. Weatherproof receptacles as specified shall be mounted in a cast steel box with gasketed, weatherproof device plate as specified. Provide cast metal in-use cover where exposed to rain.

2.04 WALL PLATES

A. Acceptable manufacturers

1. Hubbell
2. Leviton
3. Pass and Seymour
4. Approved equal

B. Material

1. Wall plates shall be 316 or 302 brushed stainless steel with cutouts as required for devices indicated on drawings, unless otherwise noted.
2. Where switches or outlets are shown adjacent to each other, they shall be ganged with partitions between different type services and covered by a single custom wall plate.
3. Exposed boxes:
 - a. Dry interior spaces: Use cast metal plates with cast metal box. Use heavy cadmium-plated sheet steel plates with steel boxes and copper-free aluminum with aluminum boxes. All screws shall be stainless steel. Edges of plates must be flush with edges of boxes.
 - b. Other locations: Use weatherproof devices plates. Provide cast metal plates with gasketed spring door
4. Jumbo plates are not permitted.
5. Weatherproof cover plate shall be gasketed cast aluminum or feraloy (by Crouse-Hinds) with hinged gasketed device covers (cast metal in-use cover where exposed to rain).

2.05 COVER PLATE LABELING

- ### A.
- Engrave cover plates in accordance with Section 260553, Electrical Identification, on all receptacles and switches indicating panelboard and circuit number (also voltage in labs).

3.00 EXECUTION

3.01 INSPECTION

- ### A.
- Installer must examine the areas and conditions under which wiring devices and floor boxes are to be installed and notify the Contractor in writing of conditions detrimental to the

proper and timely completion of the work. Inspect devices for physical damage. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.02 DEVICE COORDINATION

- A. Where items of equipment are provided under other sections of this specification or by the Owner, provide a compatible receptacle and/or device plate for the cap or plug, and cord of the equipment.

3.03 INSTALLATION

A. General:

1. Install wiring devices and floor boxes as indicated, in accordance with the applicable requirements of the latest release of NEC, NEMA, and ANSI.
2. The approximate location of lighting controls, power outlets, etc., is indicated on the drawings. These drawings, however, may not give complete and accurate information in regard to locations of such items. Determine exact locations by reference to the general building drawings and by actual measurements during construction of the building before rough-in, subject to the approval of the Constructor Inspector.
3. Where more than one device occurs in one outlet box, causing 300 volts or more voltage difference between them, a barrier must be provided for isolation to meet NEC Article 380.

B. Lighting Control Stations:

1. Location:
 - a. Install lighting control stations in suitable outlet box centered at the height of 48-inches above finished floor, OFF position down.
 - b. Where shown near doors, install lighting control stations not less than 2" and not more than 12" from door trim.
 - c. Verify all door swings before rough-in and locate lighting control stations on strike side of door as finally installed.

C. Receptacles:

1. Location:
 - a. Install convenience outlets in suitable steel outlet boxes centered at the height of 18 inches above the finished floor, 6 inches above countertop or at the backsplash level, or as indicated on the drawings. Coordinate with equipment and architectural drawings.
 - b. Install receptacles generally where indicated on drawings. The Owner's representative reserves the right to make any reasonable changes in receptacle locations without change in the contract sum.
 - c. Install specific-use receptacles at heights shown on Drawings.

2. Position:
 - a. Install receptacles vertically with ground pole on bottom. Install receptacles horizontally, where field condition does not allow vertical installation, with ground pole on left.
 3. Feed through to non-GFCI receptacles is not permitted.
- D. Plates:
1. Where cover plates do not completely conceal the rough openings for the devices, it shall be the responsibility of the General Contractor to patch, paint, etc. around the opening to the satisfaction of the Owner's representative.
 2. All devices and cover plates shall be plumb and parallel to adjacent surfaces or trim. Devices must be flush with the finished trim cover plates and plates must be tight to surfaces over which they are installed.
 3. Where switches controlling devices that are out of sight, or where three or more switches are gang mounted, plates shall be labeled to identify items being controlled, or areas being lighted. Labeling shall be 3/16-inch Condensed Gothic and shall be filled with black enamel.

END OF SECTION

26 28 13 FUSES, 600 VOLT

1.00 GENERAL

1.01 WORK INCLUDED

- A. Dual-element, current limiting Class R fuses for loads up to 600 volts, 0-600 Amps.
- B. Time delay, current limiting Class L fuses for loads up to 600 volts, 601-6000 Amps.

1.02 REFERENCES

- A. UL 248-12 - Standard For Safety for Low-Voltage Fuses-Part 12: Class R Fuses
- B. UL 248-10 - Standard For Safety for Low-Voltage Fuses-Part 10: Class L Fuses
- C. Where application of local codes, trade association standard or publications appears to be in conflict with the requirements of this Section, the Architect/Engineer shall be asked for an interpretation.

1.03 SUBMITTALS

- A. Provide submittals in accordance with and in addition to Section 260000, Basic Electrical Requirements, and Division 01 for submittal requirement.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Store fuses in a clean and dry space and protected from weather. When necessary to store outdoors, elevate materials well above grade and enclose with durable, waterproof wrapping.

2.00 PRODUCTS

2.01 MATERIAL AND EQUIPMENT

- A. Furnish fuses manufactured by Buss, or equal, in accordance with the following:
 - 1. Motors and Transformers, 0 to 600 Amp:
 - a. 250 volt - Buss LPN-RK, UL Class RK1.
 - 2. Lighting Loads, 0 to 600 Amp:
 - a. 250 volt - Buss KTN-R, UL Class RK1.
 - 3. All Applications, 601 to 6000 Amp:
 - a. 600 volt - Buss KRP-C, UL Class L.
- B. Size fuses serving motor loads as specifically recommended by motor or equipment manufacturer or in the range of 150% to 175% of motor nameplate rating per NEC in accordance to the type of motor.
- C. Interrupting Rating: 300,000 RMS Amps.

D. Maintenance Stock, Fuses:

1. Furnish the following:

- a. Three spare fuses of each size and type for a spare set.

3.00 EXECUTION

3.01 INSTALLATION

- A. Install fuses where indicated, in accordance with the manufacturer's written instructions, the applicable requirements of NEC, national and local codes, regulations, and requirements.
- B. Provide quantity of spare fuses per the requirement of this Section at the location per drawing or the direction of Owner's Representative, in addition to replace blown or defective fuses during installation, startup, system commissioning and acceptance.

END OF SECTION

26 28 16 DISCONNECT SWITCHES

1.00 GENERAL

1.01 WORK INCLUDED

- A. Disconnect switches, fusible and non-fusible.
- B. Enclosures.

1.02 REFERENCES

- A. Federal Spec. W-S-865 - Switch, Box (Enclosed), Surface-Mounted.
- B. NEMA KS 1 - Enclosed Switches.
- C. NFPA 70 - National Electrical Code.
- D. NFPA 70E - Electrical Safety Requirement for Employee Workplaces.
- E. UL 98 - Enclosed Switches.

1.03 SUBMITTALS

- A. Provide submittals in accordance with and in addition to Section 260000, Basic Electrical Requirements, and Division 01 for submittal requirement.
- B. Submit manufacturer's product data. Submit dimensioned drawings and equipment ratings for voltage, capacity, horsepower, and short circuit.
- C. Submit 1/4" scale drawing of each electrical room, electrical enclosure, and other rooms with electrical equipment to demonstrate that all equipment being submitted will fit in the space and all clearances are obtained. This drawing must be included with the submittal for equipment specified in this section.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Deliver switches individually wrapped in factory-fabricated water-resistant type containers.
- B. Handle switches carefully to avoid damage to material components, enclosure and finish. Damaged switches shall not be installed on project.
- C. Store switches in a clean and dry space and protected from weather.

2.00 PRODUCTS

2.01 ACCEPTABLE MANUFACTURER

- A. Square D
- B. Siemens
- C. Cutler-Hammer

2.02 FABRICATED SWITCHES

- A. NEMA KS 1; Type HD quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Handle lockable in ON position for service entrance disconnect. Provide defeater so that qualified personnel can open door while switch is in the closed position.
- B. Use switches that have number of poles required as per drawings.
- C. Switches shall be Underwriters' approved for duty shown and enclosure type per drawings. NEMA 3R switches shall be provided where exposed to weather. NEMA 3R switches shall have weatherproof threaded hubs for all conduit entries into switch.
- D. Use fuse clips that are rejecting type to accept Class RK or L fuses only.
- E. Identify switches, as to equipment served, with engraved laminated plastic plates. Refer to Section 260553, Electrical Identification, of this specification.
- F. Voltage rating: 240VAC or 600VAC as per drawings.

3.00 EXECUTION

3.01 INSPECTION

- A. Installer shall examine the areas and conditions under which safety and disconnect switches are to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF SAFETY AND DISCONNECT SWITCHES

- A. Install safety or disconnect switches, where required by NEC, where indicated on drawings, and where required by equipment manufacturer, in a location convenient for maintenance on switch and adjacent equipment.
- B. For equipment with motors larger than 1/8 hp, install disconnect switches within sight of the motor.
- C. Provide fused disconnect switches, whether or not indicated on drawings, when required to maintain equipment manufacturer's warranty. Coordinate with Division 23 for warranty requirements of equipment approved by submittal.
- D. Install fuses in fusible disconnect switches. Provide permanent marking inside switch enclosure for fuse type.
- E. Wall mount switches, where possible, or mount on unistrut supports.

END OF SECTION

26 36 23 MANUAL TRANSFER SWITCHES

1.00 GENERAL

1.01 WORK INCLUDED

- A. The Section specifies furnishing and installation of manual transfer switches to manually transfer between the normal and emergency power sources.

1.02 RELATED WORK

- A. This Section shall be used in conjunction with the following other specifications and related Contract Documents to establish the total requirements for manual transfer.
 - 1. Section 260000 - Basic Electrical Requirements
 - 2. Section 260533 - Raceways, Conduit, and Boxes
 - 3. Section 260519 - Cable Wire and Connectors 600V
 - 4. Section 260553 - Electrical Identification
 - 5. Section 260526 - Grounding

1.03 REFERENCE STANDARDS

- A. The materials and installation shall conform to the minimum requirements and latest revisions of the following codes, standards and regulations wherein they apply:
 - 1. IEEE C37.2 – Electrical Power System Device Function Numbers and Contact Designations
 - 2. NEMA ICS 1 – General Requirements for Industrial Control and Systems
 - 3. NEMA ICS 6 – Industrial Control and System Enclosure
 - 4. NFPA 70 – National electrical Code
 - 5. UL 1008 – Transfer Switch Equipment
 - 6. NFPA 110 – Standard for Emergency and Standby Power Systems
 - 7. IEEE 446 – Recommended Practice for Emergency and Standby Power Systems

1.04 SUBMITTALS

- A. Provide submittals in accordance with and in addition to Section 260000, Basic Electrical Requirements, and Division 01 for submittal requirement.
 - 1. Descriptive product literature, to include, but not limited to:
 - a. Rated current, voltage and frequency
 - b. Number of poles
 - c. Symmetrical rms amperes withstand current at rated voltage
 - d. Physical dimensions, to include drawout clearances and working clearances
 - e. NEMA enclosure type

- f. Itemized list of accessories
 - g. UL 1008 3-cycle close and withstand rating
- 2. Plan, elevation, side, and front view arrangement drawings, including overall dimension, weights, clearances for installation, drawout of removable components, and working clearances, as well as mounting or anchoring requirements and conduit entrance locations.
- 3. Schematic diagram (show wiring and only those components which are part of switch).
- 4. Provide wire diagram prior to shipping. Show all factory wiring on wiring diagram and clearly indicate all wiring and connections to remote devices which are to be made in the field.
- 5. Submit proposed switch settings for review and approval. Revise as directed by Owner and Engineer.
- B. Submit 1/4" scale drawing to demonstrate that all equipment being submitted will fit in the space and all clearances are obtained. This drawing must be included with the submittal for equipment specified in this section.

1.05 PRODUCT DELIVERY AND STORAGE

- A. Deliver unit to the project site, protected from the weather and damage due to shipping and handling. Cover all piping connections.
- B. Store unit in a clean and dry space and protected from weather.

2.00 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. ASCO
- B. Other manufacturers equal in design and function will be considered upon A/E approval following substitution procedure in Section 260000 and Division 01 for substitution requirement.

2.02 RATINGS

- A. The transfer switches shall have voltage rating, current rating and interrupting ratings as shown on Drawings.
- B. The transfer switches shall be 100 percent equipment rated for continuous duty as shown on the Drawings and shall conform to the applicable requirements of UL 1008 for emergency system total load. The manual transfer switches shall be fully rated to protect all types of loads, inductive and resistive, from loss of continuity of power without de-rating.
- C. All pilot devices and relays shall be of the industrial type with self-cleaning contacts and rated 10 amperes.

2.03 CONSTRUCTION

- A. The transfer switches shall consist of completely enclosed contact assemblies and a separate control logic panel. The transfer switch shall be open-transition. The contact assemblies shall be operated by a non-fused motor operator or stored energy mechanism and be energized only momentarily during transfer, providing inherently double throw switching action. Control power for all transfer operations shall be derived from the line side of the source to which the load is being transferred.
- B. Transfer switches shall be capable of being operated manually under full load conditions. Manual operation shall be accomplished via a permanently affixed manual operator or integrally mounted pushbutton operators located on the face of the transfer switch assemblies. Removable manual operating handles and handles which move in the event that electrical operations should suddenly become energized while performing a manual transfer operation are not acceptable. The manual operator shall provide contact-to-contact transfer time as to prevent possible flashovers from switching the main contacts slowly. In addition, provisions shall be made to allow disengagement of the electrical operator during manual operation.
- C. Each transfer switch shall be positively interlocked to prevent simultaneous closing of both sources. Main contacts shall be mechanically locked in position in both normal and emergency positions. A neutral position shall not be possible under normal electrical operation unless a delayed transition accessory is required for switching highly inductive loads. Each transfer switch shall have a manual neutral position for load circuit maintenance. A transfer switch position indicator shall be visible from the front of the switch to show which source the transfer switch is connected.
- D. All transfer switches shall be true three-pole switched neutral type, fully rated, and connected to a common shaft. The fourth (neutral) pole contacts shall be identical construction as, and operate simultaneously with, the main power contacts. Add-on or overlapping neutral contacts are not acceptable.

2.04 MICROPROCESSOR-BASED CONTROLLER

- A. A microprocessor-based controller shall be separately mounted from the power switching portion of the transfer switch. The two sections shall be connected by control cables with plug-in connectors. The control section shall be capable of being disconnected from the power section for maintenance purposes.
- B. The controller shall be rated for an operation temperature range of -20 degree C to +70 degree C, and a storage temperature range of -30 degree C to +85 degree C. The microprocessor-based controller shall be capable of operating with control input power available within the range of 55 percent to 133 percent of nominal voltage indefinitely. Connection to any external battery or to the engine battery is not permissible. The controller shall not in any way be adversely affected by line voltage or frequency fluctuation during the course of transferring heavy electrical loads from one source to another. Adverse effects may include, but are not limited to, an unintended retransfer to the original source.
- C. The controller shall be equipped with self diagnostics, which performs periodic checks of the memory, input/output (I/O), and communication circuits, with a watchdog/power fail circuit.

- D. The controller shall be accurate to within 1 percent of full-scale value for measured parameter. Voltage and current for all phases shall be sampled simultaneously to assure high accuracy in conditions of low power factor or large waveform distortions.
- E. A digital readout shall display each option as it is functioning. Readouts shall display:
 - 1. Three phase voltage with 1 percent accuracy to display all three separate phase-to-phase voltage simultaneously, for both the normal and emergency source.
 - 2. Frequency with 1 percent accuracy to display frequency for both normal and emergency source.
 - 3. Availability of normal source and emergency source.
- F. The following metered readings shall also be communicated by the Controller, via local display and serial communication.
 - 1. Current, per phase RMS and neutral
 - 2. Current unbalance %
 - 3. Voltage, phase-to-phase and phase-to-neutral
 - 4. Voltage unbalance %
 - 5. Real power (KW), per phase and 3-phase total
 - 6. Apparent power (KVA), per phase and 3-phase total
 - 7. Reactive power (KVAR), per phase and 3-phase total
 - 8. Power factor, per phase and 3-phase total
 - 9. Frequency
 - 10. Accumulated energy (KWH, KVAH, and KVARH)
- G. When timers are functioning, the microprocessor shall display the timer counting down. All set points can be reprogrammed from the front of the switch when the switch is in the program mode. A test push button shall be included as part of the microprocessor.
- H. The controller shall be capable of storing records in memory for access either locally or remotely for up to 100 events. The reports shall include date, time and a description of the event, and shall be maintained in a non-volatile memory.

2.05 ACCESSORIES

- A. The following logic and options shall be supplied:
 - 1. The logic of the transfer switch shall function via a microprocessor-based controller. The set points shall be field adjustable without use of the special tools. The switch shall have a multi-tap voltage selection plug for ease of voltage adjustment in the field. LED lights shall be included on the exterior of the switch to show:
 - a. Normal source available
 - b. Emergency source available
 - c. Normal source connected

- d. Emergency source connected
 - e. Load energized
 - f. Position indicators shall be visible from the front of the switch.
2. The switch shall include the following:
- a. Provided under-voltage and under-frequency sensing on the emergency power source. Voltage shall be factory set at 90 percent pickup and 80 percent dropout. Frequency sensing shall be set at 58-hertz pickup and 56-hertz dropout.
 - b. Provide a pilot light to indicate that the switch is in the normal position as an integral part of the microprocessor.
 - c. Provide a pilot light to indicate that the switch is in emergency position as an integral part of the microprocessor.
 - d. Provide a pilot light to indicate that the normal power is available as an integral part of the microprocessor.
 - e. Provide a pilot light to indicate that the emergency power is available as an integral part of the microprocessor.
 - f. Provide auxiliary relay contacts that are energized when the power is available on the normal source.
 - g. Provide auxiliary relay contacts that are energized when the power is available on the emergency source.
- B. The following features shall be provided:
- 1. Green pilot light to indicate switch in normal position and red pilot light to indicate switch in emergency position.
 - 2. White pilot lights marked "Normal Source" and "Emergency Source" to indicate that respective source voltages are available.
 - 3. Tripped position indicating lights for both sources.
- C. When the alternate source is an engine generator, the following features shall also be provided:
- 1. Frequency/voltage relay for emergency source, frequency adjustable from 45 to 50 Hz and voltage fixed at 90 percent pickup, 70 percent dropout.

2.06 WIRING TERMINATIONS

- A. Terminal blocks shall conform to NEMA ICS 4. Terminal facilities shall be arranged for entrance of external conductors from the top or bottom of the enclosure. The main transfer switch terminals shall be suitable for the termination of conductors shown on the plans.

2.07 ENCLOSURE AND FINISH

- A. Each transfer switch shall be provided in enclosure suitable for locations as indicated on Drawings.

- B. NEMA 3R enclosure shall be painted with the manufacturer's standard painting procedures to ensure suitability for environmental conditions as referenced in the plans. Color shall be light gray ANSI 61.

3.00 EXECUTION

3.01 PRODUCT HANDLING AND VISUAL INSPECTION

- A. Handle unit carefully to avoid damage to material components, enclosure and finish. Use only lifting and brackets provided for that purpose. Unit shall be inspected prior to installation for damage. Damaged units shall be rejected and not be installed on project.

3.02 FOUNDATION PAD

- A. Install transfer switch on a concrete housekeeping pad with manufacturer's instruction and/or per Drawings.
- B. Coordinate conduit stub-up locations with Structural Engineer prior to placing conduit and forms for foundation pad.

3.03 INSTALLATION

- A. Install transfer switch as shown on the drawings. Installation shall follow manufacturer's installation procedures and be in accordance with NEC.
- B. Coordinate controller functions with packaged engine generator controls. The entire system shall be demonstrated functional as a whole.
- C. Coordinate interfaces with other life safety and/or building control systems.

3.04 TOUCHUP PAINTING

- A. Restore any marred surfaces to factory finish.

3.05 FIELD TESTING

- A. Test the switches with the packaged engine generator set in operating condition. Demonstrate to the Owner that the transfer switches perform all required functions.
- B. The manufacturer's representative(s) shall be on site for testing and start-up the systems.

3.06 TRAINING

- A. Training of the SRA maintenance personnel is required. Provide competent, factory authorized personnel to provide instruction to SRA operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. The instruction shall be scheduled in coordination with the SRA Project Manager after submission and approval of formal training plans. Refer to Section 019113, Commissioning, for contractor training requirements.
- B. Provide on-site training for Owner's designated personnel in the construction, operation, maintenance, troubleshooting and repair of the transfer and bypass/isolation switch.

- C. Formal training for the operation and maintenance shall be provided by factory trained and certified personnel.
- D. The training shall consist of a minimum of 8-hour training sessions or per Owner's direction.
- E. The timing of the training shall coincide with the schedule for the manufacturer's representative(s) to be on site for testing and start-up.
- F. The specific training shall be provided at a location designated and provided by the Owner for a minimum of 10 personnel selected by the Owner.
- G. A training program shall be submitted with material, instructor's qualification, and proposed schedule, a minimum 60 days prior to the proposed training. The Owner reserves the right of approval of any training course, material, instructor and schedule.
- H. The training program shall consist of, but not limited, instruction in the following subjects:
 - 1. Review of the applicable one-line drawings, wiring diagrams, and schematic for the transfer switch.
 - 2. Review of the factory record shop drawings and placement of the various components.
 - 3. Review of Operation and Maintenance manuals.
 - 4. Instruction in manufacturer's published procedures for operation, maintenance, troubleshooting, and safety. Instruction shall include all modes of equipment operation and alignment.
 - 5. Review of maintenance procedures for removal and placement of major components, and removal and replacement of renewable parts, as applicable.
 - 6. Discuss the maintenance timetable and procedures to be followed in an ongoing maintenance program.
 - 7. Provide binders to participants complete with copies of drawings and other course material covered.
- I. A minimum of 12 bound copies of training material shall be provided at the time of training, with four additional copies submitted at the time of substantial completion included in the Owner's manuals.

3.07 FUNCTIONAL PERFORMANCE AND INTEGRATED SYSTEMS TESTING

- A. Functional Performance & Integrated Systems Testing is part of the Commissioning Process. Functional Performance & Integrated Systems Testing shall be performed by the contractor and witnessed and documented by the Commissioning Authority. Refer to Section 019113, Commissioning, for functional performance and integrated systems testing and commissioning requirements.

END OF SECTION

26 51 00 INTERIOR AND EXTERIOR LIGHTING

1.00 GENERAL

1.01 WORK INCLUDED

- A. Interior lighting fixtures and accessories
- B. Exterior lighting fixtures and accessories
- C. Exit lights
- D. LEDs
- E. LED drivers.
- F. Site Lighting Poles.

1.02 REFERENCES

- A. NFPA 101 - Code for Safety to Life from Fire in Buildings and Structures
- B. NEMA WD1 - General-Purpose Wiring Devices
- C. IESNA - Lighting Handbook
- D. NFPA 70 - National Electrical Code
- E. ASHRAE/IES 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings
- F. UL 844 - Electric Lighting Fixtures for Use in hazardous (classified) Locations
- G. UL 924 - Emergency Lighting and Power Equipment
- H. IESNA - Lighting Handbook
- I. NEMA WD 1 - General Color Requirements for Wiring devices
- J. Standards For State-Funded Outdoor Lighting Fixture - Texas House Bill 916 (1999)

1.03 SUBMITTALS

- A. Provide submittals in accordance with and in addition to Section 260000, Basic Electrical Requirements, and Division 1 for submittal requirement.
- B. Submit manufacturer's data on interior and exterior lighting fixtures in booklet form, with separate sheet for each fixture, assembled by luminaire "type" in alphabetical order, with the proposed fixture and accessories clearly labeled.
- C. Submit dimensioned drawings and performance data including complete photometric test data for each luminaire, candlepower distribution curves in two or more planes, candlepower chart zero to 90 degrees, lumen output zonal summary chart, average and maximum brightness data, and coefficients of utilization for zonal cavity calculations, spacing to mounting height ratio, efficiency and visual comfort probability. Also provide luminaire weights, mounting data, and accessory information for each luminaires type.
- D. LEDs: Catalog cuts showing voltages, colors, approximate hours life, approximate initial lumens, lumen maintenance curve, lamp type and base.

- E. Drivers: Catalog cuts showing type, wiring diagram, nominal watts, input voltage, starting current, input watts, sound rating, power factor and low temperature characteristics.
- F. Site lighting pole data and catalog cuts, including wind loading, complete dimensions and finish.
- G. Shop drawings for site lighting luminaires showing pertinent physical characteristics, including fastening details, driver type and location.
- H. Controls: Catalog cuts and/or shop drawings showing dimensions, voltage capacity, contact ratings, wiring diagrams, operating levels, and temperature ratings.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver lighting fixtures individually wrapped in factory-fabricated fiberboard type containers.
- B. Handle lighting fixtures carefully to prevent breakage, denting and scoring the fixture finish. Do not install damaged lighting fixtures.
- C. Store lighting fixtures in a clean, dry space and protected from the weather.

2.00 PRODUCTS

2.01 GENERAL

- A. Lighting fixtures and accessories shall comply with the design and function requirements of the project. Design characteristics shall be as noted in manufacturer's submittal data.
- B. Provide lighting fixtures of the size, type and rating as scheduled, complete with, but not limited to, LEDs, reflectors, drivers, and wiring.

2.02 INTERIOR LIGHTING FIXTURES

A. LEDS

1. All LED luminaires shall be UL Listed and be furnished complete with LEDs and Power supplies at locations indicated on the drawings. Each fixture shall bear the UL Label, and shall comply with Code Requirements.
2. Luminaires shall meet the US Department of Energy's Energy Star performance criteria.
3. LED luminaires shall be designed with heat sinking adequate such that the junction temperature of the LEDs is maintained to meet the rated life as published by the LED manufacturer. Luminaire manufacturer shall provide validation documentation. Heat sinking shall not become compromised with time, lack of maintenance, and/or vibration resistance so that the heat-sink does not become detached from the LED PCB.
4. The LED luminaire shall have a complete 5 year warranty from date of installation
5. The LED luminaires shall be UL, or ETL listed and be furnished complete with LEDs and power supplies.
6. LED power supplies shall operate LEDs within the current limit specification of the manufacturer

7. Shall operate from 60Hz or 50Hz input source and have input power factor above 90% and a minimum efficiency of 70-% at full rated load of the driver.
8. Shall have short circuit and overload protection.
9. Shall have a minimum starting temperature of 0°F and a maximum case temperature rating of at least 70°C.
10. Power supply output shall be regulated to +/-5% across published load range.
11. Shall have a Class A sound rating.
12. Shall comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47CFR part 15, non-consumer (Class A) for EMI/RFI.
13. Shall have a 5 year warranty from date of manufacturer against defects in material or workmanship, including a replacement, for operation at or below the maximum case temperature specification.
14. Manufacturer shall have a 15 year history of producing power supplies for the North American market.
15. Dimmable power supplies shall be controlled by a (DC 0-10V Device/AC forward-phase control device/AC reverse phase control device) and shall be capable of operating, flicker-free, from 100-1% dimming range.
16. Dimmable power supplies shall allow the light output to be maintained at the lowest control setting (prior to off) without dropping out.
17. Shall be compatible with nLight lighting control system.
18. All LEDs shall have color temperature as specified in lighting fixture schedule (Drawings) and shall have CRI ≥80.
19. L70 rated life shall be a minimum of 50,000 hours.
20. All LED modules, unless noted otherwise, shall be provided by the light fixture manufacturer and integral to the luminaire.
21. LED modules/arrays shall be replaceable in the field. If luminaires are still under warranty, the Owner shall be compensated for the labor to do replacement work or the manufacturer shall send a factory representative to the site to do the work.
22. Replacement modules should have the ability to be “tuned” to match the output of remaining adjacent luminaires in the event that some time has passed and there has been light loss.

B. Reflector Finishes

1. Painted Finishes: Provide electro-statically applied dry polyester white powder coat finish with minimum reflectance of 88 percent on all light reflecting surfaces.
2. Specular/Semispecular Finishes: Provide Alzak-type anodized finish on aluminum louvers and reflectors as specified in Luminaire Schedule as shown on the drawings. Minimum reflectivity shall be:
 - a. Specular: 80 percent
 - b. Semi-specular: 75 percent

C. UL Listing

1. All Luminaries and components shall be UL tested, listed, and labeled.
2. Luminaries installed under canopies, roofs, or similar damp or wet locations shall be UL listed and labeled as suitable for damp or wet locations.

2.03 EXTERIOR LIGHTING FIXTURES

- A. Enclosures shall be complete with gaskets to form weatherproof seal and UL approved for wet locations.
- B. Provide low temperature drivers with reliable starting to 0 degrees F.

2.04 DRIVERS

A. General Requirements

1. All drivers shall be UL listed and have the UL symbol on the label.
2. All drivers shall be integral to fixture.

2.05 LIGHTING POLES

- A. Lighting poles shall be metal, type and finish as specified in Light Fixture Schedule as shown on the drawings.
- B. Site lighting poles shall meet wind load rating requirements per local building code.
- C. Refer to pole base details as shown on the drawings for specific pole base requirements.
- D. The entire pole assembly shall be designed to withstand a steady wind load rating requirements per local building code and a gust factor of 1.3 without permanent deflection.
- E. Anchor bolts shall be fabricated from commercial quality hot rolled carbon steel bar with guaranteed minimum yield strength of 55,000 psi. Bolts shall have an "L" bend on one end and be galvanized a minimum of 12" on the tread end. Furnish four bolts and bolt setting template with each set of anchor bolts. Furnish one hex nut, 2 hardened steel washers, and one hex nut with a stainless steel locking pin with each bolt. Furnish two leveling shims with each anchor bolt set.
- F. Standard finish for pole and accessories shall be a factory applied polyester thermosetting powder coating electro-statically applied to the surface of the substrate to a minimum thickness of 3 mil. Color as specified.
- G. Provide and install pole base covers on all poles. Each pole to have internal grounding lug and ground rod.

3.00 EXECUTION

3.01 INSPECTION

- A. Prior to order of lighting fixture, check the building electrical system requirements, architectural finishes, and the type of ceilings that lighting fixture will be installed. Any discrepancies of compatibility pertaining trim, frames, color, mounting, driver, voltage and

etc. shall be brought to the attention of A/E by written notice. Do not proceed with procurement until discrepancies are resolved in a satisfactory manner.

- B. Installer shall examine the areas and conditions that light fixtures are to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF LIGHTING FIXTURES

- A. Install light fixtures in accordance with the manufacturer's written instructions, the applicable requirements of NEC, and national and local codes, standards, and regulations.
- B. Install luminaries at locations as shown on the Drawings; install aligned, aimed, and leveled. Install fixtures in accordance with manufacturer's installation instructions complete with mounting accessories, trim and support materials. Fasten fixtures securely to structural support members of the building; solid pendant fixtures shall be plumb.
- C. Coordinate with other crafts to avoid conflicts between luminaires, supports, fittings and mechanical equipment.
- D. Suspended Fixtures:
 - 1. Fixture locations in open ceiling areas shall be adjusted to miss other trades as required. Submit detailed shop drawing for fixture relocations for Owner/Engineer/Architect approval.
 - 2. Coordinate installation of exposed conduits with other trades. Electrical shall be installed prior to other ceiling trades if possible. Clearance to junction boxes shall be maintained per NEC. Submit detailed shop drawing for conduit, junction box, and pathway routing for Owner/Engineer/Architect approval.
- E. Pole Mount Lighting
 - 1. Provide a lightning surge suppressor for circuit breakers that feed exterior lighting (parking lot, building surface, etc.). Use Current Technology's "Load Guard Series".
 - 2. Provide in-line fusing at handhole for all pole-mounted luminaries.
 - 3. Provide removable unitized driver/component tray with separable connector in all pole-mounted luminaries.
 - 4. Construct base of concrete with dimension and depth as noted on the drawings.
 - 5. Install anchor bolts with minimum projection above top of bases, as specified by pole manufacturer. Ground as indicated on drawings.
 - 6. Mount standards on bases plumb and true utilizing leveling and top nuts. Grout thoroughly between base-plate and foundation.
 - 7. Touch up chips and scratches on poles (to match new finish) upon completion.
- F. Immediately before final observation, clean all fixtures, inside and out, including plastics and glassware, and adjust all trim to properly fit adjacent surface, replace broken or damaged parts, and test all fixtures for electrical as well as mechanical operation.
- G. Protect installed fixtures from damage during the remainder of the construction period.

- H. Upon completion of installation of interior lighting fixtures, and after circuitry has been energized, apply electrical energy to demonstrate capability and compliance with requirements. When possible, correct malfunctioning units at the site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

END OF SECTION

31 05 13 SOILS FOR EARTHWORK

1.00 GENERAL

1.01 WORK INCLUDED

- A. This Section of the specifications describes the various classes of Earth Fill. All of the classes of Earth Fill contained in this specification may not be used on this project. The classes of Earth Fill used on this project are shown on the drawings or specified in other sections of the specifications. This Section does not include specifications for placement and compaction of Earth Fill. Specifications for placement and compaction of Earth Fill are included in other sections of the specifications and/or shown on the drawings.

1.02 STANDARDS

- A. Soil materials shall be classified into the appropriate class of Earth Fill shown below according to ASTM D2487 "Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)" or other appropriate methods as designated by the Engineer.

2.00 PRODUCTS

2.01 MATERIALS; CLASSIFICATIONS

- A. Class 1 Earth Fill: Limited to clays and sandy clays classified as CH material with a liquid limit greater than or equal to 50, a plasticity index greater than or equal to 25, and a minimum of 60 percent passing the No. 200 sieve, which are free of organic materials.
- B. Class 2 Earth Fill: Limited to clays and sandy clays classified as CH and CL materials with a coefficient of permeability less than or equal to 1.0×10^{-7} cm/sec, a liquid limit greater than or equal to 30, a plasticity index greater than or equal to 15, and more than 50 percent passing the No. 200 sieve, which are free of organic materials.
- C. Class 3 Earth Fill: Consist of any materials classified as CH, CL, SM, SP, SP-SM, SC, and GC, which have a minimum plasticity index of 4, which are free of organic materials.
- D. Class 4 Earth Fill: Consist of materials which are classified as SP, SM, SC, CL, or dual classifications thereof, which have a liquid limit less than or equal to 35 and a plasticity index of a minimum of 4 and a maximum of 15, which are free of organic materials.
- E. Class 5 Earth Fill: Consist of materials classified as SP or SP-SM which have a plasticity index less than or equal to 4 and a maximum of 12 percent passing the No. 200 sieve, which are free of organic materials.
- F. Class 12 Earth Fill: Consist of soils suitable for topsoil which are relatively free of stones or other objectionable debris, which have sufficient humus content to readily support vegetative growth. The suitability of soils for topsoil shall be subject to the approval of the Engineer.

3.00 EXECUTION (NOT APPLICABLE)

END OF SECTION

31 11 00 CLEARING AND GRUBBING [CIVIL]

1.00 GENERAL

1.01 WORK INCLUDED

- A. Provide labor, materials, equipment and incidentals necessary to perform operations in connection with clearing, grubbing, and disposal of cleared and grubbed materials.

1.02 QUALITY ASSURANCE; DEFINITIONS

- A. Clearing: Clearing is defined as the removal of trees, shrubs, bushes, and other organic matter at or above original ground level.
- B. Grubbing: Grubbing is defined as the removal of stumps, roots, boards, logs, and other organic matter found at or below ground level.

2.00 PRODUCTS (NOT APPLICABLE)

3.00 EXECUTION

3.01 PREPARATION

- A. Mark areas to be cleared and grubbed prior to commencing clearing operations. The Owner's Representative shall approve clearing and grubbing limits prior to commencement of clearing operations.
- B. Trees and shrubs outside of the clearing limits, which are within 10 feet of the clearing limits, shall be clearly marked to avoid damage during clearing and grubbing operations.
- C. Remove trees and brush outside the clearing limits, but within the immediate vicinity of the work, upon receipt of approval by the Owner's Representative, when the trees or brush interfere with the progress of construction operations.
- D. Clearly mark trees and shrubs within the clearing limits, which are to remain, and protect the trees and shrubs from damage during the clearing and grubbing operations.
- E. The clearing limits shall not extend beyond the project limits.

3.02 INSTALLATION

- A. Clearing: Clearing shall consist of the felling, cutting up, and the satisfactory disposal of trees and other vegetation, together with the down timber, snags, brush, rubbish, fences, and debris occurring within the area to be cleared.
- B. Grubbing:
 - 1. Grubbing shall consist of the removal and disposal of stumps and roots larger than 1 inch in diameter.
 - 2. Extend grubbing to the depth indicated below: In the case of multiple construction items, the greater depth shall apply.
 - a. Embankments: 24 inches below existing ground.

3.03 FIELD QUALITY CONTROL

- A. Timber, logs, roots, brush, rotten wood, and other refuse from the clearing and grubbing operations, may be burned or removed at the Contractor's option from the Owner's property. However, when permitted in writing by the Engineer, disposal of material may be done without the burning logs and large stumps, as elected by the Contractor. Such permit shall state the conditions covering the disposal of logs and stumps without burning, including the areas of disposal. Burn timber and other refuse to be disposed of at locations approved by the Owner and in a method that does not damage existing structures, construction in progress, trees, and vegetation.
- B. The Contractor shall be responsible for compliance with the federal, state, county, and municipal laws and regulations relative to the building of fires. Constantly monitor the disposal by burning until the fires have burned out or have been extinguished. Disposal of materials in streams shall not be permitted and no materials shall be piled in stream channels or in areas where it might be washed away by floods. Timber within the area to be cleared shall become the property of the Contractor, and the Contractor may cut, trim, hew, saw, or otherwise dress felled timber within the limits of the Owner's property, provided timber and waste material is disposed of in a satisfactory manner.
- C. Burn materials weekly during the clearing and grubbing operations, unless permission is granted by the Owner's Representative to store the materials for longer periods.

END OF SECTION

APPENDIX A

A1.00 MEASUREMENT AND PAYMENT

A1.01 MEASUREMENT

- A. Measurement is based on Square Yards.

A1.02 PAYMENT

- A. Payment for the work specified will be made at the unit price bid for “Clearing and Grubbing”, which payment shall constitute full compensation for labor, equipment, tools, and incidentals necessary to complete the specified work, including refilling of depressions. No payment will be made for clearing and grubbing in the borrow or waste disposal areas, and all costs thereof shall be included in the appropriate bid price of the type of work involved.
- B. The total amount bid for “Clearing and Grubbing” shall not exceed 1 percent of the total amount bid, exclusive of “Mobilization” and “Clearing and Grubbing.”

END OF APPENDIX A

31 23 10 STRUCTURAL EXCAVATION AND BACKFILL

1.00 GENERAL

1.01 SUMMARY

- A. This Section specifies excavation, backfill materials, backfill placement and compaction procedures, and other construction activities incidental to project structures.

1.02 DEFINITIONS

- A. Cofferdams: Any temporary or removable structure constructed to hold the surrounding earth and/or water out of the excavation, whether the structure is formed of soil, timber, steel, concrete, or a combination thereof, including the use of pumping wells or well points as required by design.

1.03 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design of cofferdams, including comprehensive engineering analysis by a qualified professional engineer for project specific site conditions. Design shall comply with AASHTO LRFD Bridge Design Specifications, latest addition.

1.04 QUALIFICATION ASSURANCE

- A. Cofferdam Designer: A professional engineer licensed in the state in which the Project occurs.
- B. Testing Agency: An independent testing agency that is AASHTO accredited.

1.05 SUBMITTALS

- A. Submittals shall be in accordance with the Contract Documents and shall include:
 - 1. Qualification Data: For professional engineer responsible for cofferdam design and testing agency.
 - 2. Shop Drawings: Cofferdam placement and details for record purposes.
 - 3. Calculations: For cofferdam indicated to comply with project specific site conditions, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation. Submittal shall be for record purposes.
 - 4. Backfill material classifications: For each soil or aggregate backfill material provide a certification by the testing agency.
 - 5. Compaction Test Results: Submit test results within 24 hours of successful testing.

1.06 STANDARDS

- A. Material classification, placing, and testing shall be in compliance with the latest revisions of the following standards, unless otherwise noted in the Contract Documents.

1. ASTM International (ASTM) Standards:

ASTM D698	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft ³ (600 kN-m/m ³))
ASTM D1556	Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method
ASTM D2487	Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D4253	Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
ASTM D6938	Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM C33	Standard Specification for Concrete Aggregates

- B. Any other testing required by these specifications and not specifically referenced to a standard shall be performed under ASTM or other appropriate standards as designated by the Engineer.

1.07 DELIVERY AND STORAGE

- A. Deposit material to be used for backfill in storage piles at points convenient for handling of the material during the backfilling operations and as required to prevent contamination with other materials.

1.08 JOB CONDITIONS

- A. Review subsurface investigations. A limited subsurface investigation has been performed by Riner Engineering. A geotechnical report from that investigation is a part of the Construction Documents for information purposes only. The precise profile of soil and rock strata beneath this Site is not known.
- B. Review the Site and determine the conditions which may affect the structural excavation, prior to the commencement of the excavation.

2.00 PRODUCTS

2.01 BACKFILL MATERIALS

- A. Structural Fill Backfill: Structural Fill Backfill as indicated in drawings.
- B. Working Platform: Working Platform as indicated in drawings.

2.02 COMPACTION EQUIPMENT

- A. Compaction equipment shall conform to the following requirements.
1. Heavy Compaction Equipment:
 - a. Tamping Compactor: Steel wheels with rectangular face, tapered pads that prevent fluffing the soil. Compactor shall be equipped with cleaning fingers to remove soil accumulation from between pads.
 - 1). Operating Weight, Minimum: 30,000 pounds.

- 2). Wheels or Drum Size, Minimum: 4 feet diameter.
- 3). Travel Speed, Maximum: 10 mph.
- b. Pneumatic Rollers: Minimum eight-tire, pneumatic roller with a modular ballast system and flexible operating weight, and which will equally distribute load between tires to provide compaction uniformity.
 - 1). Operating Weight Range: As required for specified compaction, 36,000 to 50,000 pounds.
 - 2). Tire Pressure Range: 80 psi to 100 psi.
 - 3). Travel Speed, Maximum: 10 mph.
 - 4). Distance Between Edges of Adjacent Tires: Less than 50 percent of tire width.
- c. Vibratory Rollers: Smooth drum roller with 90 percent of the static weight transmitted through a single drum.
 - 1). Static Weight, Minimum: 20,000 pounds
 - 2). Centrifugal Force Per Drum, Minimum: 40,000 pounds
 - 3). Frequency: 1400 v/min
 - 4). Drum Size: Diameter 5 feet, +/- 1 foot; width between 6 and 9 feet.
 - 5). Travel Speed: 5 mph for self-propelled; 2 mph for towed.
 - 6). No backing up of the vibratory roller will be allowed on an embankment unless the vibrating mechanism is capable of being reversed.
2. Hand-Directed Compaction Equipment: Use power tampers and vibratory plate compactors in areas where it is impracticable or unacceptable to use heavy compaction equipment.

2.03 COFFERDAMS

- A. Interior Dimensions: Of sufficient size to allow for all construction and inspection activities.
- B. Walls: Watertight. Extend below proposed subgrade as required to prevent water infiltration through subgrade. Extend above 100-year water surface elevations, but not less than that required by design.
- C. Provide pumping or bailing system as required by cofferdam design and/or Construction Document requirements.
- D. Provide aggregate work platform as required by cofferdam design and/or as indicated on the Drawings. Aggregate work platform shall be installed as indicated below.

3.00 EXECUTION

3.01 PREPARATION

- A. Clear and grub the area to be excavated prior to the start of excavation Remove the surficial vegetation, waste and soils to a minimum depth of 12 inches. Depth of removal shall not be less than that required to remove trees, shrubs, stumps, roots, and other organic material

above and below ground from within the area to be excavated. Ensure below grade organic material is removed to a minimum depth of 18 inches below bottom of footing/structure.

3.02 EXCAVATION FOR FOUNDATIONS

- A. General: Excavate subgrade to the depth indicated on Drawings, +/- 0.1 feet tolerance. Extend limits of the excavation beyond the perimeter of the foundations as indicated on the Drawings.
 - 1. Exposed subgrade surfaces shall be level and of sound, stable material, free of mud, frost, snow, or ice. Testing agency or Owner's representative shall confirm exposed subgrade is a suitable bearing material based on the Construction Documents.
 - 2. Proof roll the exposed subgrade in accordance with TxDOT Item 216. Do not proof roll wet or saturated subgrades.
 - 3. Where unsound or unstable material is uncovered, notify Owner's representative. Remove objectionable material and replace after approval is received from Owner's representative. Replacement material shall be as indicated here unless otherwise indicated on Drawings:
 - a. Soil subgrade replacement material: As indicated in drawings.
- B. Aggregate Work Platform: Where indicated, install work platform on exposed foundation subgrade prior to allowing any vehicular traffic on subgrade.
- C. Excavation Safety: All excavations shall be in accordance with OSHA requirements.

3.03 COFFERDAMS

- A. Install and remove cofferdams without disturbing the subgrade or marring the structure.
- B. Pump or bail water as required for construction and inspection work, and to prevent hydrostatic uplift pressures when not accounted for in the cofferdam design.

3.04 WATER IN FOUNDATION EXCAVATIONS

- A. General:
 - 1. Prevent water infiltration into foundation excavations. Remove standing water from excavation prior to placing concrete. If removal of standing water is not possible due to continuous water infiltration, then contact Owner's representative for additional direction regarding placing concrete underwater.
 - 2. Do not dewater a foundation excavation while placing concrete or for a period of at least 24 hours after concrete placement.
- B. Rock Foundation Subgrade: If rock material becomes weathered due to water infiltration, then remove weathered material and provide rock replacement material to restore foundation subgrade elevation.
- C. Soil Foundation Subgrade: If foundation subgrade becomes saturated do not disturb the subgrade. Wait for water to evacuate the subgrade and subgrade surface to adequately stiffen prior to placing concrete. If subgrade is disturbed, then wait until subgrade has dried out, excavate disturbed subgrade and provide replacement material as indicated above.

3.05 COMPACTED BACKFILL

- A. General: Backfill excavated spaces and areas not occupied by the permanent structure.
 - 1. Backfill behind a retaining wall or basement-type wall shall not be placed until the concrete has reached its 28-day compressive strength or 7 days, whichever is longer.
 - 2. Unless otherwise indicated on Drawings, structures with a top slab shall not backfilled until the top slab has been in place at least 4 days.
 - 3. Structures with soil on opposing (opposite) sides shall be backfilled to prevent uneven loading of the structure – evenly raise backfill on opposing sides of the structure. The maximum differential backfill height between opposing sides is 1 foot.
 - 4. Do not permit rollers to operate within 3 feet of structures.
 - 5. Maximum Loose Lift Height:
 - a. Heavy Compaction Equipment: 8 inches.
 - b. Hand-Directed Compaction Equipment: 4 inches.
 - 6. Previous Compacted Layer: If backfill placement occurs over a period of time greater than 24 hours, then scarify and recompact the previous day's final compacted layer.
 - a. Scarify and Recompact: 6-inch depth; adjust the moisture content; recompact.
 - b. Saturated subgrades shall not be worked on until sufficiently dry and harden so as not to be rutted with compaction equipment. Scarify and recompact layers damaged by weather or construction equipment.
- B. Moisture: Prior to compacting backfill, mix and aerate or water the loose lift backfill material as necessary to adjust the moisture content and evenly distribute throughout. The material shall contain moisture within the limits specified below.
 - 1. In accordance with ASTM D6938, determine the optimum moisture content for the maximum dry density.
 - 2. Backfill moisture content shall be as indicated in Table 1, "Compacted Fill."
 - 3. Aggregate fill: Completely cohesionless materials, shall be at a moisture content which will allow use of the specified compaction equipment and consistent achievement of the specified density.
- C. Compaction: As required to achieve the specified density, increase the number of passes above the minimum specified and/or modify the weight of the equipment.
 - 1. Determine the maximum dry density in accordance with ASTM D698 for cohesive soils and ASTM D4253 for cohesionless soils.
 - 2. Minimum number of passes for all compacted fill types: 8.
 - 3. Cohesive Soils: A tamping compactor or tamping compactor followed by a pneumatic roller shall be used.
 - 4. Cohesionless or low cohesive soils: A vibratory roller or vibratory plate compactors shall be required if the material is cohesionless or with less than 15 percent passing the No. 200 sieve. Confirm applicability of vibratory compaction equipment in the field.

5. Overlap passes a minimum of 1 foot for heavy compaction equipment and 50 percent of the baseplate width for hand-directed equipment.
6. Backfill density shall be as indicated in Table 1, "Compacted Fill."

Table 1: Compacted Fill			
Backfill Type	Density^{1,2}	Moisture Content^{3,4}	Comments
Structural Fill	95%	-2% to +2%	N/A
Subgrade	95%	-2% to +2%	N/A

¹ The percentage indicated is the minimum required percentage of the maximum dry density as determined by the applicable ASTM.

² Below Vehicular Pavement: Scarify to a depth of 8, moisture condition, and recompact to not less than 100 percent of the maximum dry density.

³ Range indicated is the acceptable tolerance with respect to the optimum moisture content.

⁴ Completely cohesionless materials, shall be at a moisture content which will allow use of the specified compaction equipment and result in consistent achievement of the specified density.

3.06 FIELD QUALITY CONTROL

- A. Contractor is responsible for the costs involved in providing an approved testing agency to perform quality control testing of backfill operations and verification of subgrade bearing material. The testing laboratory shall make tests of in-place density and moisture in accordance with ASTM Standards previously mentioned in this Section. The testing agency shall monitor backfill operations continuously or at intervals acceptable to the Owner's representative. It shall be the responsibility of the Contractor to notify the testing agency a minimum of two business days before backfill operations begin.
1. Unless noted otherwise, in-place density tests shall be conducted at a rate of one test per 3000 square feet for every lift.

END OF SECTION

31 23 19.01 CARE OF WATER DURING CONSTRUCTION

1.00 GENERAL

1.01 WORK INCLUDED

- A. Furnish labor, materials, equipment and incidentals necessary to operate pumps, piping and other facilities to assist in the removal of surface water, stormwater runoff, and ground water, and provide protection of the work site from water of any source. Build and maintain the necessary temporary cofferdams, berms, diversions, impounding works, channels and ditches to protect the work site from lake levels and spillway discharges, streamflow, and stormwater runoff. Remove the temporary works, equipment, and materials after completion in accordance with this Section and the applicable Drawings.

1.02 SUBMITTALS

- A. Submittals shall be in accordance with the Contract Documents and shall include:
 - 1. Plans and procedures for handling flood flows, stormwater runoff, and dewatering excavations for approval by the Engineer. Modifications to these plans shall also be submitted for approval by the Engineer.
 - 2. Plans shall include a demonstration that any cofferdams or diversions provide at least 10-year flood protection for protected structures under construction.
- B. Approval of submittals does not relieve the Contractor of full responsibility and liability for care of water during construction.

2.00 PRODUCTS (NOT APPLICABLE)

3.00 EXECUTION

3.01 FLOOD FLOWS AND OTHER SURFACE WATER

- A. The Contractor is responsible for handling and diverting any flood flows, stormwater runoff, stream flows, or any other water, including groundwater encountered during the progress of the work. Build, maintain, and operate cofferdams, channels, flumes, sumps, berms, ditches, and other temporary works as needed to pass spillway discharge and divert stream flow or stormwater runoff water through or around the construction site and away from construction work while it is in progress. The handling of stormwater runoff should be coordinated with the erosion control plan. Unless otherwise approved by the Owner, a diversion must discharge into the same natural watercourse in which its headworks are located. Construct permanent Work in areas free from water. Full responsibility for the successful dewatering of the work areas rests with the Contractor. Remove protective works, after they have served their purpose, in a manner satisfactory to the Owner or its representative.

3.02 DEWATERING EXCAVATED AND OTHER FOUNDATION AREAS

- A. Contractor is responsible for dewatering foundations for all areas during construction of the Project, including areas of required backfills. Lower the water table as needed to keep work

areas free of standing water or excessively muddy conditions as needed for proper performance of the construction work. Furnish, prepare, and maintain drains, sumps, casings, well points, and other equipment needed to dewater areas for required construction work. Any dewatering method that causes a loss of fines from foundation areas shall not be permitted. Keep available standby equipment to ensure the proper and continuous operation of the dewatering system. Provide continuous monitoring (24 hours per day) of the dewatering system to ensure continuous operation.

- B. Construction modifications in the dewatering system may be required by the Engineer to provide adequate performance. In the event of failure of the system, flooding of the excavation may be ordered by the Engineer until the system is operative.

3.03 DEWATERING BORROW AREAS

- A. Unless otherwise specified on the Drawings, maintain the borrow areas in drainable condition or otherwise provide for timely removal of surface waters that accumulate, for any reason, within the borrow areas.

END OF SECTION

APPENDIX A

A1.00 MEASUREMENT AND PAYMENT

A1.01 MEASUREMENT

- A. No measurements are required.

A1.02 PAYMENT

- A. Payment for the work covered under this Section will be made at the lump sum price bid for “Dewatering (Cofferdamming)”, which payment shall constitute full compensation for all costs of furnishing the labor, equipment, and materials for any temporary diversions and drainage channels, installing pumps and other dewatering equipment as required, maintaining the work area free from water, and removing the temporary protective works as needed to comply with this Section. Partial payments will be made based upon the number of days **bid** for the Contract and the number of contract days completed. If the contract term is changed by Change Order, the remaining portion of the lump sum will be divided over the remaining term of the Contract for partial payments.

END OF APPENDIX A

31 23 33 TRENCHING AND BACKFILL [UTILITIES]

1.00 GENERAL

1.01 WORK INCLUDED

- A. Furnish labor, materials, equipment and incidentals necessary to perform operations in trenching, pipe bedding, backfilling, clearing, grubbing and site preparation; handling, storage, transportation and disposal of excavated material; pumping and dewatering; preparation of subgrades; protection of adjacent property; fills, grading; and other appurtenant work. Trenching, backfilling, and pipe embedment procedures shall be in full compliance with Section 31 23 33.14 "Trench Safety." Earth removed from excavations and which is not required for backfill shall be removed from the Site by the Contractor at his own expense, unless arrangements are made with the Owner through his representative to allow disposal on Site. If permitted, the Contractor shall dump and spread excess earth in a manner agreed upon by the Contractor and the Owner. Excavations, other than trench excavation, are not part of this Section.

1.02 QUALITY ASSURANCE

- A. Classification:
1. Excavations shall include material of whatever nature encountered, including but not limited to clays, sands, gravels, conglomeritic boulders, weathered clay shales, rock, debris and abandoned existing structures. Excavation and trenching shall include the removal and subsequent handling of materials excavated or otherwise handled in the performance of the Work.
 2. Bidders must satisfy themselves as to the actual existing subsurface conditions prior to the submittal of a proposal to complete the proposed Work.
 3. Trench excavation shall consist of excavation to the lines and grades indicated, required for installation of the pipe, pipe bedding, backfill, and to accommodate trench safety systems.

1.03 SUBMITTALS

- A. Submittals shall be in accordance with the Contract Documents and shall include:
1. Sieve analysis on embedment materials.
 2. Test results indicating soil resistivity for embedment material used on metal pipe.
 3. Record Data: Certified test reports for compaction tests.

1.04 REFERENCE SPECIFICATIONS

- A. Section 03 30 00 "Cast-In-Place Concrete."
B. Section 31 23 33.14 "Trench Safety."

1.05 STANDARDS

- A. The following publications, referred to hereafter by basic designation only, form a part of this Section to the extent indicated by the references thereto:

1. American Society for Testing and Materials (ASTM) Standards:

ASTM C33	Standard Specification for Concrete Aggregates
ASTM C88	Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C125	Standard Terminology Relating to Concrete and Concrete Aggregates
ASTM C131	Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C535	Standard Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM D448	Standard Classification for Size of Aggregate for Road Bridge Construction
ASTM D698	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft ³ (600 kN-m/m ³))
ASTM D1556	Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D2487	Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D4253	Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
ASTM D4254	Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
ASTM D6938	Standard Test Method for In-Place Density and Water Content of Soil and Soil-aggregate by Nuclear Methods (Shallow Depth)
ASTM G57	Standard Test Method for Field Measurement of Soil Resistivity Using the Wenner Four-Electrode Method

- B. Any other testing required by these specifications and not specifically referenced to a standard shall be performed under ASTM or other appropriate standards as designated by the Engineer.
- C. Reference herein or on the Drawings to soil classifications shall be understood to be according to ASTM D2487, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).

1.06 DELIVERY AND STORAGE

- A. Excavated materials to be used for backfill may be deposited in stockpiles at points convenient for rehandling the material during the backfilling process. The location of stockpiles shall be within the limits of construction easements or public right-of-way. The location of stockpiles is subject to the approval of the Owner or the Owner's representative. Keep drainage channels clear of stockpiled materials.

1.07 JOB CONDITIONS

- A. Place no embedment or backfill material during freezing weather or upon frozen subgrades or previously placed frozen embedment or backfill materials.

2.00 PRODUCTS

2.01 MATERIALS

- A. Class 1 Earth Fill: Limited to clays and sandy clays classified as CH material with a liquid limit greater than or equal to 50, a plasticity index greater than or equal to 25, and a minimum of 60 percent passing the No. 200 sieve, which are free of organic materials.
- B. Class 3 Earth Fill: Consist of any materials classified as CH, CL, SM, SP, SP-SM, SC, and GC, which have a minimum plasticity index of 4, which are free of organic materials.
- C. Class 12 Earth Fill: Consist of soils suitable for topsoil which are relatively free of stones or other objectionable debris, which have sufficient humus content to readily support vegetative growth. The suitability of soils for topsoil shall be subject to the approval of the Engineer.
- D. Class 2 Aggregate Fill: Granular embedment material shall be sandy gravel or blended sand and crushed rock, free from large stones, clay, and organic material. Embedment material shall be a soil classification of GW, GP, SW, or SP as determined by ASTM D2487. The embedment material shall be such that when wet, the fine material shall not form mud or muck. The embedment material shall be composed of angular, tough durable particles, free from thin, flat and elongated pieces, of suitable quality to insure permanence in the trench and have a percentage of wear of not more than 40 percent when tested in accordance with ASTM C131 or ASTM C535. The P.I. of the fines shall not exceed 3. Light weight aggregate is not acceptable for granular embedment. Material used for granular embedment shall have a resistivity of not less than 5000 ohms/cm as measured by ASTM G57.
1. This shall be cohesionless material meeting the following gradation requirements:

Sieve Size Square Opening	Percent Passing
1/2"	100
3/8"	85-100
No. 4	10-30
No. 8	0-10
No. 16	0-5

- E. Class 10 Aggregate Fill: Consists of washed and screened natural sands or sands manufactured by crushing stones complying with the requirements and tests of "Standard Specifications for Concrete Aggregates", ASTM C33. The gradation as included in ASTM C33 is as follows:

Sieve Size Square Opening	Percent Passing
3/8"	100
No. 4	95-100

Sieve Size Square Opening	Percent Passing
No. 8	80-100
No. 16	50-85
No. 30	25-60
No. 50	10-30
No. 100	2-10

1. Class 10 Aggregate Fill shall have not more than 45 percent passing any sieve and retained on the next consecutive sieve of those shown above, and its fineness modulus, as defined in ASTM C125, shall be not less than 2.3 nor more than 3.1.

F. Cement: Type I Portland Cement.

- G. Modified Flowable Fill: Modified flowable backfill in areas of possible future excavation shall consist of a mixture of native soils or manufactured materials, cement and/or fly ash, air entraining material and water which produces a material with unconfined compressive strength of between 250 and 450 psi after 28 days. Any materials used shall be primarily granular, with a plasticity index less than 12 and with 100 percent passing a 3/4-inch sieve. The flowable mixture shall be mixed in a pug mill, concrete mixer, or transit mixer and shall have a minimum slump of 5 inches. The flowable mixture must be allowed to set prior to the placement of any overlying materials. Modified flowable backfill in permanent areas such as abandoned pipe closures shall contain the same materials and have an unconfined compressive strength greater than 250 psi after 28 days.

2.02 MIXES; SAND-CEMENT BACKFILL [OR EMBEDMENT]

- A. A minimum sand and cement mixture of 25 parts sand and 2 parts cement will be required.

1. Fine Sand: 25 Cubic Feet.
2. Cement: 2 Bags (minimum).
3. Water: Optimum moisture.

- B. Sand shall be free of any cohesive material and shall meet the following gradation and plasticity index requirements:

Sieve Size	Percent Passing
1"	100
1/2"	95-100
No. 40	80-100

- C. PI and LL Amounts:

1. Plasticity Index: 10 Maximum.
2. Liquid Limit: 25 or less.

3.00 EXECUTION

3.01 PREPARATION

A. Site:

1. Clear sites of logs, trees, roots, brush, tree trimmings and other objectionable materials and debris which are to be occupied by pipe trenches, and grub stumps. Designate material not salvaged for reuse as surface material as spoiled and dispose of material in accordance with Paragraph 3.01.E, Disposal of Spoil Material.

B. Dewatering:

1. Provide and maintain adequate dewatering equipment to remove and dispose of surface and ground water entering the excavations, trenches, or other parts of the Work. Keep each excavation dry during subgrade preparation and continually thereafter until the proposed pipe is installed. Maintain the proper procedures necessary to protect against damage to the proposed Work from hydrostatic pressure, flotation, or other water related causes.
2. Dewater excavations which extend down to or below ground water elevation by lowering and keeping the ground water level a minimum of 2 feet below the bottom of the excavation.
3. Divert surface water or otherwise prevent water from entering excavated areas to the fullest extent possible without causing damage to adjacent property.
4. Provide and maintain any piping or conduit necessary to facilitate drainage. Do not alter area drainage patterns to the extent that adjacent property and landowners become threatened with localized flooding and/or water damage. Should such a situation occur, the Contractor shall be responsible for repairing the damage at no additional cost to the Owner.

C. Protection of Existing Structures and Utilities:

1. Prior to the start of construction, communicate with the representatives of the local utility companies, including the oil, gas, telephone and communications companies, and local water and sewer utilities operating in the location of the proposed construction area. Seek the utility companies' assistance in locating existing facilities to avoid conflicts during construction. The location, number, depth, and owner of utilities indicated are for information purposes only, and all utilities and structures may not be shown or may not be at the location shown.
2. Where construction endangers adjacent structures, utilities, embankments and/or roadways, the Contractor shall, at his own expense, carefully support and protect such structures so that no damage occurs throughout the construction process. In case damage should occur, the Contractor shall be responsible for restoring the damaged structure to a condition acceptable to the Owner of that structure and shall bear all cost of such reparations.
3. Repair or replace damaged street surfaces, driveways, sidewalks, curbs, gutters, fences, drainage structures, or other such facilities to the satisfaction of the Owner. Structures shall be returned to a condition equal to or better than the original condition and of same or better material and quality.

D. Blasting: Blasting shall not be allowed in any instance.

E. Disposal of Spoil Material:

1. Suitable material from excavations which meets the requirements for pipe backfill material as indicated, except stripping excavation, may be reused. Designate the remaining excavated materials as spoiled material and dispose of material off the Site in accordance with all applicable laws, ordinances, and codes. Contractor shall be responsible for the storage, transportation, and deposition of spoiled material and shall be responsible for acquiring the necessary permits, and the payment of fees and duties at no additional cost to the Owner.
2. No burning of materials shall be permitted on the Site.

3.02 TRENCH EXCAVATION

- A. General: The trenches shall be excavated to the alignment and depth indicated or as necessary for the proper installation of the pipe and appurtenances. Brace and dewater the trench if necessary so that the workmen may work therein safely and efficiently. Any specific requirement listed in Paragraph 3.00, Execution, may be modified as necessary to meet OSHA requirements. However, if trench widths are wider than indicated, the Contractor shall be responsible for determining and furnishing the proper class of embedment and piping for the installation with no additional compensation to the Contractor.
- B. Trench Width: The trench widths shall be as shown on the Drawings.
- C. Pipe Foundation Subgrade:
1. Excavate the trench to an even grade to permit the installation of the pipe so that the full length of the pipe barrel is supported on the proper depth of bedding material. The entire foundation subgrade area in the bottom of the excavations shall be firm, stable material, and the material shall not be disturbed below required grade except as described in this Section. Where the character of the subgrade material is such that proper subgrade cannot be obtained at the elevation indicated, deepen the excavation to a satisfactory subgrade material.
 2. Remove the material until a firm, stable, and uniform bearing is reached and the subgrade brought back to the required grade with the specified bedding material compacted in place or with lean concrete material. The expense of replacing any unsatisfactory subgrade shall be borne by the Contractor.
- D. Correcting Faulty Grade: Should any part of the trench be excavated below required grade, correct the trench with bedding material, thoroughly compacted, or with lean concrete, at no additional compensation to the Contractor.
- E. Care of Surface Material for Reuse: If local conditions permit reuse, keep surface material suitable for reuse separate from the general excavation material.
- F. Trenching Methods: The use of any suitable trench digging machinery is permitted except in places where such operations may cause damage, above or below ground, in which case, employ hand methods.
- G. Pipe Clearance in Rock: Remove ledge rock, rock fragments, shale, or other rock to provide proper clearance for bedding materials. Provide adequate clearance for properly jointing pipe laid in rock trenches at bell holes.

3.03 BACKFILL

A. Bedding within Pipe Zone:

B. Aggregate Fill Bedding:

1. After the trench has been cut to the depths indicated, bring up the bedding layer to a point slightly above grade in maximum 4-inch lifts and uniformly compact to the density indicated. Form bell holes and scoop out a trough to grade so that the pipe is uniformly supported by the embedment material. Lay and joint the pipe. Bring up the embedment material in maximum 4-inch lifts on either side of the pipe to the elevation above the pipe shown on the Drawings. Uniformly compact the pipe as indicated.
2. After moisture is gone from the embedment material, place utility detection tape and backfill and compact the remaining backfill by tamping or other appropriate methods. Water jetting shall not be permitted.

C. Compaction Requirements:

1. Compact earth fill and cohesive aggregate fill in maximum 4-inch lifts with pneumatic rollers or power hand tampers and make a minimum of eight passes.
2. Compact cohesionless aggregate fill in maximum 4-inch lifts with vibratory rollers or vibratory plate power hand compactors and make a minimum of eight passes.
3. The acceptability of the compaction equipment shall be based upon the results of a test section. Compact earth fill and cohesive aggregate fill to a minimum of 95 percent of maximum dry density as determined by ASTM D698, Standard Proctor.
4. Compact Class 1 and 2 earth fill at a moisture content within minus 0 to plus 5 percentage points of the optimum moisture content. Compact the remaining classes of earth fill and cohesive aggregate fill at a moisture content within minus 2 to plus 5 percentage points of optimum moisture content. The moisture ranges listed above are minimum and maximum limits. A tighter moisture range within these limits may be required to consistently achieve the specified density.
5. Compact cohesionless aggregate fill on which it is not practical to control the density by "Proctor" methods to a minimum of 75 percent relative density as determined by ASTM D4253 and D 4254, or at the discretion of the Engineer, by a field compaction mold method correlated to ASTM D4253 and D 4254.
6. Compact cohesionless aggregate fill at a moisture content within a range that accommodates consistent placement and compaction to the minimum relative density specified above.
7. The Owner will arrange and pay for density and moisture testing. The testing frequency and methods shall be as requested by the Engineer. The Engineer may waive testing requirements on cohesionless bedding where testing is not practical because of limited space between the pipe and trench walls, however, the minimum number of passes of the compaction equipment specified above shall be achieved.

3.04 FINISHING

- #### A. Grade and rake areas smooth and even which do not receive any type of paved surface, to allow drainage to drain away from the structures and toward the roads and streets or the

natural drainage course. Break up large clods of earth and remove rocks, trash or debris near the surface.

- B. Finish the top portion of backfill beneath established sodded (lawn) areas with not less than 6 inches of topsoil corresponding to, or better than, that underlying adjoining sodded areas.

3.05 FIELD QUALITY CONTROL

- A. Compact backfill and appropriate embedment material to a minimum of 95 percent of maximum density at a moisture content of 0 to plus 5 percent of optimum for backfill and at optimum for sand-cement embedment as determined by ASTM D698, Standard Proctor.
- B. Make periodic tests of compaction for conformance with this Section by an approved testing laboratory selected and paid for by the Owner. Contractor shall pay for re-testing until acceptable test results are obtained.

3.06 CLEAN AND ADJUST

- A. Remove surplus pipeline materials, tools, rubbish and temporary structures and leave the construction site clean, to the satisfaction of the Engineer.

END OF SECTION

31 23 33.14 TRENCH SAFETY

1.00 GENERAL

1.01 WORK INCLUDED

- A. This specification consists of the basic requirements which the Contractor must comply with in order to provide for the safety and health of workers in a trench. This specification is for the purpose of providing minimum performance specifications, and the Contractor shall develop, design, and implement the trench safety system. The Contractor shall bear the sole responsibility for the adequacy of the trench safety system and providing "a safe place to work" for the workman.
- B. Should the trench safety protection system require wider trenches than specified elsewhere, the Contractor shall be responsible for the costs associated with determining adequacy of pipe bedding and class, as well as, purchase and installation of alternate materials.

1.02 STANDARDS

- A. The following standard shall be the minimum governing requirement of this specification and is hereby made a part of this specification as if written in its entirety.
 - 1. Occupational Safety and Health Standards - Excavations (29CFR Part 1926), U.S. Department of Labor, latest edition.
- B. Comply with the applicable federal, state, and local rules, regulations, and ordinances.

2.00 PRODUCTS (NOT APPLICABLE)

3.00 EXECUTION (NOT APPLICABLE)

END OF SECTION

31 32 19.15 GEOTEXTILE

1.00 GENERAL

1.01 WORK INCLUDED

A. Furnish labor, materials, equipment and incidentals necessary to install geotextile. Use geotextile to provide for the following applications:

1. Protection/Erosion Protection:
 - a. Under boat ramp aggregate base and rock riprap

1.02 QUALITY ASSURANCE

A. Design Criteria:

1. The geotextile fabric shall be inert to commonly encountered chemicals, hydrocarbons, mildew and rot resistant, resistant to ultraviolet light exposure, insect and rodent resistant.
2. The minimum average roll value (MARV) in the weakest principle direction for strength properties of any individual roll tested from the manufacturing lot or lots of a particular shipment shall be in excess of the minimum average roll value (MARV) in the weakest principle direction stipulated herein.

B. Packing and Identification Requirements: Provide the geotextile in rolls wrapped with protective covering to protect the fabric from mud, dirt, dust, and debris. The fabric shall be free of defects or flaws which significantly affect its physical properties. Label each roll of fabric in the shipment with a number or symbol to identify that production run.

C. Sampling and Compliance Requirements: A competent laboratory must be maintained by the producer of the fabric at the point of manufacture to ensure quality control in accordance with ASTM testing procedures. The laboratory shall maintain records of its quality control results and provide a manufacturer's certificate upon request to the Engineer prior to shipment. The certificate shall include:

1. Name of manufacturer.
2. Chemical composition.
3. Product description.
4. Statement of compliance to specification requirements.
5. Signature of legally authorized official attesting to the information required.

1.03 SUBMITTALS

A. Submittals shall be in accordance with the Contract Documents and shall include:

1. Submit Manufacturer's certificate as stipulated in Paragraph **1.02.C**.
2. Samples.

2.00 PRODUCTS

2.01 MATERIALS

- A. Geotextile: Non-woven fabric composed of polypropylene fibers, formed into a stable network by needle punching.

3.00 EXECUTION

3.01 INSTALLATION

A. Protection/Erosion Protection:

1. Exposure of geotextiles to the elements between laydown and cover shall be a maximum of 14 days to minimize damage potential. Install the geotextile fabric in accordance with the Drawings. Construction vehicles will not be allowed to traffic directly on the fabric. Place and anchor geotextile on a smooth graded surface approved by the Engineer. The geotextile shall be placed so that placement of the overlying materials will not excessively stretch or tear the fabric. Anchoring of the terminal ends of the geotextile shall be accomplished through the use of key trenches or aprons at the crest and the toe of the slope. Successive geotextile sheets shall be overlapped so that the upstream sheet is placed over the downstream sheet and/or upslope over downslope. In underwater applications, the geotextile and required thickness of backfill material shall be placed the same day. The geotextile shall be placed so that placement of the overlying materials will not excessively stretch or tear the fabric. Overlaps when necessary shall be 12 inches minimum except when placed under water where the overlap shall be a minimum of 36 inches. Use securing pins when necessary to ensure proper anchoring of the fabric, with securing pins spaced at 5- to 10-foot centers. Securing pins shall be 3/16-inch steel bars, pointed at one end and fabricated with a head to retain a steel washer having an outside diameter of not less than 1-1/2 inches. The pin length shall not be less than 19 inches. U-shaped pins or special staples shall be an acceptable option, if approved by the Engineer. Damaged geotextile shall be repaired with geotextile patch placed over the damaged area and extended 3 feet beyond the perimeter of the tear or damage.
2. The backfill placement shall begin at the toe and proceed up the slope. Back-dump the aggregate onto the fabric and spread in a uniform lift maintaining design aggregate thickness. Avoid over-stressing the soil by utilizing equipment in spreading and dumping that exerts only moderate pressures on the soil. Severe rutting at the time of placement is an indication of over-stressing the soil. Such soil over-stressing must be avoided. Increasing aggregate depths and reducing loads are two methods of reducing pressures on the soil. Fill any ruts that develop during spreading or compacting with additional aggregate rather than blading from surrounding areas.

END OF SECTION

31 37 00 ROCK RIPRAP

1.00 GENERAL

1.01 WORK INCLUDED

- A. SRA will furnish all rock riprap for the project and will deliver the material to the site. Contractor is responsible to furnish labor, equipment, tools and incidentals necessary to produce and place the rock riprap and gravel bedding material.

1.02 DELIVERY AND STORAGE; ROCK RIPRAP STOCKPILE

- A. Rock Riprap temporarily stockpiled for construction purposes shall not be located so as to block or restrict equipment and vehicle access to existing structures.

2.00 PRODUCTS

2.01 MATERIALS

A. Gravel Bedding Material:

1. Gravel bedding material shall be crushed stone, gravel or a blend of crushed stone and gravel. Bedding material shall be composed of tough durable particles; shall be free from thin, flat, and elongated pieces; shall be well graded between the prescribed limits; and shall contain no organic matter or soft, friable particles in quantities considered objectionable by the Owner.
2. Gravel bedding material shall have a loss of less than 18 percent weighted average at five cycles when tested for soundness in magnesium sulfate in accordance with ASTM C88. The test shall be run using normalized gradation and standardized aggregate sizes. The standardized aggregate size is shown in the Drawings. A minimum of one soundness test shall be performed on materials delivered to the Site.
3. Gravel bedding material shall have a gradation as shown on the Drawings when tested in accordance with ASTM C136. The material shall not be skip graded, scalped of certain sizes, or have other irregularities which would be detrimental to the proper functioning of the bedding. Acceptance of bedding material shall be based on in-place gradations.

B. Rock Riprap:

1. Stone for rock riprap shall be durable and of a suitable quality for permanence in the structure and in the climate which it is to be used. The stone shall be free from cracks, seams, and other defects which would tend to increase unduly its deterioration from natural causes and shall be reasonably well graded between the prescribed limits as specified herein.
2. Except as otherwise specified, the rock fragments shall be angular to subrounded. The least dimension of an individual stone fragment shall be not less than one-third the greatest dimension of the stone.
3. Rock riprap shall have a minimum unit weight of 155 pounds per solid cubic foot based upon the bulk specific gravity (saturated surface dry) when tested in accordance with

ASTM C127. A minimum of one bulk specific gravity (saturated surface dry) shall be performed on rock riprap material delivered to the Site.

4. Rock riprap shall have a loss of less than 18 percent after five cycles when tested for soundness in magnesium sulfate in accordance with ASTM C88. A minimum of one soundness-in-magnesium sulfate test shall be performed on rock riprap material delivered to the Site.

2.02 MANUFACTURED PRODUCTS

- A. Geotextile Fabric: Geotextile fabric shall be as specified on the Drawings

3.00 EXECUTION

3.01 FOUNDATION PREPARATION

- A. Trim and dress areas on which gravel bedding and rock riprap are to be placed to conform to cross-sections shown on the Drawings within an allowable tolerance of plus or minus 2 inches from the slope lines and grades shown on the Drawings. Where such areas are below the allowable minus tolerance limit, bring areas to grade with well compacted gravel bedding material.

3.02 GEOTEXTILE FABRIC

- A. Store and place fabric as specified by the manufacturer. Place the geotextile fabric after the foundation is prepared and cover immediately with gravel bedding material.
- B. Place fabric with the length running up and down the slope unless otherwise approved. The geotextile shall be placed so that placement of the overlying materials will not excessively stretch or tear the fabric. Anchoring of the terminal ends of the geotextile shall be accomplished through the use of key trenches or aprons at the crest and the toe of the slope.
- C. Make a minimum 24-inch lap on all joints. Secure fabric with nails or pins. Use nails at least 2 inches long with washers or U-shaped pins with legs at least 9 inches long. Space nails or pins at a maximum of 10 feet in each direction and 5 feet along the seams. Alternative anchor spacing may be used when approved.
- D. Construction vehicles will not be allowed to traffic directly on the fabric. Damaged geotextile shall be repaired with geotextile patch placed over the damaged area and extended 3 feet beyond the perimeter of the tear or damage.

3.03 GRAVEL BEDDING PLACEMENT

- A. Uniformly spread gravel bedding material on the prepared surface, in a satisfactory manner, to the slope lines and grades indicated on the Drawings. Placing of material by dumping from top of slope or by any method which tends to segregate particle sizes within the layer shall not be permitted. Repair any damage to the prepared surface or geotextile fabric during placing of the gravel bedding before proceeding with the Work. Compaction of the gravel bedding will not be required, but it shall be finished to present a reasonably even surface free from mounds or windrows.

3.04 ROCK RIPRAP PLACEMENT

- A. Place stone for rock riprap on the gravel bedding in such manner as to produce a reasonably well-graded mass of rock with the minimum practicable percentage of voids, and construct within the specified tolerance to the lines and grades shown on the Drawings or staked in the field. A tolerance of plus 6 or minus 0 inches from the slope lines and grades shown on the Drawings shall be allowed in the finished surface of the rock riprap. Place rock riprap to its full course thickness at one operation and in such a manner as to avoid displacing the gravel bedding material. Distribute the larger stones evenly and conform the entire mass of stones in their final position to the specified gradation.
- B. The finished rock riprap shall be free from objectionable pockets of small stones and clusters of larger stones. Place rock riprap loads along horizontal rows and progress up the slope. Place each load against previously placed rock riprap. Placing rock riprap in layers shall not be permitted. Placing rock riprap by dumping from top of slope, dumping into chutes, or by similar methods likely to cause segregation of the various sizes shall not be permitted. The desired distribution of the various sizes of stones throughout the mass shall be obtained by methods of placement which produces the specified results. Rearrange individual stones by mechanical equipment or by hand to the extent necessary to obtain a reasonably well graded distribution of stone sizes. Maintain the rock riprap protection until accepted and replace any material displaced by any cause to the lines and grades shown on the Drawings.
- C. Rock riprap shall be placed in a manner to prevent damage to structures. Hand placing is required as necessary to prevent damage to any new and existing structures.

END OF SECTION

APPENDIX A

A1.00 MEASUREMENT AND PAYMENT

A1.01 MEASUREMENT

- A. Measurement for Rock Riprap (Labor Only) shall be to the neat lines and grades indicated on the Drawings or as modified by the Owner, and on the basis of the prescribed thickness measured perpendicular to the slope or surface on which it is placed.
- D. Geotextile fabric shall be measured by the square yard of material placed in accordance with the Contract Documents. No allowance will be made for material in laps, seams or anchor trenches.

A1.02 PAYMENT

- A. Rock Riprap (Labor Only): Payment for rock riprap material shall be made at the unit price bid per cubic yard for "Rock Riprap" which payment shall be full compensation for labor, equipment, and for performing all operations necessary to transport, haul, handle, and place the rock riprap as specified and as indicated on the Drawings.

END OF APPENDIX A

32 12 16 ASPHALT PAVING

1.00 GENERAL

1.01 WORK INCLUDED

- A. Furnish labor, materials, equipment and incidentals necessary to perform operations in connection with the construction of hot mix asphaltic concrete (HMAC) base course, leveling-up course and surface course or any other combination of these courses. Construct the pavement on the previously completed and approved subgrade, base, or existing pavement.

1.02 QUALITY ASSURANCE

- A. Design Criteria: Use the services of an independent testing laboratory to prepare a mix design to comply with Texas Department of Transportation, Standard Specification Item 340 or may use a previously prepared mix design meeting the specification requirements with satisfactory substantiation of experience with the mix.

1.03 SUBMITTALS

- A. Submittals shall be in accordance with the Contract Documents and shall include:
 - 1. Mix design as record data.

1.04 STANDARDS

- A. Hot mix asphaltic concrete (HMAC) pavement shall conform to the requirements of the current Texas Department of Transportation (TXDOT), Standard Specification for "Dense-Graded Hot Mix Asphaltic ", Item 340.
- B. Asphaltic material shall comply with Texas Department of Transportation (TXDOT) Standard Specification Item 300.

1.05 DELIVERY AND STORAGE

- A. Haul the asphaltic mixture to the job site in tight vehicles previously cleaned of foreign materials. Arrange the dispatching of vehicles so that all material delivered shall be placed and all rolling shall be completed during daylight hours. In cool weather, or for long hauls, canvas covers may be required. The inside of the truck body may be given a light coating of oil, if necessary, to prevent the asphaltic mixture from adhering to the body.

1.06 JOB CONDITIONS

- A. Do not apply prime coat when the air temperature is below 50 F and falling, but may be applied when the air temperature is above 40 F and rising, the air temperature being taken in the shade and away from artificial heat. Do not place asphaltic material when general weather conditions, in the opinion of the Owner's Representative are not suitable.
- B. The asphaltic mixture shall be at a temperature between 225 and 350 F when dumped from the mixer. The Owner's Representative shall determine the temperature, within the above

limitations. The mixture when dumped from the mixer shall not vary from the selected temperature more than 30 F.

2.00 PRODUCTS

2.01 MATERIALS

- A. Aggregate: Conform to TXDOT Standard Specification Item 340.
- A. Asphaltic Materials: Comply with TXDOT Standard Specification Item 300. In general, the grade of asphalt shall be AC-10. Other grades of asphalt shall be considered if weather conditions or mix design appear to warrant a change. Prime coat shall comply with TXDOT Standard Specification Item 300, Grade MC-30. Tack coat shall meet the requirements of cutback asphalt RC-250.

2.02 EQUIPMENT

- A. The equipment necessary for the construction of the hot mix asphaltic concrete pavement shall be on the project site and shall be approved by the Owner's Representative as to condition before the Contractor shall be permitted to begin construction operations on which the equipment is to be used. Equipment shall be maintained in good repair and operating condition.
- B. Spreading and Finishing Machines:
 - 1. The spreading and finishing machine shall be of a type approved by the Owner's Representative and capable of producing a surface that shall meet the requirements of the typical cross section and surface test.
 - 2. Rollers:
 - a. Pneumatic Tire Roller: The roller shall consist of not less than seven pneumatic tire wheels, running on axles in such a manner that the rear group of tires shall cover the entire gap between adjacent tires of forward group; mounted in a rigid frame; and provided with a loading platform or body suitable for ballast loading. The front axle shall be attached to the frame in such a manner that the roller may be turned within a minimum circle. The tire shall afford surface contact pressures up to 90 pounds per square inch or more. The roller shall be so constructed as to operate in both forward and a reverse direction with suitable provisions for moistening the surface of the tires while operating; and shall be approved by the Owner's Representative.
 - b. Two-Axle Tandem Roller: The roller shall be an acceptable power-driven, steel-wheel tandem roller weighing not less than 8 tons. The roller must operate in forward and reverse directions; contain provisions for moistening the surface of the wheels while in motion; and shall be approved by the Owner's Representative.
 - c. Three-Wheel Roller: The roller shall be an acceptable power-driven, all steel three wheel roller weighing not less than 10 tons. The roller must operate in forward and reverse directions; contain provisions for moistening the surface of the wheels while in motion; and shall be approved by the Owner's Representative.

- d. Vibratory Steel Wheel Roller: If approved for use by the Owner's Representative, this roller shall have a minimum weight of 6 tons. The compactor shall be equipped with amplitude and frequency controls and shall be specifically designed to compact the material on which it is used. The roller shall be operated in accordance with the Manufacturer's recommendations.
- 3. Straightedges: The Contractor shall provide acceptable straightedges for the surface testing. Satisfactory templates shall be provided as required by the Owner's Representative.

3.00 EXECUTION

3.01 PREPARATION

- A. Prime Coat: Apply a uniform coat of prime coat asphaltic material to the surface of the prepared subgrade, sub-base, or base, applied at a rate of not less than 0.15 gallons per square yard of surface. Apply a thin uniform coat of the prime coat material to contact surfaces of gutters, grade beams, and other structures.
- B. Tack Coat: Thoroughly clean the surface of the asphalt base course and apply a uniform coat of tack material meeting the requirements for cutback asphalt RC-250. Apply a tack coat when the surface to be paved is Portland cement concrete, brick, or asphaltic pavement. Apply the tack coat using sprayer at a rate not exceeding 0.05 gallons per square yard surface. Paint contact surfaces of curbs, gutters, vertical faces, and other structures in actual contact with asphaltic mixes with asphaltic material to provide a closely bonded, water-tight joint.
- C. Compacted Thickness of Asphaltic Concrete Surface Course:
 - 1. Surface Course: The compacted thickness or depth of the asphaltic concrete surface shall be as indicated on the plans. Where the plans indicate a depth or thickness of the surface course greater than 2 inches compacted depth, same shall be placed in multiple courses of equal depth, each which shall not exceed 2 inches compacted depth. A tack coat is required between any of the multiple courses, and applied at the rate specified.

3.02 PLACEMENT

- A. Place the asphaltic mixture on an approved base course with the previously specified spreading and finishing machine in such a manner that, when properly compacted, the finished course shall comply with the maximum thickness requirements, shall be smooth, of uniform density and meet the requirements of the typical cross-sections and the surface test. During the placing and spreading of the asphaltic material, take care to prevent the spilling of the material onto adjacent pavement, gutters, or structures.
- B. In small areas, which are inaccessible to the spreading and finishing machine, hand spreading may be authorized by the Owner's Representative, provided an acceptable surface can be obtained.

3.03 COMPACTION

- A. Rolling with the three-wheel and tandem rollers shall start longitudinally at the sides and proceed toward the center of the surface course, overlapping on successive trips by at least

half the width of the rear wheels. Alternate trips of the roller shall be slightly different in length. Rolling with the pneumatic tire roller shall be done as directed by the Owner's Representative. Rolling shall continue until no further compression can be obtained and all roller marks are eliminated. The motion of the rollers shall be slow enough at all times to avoid displacement of the asphaltic surface material. If displacement should occur, correct the situation at once by the use of rakes and fresh asphaltic mixtures. The roller shall not be allowed to stand on the surface course when it has not been fully compacted and allowed to cool. To prevent adhesion of the surface to the roller, the wheels shall be kept thoroughly moistened with water, but an excess of water shall not be permitted. Rollers must be in good mechanical condition. Take the necessary precautions to prevent the dripping of gasoline, oil, grease, or other foreign matter on the surface course while the rollers are in motion or when standing. In areas where surface course cannot be compacted with the roller, hand tamps, lightly oiled, shall be used to secure the required compaction.

- B. With approval by the Owner's Representative, the vibratory steel wheel roller may be substituted for the three-wheel roller and tandem roller. Each course, after final compaction, shall contain from 5 to 9 percent air voids determined by TXDOT Test Method TEX207-F and TEX-227-F.

3.04 FIELD QUALITY CONTROL

- A. Surface Tests: The finished surface of the pavement after compression shall be smooth and true to the established line, grade, and cross-section. When tested with a 16-foot straightedge placed parallel to the centerline of the roadway, the finished surface shall have no deviation in excess of 1/16 inch per foot from the nearest point of contact. The maximum ordinate measured from the face of the straightedge shall not exceed 1/4 inch at any point. Any point in the pavement surface not meeting these requirements shall be immediately corrected.
- B. Pavement Thickness Test: Upon completion of the work and before final acceptance and final payment shall be made, pavement thickness test shall be made by the Owner or his authorized representative unless otherwise specified in the special provisions or in the plans. The number and location of tests shall be at the discretion of the Owner's Representative. The cost for the initial pavement thickness test shall be at the expense of the Owner. In the event a deficiency in the thickness of the pavement is revealed during normal testing operations, subsequent tests necessary to isolate the deficiency shall be at the Contractor's expense. The cost for the additional coring test shall be at the same rate charged by commercial laboratories.

END OF SECTION

32 16 13 CURBS AND GUTTERS

1.00 GENERAL

1.01 WORK INCLUDED

- A. Furnish labor, materials, equipment and incidentals necessary to construct reinforced concrete curb and gutter in accordance with the lines, grades, and section indicated on the plans or as directed by the Owner's Representative.

1.02 OPTIONS

- A. A curb and gutter laydown machine may be used for placing reinforcing steel and forming and placing concrete.

2.00 PRODUCTS

2.01 MATERIALS

- A. Concrete: Conforming to the requirements for 3000-psi concrete in Section 03 30 00 "Cast-In-Place Concrete."
- B. Reinforcing Steel: Conforming to the requirements in Section 03 21 00 "Reinforcing Steel."
- C. Expansion Joint Material: Conforming to the requirements in Section 03 30 00 "Cast-In-Place Concrete."

2.02 MIXES

- A. Mortar: 1 part Portland cement and 2 parts fine aggregate.

3.00 EXECUTION

3.01 PREPARATION, EXCAVATION AND GRADING

- A. Excavate, stabilize and shape the subgrade or foundation to line, grade and section as indicated on the plans or as directed by the Owner's Representative. Lightly sprinkle the subgrade or foundation material immediately before placing concrete.
- B. Where curb and gutter is not adjacent to new pavement, use 2 inches of sand cushion. After the fine grading has been completed, evenly spread a 2-inch layer of sand or suitable gravel cushion over the subgrade for curb and gutter. Thoroughly wet and tamp sand cushion into place to the satisfaction of the Owner's Representative. Place the forms upon this sand or gravel base and use a screed to shape the sand cushion to parallel the top of gutter.

3.02 INSTALLATION

- A. Forms:
 - 1. Forms shall be made of wood or steel and framed, braced, or staked in a substantial and approved manner so as to insure perfect alignment and grade. Clean and oil the forms immediately before placing concrete. Take care in removing forms to prevent marring

or spalling of the concrete. Forms shall be of a depth equal to the depth of the curb and gutter and a minimum of 1-1/2 inches in width when wooden forms are used or a raga that provides equivalent rigidity and strength when metal forms are used.

2. Forms showing a deviation of 1/8 inch in 10 feet from a straight line shall be cause for rejection.
3. For curves with a radius of less than 250 feet, acceptable flexible metal forms or wood forms may be used upon approval by the Owner's Representative.

B. Reinforcing Steel:

1. Accurately place steel reinforcement as indicated and hold in place during progress of placing concrete, and do not allow movement from the true position. Wire the bars at intersections and laps or splices. Lap bars at splices a minimum of 20 diameters of the bar or 12 inches, whichever is greater.
2. Place the reinforcement necessary for a section of concrete, and have the Owner's Representative approve the reinforcement before any concrete is deposited in the section. Steel shall be free from paint and oil, and completely remove loose scale, rust, dirt, and other foreign substances before using.
3. Reinforcing steel shall conform to requirements in Section 03 21 00 "Reinforcing Steel."

C. Expansion Joints:

1. Form expansion joints using preformed expansion joint material as specified herein. Place expansion joints in the curb and gutter at 40-foot intervals and at intersection returns or as otherwise shown on the plans or as directed by the Owner's Representative. Place "Flagging" or a tooled joint at 6-foot intervals to provide a plane of weakness, unless otherwise shown on the plans or as directed by the Owner's Representative. Place expansion joints at abutting structures such as concrete driveways, sidewalks, buildings, inlets, etc. Expansion joints shall be 1/2 inch in thickness and shall extend the full depth of the concrete. Neatly trim any expansion material extending above the finished work to the surface of the finished work. The expansion joints in concrete pavement shall coincide with the expansion joints in the curb and gutter. Longitudinal dowels, across the expansion joints in the curb and gutter, shall be required. There shall be three No. 3 round, smooth bars for dowels at each expansion joint spaced in accordance with standard reinforcement steel. The dowel shall be a minimum of 24 inches in length. Coat one end of the dowel with asphalt and terminated with an expansion cap. The cap shall provide a minimum of 1 inch free expansion. Support dowels by an approved method to provide a true horizontal and longitudinal alignment.
2. Seal joints through the gutter with a joint sealant material as specified herein.
3. Construct joints in a neat and workmanlike manner with edges rounded in conformity with the plans and specifications, and at locations as indicated on the plans or as designated by the Owner's Representative.

3.03 PLACEMENT

- A. Deposit concrete so as to maintain a horizontal surface and thoroughly and continuously work into spaces and around all reinforcement to form a dense voidless mass.

- B. Work the coarse aggregate away from contact with the forms so as to form a smooth, hard exposed concrete surface.
- C. Continuously pour the concrete for curb and gutter between expansion joints. If construction joints are allowed at other locations by the Owner's Representative, properly construct joints with wood bulkheads so as to completely separate adjacent concrete sections.

3.04 FINISHING

- A. After the concrete has been struck off and while still plastic, thoroughly work the exposed surfaces with a wooden float. Round the exposed edges by the use of an edging tool to the radius indicated. Float and trowel exposed surfaces. Brush exposed surfaces of curb and gutter to a smooth and uniform surface. Avoid excess working of the surface. Remove excess water, laitance and inert material from the surface.

3.05 CURING

- A. Cure the completed curb and gutter in accordance with the requirements of Membrane Curing, as specified in Section 03 30 00 "Cast-In-Place Concrete." Other methods of curing as outlined herein shall be acceptable with a required curing period of 72 hours.

3.06 BACKFILLING

- A. Backfill the curb and gutter to the full height of the concrete, and tamp and slope as indicated or as directed by the Owner's Representative.

3.07 FIELD QUALITY CONTROL

- A. The top of the work and the face of the curbs shall be checked for irregularities as soon as the surface is finished, using a 10-foot straightedge. The maximum distance from the straightedges to the concrete shall not exceed 1/4 inch. Variations exceeding 1/4 inch shall be immediately corrected. Immediately chip out and patch honeycombed areas disclosed by removal of forms with mortar as specified.

END OF SECTION

32 91 19 TOPSOIL

1.00 GENERAL

1.01 RELATED DOCUMENTS

- A. The Drawings, Standard General Conditions of Contract, Supplementary Conditions and Division 01 Specification Sections apply to Work of this Section.

1.02 DESCRIPTION

- A. This Section governs the preparation of the ground surface for topsoil application, removal of topsoil from designated stockpiles or areas to be stripped from approved sources off the Site, and placement of the topsoil on prepared areas in accordance with this Section at the locations shown on the Drawings or as directed by the Owner.

1.03 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 31 05 13 "Soils for Earthwork."

2.00 PRODUCTS

2.01 MATERIALS

- A. Topsoil:
 - 1. Topsoil shall be the surface layer of soil with no admixture of refuse or any material toxic to plant growth or hazardous to humans and animals, and it shall be free from subsoil and stumps, roots, brush, stones 2 inches or more in diameter, clay lumps or similar objects. Brush and other vegetation which will not be incorporated with the soil during handling operations shall be cut and removed. Ordinary sods and herbaceous growth such as grass and weeds are not to be removed but shall be thoroughly broken up and intermixed with the soil during handling operations. The topsoil or soil mixture, unless otherwise specified or approved, shall have a pH range of approximately 5.5 pH to 7.6 pH when tested in accordance with the methods of testing of the Association of Official Agricultural Chemists in effect on the date of invitation of bids. The organic content shall be not less than 2 percent nor more than 20 percent as determined by the wet-combustion method (chromic acid reduction). There shall be not less than 20 percent nor more than 80 percent of the material passing the 200 mesh sieve as determined by the wash test in accordance with AASHTO T 11.
 - 2. All topsoil to be imported by the Contractor shall conform to the above specifications.
- B. Inspection and Tests: Ten days prior to stripping topsoil for use on Site, the Owner's representative shall be notified of the source of topsoil to be furnished by the Contractor. The topsoil shall be inspected to determine the depth to which stripping will be permitted. At this time, the Contractor may be required to take representative soil samples from several locations within the area under consideration and to the proposed stripping depths for testing purposes as specified in Paragraph 2.01.A.

3.00 EXECUTION

3.01 GENERAL

- A. Areas to receive topsoil include all areas disturbed by construction which are to be revegetated, as indicated on the Drawings, or as instructed by the Owner in writing.
- B. Suitable equipment necessary for proper preparation and treatment of the ground surface, stripping of topsoil, and for the handling and placing of all required materials shall be on hand, in good condition, and approved by the Owner before the various operations are started.

3.02 PREPARING THE GROUND SURFACE

- A. Immediately prior to dumping and spreading the topsoil on any area, the surface shall be loosened by discs or spike-tooth harrows, or by other means approved by the Owner, to a minimum depth of 2 inches to facilitate bonding of the topsoil to the covered subgrade soil. The surface of the area to be topsoiled shall be cleared of all stones larger than 1 inch in any dimension and all litter or other material which may be detrimental to proper bonding, the rise of capillary moisture, or the proper growth of the desired planting. Limited areas, as shown on the Drawings, which are too compact to respond to these operations shall receive scarification by the use of small tillers or hand tools.
- B. Grades on the areas to be topsoiled which have been established by others, as shown on the Drawings, shall be maintained in a true and even condition. Where grades have not been established, the areas shall be smooth-graded and the surface left at the prescribed grades in an even and properly compacted condition to prevent, insofar as practical, the formation of low places or pockets where water will stand.

3.03 OBTAINING TOPSOIL

- A. Prior to the stripping of topsoil from designated areas, any vegetation, briars, stumps and large roots, rubbish or stones found on such areas which may interfere with subsequent operations shall be removed using methods approved by the Owner. Heavy sod or other cover which cannot be incorporated into the topsoil by discing or other means shall be removed.
- B. When suitable topsoil is secured off the Site, the Contractor shall locate and obtain the supply, subject to the approval of the Owner. The Contractor shall notify the Owner sufficiently in advance of operations in order that necessary measurements and tests can be made. The Contractor shall remove the topsoil from approved areas and to the depth as directed. The topsoil shall be hauled to the site of the Work and placed for spreading, or spread as required. Any topsoil hauled to the site of the Work and stockpiled shall be re-handled and placed without additional compensation.

3.04 PLACING TOPSOIL

- A. The topsoil shall be evenly spread on the prepared areas to a uniform depth of 4 inches after compaction, unless otherwise shown on the Drawings. Spreading shall not be done when the ground or topsoil is frozen, excessively wet, or otherwise in a condition detrimental to the Work. Spreading shall be carried on so that turfing operations can proceed with a minimum of soil preparation or tilling.

- B. After spreading, any large stiff clods and hard lumps shall be broken with a pulverizer or by other effective means, and all stones or rocks 1 inch or more in diameter, roots, litter or any foreign matter shall be raked up and disposed of by the Contractor. After spreading is completed, the topsoil shall be satisfactorily compacted by rolling with a cultipacker or by other means approved by the Owner. The compacted topsoil surface shall conform to the required lines, grades and cross-sections. Any topsoil or other dirt falling upon pavements as a result of hauling or handling of topsoil shall be promptly removed.

END OF SECTION

32 91 19.13 TOPSOIL PLACEMENT AND GRADING

1.00 GENERAL

1.01 WORK INCLUDED

- A. Furnish labor, materials, equipment and incidentals necessary to place topsoil, free from rock and foreign material in areas designated to receive sodding or seeding.

2.00 PRODUCTS

2.01 TOPSOIL

- A. General: The topsoil shall be fertile loam, easily cultivated and free from objectionable material, and shall have a relatively high erosion resistance and be readily able to support the growth of the planting, seeding, or sodding specified on the plans.
- B. Sources:
 - 1. The topsoil may be obtained from the right-of-way at sites of proposed excavation, or it may be obtained from sources outside the right-of-way, secured by the Contractor, and meeting the approval of the Engineer.
 - 2. Topsoil required in addition to salvaged topsoil from the project shall be secured from approved off-site borrow sources. Excavated material from construction which is suitable for topsoil shall be salvaged and used before any topsoil is obtained from borrow source.

3.00 EXECUTION

3.01 INSTALLATION

- A. Stockpile topsoil material at locations approved by the Owner's Representative. Remove any trash, wood, brush, stumps or other objectionable materials prior to placement. The source and stockpile areas shall be kept drained and in a neat and presentable condition. Place and spread topsoil to a uniform depth to provide 6-inch compacted depth, while maintaining drainage in areas to be seeded or sodded.

END OF SECTION

32 92 00 SODDING

ARTICLE 1: GENERAL

1.01 SECTION INCLUDES

- A. Provide materials, labor to install and maintain for the guarantee period all areas sodded.

1.02 RELATED SECTIONS

- A. Section 32 92 13 “Hydro-Mulching”

1.03 DEFINITIONS

- A. Sod: Thick matting of growing and living grass on a smooth bed free of foreign material, rocks larger than 1 inch in diameter and weeds.
- B. Stand of Grass: A uniform growth of specified grass plants covering all bare ground surface areas designated on the Drawings.

1.04 QUALITY ASSURANCE

- A. Reference Standards:
 - 1. Official Method of Analysis of the Association of Official Analytical Chemists.
 - 2. American Sod Producers Association (ASPA), latest edition.
- B. Source Quality Control:
 - 1. Owner reserves right to inspect and approve the sod before it is cut at the source of the sod.
 - 2. Inspection of sod at the source does not preclude the right of rejection at the Site.

1.05 PROJECT CONDITIONS

- A. Environmental Requirements:
 - 1. Sodding shall be completed on or before August 1 or as approved by Owner.
 - 2. Frozen sod may not be used nor shall sod be placed on frozen ground.
 - 3. In times of drought, special provisions must be made to prevent the drying of the sod. All provisions shall be approved by the Owner.
 - 4. Do not sod when soil is excessively wet or dry.
- B. Protection: Restrict foot and vehicular traffic from sodded areas after laying until final inspection and acceptance.

1.06 GUARANTEE

- A. Substantial Completion: Sod shall be approved as being in accordance with the Specifications upon completion of the installation.

- B. Guarantee Period: A stand of grass for 90 days after Substantial Completion shall be guaranteed.
- C. Maintenance Period:
 - 1. Maintain newly laid sod until entire Project is accepted by the Owner.
 - 2. Any sodded areas that become eroded, damaged or any areas of sod that fail to become established satisfactorily, according to the Owner, shall be repaired and/or replaced at no additional expense to the Owner.
 - 3. Repair construction related damage to other plants or lawns during the maintenance period at no additional expense to the Owner.
 - 4. Maintenance shall consist of, but not be limited to:
 - a. Weeding.
 - b. Watering.
 - c. Mowing and Edging.
 - d. Spraying.
 - e. Fertilizing.
 - f. Repair of Erosion Damage.
- D. Final Acceptance will be provided by the Owner only upon completion of the entire Project and the establishment of a stand of grass as defined herein.

ARTICLE 2: PRODUCTS

2.01 MATERIALS

- A. Sod:
 - 1. Species: Common Bermuda (*Cynodon dactylon*) for all areas.
 - 2. The sod shall be free of weeds or undesirable foreign plants, large stones, roots or other materials which might be detrimental to the development of the sod or to future maintenance.
 - 3. Sod shall be cut with approved sod cutters so that after it is placed, but before it is compacted, it shall have a uniform thickness of not less than 3/4 inch. The sod sections shall be cut in uniform widths, not less than 10 inches and in lengths of not less than 18 inches.
 - 4. Sod shall be uniform in color, leaf texture and shoot density.
- B. Fertilizer:
 - 1. Uniform composition.
 - 2. Pelletized.
 - 3. Containing following minimum percentage of plant food by weight:
 - a. Nitrogen: 8 percent.

- b. Phosphoric Acid: 4 percent.
 - c. Potash: 24 percent.
- 4. The fertilizer shall be delivered to the Site in bags or other sealed containers, each fully labeled, conforming to the applicable state fertilizer laws, and bearing the name, trade name or trademark and warranty of the producer.
- C. Water: Potable, available on-site. Contractor shall furnish temporary piping, hoses and connections as required.

ARTICLE 3: EXECUTION

3.01 INSPECTION

- A. Check that preceding Work affecting ground surface is completed, properly graded and drains well.
- B. Verify that soil is within allowable range of moisture content.
- C. See that the soil is free of weeds and foreign material immediately before sodding. Remove rocks and stones which are larger than 1 inch in diameter, remove from the Site and dispose of in an approved location.
- D. Do not start Work until conditions are satisfactory. To begin Work indicates acceptance of conditions.
- E. The Owner or landscape architect shall approve prepared soil prior to sodding work commencing. This inspection shall take place 48 hours minimum before sodding is scheduled to begin.

3.02 PREPARATION

- A. All areas to be sodded are to be bladed and graded smooth. All clods shall be removed or be incorporated into existing soil. All debris shall be disposed of off-site at an approved location.
- B. Till fertilizer into top 2 inches of soil at rate of 125 pounds per acre.

3.03 APPLICATION

- A. The sod shall be moist and shall be placed on a moist soil bed.
- B. Sod shall be harvested, delivered and laid within a period of 24 hours, unless a suitable preservation method is approved prior to delivery. Sod not transplanted within this period shall be inspected for acceptance by the Owner prior to its installation.
- C. The sod shall be carefully placed by hand, edge to edge (with no gaps), and with staggered joints in rows parallel with the contours. Do not stretch or overlap sod.
- D. The sod shall immediately be pressed firmly into contact with the sod bed by rolling with approved equipment to provide a true and even surface.
- E. Screened soil of acceptable quality shall be used to fill all cracks between pads of sod; however, the quantity of the top dressing soil shall not be so great as to smother the grass.

- F. The surface of the soil in the sod after compaction shall be flush with or just below adjacent paving.
- G. Water sodded areas to a minimum depth of 2 inches after planting.

3.04 PROTECTION

- A. Immediately after sodding, erect barricades and warning signs as required to protect the areas from traffic until sod is established.

3.05 SOD ESTABLISHMENT

A. Watering:

1. The sod shall be kept moist from the time of its placement until it has become established and its continued growth ensured.
2. Watering shall be done at a rate which will avoid erosion and excessive runoff.

B. Mowing:

1. When grass reaches approximately 4 inches in height, mow to 2 to 2-1/2 inches in height.
2. Do not cut off more than 40 percent of grass leaf in single mowing.
3. Do not remove grass clippings.

- C. Repairing: Any areas that become eroded, damaged or any areas of sod that fails to become established satisfactorily, according to the Owner, shall be repaired and/or replaced at no expense to the Owner.

3.06 RESTORATION

- A. Repair damages done to the Site caused by the Contractor at no additional expense to Owner.

3.07 CLEANING

- A. Remove trash and excess materials from the Site.
- B. Maintain paved areas in clean condition.
- C. Remove barriers and signs from the Site at termination of the maintenance period.

END OF SECTION

32 92 13 HYDRO-MULCHING

1.00 GENERAL

1.01 WORK INCLUDED

- A. Furnish labor, material, equipment and incidentals necessary to prepare the ground, furnish and install fertilizer and hydro-mulching seed or a mixture of seed of the kind specified in areas disturbed by the construction operations.

1.02 SUBMITTALS

- A. Submittals shall be in accordance with the Contract Documents and shall include:
1. Texas Testing Seed Label.
 2. Specification of fertilizer to be used.

1.03 STANDARDS

- A. The applicable provision of the following standard shall apply as if written here in its entirety:
1. Texas Seed Law.

1.04 GUARANTEES

- A. Contractor shall fertilize and reseed any area which fails to survive for a period of 1 year from the date the project is accepted by the Owner.

2.00 PRODUCTS

2.01 MATERIALS

- A. General: Seed used must carry a Texas Testing Seed label showing purity and germination, name, type of seed, and that the seed meets all requirements of the Texas Seed Law. Seed furnished shall be of the previous season's crop and the date of analysis shown on each tag shall be within 9 months of the time of delivery to the project. Each variety of seed shall be furnished and delivered in separate bags or containers.
- B. Seed: The specified seed shall equal or exceed the following percentages of purity and germination:

Common Name	Purity	Germination
Common Bermuda Grass	95%	90%
Gulf Coast Annual Rye	95%	90%

- C. Mulch: The mulch shall be natural cellulose fiber mulch produced from grinding clean, whole wood chips, or fiber produced from ground newsprint with a labeled ash content not to exceed 7 percent. The mulch shall be designed for use in conventional mechanical planting, hydraulic planting of seed or hydraulic mulching of grass seed, either alone or with

fertilizers and other additives. The mulch shall be such that, when applied, the material shall form a strong, moisture-retaining mat without the need of an asphalt binder.

- D. Fertilizer: Pelleted or granulated type fertilizer of the composition for the season of the year at which applied shall be used:
 - 1. Early season (April 1-June 1) 21-0-0.
 - 2. Normal season (June 1-Sept 1) 10-10-5.
 - 3. Late season (Sept 1-Nov 1) 6-12-12.

3.00 EXECUTION

3.01 PREPARATION

- A. After the areas disturbed by construction operations have been backfilled and completed to the original pre-construction lines and grades shown on the plans and as provided for in other items of this contract, perform hydro-mulch seeding in accordance with the requirements hereinafter described.

3.02 INSTALLATION

- A. Cultivation: Cultivate areas to be seeded to a depth of at least 4 inches. Cultivate the seedbed sufficiently to reduce the soil to a state of good tilth when the soil particles on the surface are small enough and lie closely enough together to prevent the seed from being covered too deep for optimum germination. Cultivation of seedbed will not be required in loose sand where depth of sand is 4 inches or more. Maintain the cross-section previously established throughout the process of cultivation and any necessary reshaping shall be done prior to any planting of seed.
- B. Planting Season and Application Rates: Perform planting between the dates specified for each type except when specifically authorized in writing. The seeds planted per acre shall be of the type specified with the mixture, rate, and planting dates as follows:
 - 1. Common Bermuda Grass - hulled, 20 pounds per acre - February through August or a combination of.
 - 2. Common Bermuda Grass - unhulled, 15 pounds per acre and Gulf Coast Annual Rye - unhulled, 15 pounds per acre - August through February.
 - 3. Apply fertilizer uniformly at the average rate of 400 pounds per acre.
- C. Hydro-Mulch (Cellulose Fiber) Seeding: Uniformly distribute the fertilizer, seed or seed mixture, in the quantity specified over the areas to be seeded. Mechanical equipment shall be such that all varieties of seed as well as fertilizer may be distributed at the same time, provided that each component is uniformly applied at the specified rate. When seed and fertilizer are to be distributed as a water-slurry, apply the mixture to that area to be seeded within 30 minutes after all components are placed in the equipment. Upon completion of planting the seed, spread cellulose fiber mulch uniformly over the area at the following rates:
 - 1. Sandy soils with 3:1 slope or less: Min. 2000 lb./acre.
 - 2. Sandy soils with greater than 3:1 slope: Min. 2300 lb./acre.

3. Clay soils with 3:1 slope or less: Min. 2500 lb./acre.
 4. Clay soils with greater than 3:1 slope: Min. 3000 lb./acre.
 5. The rates are given in dry weight of mulch per acre. A mulching machine, approved by the Owner's Representative, shall be equipped to eject the thoroughly wet mulch material at a uniform rate to provide the mulch coverage specified.
- D. Maintenance: Water the planted area at such times as necessary for a period of 1 year after final acceptance of the project by the Owner. Fertilize and reseed any area which fails to survive for a period of 1 year from the date the project is accepted by the Owner.

END OF SECTION

33 05 01.09 POLYVINYL CHLORIDE (PVC) PRESSURE PIPE AND FITTINGS

1.00 GENERAL

1.01 WORK INCLUDED

- A. Furnish labor, materials, equipment and incidentals necessary to install polyvinyl chloride (PVC) pressure pipe, appurtenances, and fittings to the diameters indicated for water supply and wastewater pressure piping. Trenching, backfilling, and pipe embedment shall be in accordance with Section 31 23 33 "Trenching and Backfill."

1.02 QUALITY ASSURANCE

- A. Certification: Domestic water piping shall be approved by the Underwriters Laboratory and shall be accepted by the State Fire Insurance Commission for use in water distribution systems. PVC water pipe shall bear the seal of approval (or "NSF" mark) of the National Sanitation Foundation Testing Laboratory for potable water pipe.
- B. Design Criteria: The maximum allowable load for PVC pipe installations shall produce a maximum deflection of 4 percent.

1.03 SUBMITTALS

- A. Submittals shall be in accordance with the Contract Documents and shall include:
 - 1. Certified Test Reports from the Manufacturer's testing facility or an approved testing laboratory.
 - 2. Shop Drawing including the following information:
 - a. Manufacturer.
 - b. Dimension ratio.
 - c. Joint types.
 - d. Gaskets material.
 - e. Means of restraint.
 - f. Manufacturer's recommendation for maximum deflected joint angle and minimum longitudinal bending radius
 - g. Thrust restraint lengths and lay schedule as Shop Drawing. Lay schedule shall include the following:
 - 1). Pipe class.
 - 2). Joint type.
 - 3). Fittings.
 - 4). Stationing.
 - 5). Transitions.
 - 6). Joint deflection.
 - 3. Shop Drawing of Detectable Warning Tape.

1.04 REFERENCE SPECIFICATIONS

A. Section 31 23 33 "Trenching and Backfill."

1.05 STANDARDS

A. The applicable provisions of the following standards shall apply as if written here in their entirety. PVC piping and fittings shall be in full compliance with the applicable standards and specifications for each type of plastic pipe involved. Pipe may be rejected for failure to comply with any requirement of this Section.

1. ASTM International (ASTM) Standards:

ASTM D1784	Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D1785	Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D2241	Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated PVC Pipe (SDR) Series
ASTM D2464	Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D2466	Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings Schedule 40
ASTM D2467	Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D2855	Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets
ASTM D3139	Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM F1674	Standard Test Method for Joint Restraint Products for Use with PVC Pipe

2. American Water Works Association (AWWA) Standards:

AWWA C104	Cement-Mortar Lining for Ductile Iron Pipe and Fittings
AWWA C105	Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C110	Ductile-Iron and Gray-Iron Fittings
AWWA C153	Ductile-Iron Compact Fittings
AWWA C605	Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings
AWWA C900	Poly Vinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 through 60 Inches (100 mm Through 1,500 mm)
AWWA M23	PVC Pipe – Design and Installation.
AWWA M41	Ductile – Iron Pipe and Fittings

3. NSF International (NSF):

NSF 61	Drinking Water System Components – Health Effects
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4. Underwriters Laboratories, Inc. (UL).

1.06 DELIVERY AND STORAGE

- A. Store PVC material so that there is no exposure to sunlight.

2.00 PRODUCTS

2.01 MATERIALS

A. PVC Pressure Piping:

1. Smaller than 4 inches in size shall be Type 1, Grade 1, Polyvinyl Chloride, Schedule 40 pipe conforming to ASTM D1785.
2. For pipe 2 inches in diameter and smaller, joints shall be glued.
3. For pipe larger than 2 inches in diameter, joints shall be bell and spigot push-on type as specified in ASTM D3139.
4. PVC Pressure Pipe for potable water shall meet the requirements of NSF 61.
5. PVC Pressure Pipe for Sanitary Sewer shall conform to either C900 or ASTM D2241.

- B. Fittings: 3- through 24-inch ductile iron and conforming to AWWA C110 or AWWA C153. Fittings for piping smaller than 3 inches shall be in accordance with ASTM D2466.

- C. Thrust Restraint: Thrust restraint devices shall be Mega-lug or approved equal and shall be factory tested and pressure rated in accordance with ASTM F1674.

1. Joint restraint devices shall be designed specifically for use with PVC pipe of the joint type and pressure rating specified.
2. Restrained joints shall be used for a sufficient distance from each bend, tee, plug, valve or other fitting to resist thrust which will be developed at the design pressure of the pipe. For the purposes of thrust restraint, working pressure shall be **[specify]**, design pressure shall be 1.5 times the design working pressure of **[specify]** or the pipe pressure class indicated.
3. The length of pipe with restrained joints to resist thrust forces shall be the sole responsibility of and determined by the Pipe Manufacturer using the following parameters:
 - a. Laying condition equal to AWWA C605 Type 3 bedding.
 - b. No thrust restraint contribution shall be allowed for pipe in casing.
 - c. Soil density = 100 pcf.
 - d. Concrete thrust blocking shall not be accounted for in joint restraint calculations.

D. Detectable Warning Tape:

1. Provide detectable warning tape as follows:
 - a. Thickness: 5.0 mil overall thickness.
 - b. Width: 3 inch minimum.
 - c. Weight: 27.5 pounds per inch per 1000 square feet.
 - d. Triple layer with:
 - 1). Minimum thickness 0.35 mils solid aluminum foil encased in a protective inert plastic jacket.
 - 2). 100 percent virgin low density polyethylene.
 - 3). Impervious to all known alkalis, acids, chemical reagents and solvents within soil.
 - 4). Aluminum foil visible to both sides.
 - e. Locatable by conductive and inductive methods.
 - f. Printing encased to avoid ink rub-off.
 - g. Color and Legends:
 - 1). Potable Water Lines:
 - a). Color: Blue (in accordance with APWA Uniform Color Code).
 - b). Legend: Caution Potable Water Line Below (repeated every 24 inches).
 - 2). Reclaimed Water Lines:
 - a). Color: Purple (in accordance with APWA Uniform Color Code).
 - b). Legend: Caution Reclaimed Water Line Below (repeated every 24 inches).
 - 3). Sewer Line:
 - a). Color: Green (in accordance with APWA Uniform Color Code).
 - b). Legend: Caution Sewer Line Below (repeated every 24 inches).

2.02 MARKINGS

- A. The Pipe Manufacturer shall mark the piping with the size and appropriate AWWA/ASTM Standard designations as applicable.

3.00 EXECUTION

3.01 INSTALLATION

- A. Install pipe, fittings, and specials to the lines and grades indicated. Begin installation at the main supply line valve and make connections where indicated.
- B. Excavate trenches to alignment and depth specified or as required for proper installation of pipe. Carefully lower pipe, fittings, and specials into the trench to avoid damage to the pipe and/or fittings. Take necessary precautions to protect pipe during backfilling operations.

Replace any damaged pipe before it is buried. Keep the pipe clean during laying operations, and seal the pipe against the entrance of objects at the close of each operating day.

- C. Place thrust restraint fittings at bends, tees, crosses, valves, and plugs in the pipe line in accordance with approved Shop Drawing lay schedule and Paragraph **2.01.D**.
- D. Buried ductile iron fittings shall be double wrapped in 8mm high density polyethylene encasement in accordance with AWWA C105, repair or replace encasements which have tears, rips or punctures in the polyethylene wrap.
- E. The minimum cover for 1- to 4-inch PVC piping shall be 36 inches. For 6-inch PVC piping and larger, the minimum cover shall be 48 inches.
- F. Solvent weld joints shall be in accordance with ASTM D2855, and shall be made generally as follows: cut square and smooth the ends of the plastic pipe and wipe clean. Apply primer and solvent cement to the outside of the pipe and the inside of the fitting socket with a small brush. Immediately push the coated surfaces snugly together and rotate the pipe approximately one-half turn to insure uniform distribution of the cement. Remove the excess cement by wiping. Cement shall be of type which welds plastic surfaces together. Cement shall be as recommended by the Pipe Manufacturer and shall be compatible with the chemical conveyed.
- G. Push-on joints shall be in accordance with the manufacturer's instructions.
- H. Use of deflected joints shall be at 75 percent of the manufacturer recommendation or longitudinal deflection shall be 133 percent of the manufacturer's minimum radius.
- I. Joint lubricant shall be as recommended by the pipe manufacturer.

3.02 FIELD CONTROL HYDROSTATIC TESTING

- A. Test PVC pressure piping for leakage by a hydrostatic pressure test in accordance with Section 33 05 05.31 "Hydrostatic Testing."

3.03 PURGING OF WATER LINES

- A. Purge, sterilize, and test the constructed water lines in accordance with applicable local regulations.
 - 1. During construction operations, maintain the installed surfaces of the system, which come in contact with the City's water supply, in a sanitary condition.
 - 2. Every effort must be made to keep the inside of the pipe, fittings, and valves free of loose foreign matter.
 - 3. Should the Contractor's carrier be required to transport potable water to the job site for main testing, sterilize tankage and piping, including pumps used to transport or transfer potable water into the main.

- B. When the entire pipeline or selected sections have been completed and are ready for use, disinfect the line or sections:

3.04 SERVICE CONNECTIONS

- A. Service connection will be provided by G-M Water Supply Corporation. Contractor is responsible for coordinating the schedule of waterline construction.

3.05 FIELD QUALITY CONTROL

- A. Do not enclose or cover any Work until inspected.

END OF SECTION

33 71 19 UNDERGROUND DUCTBANKS

1.00 GENERAL

1.01 WORK INCLUDED

- A. This Section specifies the requirements necessary to provide underground ductbanks in reinforced concrete.

1.02 RELATED WORK

- A. This Section shall be used in conjunction with the following other specifications and related Contract Documents to establish the total requirements for underground electrical ductbanks. All earth and concrete work under this Section shall be under the supervision of the Civil Engineer.
 - 1. Division 01 Sections included in the project specifications
 - 2. Excavation Support Systems
 - 3. Excavation and Backfilling
 - 4. Concrete Formwork
 - 5. Concrete Reinforcement and Embedded Materials
 - 6. Section 26 00 00 - Basic Electrical Requirements
 - 7. Section 26 05 00 - Basic Electrical Materials and Methods
 - 8. Section 26 05 33 - Raceway, Conduit, and Boxes
- B. In the event of conflict involving underground electrical ductbank requirements between this Section and any other Sections, the provisions of this Section shall govern.

1.03 APPLICABLE CODES AND STANDARDS

- A. NEMA TC 6 & 8 – Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installations
- B. NEMA TC 9 – Fittings for Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installations
- C. ASTM C 31 – Standards Practice for Making and Curing Concrete Test Specimens in the Field
- D. ASTM C 39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
- E. ASTM C 172 – Standards Practice for Sampling Freshly Mixed Concrete
- F. ACI 301 – Structural Concrete
- G. ASTM A 615 – Deformed and Plain Carbon Steel Bars for Concrete Reinforcement
- H. ASTM D 698 – Standard Test Methods for laboratory Compaction Characteristics of Soil Using Standard Effort

1.04 SUBMITTALS

- A. Submit the following in addition to, and in accordance with, Section 26 00 00, Basic Electrical Requirements, and Division 01 for submittal requirement.
 - 1. Complete list of equipment and materials including manufacturer's descriptive and technical literature, catalog cuts, and installation instructions for conduit and fittings, concrete (including admixture), and rebar.
 - 2. Ready-mix delivery tickets shall be submitted to the Owner for review prior to unloading at the site.
 - 3. Delivery ticket minimum information:
 - a. Name of ready-mix plant
 - b. Serial number of ticket
 - c. Date and truck number
 - d. Name of contractor
 - e. Job name and location
 - f. Mix design number
 - g. Amount concrete (cubic yards)
 - h. Type and amount of admixtures
 - i. Amount of water added at the batch plant
 - j. Times of loading, arriving at the site, and unloading
 - k. Volume of water added by receiver of concrete and his initials
 - 4. Provide concrete testing and inspection as required by Division 03 specifications.
 - 5. Submit trench safety plans, sealed and signed by a professional engineer registered in the State of Texas, as outlined by 3.1 A of this specification.
- B. Provide the following one week before pulling medium-voltage cable:
 - 1. Diagram of ductbank indicating lengths of straight conduit sections, bend locations with radius of bands, conduit sizes.
 - 2. Pulling calculation per cable manufacturer's recommended method with acceptable values for pulling tension and sidewall pressure indicated for each cable size/type.

1.05 WARRANTY

- A. Provide a warranty for material and installation per Section 26 00 00, Basic Electrical Requirements, unless a longer warranty period is required in specific product specifications.

2.00 PRODUCTS

2.01 CONDUIT AND FITTINGS

- A. All products shall be new, first-quality materials.

- B. Nonmetallic Conduit: rigid PVC per NEMA TC-6 & 8. Conduit sizes and type shall be in accordance with Drawings. Conduit shall be of standard length, with tapered end and matching solvent weld couplings. Provide fitting of the same type material as ducts.
- C. Provide spacers with minimum separation between conduits as indicated on Drawings.
- D. Provide polypropylene pull full length.

2.02 CONCRETE

- A. Cast-in-place concrete and components: Conform to the following general requirements:
 - 1. Provide concrete work per ACI 301.
 - 2. Concrete shall be normal weight, air-entrained with 28 day strength of 2,500 psi or in the direction per Civil Engineer.
 - 3. Slump: Performed at the point of placement shall not exceed 6 inches. Make slump tests for each nine cubic yards of concrete placed.
 - 4. Color: Provide red dye for top 2 inches of concrete encasement of all primary duct banks and secondary service entrance duct banks.
 - 5. Cylinder Tests: Make four cylinder tests from each pouring operation and not less than four cylinders for each 18 cubic yards, or part thereof, over 10 cubic yards of concrete poured and not less than once a day nor less than once for each concreting operation. Take samples at point of placement; conform to ASTM C 172 and ASTM C 31.
 - a. Test two (2) cylinders at 7 days.
 - b. Test two (2) cylinders at 28 days.
 - c. Tests conform to ASTM C 39.
 - 6. Temperature limits for concrete work shall be in accordance with civil engineering standard.

2.03 REINFORCING STEEL

- A. All ductbanks shall be constructed with reinforcing bars in the ductbank. The quantities and sizes of the reinforcing bars shall be provided as directed by the project structural engineer.

2.04 MANHOLES

- A. The manholes shall be precast concrete quality and dimensions as per drawings. The manhole shall have grade 60 reinforcement of H20 loading and 4,500 psi concrete. Precast end bell type terminators shall be provided for each ductbank entry as noted on the Drawings. Pulling eyes shall be located opposite each set of duct openings. The manhole shall include a 30 inch type B frame and cover suitable for vehicular traffic appropriately marked "electric". The frame shall be doweled into the manhole to prevent any movement away from the opening. A #4/0 bare copper ground wire shall penetrate the side wall in the bottom Section of the manhole and shall extend 48 inches inside and outside the manhole. The exterior end of this grounding lead shall be connected to a ¾ inch diameter 10-foot long grounding rod. The interior end of this grounding lead shall be connected to a copper grounding plate. The exposed metal surfaces such as cable rack, metal conduit shall be

connected to the grounding plate. Use of a ground rod to penetrate the manhole wall is unacceptable. A sump shall be included in the bottom of each manhole.

- B. Mastic joint compound shall be provided and shall be placed in the grooves of the attached Sections.
- C. Provide cable support hardware and all supports for all cable, cable splices and cable terminations as required to support cable inside manhole.

3.00 EXECUTION

3.01 TRENCH EXCAVATION

- A. Comply with the following OSHA Part 1926 – Safety and Health Regulations for Construction, Subpart P - Excavation
 - 1. 1926.650 - Requirements for Open Excavations
 - 2. 1926.651 - Requirements for Specific Excavations
 - 3. 1926.652 - Requirements for Protective Systems
 - 4. 1926.653 - Definitions
- B. Before beginning trenching operations, stake out the proposed ductbank routing including trench width and obtain approval from the Owner's representative. After trenching has begun and before any ducts or conduits are placed, notify the Owner's representative so that the trenching and installation may be inspected. Also notify the Owner's representative prior to any placement of concrete for ductbanks, so that he may observe the placement.
- C. Excavate to permit installation of the duct bank along the grades shown on the Drawings. Deviations to ductbank depth must have prior approval from the Owner and Engineer.
- D. Excavate a trench of sufficient width to allow thorough compacting of the backfill under and around the duct bank. a level sand bed a minimum of 6 inches deep shall be placed in the trench before conduit is installed.
- E. Where excavation is in rock, remove all rock to a depth below the grade shown on the Drawings. Rock is defined as material that cannot be ripped or excavated by a backhoe with a one cubic yard bucket with rock teeth. Water shall be continuously pumped out from the trench.
- F. The Owner's approval is required for the extent of the trench excavation prior to the duct bank installation. Contractor shall schedule excavation in accordance with the Owner's requirements prior to beginning construction.
- G. Provide all necessary bracing and bridging to maintain traffic flow during construction through all areas interrupted by trenching. Provide construction signage, traffic barriers, and warning notices throughout the construction period.
- H. Provide all necessary repairs to erosion control measures and reseeding of grass in areas disturbed by trenching.
- I. Sheet and brace the excavation as required to prevent caving. The trench width may be increased accordingly. Maintain sheeting until the ductbank has been inspected and

backfilled to either a depth of 36-inch minimum over the top of the ductbank or as indicated on Drawings. Leave sheeting and shoring in place where directed by the Owner's representative.

3.02 DUCTBANK INSTALLATION

- A. Provide conduit in one complete lot. Partial shipment is not approved.
- B. Carefully handle and place all conduits to prevent breakage or other damage. Brace and support all conduits as shown on the Drawings to prevent shifting when concrete is poured. all underground ductbanks under roads and parking lots shall be steel reinforced.
- C. Lay conduit in true straight line of a gradual or uniform sweep. Maintain uniform grade between buildings and/or manholes per profile Drawings. Conduits shall be sloped to drain into manholes or buildings where possible at a minimum grade 4 inches per 100 feet. Provide factory made long sweep bends for all bends 15 degrees or more, either horizontal or vertical, unless prior approval is given by Owner to bend conduit in field. Bend radius shall be 48" minimum unless noted otherwise on Drawings.
- D. Space ducts or conduits a minimum of 3 inches, or in accordance with Drawings, from adjacent ducts. Place spacers or separators on not greater than 5-foot centers.
- E. Stagger joints 6 inches vertically and horizontally in horizontal duct runs and make joints watertight in accordance with manufacturer's recommendations. Where necessary to cut a tapered end on a duct, make the cut with a tool or lathe designed to cut such a taper to match the taper of the particular duct used.
- F. Cleanout conduits as work progresses and securely plug all open ends to prevent water, mud or debris from entering the duct.
- G. Prior to acceptance of ductbank by the Owner, the Contractor shall pull an approved mandrel through each conduit witnessed by the Owner's representative. Mandrel must not be less than 12 inches long with a diameter approximately ¼ inch less than the inside diameter of the duct or conduit. Swab all conduits clean immediately before pulling cable.
- H. Form conduits into ductbanks as shown on the Drawings. Quantity of spacers shall be as required to ensure conduit is supported to maintain a true straight line without sagging. Spacers shall be made of plastic, concrete or a suitable nonmetallic, non-decaying material. conduits shall be secured to the spacers using plastic ties; use of wire is not acceptable.
- I. Concrete forming and placement. Concrete shall be placed in forms within the excavated trench. Top of concrete shall be level. Trowel in additional red dye on top of concrete. Conduits shall be not less than 3 inches from the edge of concrete.
- J. Identify the ductbank location with metallic safety tape or vinyl tape with magnetic tracer marked "CAUTION! BURIED HIGH VOLTAGE ELECTRICAL LINE". Tape shall be located 12 inches above the ductbank. Identify each individual conduit as per the schedule in the Drawings. Conduits shall be identified in accordance with 26 05 53 Electrical Identification.

3.03 MANHOLE INSTALLATION

- A. The excavation for the manhole shall be to a suitable depth to allow for the manhole cover to be slightly elevated above the finished grade to prevent run-off from the entering. The

finished grade material shall be sloped around the manhole collar of frame to prevent adequate cover and support.

- B. The site preparation for the manhole shall conform to the manufacturer's recommendations. Generally 3 to 6 inches of stabilize sand and base material shall be spread in the bottom of the excavation. The base material or sand shall be compacted and graded to the proper elevation.

3.04 TRENCH BACKFILLING

- A. Backfill using fine material up to 24 inches above the top of the ductbank placed in 6-inch lifts and thoroughly tamped.
- B. Consolidate the ductbank fill material under roads or similar traffic areas in such a manner as to provide an unyielding foundation of the paving. Remove all excess materials.
- C. Succeeding layers of backfill 18 inches and greater above the ductbank may contain courser materials. Backfill shall be free of all organic material or any other material that would cause subsequent settlement. Maximum size of backfill stone or aggregate shall not exceed 6 inches in its greatest dimension.
- D. Surface of backfill shall be safe for vehicular traffic as soon as possible. At the upper 12 inches of the backfill provide an approved moist material, thoroughly compacted by tamping thin lifts (approximately 4 inches per lift). Lay the top layer at the required grade surface.
- E. Compact backfill by tamping or other method as approved by the Owner's representative. Maintain compaction at a minimum of 95 percent of the maximum density at optimum moisture content as determined by ASTM D 698. The Owner's representative shall direct which method of consolidation is to be followed on each part of the work.
- F. Contractor shall assume full responsibility for any deficiency in quantity of material or filling of depressions caused by settlement of backfill material. Damage to other trade's work caused by settling shall be corrected at the Contractor's expense. Contractor shall assume full responsibility for damages to any underground utility lines or other structure.
- G. Dispose of all excess material from the construction site as directed by the Owner. Contractor should remove excess spoils and other material from the site.

3.05 RECORD DRAWINGS

- A. Provide all concrete test reports required per Division 03 specifications.
- B. All duct bank locations shall be located with respect to site horizontal controls. All ductbanks shall be located at ends and change of directions. Record accurately all ductbank bends (radius and center point) ± 1 -foot by 0-inch accuracy on the construction As-Build drawings.
- C. Record the installed length of each conduit in the ductbank to the nearest foot and transmit to the Owner's representative.

END OF SECTION



TXDOT STANDARD SPECIFICATIONS

Item 110

Excavation



1. DESCRIPTION

Excavate areas as shown on the plans or as directed. Remove materials encountered to the lines, grades, and typical sections shown on the plans and cross-sections.

2. CONSTRUCTION

Accept ownership of unsuitable or excess material and dispose of material in accordance with local, state, and federal regulations at locations outside the right of way.

Maintain drainage in the excavated area to avoid damage to the roadway section. Correct any damage to the subgrade caused by weather at no additional cost to the Department.

Shape slopes to avoid loosening material below or outside the proposed grades. Remove and dispose of slides as directed.

2.1. **Rock Cuts.** Excavate to finish subgrade. Manipulate and compact subgrade in accordance with Section 132.3.4., "Compaction Methods," unless excavation is to clean homogenous rock at finish subgrade elevation. Use approved embankment material compacted in accordance with Section 132.3.4., "Compaction Methods," to replace undercut material at no additional cost if excavation extends below finish subgrade.

2.2. **Earth Cuts.** Excavate to finish subgrade. Scarify subgrade to a uniform depth at least 6 in. below finish subgrade elevation in areas where base or pavement structure will be placed on subgrade. Manipulate and compact subgrade in accordance with Section 132.3.4., "Compaction Methods."

Take corrective measures as directed if unsuitable material is encountered below subgrade elevations.

2.3. **Subgrade Tolerances.** Excavate to within 1/2 in. in cross-section and 1/2 in. in 16 ft. measured longitudinally for turnkey construction. Excavate to within 0.1 ft. in cross-section and 0.1 ft. in 16 ft. measured longitudinally for staged construction.

3. MEASUREMENT

This Item will be measured by the cubic yard in its original position as computed by the method of average end areas.

This is a plans quantity measurement Item. The quantity to be paid is the quantity shown in the proposal unless modified by Article 9.2., "Plans Quantity Measurement." Additional measurements or calculations will be made if adjustments of quantities are required.

Limits of measurement for excavation in retaining wall areas will be as shown on the plans.

Shrinkage or swelling factors will not be considered in determining the calculated quantities.

4. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Excavation (Roadway)," "Excavation (Channel)," "Excavation (Special)," or "Excavation (Roadway and Channel)." This price is full compensation for

authorized excavation; drying; undercutting subgrade and reworking or replacing the undercut material in rock cuts; hauling; disposal of material not used elsewhere on the project; scarification and compaction; and equipment, labor, materials, tools, and incidentals.

Drying required deeper than 6 in. below subgrade elevation will be paid for in accordance with Article 9.7., "Payment for Extra Work and Force Account Method." Excavation and replacement of unsuitable material below subgrade elevations will be performed and paid for in accordance with the applicable bid items. However, if Item 132, "Embankment," is not included in the Contract, payment for replacement of unsuitable material will be paid for in accordance with Article 9.7., "Payment for Extra Work and Force Account Method."

When a slide not due to the Contractor's negligence or operation occurs, payments for removal and disposal of the slide material will be in accordance with Article 9.7., "Payment for Extra Work and Force Account Method." Excavation in backfill areas of retaining walls will not be measured or paid for directly but will be subsidiary to pertinent Items.

Item 132

Embankment



1. DESCRIPTION

Furnish, place, and compact materials for construction of roadways, embankments, levees, dikes, or any designated section of the roadway where additional material is required.

2. MATERIALS

Furnish approved material capable of forming a stable embankment from required excavation in the areas shown on the plans or from sources outside the right of way. Provide one or more of the following types as shown on the plans:

- **Type A.** Granular material that is free from vegetation or other objectionable material and meets the requirements of Table 1.

Table 1
Testing Requirements

Property	Test Method	Specification Limit
Liquid limit	Tex-104-E	≤ 45
Plasticity index (PI)	Tex-106-E	≤ 15
Bar linear shrinkage	Tex-107-E	≥ 2

Perform the Linear Shrinkage test only as indicated in [Tex-104-E](#).

- **Type B.** Materials such as rock, loam, clay, or other approved materials.
- **Type C.** Material meeting the specification requirements shown on the plans. Type C may be further designated as Type C1, C2, etc.
- **Type D.** Material from required excavation areas shown on the plans.

Meet the requirements of the pertinent retaining wall Items for retaining wall backfill material.

3. CONSTRUCTION

Meet the requirements of Item 7, "Legal Relations and Responsibilities," when off right of way sources are used. Notify the Engineer before opening a material source to allow for required testing. Complete preparation of the right of way in accordance with Item 100, "Preparing Right of Way," for areas to receive embankment.

Backfill tree-stump holes or other minor excavations with approved material and tamp. Restore the ground surface, including any material disked loose or washed out, to its original slope. Compact the ground surface by sprinkling in accordance with Item 204, "Sprinkling," and by rolling using equipment complying with Item 210, "Rolling," when directed.

Scarify and loosen the unpaved surface areas, except rock, to a depth of at least 6 in. unless otherwise shown on the plans. Bench slopes before placing material. Begin placement of material at the toe of slopes. Do not place trees, stumps, roots, vegetation, or other objectionable material in the embankment. Simultaneously recompact scarified material with the placed embankment material. Do not exceed the layer depth specified in Section 132.3.4., "Compaction Methods."

Construct embankments to the grade and sections shown on the plans. Construct the embankment in layers approximately parallel to the finished grade for the full width of the individual roadway cross-sections unless otherwise shown on the plans. Ensure that each section of the embankment conforms to the detailed sections or slopes. Maintain the finished section, density, and grade until the project is accepted.

- 3.1. **Earth Embankments.** Earth embankment is mainly composed of material other than rock. Construct embankments in successive layers, evenly distributing materials in lengths suited for sprinkling and rolling.

Treat material in accordance with Item 260, "Lime Treatment (Road-Mixed)" or Item 275, "Cement Treatment (Road-Mixed)" when required. Obtain approval to incorporate rock and broken concrete produced by the construction project in the lower layers of the embankment. Place the rock and concrete outside the limits of the completed roadbed when the size of approved rock or broken concrete exceeds the layer thickness requirements in Section 132.3.4., "Compaction Methods." Cut and remove all exposed reinforcing steel from the broken concrete.

Move the material dumped in piles or windrows by blading or by similar methods and incorporate it into uniform layers. Featheredge or mix abutting layers of dissimilar material for at least 100 ft. to ensure there are no abrupt changes in the material. Break down clods or lumps of material and mix embankment until a uniform material is attained.

Apply water free of industrial wastes and other objectionable matter to achieve the uniform moisture content specified for compaction.

Roll and sprinkle each embankment layer in accordance with Section 132.3.4.1., "Ordinary Compaction," when ordinary compaction is specified. Compact the layer to the required density in accordance with Section 132.3.4.2., "Density Control," when density control is specified.

- 3.2. **Rock Embankments.** Rock embankment is mainly composed of rock. Construct rock embankments in successive layers for the full width of the roadway cross-section with a depth of 18 in. or less. Increase the layer depth for large rock sizes as approved. Do not exceed a depth of 2-1/2 ft. in any case. Fill voids created by the large stone matrix with smaller stones during the placement and filling operations.

Ensure the depth of the embankment layer is greater than the maximum dimension of any rock. Do not place rock greater than 2 ft. in its maximum dimension, unless otherwise approved. Construct the final layer with graded material so that the density and uniformity is in accordance with Section 132.3.4., "Compaction Methods." Break up exposed oversized material as approved.

Roll and sprinkle each embankment layer in accordance with Section 132.3.4.1., "Ordinary Compaction," when ordinary compaction is specified. Compact each layer to the required density in accordance with Section 132.3.4.2., "Density Control," when density control is specified. Proof-roll each rock layer as directed, where density testing is not possible, in accordance with Item 216, "Proof Rolling," to ensure proper compaction.

- 3.3. **Embankments Adjacent to Culverts and Bridges.** Compact embankments adjacent to culverts and bridges in accordance with Item 400, "Excavation and Backfill for Structures."

- 3.4. **Compaction Methods.** Begin rolling longitudinally at the sides and proceed toward the center, overlapping on successive trips by at least 1/2 the width of the roller. Begin rolling at the lower side and progress toward the high side on super elevated curves. Alternate roller trips to attain slightly different lengths. Compact embankments in accordance with Section 132.4.1., "Ordinary Compaction," or Section 132.3.4.2., "Density Control," as shown on the plans.

- 3.4.1. **Ordinary Compaction.** Use approved rolling equipment complying with Item 210, "Rolling," to compact each layer. Use specific equipment when required by the plans or the Engineer. Do not allow the loose depth of any layer to exceed 8 in., unless otherwise approved. Bring each layer to the moisture content directed

before and during rolling operations. Compact each layer until there is no evidence of further consolidation. Maintain a level layer to ensure uniform compaction. Recompact and refinish the subgrade at no additional expense to the Department if the required stability or finish is lost for any reason.

- 3.4.2. **Density Control.** Compact each layer to the required density using equipment complying with Item 210, "Rolling." Determine the maximum lift thickness based on the ability of the compacting operation and equipment to meet the required density. Do not exceed layer thickness of 16 in. loose or 12 in. compacted material unless otherwise approved. Maintain a level layer to ensure uniform compaction.

The Engineer will use [Tex-114-E](#) to determine the maximum dry density (D_a) and optimum moisture content (W_{opt}). Meet the requirements for field density and moisture content in Table 2 unless otherwise shown on the plans.

Table 2
Field Density Control Requirements

Description	Density	Moisture Content
	Tex-115-E	
$PI \leq 15$	$\geq 98\% D_a$	
$15 < PI \leq 35$	$\geq 98\% D_a$ and $\leq 102\% D_a$	$\geq W_{opt}$
$PI > 35$	$\geq 95\% D_a$ and $\leq 100\% D_a$	$\geq W_{opt}$

Each layer is subject to testing by the Engineer for density and moisture content. During compaction, the moisture content of the soil should not exceed the value shown on the moisture-density curve, above optimum, required to achieve:

- 98% dry density for soils with a PI greater than 15 but less than or equal to 35 or
- 95% dry density for soils with PI greater than 35.

Remove small areas of the layer to allow for density tests as required. Replace the removed material and recompact at no additional expense to the Department. Proof-roll in accordance with Item 216, "Proof Rolling," when shown on the plans or as directed. Correct soft spots as directed.

- 3.5. **Maintenance of Moisture and Reworking.** Maintain the density and moisture content once all requirements in Table 2 are met. Maintain the moisture content no lower than 4% below optimum for soils with a PI greater than 15. Rework the material to obtain the specified compaction when the material loses the required stability, density, moisture, or finish. Alter the compaction methods and procedures on subsequent work to obtain specified density as directed.
- 3.6. **Acceptance Criteria.**
- 3.6.1. **Grade Tolerances.**
- 3.6.1.1. **Staged Construction.** Grade to within 0.1 ft. in the cross-section and 0.1 ft. in 16 ft. measured longitudinally.
- 3.6.1.2. **Turnkey Construction.** Grade to within 1/2 in. in the cross-section and 1/2 in. in 16 ft. measured longitudinally.
- 3.6.2. **Gradation Tolerances.** Ensure no more than 1 of the 5 most recent gradation tests is outside the specified limits on any individual sieve by more than 5% when gradation requirements are shown on the plans.
- 3.6.3. **Density Tolerances.** Ensure no more than 1 of the 5 most recent density tests for compaction work is outside the specified density limits, and no test is outside the limits by more than 3 pcf.
- 3.6.4. **Plasticity Tolerances.** Ensure no more than 1 of the 5 most recent PI tests for material is outside the specified limit by more than 2 points.

4. MEASUREMENT

Embankment will be measured by the cubic yard. Measurement will be further defined for payment as follows:

- 4.1. **Final.** The cubic yard will be measured in its final position using the average end area method. The volume is computed between the original ground surface or the surface upon which the embankment is to be constructed and the lines, grades, and slopes of the embankment. In areas of salvaged topsoil, payment for embankment will be made in accordance with Item 160, "Topsoil." Shrinkage or swell factors will not be considered in determining the calculated quantities.
- 4.2. **Original.** The cubic yard will be measured in its original and natural position using the average end area method.
- 4.3. **Vehicle.** The cubic yard will be measured in vehicles at the point of delivery.

When measured by the cubic yard in its final position, this is a plans quantity measurement Item. The quantity to be paid is the quantity shown in the proposal, unless modified by Article 9.2., "Plans Quantity Measurement." Additional measurements or calculations will be made if adjustments of quantities are required.

Shrinkage or swell factors are the Contractor's responsibility. When shown on the plans, factors are for informational purposes only.

Measurement of retaining wall backfill in embankment areas is paid for as embankment unless otherwise shown on the plans. Limits of measurement for embankment in retaining wall areas are shown on the plans.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Embankment (Final)," "Embankment (Original)," or "Embankment (Vehicle)" of the compaction method and type specified. This price is full compensation for furnishing embankment; hauling; placing, compacting, finishing, and reworking; disposal of waste material; and equipment, labor, tools, and incidentals.

When proof rolling is directed, it will be paid for in accordance with Item 216, "Proof Rolling."

All sprinkling and rolling, except proof rolling, will not be paid for directly but will be considered subsidiary to this Item, unless otherwise shown on the plans.

Where subgrade is constructed under this Contract, correction of soft spots in the subgrade will be at the Contractor's expense. Where subgrade is not constructed under this Contract, correction of soft spots in the subgrade will be paid in accordance with Article 9.7., "Payment for Extra Work and Force Account Method."

Item 210

Rolling



1. DESCRIPTION

Compact embankment, subgrade, base, surface treatments, broken concrete pavement, or asphalt pavement using rollers. Break up asphalt mats, pit run material, or base materials.

2. EQUIPMENT

Use any type of roller to meet the production rates and quality requirements of the Contract unless otherwise shown on the plans or directed. Use equipment that meets the requirements of this Item when specific types of equipment are required. The Engineer may allow the use of rollers that operate in one direction only when turning does not affect the quality of work or encroach on traffic.

Table 1
Roller Requirements¹

Roller Type	Materials to be Compacted	Load (tons)	Contact Pressure	Roller Speed (mph)
Steel wheel	Embankment, subgrade, base, asphalt concrete	≥ 10	≥ 325 lb. per inch of wheel width	2–3
Tamping	Embankment, subgrade	–	125–550 psi per tamping foot	2–3
Heavy tamping	Embankment, subgrade	–	≥ 550 psi per tamping foot	2–3
Vibratory	Embankment, subgrade, base, asphalt concrete	Type A < 6 Type B > 6 Type C as shown on the plans	Per equipment specification and as approved	As approved
Light pneumatic	Embankment, subgrade, surface treatment	4.5–9.0	≥ 45 psi	2–6
	Asphalt Concrete			4–12
Medium pneumatic	Embankment, subgrade, base, surface treatment	12–25	≥ 80 psi, as directed	2–6
	Asphalt Concrete			4–12
Heavy pneumatic	Embankment, subgrade, base, previously broken concrete pavement, other pavements	≥ 25	≤ 150 psi	2–6
Grid	Embankment, breaking up existing asphalt mats or base	5–13	–	2–3

1. Unless otherwise specified in the Contract.

- 2.1. **Static Steel Wheel Rollers.** Furnish single, double, or triple steel wheel, self-propelled power rollers weighing at least 10 tons capable of operating in a forward and backward motion. Ensure all wheels are flat. The Contractor may use vibratory rollers in the static mode when static steel wheel rollers are required.

For single steel wheel rollers, pneumatic rear wheels are allowed for embankment, subgrade, and base. Provide rear wheels for triple steel wheel rollers with a minimum diameter of 48 in., a minimum width of 20 in., and a minimum compression of 325 lb. per inch of wheel width.

- 2.2. **Tamping Rollers.** Furnish self-propelled rollers with at least one self-cleaning metal tamping drum capable of operating in a forward or backward motion with a minimum effective rolling width of 5 ft. Mount drums in a frame so that each drum moves independently of the other for rollers with more than one drum. Operate rollers in static or vibratory mode.

- 2.2.1. **Tamping Roller (Minimum Requirement).** Provide tamping feet that exert a static load of 125 to 550 psi and project at least 3 in. from the surface of the drum for all tamping rollers except for heavy tamping rollers.

- 2.2.2. **Heavy Tamping Roller.** Provide tamping rollers that have:

- 2 metal tamping drums, rolls, or shells, each with a 60-in. minimum diameter and a 5-ft. minimum width, or
- 1 rear and 2 forward drums, each with a 60-in. minimum diameter. Arrange drums so that the rear drum compacts the space between the 2 forward drums and the minimum overall rolling width is 10 ft.

Equip drums with tamping feet that:

- project at least 7 in. from the drum surface,
- have an area of 7 to 21 sq. in.,
- are self-cleaning,
- exert a static load of at least 550 psi, and
- are spaced at 1 tamping foot per 0.65 to 0.70 square feet of drum area.

- 2.3. **Vibratory Rollers.** Furnish self-propelled rollers with at least one drum equipped to vibrate. Select and maintain amplitude and frequency settings per manufacturer's specifications to deliver maximum compaction without material displacement or shoving, as approved. Furnish the equipment manufacturer's specifications concerning settings and controls for amplitude and frequency. Operate rollers at speeds that will produce at least 10 blows per foot unless otherwise shown on the plans or approved. Pneumatic rear wheels are allowed for embankment, subgrade, and base. Equip each vibrating drum with:

- separate frequency and amplitude controls,
- controls to manually start and stop vibration, and
- a mechanism to continuously clean the face of the drum.

For asphalt-stabilized base and asphalt concrete pavement, furnish a roller that also has the ability to:

- automatically reverse the direction of the rotating eccentric weight,
- stop vibration before the motion of the roller stops, and
- thoroughly moisten the drum with water or approved asphalt release agent.

- 2.3.1. **Drum (Type A).** Furnish a roller with a static weight less than 6 tons and a vibratory drum.

- 2.3.2. **Drum (Type B).** Furnish a roller with a minimum static weight of 6 tons and a vibratory drum.

- 2.3.3. **Drum (Type C).** Furnish a roller as shown on the plans.

- 2.4. **Pneumatic Tire Rollers.** Pneumatic tire rollers consist of rubber tire wheels on axles mounted in a frame with either a loading platform or body suitable for ballast loading. Arrange the rear tires to cover the gaps between adjacent tires of the forward group. Furnish rollers capable of forward and backward motion. Compact asphalt pavements and surface treatments with a roller equipped with smooth-tread tires. Compact

without damaging the surface. Moisten the wheels with water or an approved asphalt release agent when necessary.

Select and maintain the operating load and tire air pressure within the range of the manufacturer's charts or tabulations to attain maximum compaction throughout the lift, as approved. Furnish the manufacturer's chart or tabulations showing the contact areas and contact pressures for the full range of tire inflation pressures and for the full range of loadings for the particular tires furnished. Maintain individual tire inflation pressures within 5 psi of each other. Provide uniform compression under all tires.

2.4.1. **Light Pneumatic Tire.** Furnish a unit:

- with at least 9 pneumatic tires,
- with an effective rolling width of approximately 5 ft.,
- capable of providing a total uniform load of 4.5 to 9 tons, and
- with tires capable of maintaining a minimum ground contact pressure of 45 psi.

2.4.2. **Medium Pneumatic Tire.** Furnish a unit:

- with at least 7 pneumatic tires,
- with an effective rolling width of approximately 7 ft.,
- capable of providing a total uniform load of 12 to 25 tons, and
- with tires capable of maintaining a minimum ground contact pressure of 80 psi or 90 psi as directed.

2.4.3. **Heavy Pneumatic Tire.** Furnish a unit:

- with at least 4 pneumatic-tired wheels mounted on axles carrying no more than 2 wheels,
- with wheels arranged to carry approximately equal loads on uneven surfaces,
- with a width between 8 and 10 ft. that can turn 180° in the crown width,
- capable of providing a total uniform load of at least 25 tons,
- with tires capable of maintaining a maximum ground contact pressure of 150 psi, and
- with liquid-filled tires inflated to such a level that liquid will flow from the valve stem when the stem is in the uppermost position.

2.5. **Grid Rollers.** Furnish rollers that have 2 cylindrical cages with a minimum diameter of 66 in. and a minimum width of 32 in. Mount cages in a rigid frame with weight boxes. Use a cage surface of cast or welded steel fabric grid with bars 1-1/2 in. wide, spaced on 5-in. centers in each direction, that undulate approximately 1 in. between the high and low points.

Furnish rollers capable of providing a total load of 5 to 13 tons and capable of being operated in a forward or backward motion.

2.6. **Alternate Equipment.** The Contractor may use alternate compaction equipment that produces results equivalent to the specified equipment as approved. Discontinue the use of the alternate equipment and furnish the specified equipment if the desired results are not achieved.

3. CONSTRUCTION

Perform this work in accordance with the applicable Items using equipment and roller speeds specified in Table 1. Use only rubber-tired equipment to push or pull compaction equipment on base courses. Use equipment that does not damage material being rolled.

4. MEASUREMENT AND PAYMENT

The work performed, materials furnished, equipment, labor, tools, and incidentals will not be measured or paid for directly but will be subsidiary to pertinent Items.

Item 216

Proof Rolling



1. DESCRIPTION

Proof-roll earthwork, base, or both to locate unstable areas.

2. EQUIPMENT

- 2.1. **Specified Equipment.** Furnish rollers that weigh at least 25 tons when loaded. The maximum acceptable load is 50 tons. Provide rollers that meet the requirements of Section 210.2.4., "Pneumatic Tire Rollers."
- 2.2. **Alternative Equipment.** The Contractor may use alternate compaction equipment that produces results equivalent to the specified equipment in the same period of time as approved. Discontinue the use of the alternative equipment and furnish the specified equipment if the desired results are not achieved.

3. CONSTRUCTION

Perform proof rolling as directed. Adjust the load and tire inflation pressures within the range of the manufacturer's charts or tabulations, as directed. Make at least 2 coverages with the proof roller. Offset each trip of the roller by at most one tire width. Operate rollers at a speed between 2 and 6 mph, as directed. Correct unstable or nonuniform areas, if found, in accordance with the applicable Item.

4. MEASUREMENT

Rolling will be measured by the hour operated on surfaces being tested.

5. PAYMENT

The work performed and equipment furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Proof Rolling." This price is full compensation for furnishing and operating equipment and for labor, materials, tools, and incidentals.

Item 247

Flexible Base



1. DESCRIPTION

Construct a foundation course composed of flexible base.

2. MATERIALS

Furnish uncontaminated materials of uniform quality that meet the requirements of the plans and specifications. Notify the Engineer of the proposed material sources and of changes to material sources. The Engineer may sample and test project materials at any time before compaction throughout the duration of the project to assure specification compliance. Use [Tex-100-E](#) material definitions.

- 2.1. **Aggregate.** Furnish aggregate of the type and grade shown on the plans and meeting the requirements of Table 1. Each source must meet Table 1 requirements for liquid limit, plasticity index, and wet ball mill for the grade specified. Do not use additives, such as but not limited to lime, cement, or fly ash to modify aggregates to meet the requirements of Table 1 unless shown on the plans.

Table 1
Material Requirements

Property	Test Method	Grade 1–2	Grade 3	Grade 4 ²	Grade 5
Sampling	Tex-400-A				
Master gradation sieve size (cumulative % retained)	Tex-110-E			As shown on the plans	
2-1/2"		0	0		0
1-3/4"		0–10	0–10		0–5
7/8"		10–35	–		10–35
3/8"		30–65	–		35–65
#4		45–75	45–75		45–75
#40		65–90	50–85		70–90
Liquid Limit, % Max	Tex-104-E	40	40	As shown on the plans	35
Plasticity Index, Max ¹	Tex-106-E	10	12	As shown on the plans	10
Plasticity index, Min ¹		As shown on the plans	As shown on the plans	As shown on the plans	As shown on the plans
Wet ball mill, % Max	Tex-116-E	40	–	As shown on the plans	40
Wet ball mill, % Max increase passing the #40 sieve		20	–	As shown on the plans	20
Min compressive strength, psi	Tex-117-E			As shown on the plans	
lateral pressure 0 psi		35	–		–
lateral pressure 3 psi		–	–		90
lateral pressure 15 psi		175	–		175

- Determine plastic index in accordance with [Tex-107-E](#) (linear shrinkage) when liquid limit is unattainable as defined in [Tex-104-E](#).
- Grade 4 may be further designated as Grade 4A, Grade 4B, etc.

- 2.1.1. **Material Tolerances.** The Engineer may accept material if no more than 1 of the 5 most recent gradation tests has an individual sieve outside the specified limits of the gradation.

When target grading is required by the plans, no single failing test may exceed the master grading by more than 5 percentage points on sieves No. 4 and larger or 3 percentage points on sieves smaller than No. 4.

The Engineer may accept material if no more than 1 of the 5 most recent plasticity index tests is outside the specified limit. No single failing test may exceed the allowable limit by more than 2 points.

- 2.1.2. **Material Types.** Do not use fillers or binders unless approved. Furnish the type specified on the plans in accordance with the following:
- 2.1.2.1. **Type A.** Crushed stone produced and graded from oversize quarried aggregate that originates from a single, naturally occurring source. Do not use gravel or multiple sources.
- 2.1.2.2. **Type B.** Crushed or uncrushed gravel. Blending of 2 or more sources is allowed.
- 2.1.2.3. **Type C.** Crushed gravel with a minimum of 60% of the particles retained on a No. 4 sieve with 2 or more crushed faces as determined by [Tex-460-A](#), Part I. Blending of 2 or more sources is allowed.
- 2.1.2.4. **Type D.** Type A material or crushed concrete. Crushed concrete containing gravel will be considered Type D material. Crushed concrete must meet the requirements in Section 247.2.1.3.2., "Recycled Material (Including Crushed Concrete) Requirements," and be managed in a way to provide for uniform quality. The Engineer may require separate dedicated stockpiles in order to verify compliance.
- 2.1.2.5. **Type E.** Caliche, iron ore or as otherwise shown on the plans.
- 2.1.3. **Recycled Material.** Reclaimed asphalt pavement (RAP) and other recycled materials may be used when shown on the plans. Request approval to blend 2 or more sources of recycled materials.
- 2.1.3.1. **Limits on Percentage.** Do not exceed 20% RAP by weight, when RAP is allowed, unless otherwise shown on the plans. The percentage limitations for other recycled materials will be as shown on the plans.
- 2.1.3.2. **Recycled Material (Including Crushed Concrete) Requirements.**
- 2.1.3.2.1. **Contractor-Furnished Recycled Materials.** Provide recycled materials, other than RAP, that have a maximum sulfate content of 3,000 ppm when tested in accordance with [Tex-145-E](#). When the Contractor furnishes the recycled materials, including crushed concrete, the final product will be subject to the requirements of Table 1 for the grade specified. Certify compliance with [DMS-11000](#), "Evaluating and Using Nonhazardous Recyclable Materials Guidelines," for Contractor furnished recycled materials. In addition, recycled materials must be free from reinforcing steel and other objectionable material and have at most 1.5% deleterious material when tested in accordance with [Tex-413-A](#). For RAP, do not exceed a maximum percent loss from decantation of 5.0% when tested in accordance with [Tex-406-A](#). Test RAP without removing the asphalt.
- 2.1.3.2.2. **Department-Furnished Required Recycled Materials.** When the Department furnishes and requires the use of recycled materials, unless otherwise shown on the plans:
- Department-required recycled material will not be subject to the requirements in Table 1,
 - Contractor-furnished materials are subject to the requirements in Table 1 and this Item,
 - the final product, blended, will be subject to the requirements in Table 1, and
 - for final product, unblended (100% Department-furnished required recycled material), the liquid limit, plasticity index, wet ball mill, and compressive strength is waived.

Crush Department-furnished RAP so that 100% passes the 2 in. sieve. The Contractor is responsible for uniformly blending to meet the percentage required.

2.1.3.2.3. **Department-Furnished and Allowed Recycled Materials.** When the Department furnishes and allows the use of recycled materials or allows the Contractor to furnish recycled materials, the final blended product is subject to the requirements of Table 1 and the plans.

2.1.3.3. **Recycled Material Sources.** Department-owned recycled material is available to the Contractor only when shown on the plans. Return unused Department-owned recycled materials to the Department stockpile location designated by the Engineer unless otherwise shown on the plans.

The use of Contractor-owned recycled materials is allowed when shown on the plans. Contractor-owned surplus recycled materials remain the property of the Contractor. Remove Contractor-owned recycled materials from the project and dispose of them in accordance with federal, state, and local regulations before project acceptance. Do not intermingle Contractor-owned recycled material with Department-owned recycled material unless approved.

2.2. **Water.** Furnish water free of industrial wastes and other objectionable matter.

2.3. **Material Sources.** Expose the vertical faces of all strata of material proposed for use when non-commercial sources are used. Secure and process the material by successive vertical cuts extending through all exposed strata, when directed.

3. EQUIPMENT

Provide machinery, tools, and equipment necessary for proper execution of the work.

3.1. Provide rollers in accordance with Item 210, "Rolling." Provide proof rollers in accordance with Item 216, "Proof Rolling," when required.

3.2. When ride quality measurement is required, provide a high speed or lightweight inertial profiler certified at the Texas A&M Transportation Institute. Provide equipment certification documentation. Display a current decal on the equipment indicating the certification expiration date.

4. CONSTRUCTION

Construct each layer uniformly, free of loose or segregated areas, and with the required density and moisture content. Provide a smooth surface that conforms to the typical sections, lines, and grades shown on the plans or as directed.

Stockpile base material temporarily at an approved location before delivery to the roadway. Build stockpiles in layers no greater than 2 ft. thick. Stockpiles must have a total height between 10 and 16 ft. unless otherwise approved. After construction and acceptance of the stockpile, loading from the stockpile for delivery is allowed. Load by making successive vertical cuts through the entire depth of the stockpile.

Do not add or remove material from temporary stockpiles that require sampling and testing before delivery unless otherwise approved. Charges for additional sampling and testing required as a result of adding or removing material will be deducted from the Contractor's estimates.

Haul approved flexible base in clean trucks. Deliver the required quantity to each 100-ft. station or designated stockpile site as shown on the plans. Prepare stockpile sites as directed. When delivery is to the 100-ft. station, manipulate in accordance with the applicable Items.

4.1. **Preparation of Subgrade or Existing Base.** Remove or scarify existing asphalt concrete pavement in accordance with Item 105, "Removing Treated and Untreated Base and Asphalt Pavement," when shown on

the plans or as directed. Shape the subgrade or existing base to conform to the typical sections shown on the plans or as directed.

When new base is required to be mixed with existing base, deliver, place, and spread the new flexible base in the required amount per station. Manipulate and thoroughly mix the new base with existing material to provide a uniform mixture to the specified depth before shaping.

Proof roll the roadbed in accordance with Item 216, "Proof Rolling," before pulverizing or scarifying when shown on the plans or directed. Correct soft spots as directed.

- 4.2. **Placing.** Spread and shape flexible base into a uniform layer with an approved spreader the same day as delivered unless otherwise approved. Construct layers to the thickness shown on the plans. Maintain the shape of the course. Control dust by sprinkling, as directed. Correct or replace segregated areas as directed, at no additional expense to the Department.

Place successive base courses and finish courses using the same construction methods required for the first course.

- 4.3. **Compaction.** Compact using density control unless otherwise shown on the plans. Multiple lifts are permitted when shown on the plans or approved. Bring each layer to the moisture content directed. When necessary, sprinkle the material in accordance with Item 204, "Sprinkling."

Begin rolling longitudinally at the sides and proceed towards the center, overlapping on successive trips by at least 1/2 the width of the roller unit. Begin rolling at the low side and progress toward the high side on superelevated curves. Offset alternate trips of the roller. Operate rollers at a speed between 2 and 6 mph as directed.

Rework, recompact, and refinish material that fails to meet or that loses required moisture, density, stability, or finish requirements before the next course is placed or the project is accepted. Continue work until specification requirements are met. Perform the work at no additional expense to the Department.

Before final acceptance, the Engineer will select the locations of tests and measure the flexible base depth in accordance with [Tex-140-E](#). Correct areas deficient by more than 1/2 in. in thickness by scarifying, adding material as required, reshaping, recompacting, and refinishing at the Contractor's expense.

- 4.3.1. **Ordinary Compaction.** Roll with approved compaction equipment as directed. Correct irregularities, depressions, and weak spots immediately by scarifying the areas affected, adding or removing approved material as required, reshaping, and recompacting.

- 4.3.2. **Density Control.** Compact to at least 100% of the maximum dry density determined by [Tex-113-E](#), unless otherwise shown on the plans. Maintain moisture during compaction within ± 2 percentage points of the optimum moisture content as determined by [Tex-113-E](#). Measure the moisture content of the material in accordance with [Tex-115-E](#) or [Tex-103-E](#) during compaction daily and report the results the same day to the Engineer, unless otherwise shown on the plans or directed. Do not achieve density by drying the material after compaction.

The Engineer will determine roadway density and moisture content of completed sections in accordance with [Tex-115-E](#). The Engineer may accept the section if no more than 1 of the 5 most recent density tests is below the specified density and the failing test is no more than 3 pcf below the specified density.

- 4.4. **Finishing.** After completing compaction, clip, skin, or tight-blade the surface with a maintainer or subgrade trimmer to a depth of approximately 1/4 in. Remove loosened material and dispose of it at an approved location. Seal the clipped surface immediately by rolling with a pneumatic tire roller until a smooth surface is

attained. Add small increments of water as needed during rolling. Shape and maintain the course and surface in conformity with the typical sections, lines, and grades as shown on the plans or as directed.

Correct grade deviations greater than 1/4 in. in 16 feet measured longitudinally or greater than 1/4 in. over the entire width of the cross-section in areas where surfacing is to be placed. Correct by loosening and adding, or removing material. Reshape and re-compact in accordance with Section 247.4.3., "Compaction."

- 4.5. **Curing.** Cure the finished section until the moisture content is at least 2 percentage points below optimum or as directed before applying the next successive course or prime coat.

- 4.6. **Ride Quality.** This section applies to the final travel lanes that receive a 1 or 2 course surface treatment for the final surface, unless otherwise shown on the plans. Measure ride quality of the base course after placement of the prime coat and before placement of the surface treatment, unless otherwise approved. Use a certified profiler operator from the Department's MPL. When requested, furnish the Engineer documentation for the person certified to operate the profiler.

Provide all profile measurements to the Engineer in electronic data files within 3 days after placement of the prime coat using the format specified in [Tex-1001-S](#). The Engineer will use Department software to evaluate longitudinal profiles to determine areas requiring corrective action. Correct 0.1-mi.sections having an average international roughness index (IRI) value greater than 100.0 in. per mile to an IRI value of 100.0 in. per mile or less for each wheel path, unless otherwise shown on the plans.

Re-profile and correct sections that fail to maintain ride quality until placement of the next course, as directed. Correct re-profiled sections until specification requirements are met, as approved. Perform this work at no additional expense to the Department.

5. MEASUREMENT

Flexible base will be measured as follows:

- **Flexible Base (Complete In Place).** The ton, square yard, or any cubic yard method.
- **Flexible Base (Roadway Delivery).** The ton or any cubic yard method.
- **Flexible Base (Stockpile Delivery).** The ton, cubic yard in vehicle, or cubic yard in stockpile.

Measurement by the cubic yard in final position and square yard is a plans quantity measurement. The quantity to be paid for is the quantity shown in the proposal unless modified by Article 9.2., "Plans Quantity Measurement." Additional measurements or calculations will be made if adjustments of quantities are required.

Measurement is further defined for payment as follows.

- 5.1. **Cubic Yard in Vehicle.** By the cubic yard in vehicles of uniform capacity at the point of delivery.
- 5.2. **Cubic Yard in Stockpile.** By the cubic yard in the final stockpile position by the method of average end areas.
- 5.3. **Cubic Yard in Final Position.** By the cubic yard in the completed and accepted final position. The volume of base course is computed in place by the method of average end areas between the original subgrade or existing base surfaces and the lines, grades, and slopes of the accepted base course as shown on the plans.
- 5.4. **Square Yard.** By the square yard of surface area in the completed and accepted final position. The surface area of the base course is based on the width of flexible base as shown on the plans.

- 5.5. **Ton.** By the ton of dry weight in vehicles as delivered. The dry weight is determined by deducting the weight of the moisture in the material at the time of weighing from the gross weight of the material. The Engineer will determine the moisture content in the material in accordance with [Tex-103-E](#) from samples taken at the time of weighing.

When material is measured in trucks, the weight of the material will be determined on certified scales, or the Contractor must provide a set of standard platform truck scales at a location approved by the Engineer. Scales must conform to the requirements of Item 520, "Weighing and Measuring Equipment."

6. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for the types of work shown below. No additional payment will be made for thickness or width exceeding that shown on the typical section or provided on the plans for cubic yard in the final position or square yard measurement.

Sprinkling and rolling, except proof rolling, will not be paid for directly but will be subsidiary to this Item unless otherwise shown on the plans. When proof rolling is shown on the plans or directed, it will be paid for in accordance with Item 216, "Proof Rolling."

Where subgrade is constructed under this Contract, correction of soft spots in the subgrade will be at the Contractor's expense. Where subgrade is not constructed under this Contract, correction of soft spots in the subgrade will be paid in accordance with pertinent Items or Article 4.4., "Changes in the Work."

- 6.1. **Flexible Base (Complete In Place).** Payment will be made for the type and grade specified. For cubic yard measurement, "In Vehicle," "In Stockpile," or "In Final Position" will be specified. For square yard measurement, a depth will be specified. This price is full compensation for furnishing materials, temporary stockpiling, assistance provided in stockpile sampling and operations to level stockpiles for measurement, loading, hauling, delivery of materials, spreading, blading, mixing, shaping, placing, compacting, reworking, finishing, correcting locations where thickness is deficient, curing, furnishing scales and labor for weighing and measuring, and equipment, labor, tools, and incidentals.
- 6.2. **Flexible Base (Roadway Delivery).** Payment will be made for the type and grade specified. For cubic yard measurement, "In Vehicle," "In Stockpile," or "In Final Position" will be specified. The unit price bid will not include processing at the roadway. This price is full compensation for furnishing materials, temporary stockpiling, assistance provided in stockpile sampling and operations to level stockpiles for measurement, loading, hauling, delivery of materials, furnishing scales and labor for weighing and measuring, and equipment, labor, tools, and incidentals.
- 6.3. **Flexible Base (Stockpile Delivery).** Payment will be made for the type and grade specified. For cubic yard measurement, "In Vehicle" or "In Stockpile" will be specified. The unit price bid will not include processing at the roadway. This price is full compensation for furnishing and disposing of materials, preparing the stockpile area, temporary or permanent stockpiling, assistance provided in stockpile sampling and operations to level stockpiles for measurement, loading, hauling, delivery of materials to the stockpile, furnishing scales and labor for weighing and measuring, and equipment, labor, tools, and incidentals.

Item 340

Dense-Graded Hot-Mix Asphalt (Small Quantity)



1. DESCRIPTION

Construct a hot-mix asphalt (HMA) pavement layer composed of a compacted, dense-graded mixture of aggregate and asphalt binder mixed hot in a mixing plant. This specification is intended for small quantity (SQ) HMA projects, typically under 5,000 tons total production.

2. MATERIALS

Furnish uncontaminated materials of uniform quality that meet the requirements of the plans and specifications.

Notify the Engineer of all material sources and before changing any material source or formulation. The Engineer will verify that the specification requirements are met when the Contractor makes a source or formulation change, and may require a new laboratory mixture design, trial batch, or both. The Engineer may sample and test project materials at any time during the project to verify specification compliance in accordance with Item 6, "Control of Materials."

- 2.1. **Aggregate.** Furnish aggregates from sources that conform to the requirements shown in Table 1 and as specified in this Section. Aggregate requirements in this Section, including those shown in Table 1, may be modified or eliminated when shown on the plans. Additional aggregate requirements may be specified when shown on the plans. Provide aggregate stockpiles that meet the definitions in this Section for coarse, intermediate, or fine aggregate. Aggregate from reclaimed asphalt pavement (RAP) is not required to meet Table 1 requirements unless otherwise shown on the plans. Supply aggregates that meet the definitions in [Tex-100-E](#) for crushed gravel or crushed stone. The Engineer will designate the plant or the quarry as the sampling location. Provide samples from materials produced for the project. The Engineer will establish the Surface Aggregate Classification (SAC) and perform Los Angeles abrasion, magnesium sulfate soundness, and Micro-Deval tests. Perform all other aggregate quality tests listed in Table 1. Document all test results on the mixture design report. The Engineer may perform tests on independent or split samples to verify Contractor test results. Stockpile aggregates for each source and type separately. Determine aggregate gradations for mixture design and production testing based on the washed sieve analysis given in [Tex-200-F](#), Part II.

- 2.1.1. **Coarse Aggregate.** Coarse aggregate stockpiles must have no more than 20% material passing the No. 8 sieve. Aggregates from sources listed in the Department's *Bituminous Rated Source Quality Catalog* (BRSQC) are preapproved for use. Use only the rated values for hot-mix listed in the BRSQC. Rated values for surface treatment (ST) do not apply to coarse aggregate sources used in hot-mix asphalt.

For sources not listed on the Department's BRSQC:

- build an individual stockpile for each material;
- request the Department test the stockpile for specification compliance; and
- once approved, do not add material to the stockpile unless otherwise approved.

Provide aggregate from non-listed sources only when tested by the Engineer and approved before use. Allow 30 calendar days for the Engineer to sample, test, and report results for non-listed sources.

Provide coarse aggregate with at least the minimum SAC shown on the plans. SAC requirements only apply to aggregates used on the surface of travel lanes. SAC requirements apply to aggregates used on surfaces other than travel lanes when shown on the plans. The SAC for sources on the Department's *Aggregate Quality Monitoring Program* (AQMP) ([Tex-499-A](#)) is listed in the BRSQC.

- 2.1.1.1. **Blending Class A and Class B Aggregates.** Class B aggregate meeting all other requirements in Table 1 may be blended with a Class A aggregate to meet requirements for Class A materials. Ensure that at least 50% by weight, or volume if required, of the material retained on the No. 4 sieve comes from the Class A aggregate source when blending Class A and B aggregates to meet a Class A requirement. Blend by volume if the bulk specific gravities of the Class A and B aggregates differ by more than 0.300. Coarse aggregate from RAP and Recycled Asphalt Shingles (RAS) will be considered as Class B aggregate for blending purposes.

The Engineer may perform tests at any time during production, when the Contractor blends Class A and B aggregates to meet a Class A requirement, to ensure that at least 50% by weight, or volume if required, of the material retained on the No. 4 sieve comes from the Class A aggregate source. The Engineer will use the Department's mix design template, when electing to verify conformance, to calculate the percent of Class A aggregate retained on the No. 4 sieve by inputting the bin percentages shown from readouts in the control room at the time of production and stockpile gradations measured at the time of production. The Engineer may determine the gradations based on either washed or dry sieve analysis from samples obtained from individual aggregate cold feed bins or aggregate stockpiles. The Engineer may perform spot checks using the gradations supplied by the Contractor on the mixture design report as an input for the template; however, a failing spot check will require confirmation with a stockpile gradation determined by the Engineer.

- 2.1.2. **Intermediate Aggregate.** Aggregates not meeting the definition of coarse or fine aggregate will be defined as intermediate aggregate. Supply intermediate aggregates, when used that are free from organic impurities.

The Engineer may test the intermediate aggregate in accordance with [Tex-408-A](#) to verify the material is free from organic impurities. Supply intermediate aggregate from coarse aggregate sources, when used that meet the requirements shown in Table 1 unless otherwise approved.

Test the stockpile if 10% or more of the stockpile is retained on the No. 4 sieve, and verify that it meets the requirements in Table 1 for crushed face count ([Tex-460-A](#)) and flat and elongated particles ([Tex-280-F](#)).

- 2.1.3. **Fine Aggregate.** Fine aggregates consist of manufactured sands, screenings, and field sands. Fine aggregate stockpiles must meet the gradation requirements in Table 2. Supply fine aggregates that are free from organic impurities. The Engineer may test the fine aggregate in accordance with [Tex-408-A](#) to verify the material is free from organic impurities. No more than 15% of the total aggregate may be field sand or other uncrushed fine aggregate. Use fine aggregate, with the exception of field sand, from coarse aggregate sources that meet the requirements shown in Table 1 unless otherwise approved.

Test the stockpile if 10% or more of the stockpile is retained on the No. 4 sieve, and verify that it meets the requirements in Table 1 for crushed face count ([Tex-460-A](#)) and flat and elongated particles ([Tex-280-F](#)).

Table 1
Aggregate Quality Requirements

Property	Test Method	Requirement
Coarse Aggregate		
SAC	Tex-499-A (AQMP)	As shown on the plans
Deleterious material, %, Max	Tex-217-F , Part I	1.5
Decantation, %, Max	Tex-217-F , Part II	1.5
Micro-Deval abrasion, %	Tex-461-A	Note 1
Los Angeles abrasion, %, Max	Tex-410-A	40
Magnesium sulfate soundness, 5 cycles, %, Max	Tex-411-A	30
Crushed face count, ² %, Min	Tex-460-A , Part I	85
Flat and elongated particles @ 5:1, %, Max	Tex-280-F	10
Fine Aggregate		
Linear shrinkage, %, Max	Tex-107-E	3
Combined Aggregate³		
Sand equivalent, %, Min	Tex-203-F	45

1. Not used for acceptance purposes. Optional test used by the Engineer as an indicator of the need for further investigation.
2. Only applies to crushed gravel.
3. Aggregates, without mineral filler, RAP, RAS, or additives, combined as used in the job-mix formula (JMF).

Table 2
Gradation Requirements for Fine Aggregate

Sieve Size	% Passing by Weight or Volume
3/8"	100
#8	70–100
#200	0–30

- 2.2. **Mineral Filler.** Mineral filler consists of finely divided mineral matter such as agricultural lime, crusher fines, hydrated lime, or fly ash. Mineral filler is allowed unless otherwise shown on the plans. Use no more than 2% hydrated lime or fly ash unless otherwise shown on the plans. Use no more than 1% hydrated lime if a substitute binder is used unless otherwise shown on the plans or allowed. Test all mineral fillers except hydrated lime and fly ash in accordance with [Tex-107-E](#) to ensure specification compliance. The plans may require or disallow specific mineral fillers. Provide mineral filler, when used, that:

- is sufficiently dry, free-flowing, and free from clumps and foreign matter as determined by the Engineer;
- does not exceed 3% linear shrinkage when tested in accordance with [Tex-107-E](#); and
- meets the gradation requirements in Table 3.

Table 3
Gradation Requirements for Mineral Filler

Sieve Size	% Passing by Weight or Volume
#8	100
#200	55–100

- 2.3. **Baghouse Fines.** Fines collected by the baghouse or other dust-collecting equipment may be reintroduced into the mixing drum.
- 2.4. **Asphalt Binder.** Furnish the type and grade of performance-graded (PG) asphalt specified on the plans.
- 2.5. **Tack Coat.** Furnish CSS-1H, SS-1H, or a PG binder with a minimum high-temperature grade of PG 58 for tack coat binder in accordance with Item 300, "Asphalts, Oils, and Emulsions." Specialized or preferred tack coat materials may be allowed or required when shown on the plans. Do not dilute emulsified asphalts at the terminal, in the field, or at any other location before use.

The Engineer will obtain at least one sample of the tack coat binder per project in accordance with [Tex-500-C](#), Part III, and test it to verify compliance with Item 300, "Asphalts, Oils, and Emulsions." The Engineer will obtain the sample from the asphalt distributor immediately before use.

2.6. **Additives.** Use the type and rate of additive specified when shown on the plans. Additives that facilitate mixing, compaction, or improve the quality of the mixture are allowed when approved. Provide the Engineer with documentation, such as the bill of lading, showing the quantity of additives used in the project unless otherwise directed.

2.6.1. **Lime and Liquid Antistripping Agent.** When lime or a liquid antistripping agent is used, add in accordance with Item 301, "Asphalt Antistripping Agents." Do not add lime directly into the mixing drum of any plant where lime is removed through the exhaust stream unless the plant has a baghouse or dust collection system that reintroduces the lime into the drum.

2.6.2. **Warm Mix Asphalt (WMA).** Warm Mix Asphalt (WMA) is defined as HMA that is produced within a target temperature discharge range of 215°F and 275°F using approved WMA additives or processes from the Department's MPL.

WMA is allowed for use on all projects and is required when shown on the plans. When WMA is required, the maximum placement or target discharge temperature for WMA will be set at a value below 275°F.

Department-approved WMA additives or processes may be used to facilitate mixing and compaction of HMA produced at target discharge temperatures above 275°F; however, such mixtures will not be defined as WMA.

2.7. **Recycled Materials.** Use of RAP and RAS is permitted unless otherwise shown on the plans. Do not exceed the maximum allowable percentages of RAP and RAS shown in Table 4. The allowable percentages shown in Table 4 may be decreased or increased when shown on the plans. Determine asphalt binder content and gradation of the RAP and RAS stockpiles for mixture design purposes in accordance with [Tex-236-F](#). The Engineer may verify the asphalt binder content of the stockpiles at any time during production. Perform other tests on RAP and RAS when shown on the plans. Asphalt binder from RAP and RAS is designated as recycled asphalt binder. Calculate and ensure that the ratio of the recycled asphalt binder to total binder does not exceed the percentages shown in Table 5 during mixture design and HMA production when RAP or RAS is used. Use a separate cold feed bin for each stockpile of RAP and RAS during HMA production.

Surface, intermediate, and base mixes referenced in Tables 4 and 5 are defined as follows:

- **Surface.** The final HMA lift placed at or near the top of the pavement structure;
- **Intermediate.** Mixtures placed below an HMA surface mix and less than or equal to 8.0 in. from the riding surface; and
- **Base.** Mixtures placed greater than 8.0 in. from the riding surface.

2.7.1. **RAP.** RAP is salvaged, milled, pulverized, broken, or crushed asphalt pavement. Crush or break RAP so that 100% of the particles pass the 2 in. sieve. Fractionated RAP is defined as 2 or more RAP stockpiles, divided into coarse and fine fractions.

Use of Contractor-owned RAP, including HMA plant waste, is permitted unless otherwise shown on the plans. Department-owned RAP stockpiles are available for the Contractor's use when the stockpile locations are shown on the plans. If Department-owned RAP is available for the Contractor's use, the Contractor may use Contractor-owned fractionated RAP and replace it with an equal quantity of Department-owned RAP. This allowance does not apply to a Contractor using unfractionated RAP. Department-owned RAP generated through required work on the Contract is available for the Contractor's use when shown on the plans. Perform any necessary tests to ensure Contractor- or Department-owned RAP is appropriate for use. The Department will not perform any tests or assume any liability for the quality of the Department-owned RAP unless otherwise shown on the plans. The Contractor will retain ownership of RAP generated on the project when shown on the plans.

The coarse RAP stockpile will contain only material retained by processing over a 3/8-in. or 1/2-in. screen unless otherwise approved. The fine RAP stockpile will contain only material passing the 3/8-in. or 1/2-in. screen unless otherwise approved. The Engineer may allow the Contractor to use an alternate to the 3/8-in.

or 1/2-in. screen to fractionate the RAP. The maximum percentages of fractionated RAP may be comprised of coarse or fine fractionated RAP or the combination of both coarse and fine fractionated RAP.

Do not use Department- or Contractor-owned RAP contaminated with dirt or other objectionable materials. Do not use Department- or Contractor-owned RAP if the decantation value exceeds 5% and the plasticity index is greater than 8. Test the stockpiled RAP for decantation in accordance with [Tex-406-A](#), Part I. Determine the plasticity index in accordance with [Tex-106-E](#) if the decantation value exceeds 5%. The decantation and plasticity index requirements do not apply to RAP samples with asphalt removed by extraction or ignition.

Do not intermingle Contractor-owned RAP stockpiles with Department-owned RAP stockpiles. Remove unused Contractor-owned RAP material from the project site upon completion of the project. Return unused Department-owned RAP to the designated stockpile location.

Table 4
Maximum Allowable Amounts of RAP¹

Maximum Allowable Fractionated RAP ² (%)			Maximum Allowable Unfractionated RAP ³ (%)		
Surface	Intermediate	Base	Surface	Intermediate	Base
20.0	30.0	40.0	10.0	10.0	10.0

1. Must also meet the recycled binder to total binder ratio shown in Table 5.
2. Up to 5% RAS may be used separately or as a replacement for fractionated RAP.
3. Unfractionated RAP may not be combined with fractionated RAP or RAS.

2.7.2.

RAS. Use of post-manufactured RAS or post-consumer RAS (tear-offs) is permitted unless otherwise shown on the plans. Up to 5% RAS may be used separately or as a replacement for fractionated RAP in accordance with Table 4 and Table 5. RAS is defined as processed asphalt shingle material from manufacturing of asphalt roofing shingles or from re-roofing residential structures. Post-manufactured RAS is processed manufacturer's shingle scrap by-product. Post-consumer RAS is processed shingle scrap removed from residential structures. Comply with all regulatory requirements stipulated for RAS by the TCEQ. RAS may be used separately or in conjunction with RAP.

Process the RAS by ambient grinding or granulating such that 100% of the particles pass the 3/8 in. sieve when tested in accordance with [Tex-200-F](#), Part I. Perform a sieve analysis on processed RAS material before extraction (or ignition) of the asphalt binder.

Add sand meeting the requirements of Table 1 and Table 2 or fine RAP to RAS stockpiles if needed to keep the processed material workable. Any stockpile that contains RAS will be considered a RAS stockpile and be limited to no more than 5.0% of the HMA mixture in accordance with Table 4.

Certify compliance of the RAS with [DMS-11000](#), "Evaluating and Using Nonhazardous Recyclable Materials Guidelines." Treat RAS as an established nonhazardous recyclable material if it has not come into contact with any hazardous materials. Use RAS from shingle sources on the Department's MPL. Remove substantially all materials before use that are not part of the shingle, such as wood, paper, metal, plastic, and felt paper. Determine the deleterious content of RAS material for mixture design purposes in accordance with [Tex-217-F](#), Part III. Do not use RAS if deleterious materials are more than 0.5% of the stockpiled RAS unless otherwise approved. Submit a sample for approval before submitting the mixture design. The Department will perform the testing for deleterious material of RAS to determine specification compliance.

2.8.

Substitute Binders. Unless otherwise shown on the plans, the Contractor may use a substitute PG binder listed in Table 5 instead of the PG binder originally specified, if the substitute PG binder and mixture made with the substitute PG binder meet the following:

- the substitute binder meets the specification requirements for the substitute binder grade in accordance with Section 300.2.10., "Performance-Graded Binders;" and
- the mixture has less than 10.0 mm of rutting on the Hamburg Wheel test ([Tex-242-F](#)) after the number of passes required for the originally specified binder. Use of substitute PG binders may only be allowed at the discretion of the Engineer if the Hamburg Wheel test results are between 10.0 mm and 12.5 mm.

Table 5
Allowable Substitute PG Binders and Maximum Recycled Binder Ratios

Originally Specified PG Binder	Allowable Substitute PG Binder	Maximum Ratio of Recycled Binder ¹ to Total Binder (%)		
		Surface	Intermediate	Base
HMA				
76-22 ²	70-22 or 64-22	20.0	20.0	20.0
	70-28 or 64-28	30.0	35.0	40.0
70-22 ²	64-22	20.0	20.0	20.0
	64-28 or 58-28	30.0	35.0	40.0
64-22 ²	58-28	30.0	35.0	40.0
76-28 ²	70-28 or 64-28	20.0	20.0	20.0
	64-34	30.0	35.0	40.0
70-28 ²	64-28 or 58-28	20.0	20.0	20.0
	64-34 or 58-34	30.0	35.0	40.0
64-28 ²	58-28	20.0	20.0	20.0
	58-34	30.0	35.0	40.0
WMA ³				
76-22 ²	70-22 or 64-22	30.0	35.0	40.0
70-22 ²	64-22 or 58-28	30.0	35.0	40.0
64-22 ⁴	58-28	30.0	35.0	40.0
76-28 ²	70-28 or 64-28	30.0	35.0	40.0
70-28 ²	64-28 or 58-28	30.0	35.0	40.0
64-28 ⁴	58-28	30.0	35.0	40.0

1. Combined recycled binder from RAP and RAS.
2. Use no more than 20.0% recycled binder when using this originally specified PG binder.
3. WMA as defined in Section 340.2.6.2., "Warm Mix Asphalt (WMA)."
4. When used with WMA, this originally specified PG binder is allowed for use at the maximum recycled binder ratios shown in this table.

3. EQUIPMENT

Provide required or necessary equipment in accordance with Item 320, "Equipment for Asphalt Concrete Pavement."

4. CONSTRUCTION

Produce, haul, place, and compact the specified paving mixture. In addition to tests required by the specification, Contractors may perform other QC tests as deemed necessary. At any time during the project, the Engineer may perform production and placement tests as deemed necessary in accordance with Item 5, "Control of the Work." Schedule and participate in a pre-paving meeting with the Engineer on or before the first day of paving unless otherwise directed.

- 4.1. **Certification.** Personnel certified by the Department-approved hot-mix asphalt certification program must conduct all mixture designs, sampling, and testing in accordance with Table 6. Supply the Engineer with a list of certified personnel and copies of their current certificates before beginning production and when personnel changes are made. Provide a mixture design developed and signed by a Level 2 certified specialist.

Table 6
Test Methods, Test Responsibility, and Minimum Certification Levels

Test Description	Test Method	Contractor	Engineer	Level ¹
1. Aggregate and Recycled Material Testing				
Sampling	Tex-221-F	✓	✓	1A
Dry sieve	Tex-200-F , Part I	✓	✓	1A
Washed sieve	Tex-200-F , Part II	✓	✓	1A
Deleterious material	Tex-217-F , Parts I & III	✓	✓	1A
Decantation	Tex-217-F , Part II	✓	✓	1A
Los Angeles abrasion	Tex-410-A		✓	TxDOT
Magnesium sulfate soundness	Tex-411-A		✓	TxDOT
Micro-Deval abrasion	Tex-461-A		✓	2
Crushed face count	Tex-460-A	✓	✓	2
Flat and elongated particles	Tex-280-F	✓	✓	2
Linear shrinkage	Tex-107-E	✓	✓	2
Sand equivalent	Tex-203-F	✓	✓	2
Organic impurities	Tex-408-A	✓	✓	2
2. Asphalt Binder & Tack Coat Sampling				
Asphalt binder sampling	Tex-500-C , Part II	✓	✓	1A/1B
Tack coat sampling	Tex-500-C , Part III	✓	✓	1A/1B
3. Mix Design & Verification				
Design and JMF changes	Tex-204-F	✓	✓	2
Mixing	Tex-205-F	✓	✓	2
Molding (TGC)	Tex-206-F	✓	✓	1A
Molding (SGC)	Tex-241-F	✓	✓	1A
Laboratory-molded density	Tex-207-F	✓	✓	1A
VMA ² (calculation only)	Tex-204-F	✓	✓	2
Rice gravity	Tex-227-F	✓	✓	1A
Ignition oven correction factors ³	Tex-236-F	✓	✓	2
Indirect tensile strength	Tex-226-F	✓	✓	2
Hamburg Wheel test	Tex-242-F	✓	✓	2
Boil test	Tex-530-C	✓	✓	1A
4. Production Testing				
Mixture sampling	Tex-222-F	✓	✓	1A
Molding (TGC)	Tex-206-F		✓	1A
Molding (SGC)	Tex-241-F		✓	1A
Laboratory-molded density	Tex-207-F		✓	1A
VMA ² (calculation only)	Tex-204-F		✓	1A
Rice gravity	Tex-227-F		✓	1A
Gradation & asphalt binder content ³	Tex-236-F		✓	1A
Moisture content	Tex-212-F		✓	1A
Hamburg Wheel test	Tex-242-F		✓	2
Boil test	Tex-530-C		✓	1A
5. Placement Testing				
Trimming roadway cores	Tex-207-F	✓	✓	1A/1B
In-place air voids	Tex-207-F		✓	1A/1B
Establish rolling pattern	Tex-207-F	✓		1B
Ride quality measurement	Tex-1001-S	✓	✓	Note 4

1. Level 1A, 1B, and 2 are certification levels provided by the Hot Mix Asphalt Center certification program.

2. Voids in mineral aggregates.

3. Refer to Section 340.4.8.3., "Production Testing," for exceptions to using an ignition oven.

4. Profiler and operator are required to be certified at the Texas A&M Transportation Institute facility when Surface Test Type B is specified.

4.2.

Reporting, Testing, and Responsibilities. Use Department-provided templates to record and calculate all test data pertaining to the mixture design. The Engineer will use Department templates for any production and placement testing. Obtain the current version of the templates at <http://www.txdot.gov/inside-txdot/forms-publications/consultants-contractors/forms/site-manager.html> or from the Engineer.

The maximum allowable time for the Engineer to exchange test data with the Contractor is as given in Table 7 unless otherwise approved. The Engineer will immediately report to the Contractor any test result that requires suspension of production or placement or that fails to meet the specification requirements.

Subsequent mix placed after test results are available to the Contractor, which require suspension of operations, may be considered unauthorized work. Unauthorized work will be accepted or rejected at the discretion of the Engineer in accordance with Article 5.3., "Conformity with Plans, Specifications, and Special Provisions."

Table 7
Reporting Schedule

Description		Reported By	Reported To	To Be Reported Within
Production Testing				
Gradation	Engineer	Contractor	1 working day of completion of the test	
Asphalt binder content				
Laboratory-molded density				
VMA (calculation)				
Hamburg Wheel test				
Moisture content				
Boil test				
Binder tests				
Placement Testing				
In-place air voids	Engineer	Contractor	1 working day of completion of the test ¹	

1. 2 days are allowed if cores cannot be dried to constant weight within 1 day.

4.3. Mixture Design.

4.3.1. **Design Requirements.** The Contractor may design the mixture using a Texas Gyratory Compactor (TGC) or a Superpave Gyratory Compactor (SGC) unless otherwise shown on the plans. Use the dense-graded design procedure provided in [Tex-204-F](#). Design the mixture to meet the requirements listed in Tables 1, 2, 3, 4, 5, 8, 9, and 10.

4.3.1.1. **Target Laboratory-Molded Density When The TGC Is Used.** Design the mixture at a 96.5% target laboratory-molded density. Increase the target laboratory-molded density to 97.0% or 97.5% at the Contractor's discretion or when shown on the plans or specification.

4.3.1.2. **Design Number of Gyration (Ndesign) When The SGC Is Used.** Design the mixture at 50 gyrations (Ndesign). Use a target laboratory-molded density of 96.0% to design the mixture; however, adjustments can be made to the Ndesign value as noted in Table 9. The Ndesign level may be reduced to no less than 35 gyrations at the Contractor's discretion.

Use an approved laboratory from the Department's MPL to perform the Hamburg Wheel test in accordance with [Tex-242-F](#), and provide results with the mixture design, or provide the laboratory mixture and request that the Department perform the Hamburg Wheel test. The Engineer will be allowed 10 working days to provide the Contractor with Hamburg Wheel test results on the laboratory mixture design.

The Engineer will provide the mixture design when shown on the plans. The Contractor may submit a new mixture design at any time during the project. The Engineer will verify and approve all mixture designs (JMF1) before the Contractor can begin production.

Provide the Engineer with a mixture design report using the Department-provided template. Include the following items in the report:

- the combined aggregate gradation, source, specific gravity, and percent of each material used;
- asphalt binder content and aggregate gradation of RAP and RAS stockpiles;
- the target laboratory-molded density (or Ndesign level when using the SGC);
- results of all applicable tests;

- the mixing and molding temperatures;
- the signature of the Level 2 person or persons that performed the design;
- the date the mixture design was performed; and
- a unique identification number for the mixture design.

Table 8
Master Gradation Limits (% Passing by Weight or Volume) and VMA Requirements

Sieve Size	A Coarse Base	B Fine Base	C Coarse Surface	D Fine Surface	F Fine Mixture
2"	100.0 ¹	—	—	—	—
1-1/2"	98.0–100.0	100.0 ¹	—	—	—
1"	78.0–94.0	98.0–100.0	100.0 ¹	—	—
3/4"	64.0–85.0	84.0–98.0	95.0–100.0	100.0 ¹	—
1/2"	50.0–70.0	—	—	98.0–100.0	100.0 ¹
3/8"	—	60.0–80.0	70.0–85.0	85.0–100.0	98.0–100.0
#4	30.0–50.0	40.0–60.0	43.0–63.0	50.0–70.0	70.0–90.0
#8	22.0–36.0	29.0–43.0	32.0–44.0	35.0–46.0	38.0–48.0
#30	8.0–23.0	13.0–28.0	14.0–28.0	15.0–29.0	12.0–27.0
#50	3.0–19.0	6.0–20.0	7.0–21.0	7.0–20.0	6.0–19.0
#200	2.0–7.0	2.0–7.0	2.0–7.0	2.0–7.0	2.0–7.0
Design VMA, % Minimum					
—	12.0	13.0	14.0	15.0	16.0
Production (Plant-Produced) VMA, % Minimum					
—	11.5	12.5	13.5	14.5	15.5

1. Defined as maximum sieve size. No tolerance allowed.

Table 9
Laboratory Mixture Design Properties

Mixture Property	Test Method	Requirement
Target laboratory-molded density, % (TGC)	Tex-207-F	96.5 ¹
Design gyrations (Ndesign for SGC)	Tex-241-F	50 ²
Indirect tensile strength (dry), psi	Tex-226-F	85–200 ³
Boil test ⁴	Tex-530-C	—

- Increase to 97.0% or 97.5% at the Contractor's discretion or when shown on the plans or specification.
- Adjust within a range of 35–100 gyrations when shown on the plans or specification or when mutually agreed between the Engineer and Contractor.
- The Engineer may allow the IDT strength to exceed 200 psi if the corresponding Hamburg Wheel rut depth is greater than 3.0 mm and less than 12.5 mm.
- Used to establish baseline for comparison to production results. May be waived when approved.

Table 10
Hamburg Wheel Test Requirements

High-Temperature Binder Grade	Test Method	Minimum # of Passes @ 12.5 mm ¹ Rut Depth, Tested @ 50°C
PG 64 or lower	Tex-242-F	10,000 ²
PG 70		15,000 ³
PG 76 or higher		20,000

- When the rut depth at the required minimum number of passes is less than 3 mm, the Engineer may require the Contractor to increase the target laboratory-molded density (TGC) by 0.5% to no more than 97.5% or lower the Ndesign level (SGC) to no less than 35 gyrations.
- May be decreased to no less than 5,000 passes when shown on the plans.
- May be decreased to no less than 10,000 passes when shown on the plans.

4.3.2.

Job-Mix Formula Approval. The job-mix formula (JMF) is the combined aggregate gradation, target laboratory-molded density (or Ndesign level), and target asphalt percentage used to establish target values for hot-mix production. JMF1 is the original laboratory mixture design used to produce the trial batch. When

WMA is used, JMF1 may be designed and submitted to the Engineer without including the WMA additive. When WMA is used, document the additive or process used and recommended rate on the JMF1 submittal. Furnish a mix design report (JMF1) with representative samples of all component materials and request approval to produce the trial batch. Provide approximately 10,000 g of the design mixture and request that the Department perform the Hamburg Wheel test if opting to have the Department perform the test. The Engineer will verify JMF1 based on plant-produced mixture from the trial batch unless otherwise determined. The Engineer may accept an existing mixture design previously used on a Department project and may waive the trial batch to verify JMF1. Provide split samples of the mixtures and blank samples used to determine the ignition oven correction factors. The Engineer will determine the aggregate and asphalt correction factors from the ignition oven used for production testing in accordance with [Tex-236-F](#).

The Engineer will use a TGC calibrated in accordance with [Tex-914-K](#) in molding production samples. Provide an SGC at the Engineer's field laboratory for use in molding production samples if the SGC is used to design the mix.

The Engineer may perform [Tex-530-C](#) and retain the tested sample for comparison purposes during production. The Engineer may waive the requirement for the boil test.

4.3.3. **JMF Adjustments.** If JMF adjustments are necessary to achieve the specified requirements, the adjusted JMF must:

- be provided to the Engineer in writing before the start of a new lot;
- be numbered in sequence to the previous JMF;
- meet the mixture requirements in Table 4 and Table 5;
- meet the master gradation limits shown in Table 8; and
- be within the operational tolerances of the current JMF listed in Table 11.

The Engineer may adjust the asphalt binder content to maintain desirable laboratory density near the optimum value while achieving other mix requirements.

Table 11
Operational Tolerances

Description	Test Method	Allowable Difference Between Trial Batch and JMF1 Target	Allowable Difference from Current JMF Target
Individual % retained for #8 sieve and larger	Tex-200-F or Tex-236-F	Must be within master grading limits in Table 8	$\pm 5.0^{1,2}$
Individual % retained for sieves smaller than #8 and larger than #200			$\pm 3.0^{1,2}$
% passing the #200 sieve			$\pm 2.0^{1,2}$
Asphalt binder content, %	Tex-236-F	± 0.5	$\pm 0.3^2$
Laboratory-molded density, %	Tex-207-F	± 1.0	± 1.0
VMA, %, min	Tex-204-F	Note 3	Note 3

1. When within these tolerances, mixture production gradations may fall outside the master grading limits; however, the % passing the #200 will be considered out of tolerance when outside the master grading limits.
2. Only applies to mixture produced for Lot 1 and higher.
3. Mixture is required to meet Table 8 requirements.

4.4. **Production Operations.** Perform a new trial batch when the plant or plant location is changed. Take corrective action and receive approval to proceed after any production suspension for noncompliance to the specification. Submit a new mix design and perform a new trial batch when the asphalt binder content of:

- any RAP stockpile used in the mix is more than 0.5% higher than the value shown on the mixture design report; or
- RAS stockpile used in the mix is more than 2.0% higher than the value shown on the mixture design report.

4.4.1. **Storage and Heating of Materials.** Do not heat the asphalt binder above the temperatures specified in Item 300, "Asphalts, Oils, and Emulsions," or outside the manufacturer's recommended values. Provide the Engineer with daily records of asphalt binder and hot-mix asphalt discharge temperatures (in legible and discernible increments) in accordance with Item 320, "Equipment for Asphalt Concrete Pavement," unless

otherwise directed. Do not store mixture for a period long enough to affect the quality of the mixture, nor in any case longer than 12 hr. unless otherwise approved.

- 4.4.2. **Mixing and Discharge of Materials.** Notify the Engineer of the target discharge temperature and produce the mixture within 25°F of the target. Monitor the temperature of the material in the truck before shipping to ensure that it does not exceed 350°F (or 275°F for WMA) and is not lower than 215°F. The Department will not pay for or allow placement of any mixture produced above 350°F.

Produce WMA within the target discharge temperature range of 215°F and 275°F when WMA is required. Take corrective action any time the discharge temperature of the WMA exceeds the target discharge range. The Engineer may suspend production operations if the Contractor's corrective action is not successful at controlling the production temperature within the target discharge range. Note that when WMA is produced, it may be necessary to adjust burners to ensure complete combustion such that no burner fuel residue remains in the mixture.

Control the mixing time and temperature so that substantially all moisture is removed from the mixture before discharging from the plant. The Engineer may determine the moisture content by oven-drying in accordance with [Tex-212-F](#), Part II, and verify that the mixture contains no more than 0.2% of moisture by weight. The Engineer will obtain the sample immediately after discharging the mixture into the truck, and will perform the test promptly.

- 4.5. **Hauling Operations.** Clean all truck beds before use to ensure that mixture is not contaminated. Use a release agent shown on the Department's MPL to coat the inside bed of the truck when necessary.

Use equipment for hauling as defined in Section 340.4.6.3.2., "Hauling Equipment." Use other hauling equipment only when allowed.

- 4.6. **Placement Operations.** Collect haul tickets from each load of mixture delivered to the project and provide the Department's copy to the Engineer approximately every hour, or as directed. Use a hand-held thermal camera or infrared thermometer to measure and record the internal temperature of the mixture as discharged from the truck or Material Transfer Device (MTD) before or as the mix enters the paver and an approximate station number or GPS coordinates on each ticket unless otherwise directed. Calculate the daily yield and cumulative yield for the specified lift and provide to the Engineer at the end of paving operations for each day unless otherwise directed. The Engineer may suspend production if the Contractor fails to produce and provide haul tickets and yield calculations by the end of paving operations for each day.

Prepare the surface by removing raised pavement markers and objectionable material such as moisture, dirt, sand, leaves, and other loose impediments from the surface before placing mixture. Remove vegetation from pavement edges. Place the mixture to meet the typical section requirements and produce a smooth, finished surface with a uniform appearance and texture. Offset longitudinal joints of successive courses of hot-mix by at least 6 in. Place mixture so that longitudinal joints on the surface course coincide with lane lines, or as directed. Ensure that all finished surfaces will drain properly.

Place the mixture at the rate or thickness shown on the plans. The Engineer will use the guidelines in Table 12 to determine the compacted lift thickness of each layer when multiple lifts are required. The thickness determined is based on the rate of 110 lb./sq. yd. for each inch of pavement unless otherwise shown on the plans.

Table 12
Compacted Lift Thickness and Required Core Height

Mixture Type	Compacted Lift Thickness Guidelines		Minimum Untrimmed Core Height (in.) Eligible for Testing
	Minimum (in.)	Maximum (in.)	
A	3.00	6.00	2.00
B	2.50	5.00	1.75
C	2.00	4.00	1.50
D	1.50	3.00	1.25
F	1.25	2.50	1.25

4.6.1. **Weather Conditions.** Place mixture when the roadway surface temperature is at or above 60°F unless otherwise approved. Measure the roadway surface temperature with a hand-held thermal camera or infrared thermometer. The Engineer may allow mixture placement to begin before the roadway surface reaches the required temperature if conditions are such that the roadway surface will reach the required temperature within 2 hr. of beginning placement operations. Place mixtures only when weather conditions and moisture conditions of the roadway surface are suitable as determined by the Engineer. The Engineer may restrict the Contractor from paving if the ambient temperature is likely to drop below 32°F within 12 hr. of paving.

4.6.2. **Tack Coat.** Clean the surface before placing the tack coat. The Engineer will set the rate between 0.04 and 0.10 gal. of residual asphalt per square yard of surface area. Apply a uniform tack coat at the specified rate unless otherwise directed. Apply the tack coat in a uniform manner to avoid streaks and other irregular patterns. Apply a thin, uniform tack coat to all contact surfaces of curbs, structures, and all joints. Allow adequate time for emulsion to break completely before placing any material. Prevent splattering of tack coat when placed adjacent to curb, gutter, and structures. Roll the tack coat with a pneumatic-tire roller to remove streaks and other irregular patterns when directed.

4.6.3. **Lay-Down Operations.**

4.6.3.1. **Windrow Operations.** Operate windrow pickup equipment so that when hot-mix is placed in windrows substantially all the mixture deposited on the roadbed is picked up and loaded into the paver.

4.6.3.2. **Hauling Equipment.** Use belly dumps, live bottom, or end dump trucks to haul and transfer mixture; however, with exception of paving miscellaneous areas, end dump trucks are only allowed when used in conjunction with an MTD with remixing capability unless otherwise allowed.

4.6.3.3. **Screed Heaters.** Turn off screed heaters, to prevent overheating of the mat, if the paver stops for more than 5 min.

4.7. **Compaction.** Compact the pavement uniformly to contain between 3.8% and 8.5% in-place air voids.

Furnish the type, size, and number of rollers required for compaction as approved. Use a pneumatic-tire roller to seal the surface unless excessive pickup of fines occurs. Use additional rollers as required to remove any roller marks. Use only water or an approved release agent on rollers, tamps, and other compaction equipment unless otherwise directed.

Use the control strip method shown in [Tex-207-F](#), Part IV, on the first day of production to establish the rolling pattern that will produce the desired in-place air voids unless otherwise directed.

Use tamps to thoroughly compact the edges of the pavement along curbs, headers, and similar structures and in locations that will not allow thorough compaction with rollers. The Engineer may require rolling with a trench roller on widened areas, in trenches, and in other limited areas.

Complete all compaction operations before the pavement temperature drops below 160°F unless otherwise allowed. The Engineer may allow compaction with a light finish roller operated in static mode for pavement temperatures below 160°F.

Allow the compacted pavement to cool to 160°F or lower before opening to traffic unless otherwise directed. Sprinkle the finished mat with water or limewater, when directed, to expedite opening the roadway to traffic.

4.8. **Production Acceptance.**

4.8.1. **Production Lot.** Each day of production is defined as a production lot. Lots will be sequentially numbered and correspond to each new day of production. Note that lots are not subdivided into sublots for this specification.

4.8.2. **Production Sampling.**

4.8.2.1. **Mixture Sampling.** The Engineer may obtain mixture samples in accordance with [Tex-222-F](#) at any time during production.

4.8.2.2. **Asphalt Binder Sampling.** The Engineer may obtain or require the Contractor to obtain 1 qt. samples of the asphalt binder at any time during production from a port located immediately upstream from the mixing drum or pug mill in accordance with [Tex-500-C](#), Part II. The Engineer may test any of the asphalt binder samples to verify compliance with Item 300, "Asphalts, Oils, and Emulsions."

4.8.3. **Production Testing.** The Engineer will test at the frequency listed in the Department's *Guide Schedule of Sampling and Testing* and this specification. The Engineer may suspend production if production tests do not meet specifications or are not within operational tolerances listed in Table 11. Take immediate corrective action if the Engineer's laboratory-molded density on any sample is less than 95.0% or greater than 98.0%, to bring the mixture within these tolerances. The Engineer may suspend operations if the Contractor's corrective actions do not produce acceptable results. The Engineer will allow production to resume when the proposed corrective action is likely to yield acceptable results.

The Engineer may use alternate methods for determining the asphalt binder content and aggregate gradation if the aggregate mineralogy is such that [Tex-236-F](#) does not yield reliable results. Use the applicable test procedure if an alternate test method is selected.

Table 13
Production and Placement Testing

Description	Test Method
Individual % retained for #8 sieve and larger	Tex-200-F or Tex-236-F
Individual % retained for sieves smaller than #8 and larger than #200	
% passing the #200 sieve	
Laboratory-molded density	Tex-207-F
Laboratory-molded bulk specific gravity	
In-Place air voids	
VMA	Tex-204-F
Moisture content	Tex-212-F , Part II
Theoretical maximum specific (Rice) gravity	Tex-227-F
Asphalt binder content	Tex-236-F
Hamburg Wheel test	Tex-242-F
Recycled Asphalt Shingles (RAS) ¹	Tex-217-F , Part III
Asphalt binder sampling and testing	Tex-500-C
Tack coat sampling and testing	Tex-500-C , Part III
Boil test	Tex-530-C

1. Testing performed by the Construction Division or designated laboratory.

4.8.3.1. **voids in Mineral Aggregates (VMA).** The Engineer may determine the VMA for any production lot. Take immediate corrective action if the VMA value for any lot is less than the minimum VMA requirement for production listed in Table 8. Suspend production and shipment of the mixture if the Engineer's VMA result is more than 0.5% below the minimum VMA requirement for production listed in Table 8. In addition to suspending production, the Engineer may require removal and replacement or may allow the lot to be left in place without payment.

- 4.8.3.2. **Hamburg Wheel Test.** The Engineer may perform a Hamburg Wheel test at any time during production, including when the boil test indicates a change in quality from the materials submitted for JMF1. In addition to testing production samples, the Engineer may obtain cores and perform Hamburg Wheel tests on any areas of the roadway where rutting is observed. Suspend production until further Hamburg Wheel tests meet the specified values when the production or core samples fail the Hamburg Wheel test criteria in Table 10. Core samples, if taken, will be obtained from the center of the finished mat or other areas excluding the vehicle wheel paths. The Engineer may require up to the entire lot of any mixture failing the Hamburg Wheel test to be removed and replaced at the Contractor's expense.

If the Department's or Department-approved laboratory's Hamburg Wheel test results in a "remove and replace" condition, the Contractor may request that the Department confirm the results by re-testing the failing material. The Construction Division will perform the Hamburg Wheel tests and determine the final disposition of the material in question based on the Department's test results.

- 4.8.4. **Individual Loads of Hot-Mix.** The Engineer can reject individual truckloads of hot-mix. When a load of hot-mix is rejected for reasons other than temperature, contamination, or excessive uncoated particles, the Contractor may request that the rejected load be tested. Make this request within 4 hr. of rejection. The Engineer will sample and test the mixture. If test results are within the operational tolerances shown in Table 11, payment will be made for the load. If test results are not within operational tolerances, no payment will be made for the load.

4.9. **Placement Acceptance.**

- 4.9.1. **Placement Lot.** A placement lot is defined as the area placed during a production lot (one day's production). Placement lot numbers will correspond with production lot numbers.

- 4.9.2. **Miscellaneous Areas.** Miscellaneous areas include areas that typically involve significant handwork or discontinuous paving operations, such as temporary detours, driveways, mailbox turnouts, crossovers, gores, spot level-up areas, and other similar areas. Miscellaneous areas also include level-ups and thin overlays when the layer thickness specified on the plans is less than the minimum untrimmed core height eligible for testing shown in Table 12. The specified layer thickness is based on the rate of 110 lb./sq. yd. for each inch of pavement unless another rate is shown on the plans. Compact miscellaneous areas in accordance with Section 340.4.7., "Compaction." Miscellaneous areas are not subject to in-place air void determination except for temporary detours when shown on the plans.

- 4.9.3. **Placement Sampling.** Provide the equipment and means to obtain and trim roadway cores on site. On site is defined as in close proximity to where the cores are taken. Obtain the cores within one working day of the time the placement lot is completed unless otherwise approved. Obtain two 6-in. diameter cores side-by-side at each location selected by the Engineer for in-place air void determination unless otherwise shown on the plans. For Type D and Type F mixtures, 4-in. diameter cores are allowed. Mark the cores for identification, measure and record the untrimmed core height, and provide the information to the Engineer. The Engineer will witness the coring operation and measurement of the core thickness.

Visually inspect each core and verify that the current paving layer is bonded to the underlying layer. Take corrective action if an adequate bond does not exist between the current and underlying layer to ensure that an adequate bond will be achieved during subsequent placement operations.

Trim the cores immediately after obtaining the cores from the roadway in accordance with [Tex-207-F](#) if the core heights meet the minimum untrimmed value listed in Table 12. Trim the cores on site in the presence of the Engineer. Use a permanent marker or paint pen to record the date and lot number on each core as well as the designation as Core A or B. The Engineer may require additional information to be marked on the core and may choose to sign or initial the core. The Engineer will take custody of the cores immediately after they are trimmed and will retain custody of the cores until the Department's testing is completed. Before turning the trimmed cores over to the Engineer, the Contractor may wrap the trimmed cores or secure them in a manner that will reduce the risk of possible damage occurring during transport by the Engineer. After testing, the Engineer will return the cores to the Contractor.

The Engineer may have the cores transported back to the Department's laboratory at the HMA plant via the Contractor's haul truck or other designated vehicle. In such cases where the cores will be out of the Engineer's possession during transport, the Engineer will use Department-provided security bags and the Roadway Core Custody protocol located at <http://www.txdot.gov/business/specifications.htm> to provide a secure means and process that protects the integrity of the cores during transport.

Instead of the Contractor trimming the cores on site immediately after coring, the Engineer and the Contractor may mutually agree to have the trimming operations performed at an alternate location such as a field laboratory or other similar location. In such cases, the Engineer will take possession of the cores immediately after they are obtained from the roadway and will retain custody of the cores until testing is completed. Either the Department or Contractor representative may perform trimming of the cores. The Engineer will witness all trimming operations in cases where the Contractor representative performs the trimming operation.

Dry the core holes and tack the sides and bottom immediately after obtaining the cores. Fill the hole with the same type of mixture and properly compact the mixture. Repair core holes with other methods when approved.

4.9.4. **Placement Testing.** The Engineer may measure in-place air voids at any time during the project to verify specification compliance.

4.9.4.1. **In-Place Air Voids.** The Engineer will measure in-place air voids in accordance with [Tex-207-F](#) and [Tex-227-F](#). Cores not meeting the height requirements in Table 12 will not be tested. Before drying to a constant weight, cores may be pre-dried using a Corelok or similar vacuum device to remove excess moisture. The Engineer will use the corresponding theoretical maximum specific gravity to determine the air void content of each core. The Engineer will use the average air void content of the 2 cores to determine the in-place air voids at the selected location.

The Engineer will use the vacuum method to seal the core if required by [Tex-207-F](#). The Engineer will use the test results from the unsealed core if the sealed core yields a higher specific gravity than the unsealed core. After determining the in-place air void content, the Engineer will return the cores and provide test results to the Contractor.

Take immediate corrective action when the in-place air voids exceed the range of 3.8% and 8.5% to bring the operation within these tolerances. The Engineer may suspend operations or require removal and replacement if the in-place air voids are less than 2.7% or greater than 9.9%. The Engineer will allow paving to resume when the proposed corrective action is likely to yield between 3.8% and 8.5% in-place air voids. Areas defined in Section 340.9.2., "Miscellaneous Areas," are not subject to in-place air void determination.

4.9.5. **Irregularities.** Identify and correct irregularities including segregation, rutting, raveling, flushing, fat spots, mat slippage, irregular color, irregular texture, roller marks, tears, gouges, streaks, uncoated aggregate particles, or broken aggregate particles. The Engineer may also identify irregularities, and in such cases, the Engineer will promptly notify the Contractor. If the Engineer determines that the irregularity will adversely affect pavement performance, the Engineer may require the Contractor to remove and replace (at the Contractor's expense) areas of the pavement that contain irregularities and areas where the mixture does not bond to the existing pavement. If irregularities are detected, the Engineer may require the Contractor to immediately suspend operations or may allow the Contractor to continue operations for no more than one day while the Contractor is taking appropriate corrective action.

4.9.6. **Ride Quality.** Use Surface Test Type A to evaluate ride quality in accordance with Item 585, "Ride Quality for Pavement Surfaces," unless otherwise shown on the plans.

5. MEASUREMENT

Hot mix will be measured by the ton of composite hot-mix, which includes asphalt, aggregate, and additives. Measure the weight on scales in accordance with Item 520, "Weighing and Measuring Equipment."

6. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under Article 340.5., "Measurement," will be paid for at the unit bid price for "Dense Graded Hot-Mix Asphalt (SQ)" of the mixture type, SAC, and binder specified. These prices are full compensation for surface preparation, materials including tack coat, placement, equipment, labor, tools, and incidentals.

Trial batches will not be paid for unless they are included in pavement work approved by the Department.

Payment adjustment for ride quality, if applicable, will be determined in accordance with Item 585, "Ride Quality for Pavement Surfaces."

Item 400



Excavation and Backfill for Structures

1. DESCRIPTION

Excavate for placement and construction of structures and backfill structures. Cut and restore pavement.

2. MATERIALS

Use materials that meet the requirements of the following Items.

- Item 401, "Flowable Backfill,"
- Item 421, "Hydraulic Cement Concrete," and
- [DMS-4600](#), "Hydraulic Cement."

3. CONSTRUCTION

3.1. Excavation.

- 3.1.1. **General.** Excavate to the lines and grades shown on the plans or as directed. Provide slopes, benching, sheeting, bracing, pumping, and bailing as necessary to maintain the stability and safety of excavations up to 5 ft. deep. Excavation protection for excavations deeper than 5 ft. are governed by Item 402, "Trench Excavation Protection," and Item 403, "Temporary Special Shoring." Use satisfactory excavated material as backfill or as embankment fill in accordance with Item 132, "Embankment." Dispose of material not incorporated into the final project off the right of way in accordance with federal, state, and local regulations.

Keep any topsoil that has been removed separate, and replace it, as nearly as feasible, in its original position when excavating for installation of structures across private property or beyond the limits of the embankment. Restore the area to an acceptable condition.

Excavate drilled shafts in accordance with Item 416, "Drilled Shaft Foundations."

- 3.1.1.1. **Obstructions.** Remove obstructions to the proposed construction, including trees and other vegetation, debris, and structures, over the width of the excavation to a depth of 1 ft. below the bottom of excavation. Remove as required to clear the new structure and plug in an approved manner if abandoned storm drains, sewers, or other drainage systems are encountered. Restore the bottom of the excavation to grade by backfilling after removing obstructions in accordance with this Item. Dispose of surplus materials in accordance with federal, state, and local regulations.

- 3.1.1.2. **Excavation in Streets.** Cut pavement and base to neat lines when structures are installed in streets, highways, or other paved areas. Restore pavement structure after completion of excavation and backfilling.

Maintain and control traffic in accordance with the approved traffic control plan and the TMUTCD.

- 3.1.1.3. **Utilities.** Comply with the requirements of Article 7.15., "Responsibility for Damage Claims." Conduct work with minimum disturbance of existing utilities, and coordinate work in or near utilities with the utility owners. Inform utility owners before work begins, allowing them enough time to identify, locate, reroute, or make other adjustments to utility lines.

Avoid cutting or damaging underground utility lines that are to remain in place. Promptly notify the utility company if damage occurs. Provide temporary flumes across the excavation while open if an active sanitary

sewer line is damaged during excavation, and restore the lines when backfilling has progressed to the original bedding lines of the cut sewer.

3.1.1.4.

De-Watering. Construct or place structures in the presence of water only if approved. Place precast members, pipe, and concrete only on a dry, firm surface. Remove water by bailing, pumping, well-point installation, deep wells, underdrains, or other approved method.

Remove standing water in a manner that does not allow water movement through or alongside concrete being placed if structures are approved for placement in the presence of water. Pump or bail only from a suitable sump separated from the concrete work while placing structural concrete or for a period of at least 36 hr. thereafter. Pump or bail during placement of seal concrete only to the extent necessary to maintain a static head of water within the cofferdam. Pump or bail to de-water inside a sealed cofferdam only after the seal has aged at least 36 hr.

Place a stabilizing material in the bottom of the excavation if the bottom of an excavation cannot be de-watered to the point the subgrade is free of mud or it is difficult to keep reinforcing steel clean. Use flexible base, cement-stabilized base or backfill, lean concrete, or other approved stabilizing material. Provide concrete with at least 275 lb. of cement per cubic yard, if lean concrete is used, and place to a minimum depth of 3 in. Stabilizing material placed for the convenience of the Contractor will be at the Contractor's expense.

3.1.2.

Bridge Foundations and Retaining Walls. Do not disturb material below the bottom of footing grade. Do not backfill to compensate for excavation that has extended below grade. Fill the area with concrete at the time the footing is placed if excavation occurs below the proposed footing grade. Additional concrete placed will be at the Contractor's expense.

Take core samples to determine the character of the supporting materials if requested. Provide an intact sample adequate to judge the character of the founding material. Take these cores when the excavation is close to completion. Cores should be approximately 5 ft. deeper than the proposed founding grade.

Remove loose material if the founding stratum is rock or another hard material, and clean and cut it to a firm surface that is level, stepped, or serrated, as directed. Clean out soft seams, and fill with concrete at the time the footing is placed.

Place the foundation once the Engineer has inspected the excavation and authorized changes have been made to provide a uniform bearing condition if the material at the footing grade of a retaining wall, bridge bent, or pier is a mixture of compressible and incompressible material.

3.1.3.

Cofferdams. The term "cofferdam" designates any temporary or removable structure constructed to hold surrounding earth, water, or both out of the excavation whether the structure is formed of soil, timber, steel, concrete, or a combination of these. Use pumping wells or well points for de-watering cofferdams if required.

Submit details and design calculations for sheet-pile or other types of cofferdams requiring structural members bearing the seal of a licensed professional engineer for review before constructing the cofferdam. The Department reserves the right to reject designs. Design structural systems to comply with the AASHTO *Standard Specifications for Highway Bridges* or AASHTO LRFD *Bridge Design Specifications*. Interior dimensions of cofferdams must provide enough clearance for the construction, inspection, and removal of required forms and, if necessary, enough room to allow pumping outside the forms. Extend sheet-pile cofferdams well below the bottom of the footings, and make concrete seals as well braced and watertight as practicable.

Use Class E concrete for foundation seals unless otherwise specified. Place concrete foundation seals in accordance with Item 420, "Concrete Substructures." Seals placed for the convenience of the Contractor will be at the Contractor's expense.

Make the excavation deep enough to allow for swelling of the material at the base of the excavation during pile-driving operations when the Engineer judges it to be impractical to de-water inside a cofferdam and a

concrete seal is to be placed around piling driven within the cofferdam. Remove swelling material to the bottom of the seal grade after driving the piling. Remove the foundation material to exact footing grades where it is possible to de-water inside the cofferdam without placing a seal after driving piling. Do not backfill a foundation to compensate for excavation that has been extended below grade; fill such areas below grade with concrete at the time the seals or footings are placed.

Remove cofferdams after completing the substructure without disturbing or damaging the structure unless otherwise provided.

- 3.1.4. **Culverts and Storm Drains.** When the design requires special bedding conditions for culverts or storm drains, an excavation diagram will be shown on the plans. Do not exceed these limits of excavation.

Construct pipe structures in an open cut with vertical sides extending to a point 1 ft. above the pipe unless otherwise shown on the plans. When site conditions or the plans do not prohibit sloping the cut, the excavation may be stepped or laid back to a stable slope beginning 1 ft. above the pipe. Maintain the stability of the excavation throughout the construction period.

Construct the embankment for pipe to be installed in fill above natural ground to an elevation at least 1 ft. above the top of the pipe, and then excavate for the pipe.

- 3.1.4.1. **Unstable Material.** Remove the material to a depth of no more than 2 ft. below the grade of the structure when unstable soil is encountered at established footing grade, unless the Engineer authorizes additional depth. Replace soil removed with stable material in uniform layers no greater than 8 in. deep (loose measurement). Each layer must have enough moisture to be compacted by rolling or tamping as required to provide a stable foundation for the structure.

Use special materials such as flexible base, cement-stabilized base, cement-stabilized backfill, or other approved material when it is not feasible to construct a stable foundation as outlined above.

- 3.1.4.2. **Incompressible Material.** Remove the incompressible material to 6 in. below the footing grade, backfill with an approved compressible material, and compact in accordance with Section 400.3.3., "Backfill," if rock, part rock, or other incompressible material is encountered at established footing grade while placing prefabricated elements.

- 3.2. **Shaping and Bedding.** Place at least 2 in. of fine granular material for precast box sections on the base of the excavation before placing the box sections. Use bedding as shown in Figure 1 for pipe installations. Use Class C bedding unless otherwise shown on the plans. The Engineer may require the use of a template to secure reasonably accurate shaping of the foundation material. Undercut the excavation at least 4 in. where cement-stabilized backfill is indicated on the plans and backfill with stabilized material to support the pipe or box at the required grade.

B_c - Outside diameter or horizontal dimension
 D - Inside diameter of pipe
 d - Min. bedding material below pipe

D	d
$\leq 27"$	3"
30" to 60"	4"
$\geq 66"$	6"

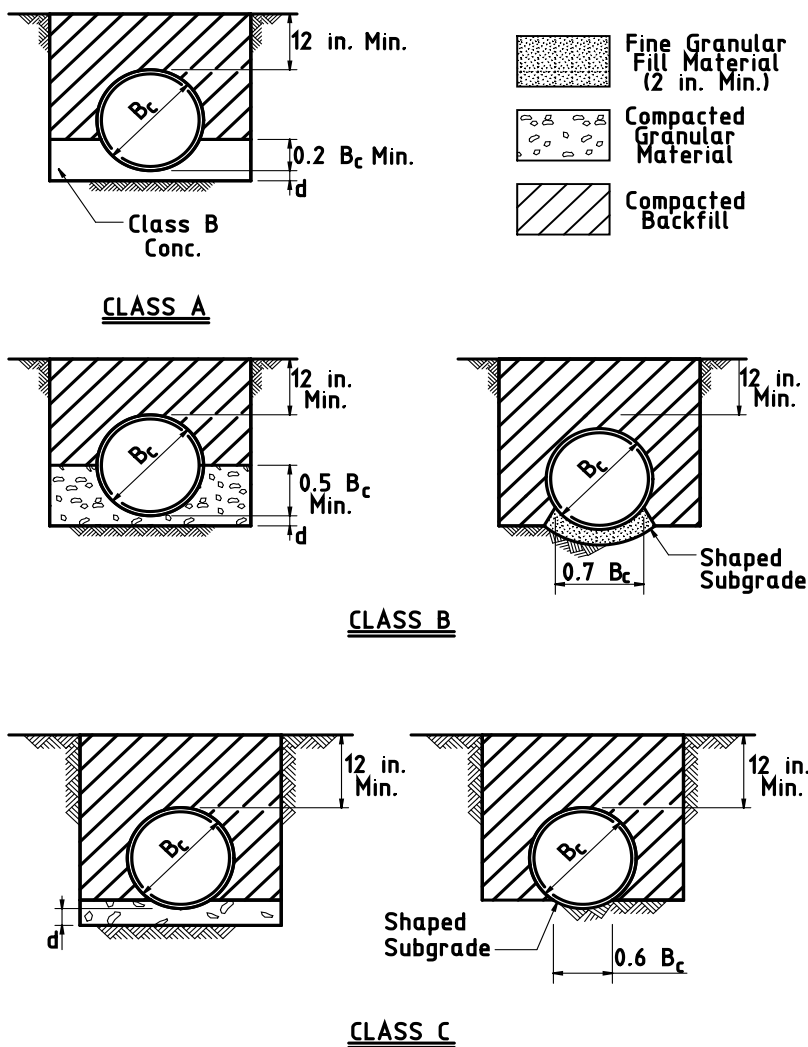


Figure 1
Bedding Diagrams

3.3. Backfill.

3.3.1. **General.** Backfill the excavation after placement of the permanent structure as soon as practical. Use backfill free from stones large enough to interfere with compaction; large or frozen lumps that will not break down readily under compaction; and wood or other extraneous material. Obtain backfill material from excavation or from other sources.

Place backfill in layers no greater than 10 in. deep (loose measurement) in areas not supporting a completed roadbed, retaining wall, or embankment. Place backfill in uniform layers no greater than 8 in. deep (loose measurement) in areas supporting a portion of a roadbed, retaining wall, or embankment. Compact each layer to meet the density requirements of the roadbed, retaining wall, embankment material, or as shown on the plans.

Bring each layer of backfill material to the moisture content needed to obtain the required density. Use mechanical tamps or rammers to compact the backfill. Rollers may be used to compact backfill if feasible.

Cohesionless materials may be used for backfilling. Use cohesionless materials that conform to the requirements of Table 1.

Table 1
Cohesionless Material Gradation Limits

Sieve Size	Percent Retained
3"	0
#10	Note 1
#200	90–100

- No. 10 sieve requirements are 0 to 30% retained when used as aggregate for cement-stabilized backfill.

Compact cohesionless materials using vibratory equipment, water-ponding, or a combination of both.

3.3.2.

Bridge Foundations, Retaining Walls, Manholes/Inlets, and Box Culverts. Place backfill against the structure only after the concrete has reached the design strength required in Item 421, "Hydraulic Cement Concrete."

Backfill retaining walls with material meeting the requirements of Item 423, "Retaining Walls." Backfill around bridge foundations, manholes/inlets and culverts using material with particles no more than 4 in. in greatest dimension and a gradation that permits thorough compaction. Use rock or gravel mixed with soil if the percentage of fines is enough to fill all voids and ensure a uniform and thoroughly compacted mass of proper density.

Use mechanical tamps and rammers to avoid damage to the structure where backfill material is being placed too close to the structure to permit compaction with blading and rolling equipment.

Avoid wedging action of backfill against structures. Step or serrate slopes bounding the excavation to prevent such action. Place backfill uniformly around bridge foundations. Place backfill equally and in uniform layers along both sides of manholes/inlets and culverts.

The Engineer may require backfilling of structures excavated into hard, erosion-resistant material, and subject to erosive forces, with stone or lean concrete.

Box culverts may be opened to traffic as soon as enough backfill and embankment has been placed over the top to protect culverts against damage from heavy construction equipment. Repair damage to culvert caused by construction traffic at no additional expense to the Department.

3.3.3.

Pipe. Bring backfill material to the proper moisture condition after installing bedding and pipe as required and place it equally along both sides of the pipe in uniform layers no greater than 8 in. deep (loose measurement). Compact each lift mechanically. Thoroughly compact materials placed under the haunches of the pipe to prevent damage or displacement of the pipe. Place backfill in this manner to the top-of-pipe elevation. Place and compact backfill above the top of the pipe in accordance with Section 400.3.3.1., "General."

The Engineer may reject backfill material containing more than 20% by weight of material retained on a 3 in. sieve with large lumps not easily broken down or that cannot be spread in loose layers. Material excavated by a trenching machine will generally meet the requirements of this Section as long as large stones are not present.

Place and compact additional material where pipe extends beyond the toe of slope of the embankment and the depth of cover provided by backfill to the original ground level is less than the minimum required by the specifications for the type of pipe involved until the minimum cover has been provided.

- 3.3.4. **Cement-Stabilized Backfill.** Backfill the excavation to the elevations shown with cement-stabilized backfill when shown on the plans. Use cement-stabilized backfill that contains aggregate conforming to the gradation limits shown in Table 1, water, and a minimum of 7% hydraulic cement based on the dry weight of the aggregate, in accordance with [Tex-120-E](#).

Place cement-stabilized backfill equally along the sides of structures to prevent strain on or displacement of the structure. Fill voids when placing cement-stabilized backfill. Use hand-operated tampers if necessary to fill voids.

- 3.3.5. **Flowable Backfill.** Backfill the excavation with flowable backfill to the elevations indicated when shown on the plans. Prevent the structure from being displaced during the placement of the flowable fill, and prevent flowable fill from entering manholes/inlets and culverts, and drainage structures.

4. MEASUREMENT

This is a plans quantity measurement item. The quantity to be paid is the quantity shown in the proposal, unless modified by Article 9.2., "Plans Quantity Measurement." Additional measurements or calculations will be made if adjustments of quantities are required.

- 4.1. **Structural Excavation.** Unless shown on the plans as a pay item, structural excavation quantities shown are for information purposes only.

When structural excavation is specified as a pay item, structural excavation for pipe headwalls, inlets, manholes, culvert or storm drain extensions less than 15 ft. long, bridge abutments, retaining walls, and side road and private entrance pipe culverts will not be measured. No allowance will be made for variance from plans quantity incurred by an alternate bid.

When specified as a pay item, structural excavation will be measured by the cubic yard as computed by the average end areas method. Excavation diagrams on the plans take precedence over the provisions of this Article.

- 4.1.1. **Boundaries of Measurement.**

- 4.1.1.1. **Pipe.**

- 4.1.1.1.1. **Pipe up to 42 Inches.** For pipe up to 42 in. nominal or equivalent diameter, no material outside of vertical planes 1 ft. beyond and parallel to the horizontal projection of the outside surfaces of the pipe will be included.

- 4.1.1.1.2. **Pipe Larger than 42 Inches.** For pipes larger than 42 in. nominal or equivalent diameter, no material outside of vertical planes located 2 ft. beyond and parallel to the horizontal projection of the outside surfaces of the pipe will be included.

Quantities for excavation in fill above natural ground include 1 ft. above the top of the pipe regardless of the height of completed fill. Excavation for pipe will be measured between the extreme ends of the completed structure including end appurtenances as shown on the plans and from centerline to centerline of inlets, manholes, etc.

- 4.1.1.2. **Structural Plate Structures.** No material outside of vertical planes 3 ft. beyond and parallel to the horizontal projection of the outside surfaces of the structure will be included. When the quality of the existing soil or embankment is less than that of the proposed backfill material, the limits of measurement will be extended to vertical planes located 1/2 of the span beyond the horizontal projection of the outside surfaces of the structure.

- 4.1.1.3. **Footings, Walls, Boxes, and Other Excavation.** No material outside of vertical planes 1 ft. beyond and parallel to the edges of the footings or outside walls will be included whether or not a cofferdam or shoring is

used. When plans provide the option of cast-in-place or precast boxes, measurement will be based on the cast-in-place option.

Where excavation in addition to that allowed for the footings is required for other portions of the structure, measurement for the additional excavation will be limited laterally by vertical planes 1 ft. beyond the face of the member and parallel to it, and vertically to a depth of 1 ft. below the bottom of the member.

- 4.1.1.4. **Excavation near Roadways and Channels.** At structure sites other than culverts and pipe excavations, the measurement of structural excavation will include only material below or outside the limits of the completed road or channel excavation. Roadway and channel excavation will be paid under Item 110, "Excavation." For culverts except side road and private entrance culverts, excavation within the limits of the structure and below or outside the limits of the completed roadway excavation will be measured as structural excavation.
- 4.1.2. **Falsework.** No measurement will be made for excavation necessary for placing forms or falsework that exceeds the limits given in Section 400.4.1.1., "Boundaries of Measurement."
- 4.1.3. **Swelling.** Measurement will not include materials removed below footing grades to compensate for anticipated swelling due to pile-driving, nor will it include material required to be removed due to swelling beyond the specified limits during pile-driving operations.
- 4.1.4. **Cave-Ins.** Measurement will not include additional volume caused by slips, slides, cave-ins, silting, or fill material resulting from the action of the elements or the Contractor's operation.
- 4.1.5. **Undercut.** Where rock or other incompressible or unstable material is undercut to provide a suitable foundation for pipe or box sections, such material below grade directed to be removed will be measured for payment.
- 4.1.6. **Grade Change.** Additional measurement will be made of the volume of excavation involved in the lowering or raising of the elevation of a footing, foundation, or structure unit, when such grade change is authorized.
- 4.2. **Cement-Stabilized Backfill.** Cement-stabilized backfill will be measured by the cubic yard as shown on the plans.
- 4.3. **Cutting and Restoring Pavement.** Cutting and restoring pavement will be measured by the square yard as shown on the plans. Excavation below pavement or base will be measured as structural excavation of the pertinent type.

5. PAYMENT

- 5.1. **Structural Excavation.** Unless specified as a pay item, structural excavation and backfill performed, and material furnished in accordance with this Item will not be paid for directly but are subsidiary to pertinent Items.

When structural excavation is specified as a pay item, the excavation and backfill work performed, and materials furnished will be paid for at the unit price bid for "Structural Excavation," "Structural Excavation (Box)," "Structural Excavation (Pipe)," and "Structural Excavation (Bridge)." This price includes concrete to compensate for excavation that has extended below grade for bridge foundations and retaining walls, and backfilling and compacting areas that were removed as part of structural excavation.

Cofferdams or other measures necessary for supporting excavations less than 5 ft. deep will not be measured or paid for directly but will be subsidiary to the Contract.

Foundation seal concrete for cofferdams, when required, will be paid for as provided in the pertinent Items. If no direct method of payment is provided in the Contract, the work will be measured and paid for in accordance with Article 9.7., "Payment for Extra Work and Force Account Method." Seal placed for the convenience of the Contractor will not be paid for.

Unless otherwise provided, stone or lean concrete backfill around structures as provided for in Section 400.3.3.2., "Bridge Foundations, Retaining Walls, Manholes/Inlets, and Box Culverts," will be measured and paid for as extra work in accordance with Article 9.7., "Payment for Extra Work and Force Account Method."

When structural excavation is specified as a pay item, a partial payment of 50% of the bid price will be made for structural excavation completed to the satisfaction of the Engineer but not backfilled. The remaining amount will be paid upon completion of backfilling. When the Contractor elects to excavate beyond plan requirements, no measurement will be made of the additional volume.

- 5.2. **Removal and Replacement of Unsuitable or Incompressible Material.** Removal and replacement of material will be paid for if directed. Removal and replacement of material or placement of special material made necessary by the softening of founding material due to the Contractor's sequence of work or operation, will be at the Contractor's expense. Special material used or additional excavation made for the Contractor's convenience will not be paid for.

- 5.2.1. **Structural Excavation as a Pay Item.** Where special materials are not required or specified, payment for the removal and replacement of unstable or incompressible material will be made at a price equal to 200% of the unit price bid per cubic yard for Structural Excavation. When the Contractor elects to remove and replace material deeper than directed, no measurement will be made on that portion below the directed elevation. This price is full compensation for removing the unstable or incompressible material; furnishing, hauling, placing, and compacting suitable replacement material; and equipment, labor, tools, and incidentals.

When the plans specify or when directed, the use of special materials such as flexible base, cement-stabilized base, cement-stabilized backfill, or other special material, payment for excavation below footing grades will be made at the unit price bid for Structural Excavation. Payment for furnishing, hauling, placing, and compacting the flexible base, cement-stabilized base, cement-stabilized backfill, or other special materials will be made at the unit price bid for these items in the Contract, or, if the required material is not a bid item, in accordance with Article 9.7., "Payment for Extra Work and Force Account Method."

- 5.2.2. **Structural Excavation Not a Pay Item.** Where special materials for backfill are not required or specified, payment for the authorized removal and replacement of unstable or incompressible material will be measured and paid for at \$15 per cubic yard of material removed. This price is full compensation for removing the unstable or incompressible material; furnishing, hauling, placing, and compacting suitable replacement material; and equipment, labor, tools, and incidentals.

When the plans specify or when directed, the use of special materials such as flexible base, cement-stabilized base, cement-stabilized backfill, or other special material, excavation below the footing grades will be paid for at \$10 per cubic yard. Payment for furnishing, hauling, placing, and compacting the flexible base, cement-stabilized base, cement-stabilized backfill, or other special materials will be made at the unit price bid for these items, or, if the required material is not a bid item, in accordance with Article 9.7., "Payment for Extra Work and Force Account Method."

- 5.3. **Lowering of a Structure Foundation.** If the Engineer requires a structure foundation to be lowered to an elevation below the grade shown on the plans, overexcavation will be paid in accordance with Table 2.

Table 2
Payment for Required Overexcavation

Variance of Revised Footing Grade from Plan Grade	Payment Terms	Variance of Revised Footing Grade from Plan Grade
	"Structural Excavation" is a Bid Item	"Structural Excavation" is not a Bid Item
Up to and including 5 ft.	Unit price equal to 115% of unit price bid for "Structural Excavation"	\$10 per cubic yard
Over 5 ft. up to 10 ft.	Unit price equal to 125% of unit price bid for "Structural Excavation"	\$12 per cubic yard
Over 10 ft.	In accordance with Article 9.7., "Payment for Extra Work and Force Account Method."	

- 5.4. **Cement-Stabilized Backfill.** Cement-stabilized backfill will be paid for at the unit price bid for "Cement-Stabilized Backfill."
- 5.5. **Cutting and Restoring Pavement.** Cutting and restoring pavement will be paid for at the unit price bid for "Cutting and Restoring Pavement" of the type specified.

Work done to repair damage to base or pavement incurred outside the limits shown on the plans, or the limits authorized, will not be measured for payment.

The unit prices bid are full compensation for excavation including removing obstructions and plugging drainage systems; bedding and backfilling including placing, sprinkling and compaction of material; soundings; cleaning and filling seams; constructing and removing cofferdams; de-watering, sheeting, or bracing excavations up to and including 5 ft. deep; pumps; drills; explosives; disposition of surplus material; cutting pavement and base to neat lines; and materials, hauling, equipment, labor, tools, and incidentals.

Flowable backfill will be paid for as provided in Item 401, "Flowable Backfill." Protection methods for open excavations deeper than 5 ft. will be measured and paid for as required under Item 402, "Trench Excavation Protection," or Item 403, "Temporary Special Shoring."

Item 404

Driving Piling



1. DESCRIPTION

Drive piling.

2. EQUIPMENT

- 2.1. **Driving Equipment.** Use power hammers for driving piling with specified bearing resistance. Use power hammers that comply with Table 1. Gravity hammers may be used for driving sheet piling and timber piling if no required design load is shown on the plans.

For initial rating of diesel hammers to determine compliance with the requirements shown in Table 1, the height of fall of the ram of the single-acting (open-end) hammer must be 7 ft. For a double-acting (enclosed ram) hammer, the energy rating must be 85% of the rated output by the manufacturer.

A hammer that produces less energy than required in Table 1 may be approved if a wave equation analysis indicates the hammer can drive the specified pile against a bearing resistance of three times the required design load before reaching 0.1 in. of penetration per blow. The bearing resistance of the piling driven with this particular equipment will be determined in accordance with the Wave Equation Method.

Use an air compressor that supplies the volume and pressure specified by the manufacturer of the hammer. Provide an accurate pressure gauge.

Maintain the valve mechanism and other parts of power hammers so the hammer will operate at the speed and stroke length specified by the manufacturer.

Equip enclosed ram diesel hammers with a gauge and provide charts to evaluate the equivalent energy being produced. Calibrate the gauge before work begins, whenever gauge accuracy is in question, and at least once each 6 mo.

Table 1
Size of Driving Equipment

Piling Type	Hammer Type	Ram Weight (lb.)	Max Ram Stroke (ft.)	Min Hammer Energy (ft.-lb.) ¹
Timber	Air, Hydraulic	2,000 Min	5	330R
	Diesel	2,000 Min	10	330R
Steel	Air, Hydraulic	3,000 Min	5	Larger of 250R or 2-1/2 Wp
	Diesel	2,000 Min	10	Larger of 250R or 2-1/2 Wp
Concrete	Air, Hydraulic	3,000 Min, but not less than 1/4 Wp	5	250R, but not less than 1 ft.-lb. per pound of pile weight
	Diesel	2,700 Min, but not less than 1/4 Wp	8 ²	250R, but not less than 1 ft.-lb. per pound of pile weight

1. R = Design load in tons. Wp = Weight of pile in pounds based on plan length.

2. Diesel hammers with less ram weight or greater ram stroke are permitted if a wave equation analysis indicates the combination of ram weight, stroke, and cushioning will not overstress the piling.

Provide hammer cushion consisting of layers of micarta and aluminum or other material specifically produced and approved for this application. Use a wood, wire rope, or asbestos hammer cushion only if permitted.

Regulate the height of fall when using gravity hammers to avoid damage to the piling.

Drive all test piling in a structure or in any approved segment of it using the same hammer, and use the same type and size of hammer to drive the remainder of the piling in the structure or segment.

Equip pile drivers with leads constructed to allow freedom of movement of the hammer and to provide adequate support to the pile during driving. The longitudinal axis of the leads, hammer, and pile should coincide.

Ensure leads are long enough, except where piling is driven through water, that a follower will not be necessary. Use one pile in every 10 that is long enough to permit driving without a follower when driving piling underwater and a follower is required. Drive it as a test pile for proper correlation of the follower-driven piling. Payment will be made as regular piling.

Hammers designed to operate underwater may be used for underwater driving without a follower and without the correlation required for other hammers.

- 2.2. **Protection of Pile Heads.** Use a steel driving head (helmet) suitable for the type and size of piling. Drive steel H-piling and sheet piling using a helmet compatible with the specific pile shape driven.

Provide a cushion block for concrete piling between the driving head and the top of the pile. Use a cushion block that is at least 4 in. thick for short piling (50 ft. or less) and at least 6 in. thick for longer piling, unless otherwise directed. Use multiple layers of one of the following:

- 3/4-in. or 1-in. structural-grade southern pine or fir plywood;
- green oak or gum, with the grain of the wood horizontal; or
- other approved material specifically produced for this application.

Pay special attention to the condition of the cushioning material. Drive no more than three piles using one cushion block. Change cushioning more frequently if necessary to prevent damage. Immediately replace any cushion block that has ignited. Do not use a tight-fitting driving helmet for concrete piling. Allow room for slight movement, but ensure the driving helmet is not large enough for the pile head to rotate freely. Center concrete piling and cushion within the helmet throughout the driving operation.

3. CONSTRUCTION

This Item uses the following terms.

- **Foundation Piling.** Piling placed under interior bent footings or retaining wall abutment footings.
- **Trestle Piling.** Piling embedded directly into the abutment cap or interior bent cap.
- **Sheet Piling.** Retaining piling not considered either foundation or trestle piling.
- **Test Piling.** Specific piling driven to investigate site conditions and determine regular piling lengths.
- **Test-Loaded Piling.** Specific piling driven and test-loaded to investigate site conditions and determine regular piling lengths. Do not fabricate regular piling until test loading and analysis are completed.
- **Regular Piling.** All piling other than test piling and test-loaded piling.

Do not fabricate regular piling until test pile driving and analysis or test loading and analysis are completed.

Complete the embankment at bridge ends before driving abutment piling. Refer to Item 423, "Retaining Walls," for provisions pertinent to piling that passes through the structural volume of retaining walls.

Do not drive foundation piling until the footing excavation is complete. Drive concrete piling once the piling concrete, including buildups, has cured at least 14 days. Do not drive piling in a saltwater environment until the piling concrete, including buildups, has cured at least 21 days after concrete placement.

Re-drive any piling that is raised when driving adjacent piling. Withdraw and replace any broken, split, or displaced piling, or correct it as directed after a design analysis.

To control excessive stresses resulting in damage to the piling during driving, the following, alone or in combination, may be required:

- increase in cushion thickness,
- reduction of ram stroke,
- heavier ram with a shorter stroke,
- use of pilot holes or jetting when driving through hard or alternating hard and soft strata.

- 3.1. **Tolerance for Driving.** Drive piling to the required vertical or batter alignment, within the tolerances in accordance with this Section. Drive piling with rigid templates when using swinging leads or when necessary to comply with tolerances. Drive battered piles using a two-tiered template or a template equipped with a device to hold the pile at the required batter. Construct the template to allow the pile to pass freely through the template without binding. Cut off piling reasonably square at the elevation shown on the plans, with a tolerance of no more than 2 in. above or below established cutoff grade. Submit for approval a structural analysis and proposed corrective action, signed and sealed by a licensed professional engineer, when tolerances are exceeded and the Engineer requires corrective action.

- 3.1.1. **Trestle Piling.**
- Transverse to the centerline of the bent, the top of the piling may be no more than 2 in. from the position shown on the plans.
 - Parallel to the centerline of the bent, the top of the piling may be no more than 4 in. from the position shown on the plans.

- 3.1.2. **Foundation Piling.**
- The top of each pile may be no more than 4 in. in any direction from the position shown on the plans.
 - The center of gravity of the piling group may be no more than 3 in. from the center of gravity determined from plan location.
 - The minimum edge distance for piling in a footing is 5 in. Additional concrete required to obtain this edge distance and specified reinforcing steel cover will be at the Contractor's expense.

- 3.2. **Penetration.** Piling lengths shown on the plans are the lengths estimated to provide required bearing and for estimating purposes only. Drive piling to plan tip elevations or to greater depths as necessary to obtain the required allowable dynamic resistance meeting or exceeding the foundation load shown on the plans.

The Engineer will establish regular pile lengths based on the test data when test piling or test-loaded piling is used. Drive regular piling to this approximate elevation in these cases and to greater depths as required to obtain the plan bearing resistance.

Provide either pilot holes, jetting, or a combination of both for unusually hard driving conditions, typically less than 0.1 in. of penetration per blow if plan penetration is not obtained. Reduce penetration upon approval when the piling is advanced to within 5 ft. of plan length, unless other penetration requirements or bearing evaluation methods govern.

- 3.3. **Pilot Holes.** Extend pilot holes no more than 5 ft. below the bottom of footings for foundation piling or 10 ft. below finished ground line for trestle piling, unless the specified penetration cannot be obtained by using the depth of holes indicated or specified. The maximum hole diameter permitted will be approximately 4 in. less than the diagonal of square piling or steel H-piling and 1 in. less than the diameter of round piling. Determine the size and depth of pilot holes from the results of trial operations on the first piling driven or from available test pile data when deeper ones are required. Obtain approval for any depth or size of pilot holes that exceeds the maximums specified in this Section. The Engineer may vary hole size and depth to obtain penetration and bearing resistance.

Extend pilot holes through all embankments to natural ground when driving concrete piling.

Where a pilot hole is required in granular material that cannot be sealed off by ordinary drilling methods, a casing may be required around the boring device deep enough to prevent loose material from falling into the pilot hole.

Drive the piling below the depth of the pilot hole at least 1 ft. or 100 blows, but not less than the required bearing resistance shown on the plans. Do not drive piling beyond the point where the penetration per blow is less than 0.1 in. as determined by an average of 10 blows, unless directed otherwise. Stop driving if damage to the pile is apparent.

- 3.4. **Jetting.** Jetting is permitted when the specified penetration cannot be obtained by driving and pilot holes or other methods are not feasible. Submit details of the proposed methods for approval before jetting. The Engineer may authorize varying depths of jetting to achieve the desired results.

Jet as required in conjunction with driving but only to the approved depth. Use enough power for jetting operations to simultaneously operate at least two 2-1/2 in. diameter pipes equipped with 3/4-in. nozzles at a pressure of 150 psi. Perform the jetting with one or two jets as determined and approved from results of trial operations.

Drive the piling below the depth of the jetting at least 1 ft. or 100 blows, but not less than the required bearing resistance shown on the plans. Do not drive piling beyond the point where the penetration per blow is less than 0.1 in. as determined by an average of 10 blows, unless directed otherwise. Stop driving if damage to the pile is apparent.

- 3.5. **Hammer Formula Method of Bearing Evaluation.** Determine the allowable dynamic bearing resistance of piling by one of the hammer formulas in this Section unless otherwise shown on the plans. If the Engineer has determined a K factor based on test piling, test-loaded piling, or other methods, the computed allowable resistance will be the driving resistance determined based on the appropriate formula multiplied by the K factor. The computed allowable resistance should be greater than or equal to the foundation load shown on the plans.

- 3.5.1. **Single-Acting Power Hammers.** Use the following formula.

$$P_a = \frac{2WH}{S + 0.1}$$

where:

P_a = allowable dynamic resistance in pounds

W = weight of ram in pounds

H = height of fall of ram in feet (field-measured)

S = average penetration in inches per blow for the last 20 blows

Determine H by an approved electronic stroke indicator and blow count logging device provided by the Contractor. Pending approval, H can be determined by visual observation of the ram against a calibrated rod mounted on the hammer, or by the following formula.

$$H = 16.1 \times \left(\frac{30}{B} \right)^2 - 0.3$$

where:

B = blows per minute

- 3.5.2. **Double-Acting Power Hammers.** Use the following formula.

$$P_a = \frac{2E}{S + 0.1}$$

where:

P_a = allowable dynamic resistance in pounds

E = manufacturer's rated energy in foot-pounds (for double-acting power hammers), or the equivalent energy in foot-pounds determined by a calibrated gauge attached to the hammer and taken when the average penetration in inches per blow is determined (for enclosed ram diesel hammer)

S = average penetration in inches per blow for the last 20 blows

- 3.5.3. **Other Hammer Types.** Provide a wave equation analysis for each pile, hammer, soil, and load combination for which the driving system is to be used. The analysis will determine the bearing capacity of the piling.

- 3.6. **Wave Equation Method of Bearing Evaluation.** Submit the following data when the plans specify the bearing capacity of the piling is determined by the wave equation method:

- manufacturer's specification data for the hammer proposed for use, including all modifications and
- complete description and dimensions of all cushioning material used between the pile and helmet and in the cap block, including total thickness of each, and the direction of grain if wood is used.

These data will be used by the Engineer to determine the required number of blows per unit of penetration the hammer must deliver to obtain the required bearing resistance.

After evaluation by the wave equation method, any change in the driving equipment may require reevaluation. Such changes must be approved before further driving.

- 3.7. **Test Piling.** Drive test piling at locations shown on the plans or as directed. Make test piling part of the completed work, cut off or built up to grade as necessary. Use the required bearing evaluation method to determine bearing resistance.

Initially drive test piling to 3 ft. above plan tip elevation of the regular piling for the structure with the blow count recorded for each foot of driving. (For example, drive test piling to 13 ft. above its plan tip elevation if the test piling is 10 ft. longer than regular piling.) Retain the cushion if used.

Re-drive the test piling the additional length required by the plans at least 7 days after the original driving using the same hammer and cushion originally used. Record the blow count for each inch of driving for the first foot, for every 3 in. for the next 2 ft., and for each foot thereafter.

Provide the data to the Engineer for use in determining regular piling lengths and K factors. The K factor will be determined based on the following formula.

$$K = P_R / P$$

where:

K = a static correction factor applied to the evaluation method

P_R = re-drive bearing (ton) of the test pile determined by the evaluation method

P = original bearing (ton) of test pile determined by the evaluation method

- 3.8. **Test-Loaded Piling.** Conduct test load in accordance with Item 405, "Foundation Load Test."

Provide the data to the Engineer for use in determining regular piling lengths and K factors. The K factor will be determined based on the following formula.

$$K = L / P$$

where:

K = a static correction factor applied to the evaluation method

L = maximum safe static load proven by test load

P = bearing resistance of the test-loaded pile determined by the evaluation method

4. MEASUREMENT AND PAYMENT

The work performed, materials furnished, equipment, labor, tools, and incidentals will not be paid for directly, but will be subsidiary to pertinent Items.

Item 406

Timber Piling



1. DESCRIPTION

Furnish and place treated or untreated timber piling.

2. MATERIALS

Furnish timber piling in accordance with ASTM D25. Use any species of durable timber for untreated piling that will satisfactorily stand driving. Use Southern pine impregnated with a preservative for treated piling in accordance with Item 492, "Timber Preservative and Treatment," or as shown on the plans.

Furnish round piling in the lengths shown on the plans, with a minimum circumference of 38 in. for piling 40 ft. or less in length, and 41 in. for piling more than 40 ft. Measure the circumference under the bark at a section 3 ft. from the butt or at the tip.

For treated timber piling, treat cuts, bolt holes, and other areas where the surface of the piling is broken in accordance with Item 492.

2.1. **Inspection.** All piling is subject to inspection before and after treatment. Allow the Inspector free access to all sites where materials are being produced or processed, and provide any assistance necessary for the proper inspection of materials.

2.2. **Storing and Handling.** Prevent excessive splitting, checking, warping, distortion, or any other damage that may cause the piling to be rejected. Handle all timber piling carefully without dropping, breaking outer fibers, bruising, or penetrating the surface with tools.

3. EQUIPMENT

Handle piling with rope slings. Use handling equipment that does not penetrate the treated shell into untreated wood.

4. CONSTRUCTION

Drive piling in accordance with Item 404, "Driving Piling."

4.1. **Splices, Buildups, and Cutoffs.** Saw tops of all piling to a true plane as shown on the plans and at the established elevation. Saw piling that supports timber caps or connects to other members to the exact plane of the connected member.

Build up piling by splicing on an additional length of piling of the same diameter and quality when required. Make splices as shown on the plans or as directed. Construct the splice after the pile head and the lower end of the buildup section have been squared up and treated in accordance with Section 406.4.2., "Treatment of Pile Ends." Use no more than one splice in any single pile.

4.2. **Treatment of Pile Ends.**

4.2.1. **Treated Timber.** Give the ends of piling three coats of a preservative determined appropriate for the original preservative in accordance with AWPA Standard M4 after cutting. Follow with one coat of coal-tar roofing cement in accordance with ASTM D5643.

- 4.2.2. **Untreated Timber.** Coat the heads of piling thoroughly with a thick protective coat of hot tar or hot asphaltum.

Cover the pile heads after treatment with a sheet of 20-gauge galvanized metal when shown on the plans. Provide a cover that overlaps the sides of the piling at least 3 in. Bend the cover down over the piling and fasten it with large-headed galvanized nails or as shown on the plans.

5. MEASUREMENT

- 5.1. **Timber Piling.** Timber piling will be measured by the foot of acceptable piling in place after all cutoffs and splices have been made. When the Contractor elects to drive piling deeper than required to meet the specified length and bearing requirements, no measurement will be made on that portion below the elevation at which length and bearing requirements were first obtained.
- 5.2. **Splices.** Splices will be measured by each authorized, completed splice made necessary by driving beyond the plan pile length to obtain required bearing resistance. No measurement will be made for a splice made necessary by unsuitable material, handling, driving, or overdriving.
- 5.3. **Cutoffs.** Cutoffs will be measured by the foot of cutoff above required grade. No cutoff will be measured on any pile that is built up.

6. PAYMENT

The unit price bid is full compensation for jetting, pilot holes, alignment holes, driving piling, repairs, materials, equipment, tools, labor, and incidentals.

- 6.1. **Timber Piling.** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Treated Timber Piling" or "Untreated Timber Piling."
- 6.2. **Splices.** An additional payment for each authorized, completed splice, regardless of buildup length, will be made at a price equal to four times the unit price bid for "Treated Timber Piling" or "Untreated Timber Piling." Where piling is trimmed back for the purpose of constructing a splice, payment for the cutoff is included in the payment for the splice.
- 6.3. **Cutoffs.** Payment for cutoff lengths will be made at a price equal to 1/2 the unit price bid for "Treated Timber Piling" or "Untreated Timber Piling."

Item 416

Drilled Shaft Foundations



1. DESCRIPTION

Construct foundations consisting of reinforced or non-reinforced concrete drilled shafts.

2. MATERIALS

Use materials that meet the requirements of the following Items.

- Item 421, "Hydraulic Cement Concrete,"
- Item 440, "Reinforcement for Concrete," and
- Item 448, "Structural Field Welding."

Use concrete for drilled shafts that meets the requirements of Table 1 unless otherwise shown on the plans.

Table 1
Concrete for Drilled Shafts

Drilled Shaft Type	Concrete
Non-reinforced	Class A
Reinforced	Class C
Slurry and underwater concrete placement	Class SS

Use coarse aggregate Grade 4, 5, or 6 for drilled shaft concrete in reinforced drilled shafts. Grade 2 or 3 may be used if the shaft is dry and reinforcing steel has a 5 in. minimum clear spacing.

Use a water-reducing, retarding admixture in accordance with [DMS-4640](#), "Chemical Admixtures for Concrete," in all concrete when using casing that will be pulled or when placing shafts underwater or under slurry.

Use concrete with slump that meets the requirements of Table 2 as determined by [Tex-415-A](#).

Table 2
Slump Requirements

Placement Type	Minimum Acceptable Placement Slump, in.	Recommended Design and Placement Slump, in.	Maximum Acceptable Placement Slump, in.
Dry	5-1/2	6-1/2	7-1/2
Underwater and under slurry	7	8	9

Perform a slump loss test in accordance with [Tex-430-A](#) before beginning work when casing is to be pulled or concrete is to be placed underwater or under slurry. Provide concrete that will maintain a slump of at least 4 in. throughout the entire anticipated time of concrete placement. Time of concrete placement is described in Section 416.3.6., "Concrete," and Section 416.3.7., "Additional Requirements for Slurry Displacement or Underwater Concrete Placement Methods." Note the temperature of the concrete mix at the beginning of the slump loss test. Place the concrete if its temperature at the time of placement into the drilled shaft is no more than 10°F higher than the slump loss test temperature. Use ice or other concrete cooling ingredients to lower concrete temperature, or run additional slump loss tests at the higher temperatures. Slump loss testing will be waived if anticipated time of concrete placement is less than 90 minutes.

Use mineral drilling slurry that meets the requirements of Table 3, as determined by [Tex-130-E](#). Determine pH of slurry by [Tex-128-E](#) or pH paper strips.

Table 3
Mineral Slurry Requirements

Before Introduction into the Excavation			Sampled from the Bottom of the Excavation before Concreting		
Specific Gravity	Sand Content	pH	Specific Gravity	Viscosity (sec.)	Sand Content
≤ 1.10	≤ 1%	8–11	≤ 1.15	≤ 45	≤ 4%

Use mineral slurry consisting of processed bentonite or attapulgitic clays mixed with clean fresh water. Do not use partially hydrolyzed polyacrylamide (PHPA) polymeric slurry or any blended mineral-polymer slurry.

If approved, water may be used as the drilling fluid. In this case, all of the provisions of Table 3 must be met except that the maximum specific gravity is not to exceed 1.12.

Sample slurry from the bottom of the hole, before placing concrete, and test it in accordance with [Tex-130-E](#). Use a pump or air lift to remove slurry that does not meet the requirements of Table 3 while adding fresh clean slurry to the top of the hole to maintain the slurry level. Continue this operation until the slurry sampled from the bottom of the hole meets the requirements.

3. CONSTRUCTION

Submit Drilled Shaft installation plan for review no later than one month before drilled shaft construction. Include the following in the plan:

- Name and experience record of the drilled shaft superintendent who will be in charge of drilled shaft operations for this project.
- List of proposed equipment to be used, including cranes, drills, augers, bailing buckets, final cleaning equipment, desanding equipment, slurry pumps, core sampling equipment, tremies or concrete pumps, casing, etc.
- Details of overall construction operation sequence and the sequence of shaft construction in bents or groups.
- Details of shaft excavation methods.
- When the use of slurry is anticipated, details of the slurry mix design and its suitability for the subsurface conditions at the construction site, mixing and storage methods, maintenance methods and disposal procedures.
- Details of methods to clean the shaft excavation.
- Details of reinforcement placement, including support and centralization methods.
- Details of concrete placement, including proposed operational procedures for free fall, tremie or pumping methods.
- Details of casing installation and removal methods.

The installation plan will be reviewed for conformance with the plans, specifications and special provisions. The Contractor will be notified within 14 days of receipt of the installation plan of any additional information required and/or changes necessary to meet the contract requirements. All procedural approvals given will be subject to trial in the field and will not relieve the Contractor of the responsibility to satisfactorily complete the work as detailed in the plans and specifications.

Place the shaft to within the following tolerances:

- Vertical plumbness—1 in. per 10 feet of depth.
- Center of shaft located under column—1 in. of horizontal plan position.
- Center of shaft located under footing—3 in. of horizontal plan position.

Complete the embankment at bridge ends before installing drilled shafts that pass through the fill. Refer to Item 423, "Retaining Walls," for provisions for drilled shafts passing through the structural volume of retaining walls.

- 3.1. **Excavation.** The plans indicate the expected depths and elevations for encountering satisfactory bearing material. Excavate as required for the shafts through all materials encountered to the dimensions and elevations shown on the plans or required by the site conditions. Removal of man-made obstructions not shown on the plans will be paid for in accordance with Article 9.7., "Payment for Extra Work and Force Account Method." Adjust the bottom of the shaft or alter the foundation if satisfactory founding material is not encountered at plan elevation, as approved to satisfactorily comply with design requirements. Blasting is not allowed for excavations.
- Stop drilling if caving conditions are encountered, and adopt a construction method that stabilizes the shaft walls.
- Do not excavate a shaft within 2 shaft diameters (clear) of an open shaft excavation, or one in which concrete has been placed in the preceding 24 hr.
- Dispose of material excavated from shafts and not incorporated into the finished project in accordance with the plans and with federal, state, and local laws.
- Provide suitable access, lighting, and equipment for proper inspection of the completed excavation and checking the dimensions and alignment of shafts excavation.
- 3.2. **Core Holes.** Take cores to determine the character of the supporting materials if directed. Use a method that will result in recovery of an intact sample adequate for judging the character of the founding material. Such cores should be at least 5 ft. deeper than the proposed founding grade or a depth equal to the diameter of the shaft, whichever is greater. Take these cores when the excavation is complete.
- 3.3. **Casing.** Use casing when necessary to prevent caving of the material, to exclude ground water, when slurry is used for hole stabilization, or when required as part of the Contractor's Safety Plan. Provide casing with an outside diameter not less than the specified diameter of the shaft. The portion of shaft below the casing may be as much as 2 in. smaller than the specified shaft diameter. No extra compensation will be made for concrete required to fill an oversized casing or oversized excavation. Use casing strong enough to withstand handling stresses and pressures of concrete and of the surrounding earth or water, and that is watertight, smooth, clean, and free of accumulations of hardened concrete.
- Use construction methods that result in a minimal amount of disturbed soil being trapped outside the casing. This does not apply to temporary undersized casings used to protect workers inside shafts or to drilled shafts designed for point bearing only.
- Leave casing in place only if authorized or shown on the plans. Extract casing only after placing the concrete to an appropriate level. Maintain sufficient concrete in the casing at all times to counteract soil and water pressure. Rotate or move the casing up or down a few inches if necessary before and during concrete placement to facilitate extraction of the casing.
- 3.4. **Requirements for Slurry Displacement Method.** When soil conditions warrant, use the slurry displacement method to construct drilled shafts unless otherwise shown on the plans. Use this method to support the sides of the excavation with processed mineral slurry that is then displaced by concrete to form a continuous concrete shaft.
- Install surface casing to a minimum of 10 ft. below existing ground before introducing slurry. Do not use casing other than surface casing. Do not use surface casing longer than 20 ft. without approval. Do not extract the surface casing until after placing the concrete.
- Pre-mix slurry in a reservoir with enough capacity to fill the excavation and for recovery of the slurry during concrete placement. Do not mix slurry in the shaft excavation or other hole. Allow adequate time for hydration of the slurry before introduction into the excavation.
- Maintain a head of slurry in the shaft excavation at or near ground level or higher, as necessary, to counteract ground water pressure during and after drilling.

Use an air lift or proper size cleanout bucket, just before placing reinforcing steel, to remove any material that may have fallen from the sides of the excavation or accumulated on the bottom after the completion of drilling. Use a cleanout bucket if material is too large to be picked up with an air lift.

Re-process the hole with the auger as directed if concrete placement is not started within 4 hr. of the completion of the shaft excavation. Then clean the bottom with an air lift or cleanout bucket, and check the slurry at the bottom of the hole for compliance with the slurry requirements of Article 416.2., "Materials."

Agitate the congealed slurry to liquefaction if the slurry forms a gel before concrete placement, and whenever directed.

Recover and dispose of all slurry as approved, and in accordance with all federal, state, and local laws. Do not discharge slurry into or in close proximity to streams or other bodies of water.

3.5.

Reinforcing Steel. Completely assemble the cage of reinforcing steel, and place it as a unit immediately before concrete placement. The cage consists of longitudinal bars and lateral reinforcement (spiral reinforcement, lateral ties, or horizontal bands). Connect individual segments with couplers or by lapping steel as approved if overhead obstacles prevent placement of the cage as a single unit.

Extend the reinforcing steel cage as follows if the shaft is lengthened beyond plan length unless directed otherwise.

- Extend the cage to the bottom for shafts supporting structures other than bridges.
- Extend the cage to 25 ft. or to the bottom, whichever is shorter, for bridge shafts with plan lengths less than 25 ft.
- Do not extend the cage for bridge shafts with plan lengths at least 25 ft. that are lengthened less than 33% of plan length.
- Extend the cage as directed for bridge shafts with plan lengths at least 25 ft. that are lengthened more than 33% of plan length.

If the cage does not reach the bottom of the shaft, it may be suspended, or a portion of the longitudinal steel may be extended to support the cage on the bottom of the shaft. Bars used to extend or support the cage may be lap spliced or welded by a qualified welder. Place the extension at the bottom of the shaft.

Tie spiral reinforcement to the longitudinal bars at a spacing no more than 24 in., or as required for a stable cage. Ensure lateral reinforcement is not welded to longitudinal bars unless otherwise shown on the plans.

Center the reinforcing steel cage in the excavation using approved "roller" type centering devices unless otherwise approved. Use concrete or plastic chairs to keep the reinforcing cage off of the bottom of the hole. Use centering devices starting at 1.5 ft. off from the bottom of the cage and spaced vertically at intervals not exceeding 10 ft. Use a minimum of 3 centering devices per level at a spacing not to exceed 30 in. Flat or crescent-shaped centralizers ("sleds") are not allowed.

Support or hold down the cage to control vertical displacement during concrete placement or extraction of the casing. Use support that is concentric with the cage to prevent racking and distortion of the steel.

Check the elevation of the top of the steel cage before and after concrete placement or after casing extraction when casing is used. Downward movement of the steel up to 6 in. per 20 feet of shaft length and upward movement of the steel up to 6 in. total are acceptable.

Maintain the minimum length of steel required for lap with column steel. Use dowel bars if the proper lap length is provided both into the shaft and into the column. Locate and tie all dowel bars into the cage before placing concrete or insert dowel bars into fresh, workable concrete.

Locate and tie anchor bolts when required before placement of concrete. Use templates or other devices to assure accurate placement of anchor bolts.

- 3.6. **Concrete.** Perform all work in accordance with Item 420, "Concrete Substructures." Provide concrete with maximum placement temperatures as specified in Table 4. Provide thermal analysis to show and temperature recording devices to verify maximum core temperature requirements are met as specified in Section 420.4.7.14., "Mass Placements," as directed.

Table 4
Maximum Concrete Placing Temperature

Shaft Size	Mix Design Options 1–5	Mix Design Options 6–8
Diameter < 5 ft.	95°F	95°F
5 ft. ≤ Diameter ≤ 7 ft.	95°F	85°F
7 ft. < Diameter	85°F	75°F

Form portions of drilled shaft that project above natural ground.

Remove loose material and accumulated seep water from the bottom of the excavation before placing concrete. Place concrete using underwater placement methods if water cannot be removed.

Place concrete as soon as possible after all excavation is complete and reinforcing steel is placed. Provide workable concrete that does not require vibrating or rodding. Vibrate formed portions of drilled shafts.

Place concrete continuously for the entire length of the shaft. Limit free fall of concrete to 25 ft. for dry shafts of 24 in. or smaller diameter. Use a suitable tube or tremie to prevent segregation of materials. Use a tube or tremie in sections to provide proper discharge and permit raising as the placement progresses. For dry shafts over 24 in. diameter, concrete can be allowed to free fall an unlimited distance if it does not strike the reinforcing cage or sides of the hole during placement. Provide a hopper with a minimum 3-ft. long drop-tube at the top of the shaft to direct concrete vertically down the center of the shaft when free fall is used. Do not use a shovel or other means to simply deflect the concrete discharge from the truck.

Maintain a sufficient head of concrete for cased shafts at all times above the bottom of the casing to overcome hydrostatic pressure. Extract casing at a slow, uniform rate with the pull in line with the axis of the shaft. Monitor the concrete level in the casing during extraction. Stop the extraction and add concrete to the casing as required to ensure a completely full hole upon casing removal. The elapsed time from the mixing of the first concrete placed into the cased portion of the shaft until the completion of extraction of the casing must not exceed the time for which the concrete maintains a slump of over 4 in. in accordance with Article 416.2., "Materials." Modify the concrete mix, the construction procedures, or both for subsequent shafts if the elapsed time is exceeded.

Cure the top surface and treat any construction joint area in accordance with Item 420, "Concrete Substructures."

- 3.7. **Additional Requirements for Slurry Displacement or Underwater Concrete Placement Methods.** Place concrete on the same day the shaft is excavated and as soon as possible after all excavation is complete and reinforcing steel is placed. Use an air lift or cleanout bucket of the proper size to clean the bottom of the excavation before placing the reinforcing steel cage and concrete. Place concrete through a closed tremie or pump it to the bottom of the excavation. The minimum tremie diameter will be at least 6 times the maximum size of aggregate used in the concrete mix but not less than 10 in. Initially seal the tremie or pump line to positively separate the concrete from the slurry or water. Place concrete continuously from the beginning of placement until the shaft is completed. Keep the tremie full of concrete and well submerged in the previously placed concrete at all times if using a tremie. Raise the tremie as necessary to maintain the free flow of concrete and the stability of any casing used. Keep the discharge tube submerged in the previously placed concrete at all times if using a pump. Place additional concrete to ensure the removal of any contaminated concrete at the top of the shaft. Allow the top portion of concrete to flush completely from the hole at the completion of the pour until there is no evidence of slurry or water contamination. Do not attempt to remove this concrete with shovels, pumps, or other means. Level the top of shaft with hand tools as necessary.

Use a sump or other approved method to channel displaced fluid and concrete away from the shaft excavation. Recover slurry and dispose of it as approved. Do not discharge displaced fluids into or near

streams or other bodies of water. Provide a collar or other means of capturing slurry and the top portion of concrete flushed from the shaft for pours over water.

Remove the tube, reseal it at the bottom, penetrate with the tube into the concrete already placed by at least 5 ft., and recharge it before continuing if concrete placement is interrupted due to withdrawal of the submerged end of the tremie or pump discharge tube before completion. If this condition exists, notify the Engineer and note the elevation and circumstances related to the loss of seal on the drilled shaft log.

The elapsed time from the mixing of the first concrete placed until the completion of concrete placement, including extraction of the casing, must not exceed the time for which the concrete maintains a slump of over 4 in. in accordance with Article 416.2., "Materials." Modify the concrete mix, the construction procedures, or both for subsequent shafts if the elapsed time is exceeded.

3.8. **Test Load.** Load test shafts, if required, in accordance with Item 405, "Foundation Load Test."

3.9. **Trial Shaft.** When required on the plans, construct trial shafts to the depth and diameter specified on the plans. Trial shafts include: drilling the hole, placement of the rebar cage (unless otherwise stated), and placement of the concrete. When trial shafts are required, delay start of production shafts until successful completion of trial shafts.

4. MEASUREMENT

4.1. **Drilled Shaft.** Drilled shaft foundations will be measured by the foot to the bottom of the shaft.

4.1.1. **Interior Bents and Piers.** Shafts will be measured from a point approximately 6 in. below the finished earthwork elevation at the center of each shaft, unless specific elevations or dimensions are indicated on the plans or unless otherwise directed to meet unusual conditions. The bent height shown on the plans is for estimating purposes only and does not control the top-of-shaft measurement.

4.1.2. **Abutment Bents and Retaining Walls.** Shafts will be measured from the bottom of footing or cap elevation.

4.1.3. **Other Non-Bridge Structures.** Shafts, including trial shafts, will be measured from the top of the shaft.

4.2. **Core Hole.** Core holes will be measured by each core hole drilled.

5. PAYMENT

The unit prices bid for the various classifications of drilled shafts will be full compensation for excavation; furnishing, placing, and removing casing; furnishing, processing, and recovering slurry; furnishing, and placing reinforcing steel; pumping; furnishing and placing concrete, including additional concrete required to fill an oversize casing or oversize excavation; conducting slump loss tests; backfilling; disposing of cuttings and slurry; and materials, tools, equipment, labor, and incidentals.

When the bottom of a drilled shaft is placed at an elevation below plan grade, no direct payment will be made for extra reinforcement placed to support the cage. The extra reinforcement will be considered subsidiary to the price bid per foot of shaft. No extra payment will be made for casings left in place.

No payment will be made for "Drilled Shaft" until the concrete has been placed.

5.1. **Drilled Shaft.** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Drilled Shaft," "Drilled Shaft (Non-reinforced)," "Drilled Shaft (Sign Mounts)," "Drilled Shaft (High Mast Pole)," "Drilled Shaft (Roadway Illumination Pole)," or "Drilled Shaft (Traffic Signal Pole)" of the specified diameter, subject to the limitations for overruns authorized by the Engineer given in Section 416.5.1.1., "Overrun."

- 5.1.1. **Overrun.** Payment for individual completed shaft lengths up to and including 5 ft. in excess of the maximum plan length shaft, as defined in Section 416.5.1.2., "Maximum Plan Length Shaft," will be made at the unit price bid per foot of the specified diameter.

Payment for the portion of individual completed shaft length in excess of 5 ft. and up to and including 15 ft. more than the maximum plan length shaft, as defined in this Item, will be made at a unit price equal to 115% of the unit price bid per foot of the specified diameter.

Payment for the portion of individual completed shaft length in excess of 15 ft. more than the maximum plan length shaft, as defined in Section 416.5.1.2., "Maximum Plan Length Shaft," will be made at a unit price equal to 125% of the unit price bid per foot of the specified diameter.

- 5.1.2. **Maximum Plan Length Shaft.** Payment described above is subject to the following provisions for extra depth drilling:

- For bridge structures, the maximum plan length shaft is the maximum length shaft, regardless of diameter, for any drilled shaft on that specific bridge.
- For retaining walls, the maximum plan length shaft is the maximum length shaft, regardless of diameter, for any drilled shaft on that specific retaining wall.
- For overhead sign structures, the maximum plan length shaft is the maximum length shaft, regardless of diameter, for any overhead sign structures included in the Contract.
- For high mast illumination poles, the maximum plan length shaft is the maximum length shaft, regardless of diameter, for any high mast illumination pole included in the Contract.
- For roadway illumination poles, the maximum plan length shaft is the maximum length shaft, regardless of diameter, for any roadway illumination pole included in the Contract.
- For traffic signal poles, the maximum plan length shaft is the maximum length shaft, regardless of diameter, for any traffic signal pole included in the Contract.

- 5.2. **Core Hole.** Core holes will be paid at \$200 each.

Item 464

Reinforced Concrete Pipe



1. DESCRIPTION

Furnish and install reinforced concrete pipe, materials for precast concrete pipe culverts, or precast concrete storm drain mains, laterals, stubs, and inlet leads.

2. MATERIALS

- 2.1. **Fabrication.** Fabrication plants must be approved by the Construction Division in accordance with [DMS-7310](#), "Reinforced Concrete Pipe and Machine-Made Precast Concrete Box Culvert Fabrication and Plant Qualification," before furnishing precast reinforced concrete pipe for Department projects. The Department's MPL has a list of approved reinforced concrete pipe plants.

Furnish material and fabricate reinforced concrete pipe in accordance with [DMS-7310](#), "Reinforced Concrete Pipe and Machine-Made Precast Concrete Box Culvert Fabrication and Plant Qualification."

- 2.2. **Design.**

- 2.2.1. **General.** The class and D-load equivalents are shown in Table 1. Furnish arch pipe in accordance with ASTM C506 and the dimensions shown in Table 2. Furnish horizontal elliptical pipe in accordance with ASTM C507 and the dimensions shown in Table 3. For arch pipe and horizontal elliptical pipe the minimum height of cover required is 1 ft.

Table 1
Circular Pipe
ASTM C76 & ASTM C655

Class	D-Load
I	800
II	1,000
III	1,350
IV	2,000
V	3,000

Table 2
Arch Pipe

Design Size	Equivalent Diameter (in.)	Rise (in.)	Span (in.)
1	18	13-1/2	22
2	21	15-1/2	26
3	24	18	28-1/2
4	30	22-1/2	36-1/4
5	36	26-5/8	43-3/4
6	42	31-5/16	51-1/8
7	48	36	58-1/2
8	54	40	65
9	60	45	73
10	72	54	88

Table 3
Horizontal Elliptical Pipe

Design Size	Equivalent Diameter (in.)	Rise (in.)	Span (in.)
1	18	14	23
2	24	19	30
3	27	22	34
4	30	24	38
5	33	27	42
6	36	29	45
7	39	32	49
8	42	34	53
9	48	38	60
10	54	43	68

- 2.2.2. **Jacking, Boring, or Tunneling.** Design pipe for jacking, boring, or tunneling considering the specific installation conditions such as the soil conditions, installation methods, anticipated deflection angles, and jacking stresses. Provide design notes and drawings signed and sealed by a Texas licensed professional engineer when requested.
- 2.3. **Marking.** Furnish each section of reinforced concrete pipe marked with the following information specified in [DMS-7310](#), "Reinforced Concrete Pipe and Machine-Made Precast Concrete Box Culvert Fabrication and Plant Qualification."
- class or D-load of pipe,
 - ASTM designation,
 - date of manufacture,
 - pipe size,
 - name or trademark of fabricator and plant location,
 - designated fabricator's approval stamp,
 - pipe to be used for jacking and boring (when applicable), and
 - designation "SR" for pipe meeting sulfate-resistant concrete plan requirements (when applicable).
- Clearly mark 1 end of each section during the process of manufacture or immediately thereafter for pipe with elliptical reinforcement. Mark the pipe on the inside and outside of opposite walls to show the location of the top or bottom of the pipe as it should be installed unless the external shape of the pipe is such that the correct position of the top and bottom is obvious. Mark the pipe section by indenting or painting with waterproof paint.
- 2.4. **Inspection.** Provide access for inspection of the finished pipe at the project site before and during installation.
- 2.5. **Causes for Rejection.** Individual section of pipe may be rejected for any of the conditions stated in the Annex of [DMS-7310](#), "Reinforced Concrete Pipe and Machine-Made Precast Concrete Box Culvert Fabrication and Plant Qualification."
- 2.6. **Repairs.** Make repairs if necessary as stated in the Annex of [DMS-7310](#), "Reinforced Concrete Pipe and Machine-Made Precast Concrete Box Culvert Fabrication and Plant Qualification."
- 2.7. **Jointing Materials.** Use any of the following materials for the making of joints unless otherwise shown on the plans. Furnish a manufacturer's certificate of compliance for all jointing materials except mortar.
- 2.7.1. **Mortar.** Provide mortar for joints that meets the requirements of Section 464.3.3., "Jointing."
- 2.7.2. **Cold-Applied, Plastic Asphalt Sewer Joint Compound.** Provide a material that consists of natural or processed asphalt base, suitable volatile solvents, and inert filler. Ensure the consistency is such that the ends of the pipe can be coated with a layer of the compound up to 1/2 in. thick by means of a trowel. Provide

a joint compound that cures to a firm, stiff plastic condition after application. Provide a material of a uniform mixture. Stir any small separation found in the container into a uniform mix before using.

Provide a material that meets the requirements of Table 4 when tested in accordance with [Tex-526-C](#).

Table 4
Cold-Applied, Plastic Asphalt Sewer Joint Compound Material Requirements

Composition	Analysis
Asphalt base, 100%–% volatiles–% ash, % by weight	28–45
Volatiles, 212°F evaporation, 24 hr., % by weight	10–26
Mineral matter, determined as ash, % by weight	30–55
Consistency, cone penetration, 150 g, 5 sec., 77°F	150–275

- 2.7.3. **Rubber Gaskets.** Provide gaskets that conform to ASTM C1619 Class A or C. Meet the requirements of ASTM C443 for design of the pipe joints and permissible variations in dimensions.
- 2.7.4. **Pre-Formed Flexible Joint Sealants.** Pre-formed flexible joint sealants may be used for sealing joints of tongue-and-groove concrete pipe. Provide flexible joint sealants that meet the requirements of ASTM C990. Use flexible joint sealants that do not depend on oxidizing, evaporating, or chemical action for its adhesive or cohesive strength. Supply in extruded rope form of suitable cross-section. Provide a size of the pre-formed flexible joint sealant in accordance with the manufacturer's recommendations and large enough to properly seal the joint. Protect flexible joint sealants with a suitable wrapper able to maintain the integrity of the jointing material when the wrapper is removed.

3. CONSTRUCTION

- 3.1. **Excavation, Shaping, Bedding, and Backfill.** Excavate, shape, bed, and backfill in accordance with Item 400, "Excavation and Backfill for Structures," except where jacking, boring, or tunneling methods are permitted. Jack, bore, or tunnel the pipe in accordance with Item 476, "Jacking, Boring, or Tunneling Pipe or Box." Immediate backfilling is permitted if joints consist of materials other than mortar. Take special precautions in placing and compacting the backfill to avoid any movement of the pipe or damage to the joints. Do not use heavy earth-moving equipment to haul over the structure until a minimum of 4 ft. of permanent or temporary compacted fill has been placed over the structure unless otherwise shown on the plans or permitted in writing. Remove and replace pipe damaged by the Contractor at no expense to the Department.
- 3.2. **Laying Pipe.** Start the laying of pipe on the bedding at the outlet end with the spigot or tongue end pointing downstream, and proceed toward the inlet end with the abutting sections properly matched, true to the established lines and grades unless otherwise authorized. Fit, match, and lay the pipe to form a smooth, uniform conduit. Cut cross trenches in the foundation to allow the barrel of the pipe to rest firmly upon the bedding where bell-and-spigot pipe is used. Cut cross trenches no more than 2 in. larger than the bell ends of the pipe. Lower sections of pipe into the trench without damaging the pipe or disturbing the bedding and the sides of the trench. Carefully clean the ends of the pipe before the pipe is placed. Prevent the earth or bedding material from entering the pipe as it is laid. Lay the pipe in the trench, when elliptical pipe with circular reinforcing or circular pipe with elliptical reinforcing is used, so the markings for the top or bottom are not more than 5° from the vertical plane through the longitudinal axis of the pipe. Remove and re-lay, without extra compensation, pipe that is not in alignment or shows excessive settlement after laying.

Lay multiple lines of reinforced concrete pipe with the centerlines of the individual barrels parallel. Use the clear distances between outer surfaces of adjacent pipes shown in Table 5 unless otherwise shown on the plans. Use the equivalent diameter from Table 2 or Table 3 for arch pipe or horizontal elliptical pipe to determine the clear distance requirement in Table 5.

Table 5
Minimum Clear Distance between Pipes

Equivalent Diameter	Min Clear Distance
18 in.	9 in.
24 in.	11 in.
30 in.	1 ft. 1 in.
36 in.	1 ft. 3 in.
42 in.	1 ft. 5 in.
48 in.	1 ft. 7 in.
54 in.	1 ft. 11 in.
60 to 84 in.	2 ft.

- 3.3. **Jointing.** Make available an appropriate rolling device similar to an automobile mechanic's "creeper" for conveyance through small-size pipe structures.
- 3.3.1. **Joints Sealed with Hydraulic Cement Mortar.** Use Type S mortar meeting the requirements of ASTM C270. Clean and wet the pipe ends before making the joint. Plaster the lower half of the bell or groove and the upper half of the tongue or spigot with mortar. Pack mortar into the joint from both inside and outside the pipe after the pipes are tightly jointed. Finish the inside smooth and flush with adjacent joints of pipe. Form a bead of semicircular cross-section over tongue-and-groove joints outside the pipe, extending at least 1 in. on each side of the joint. Form the mortar for bell-and-spigot joints to a 45° fillet between the outer edge of the bell and the spigot. Cure mortar joints by keeping the joints wet for at least 48 hr. or until the backfill has been completed, whichever comes first. Place fill or backfill once the mortar jointing material has cured for at least 6 hr. Conduct jointing only when the atmospheric temperature is above 40°F. Protect mortared joints against freezing by backfilling or other approved methods for at least 24 hr.
- Driveway culverts do not require mortar banding on the outside of the pipe.
- Furnish pipes, with approval, that are large enough for a person to enter with the groove between 1/2 in. and 3/4 in. longer than the tongue. Such pipe may be laid and backfilled without mortar joints. Clean the space on the interior of the pipe between the end of the tongue and the groove of all foreign material, thoroughly wet and fill with mortar around the entire circumference of the pipe, and finish flush after the backfilling has been completed.
- 3.3.2. **Joints Using Cold-Applied, Plastic Asphalt Sewer Joint Compound.** Ensure both ends of the pipes are clean and dry. Trowel or otherwise place a 1/2-in. thick layer of the compound in the groove end of the pipe covering at least 2/3 of the joint face around the entire circumference. Shove home the tongue end of the next pipe with enough pressure to make a tight joint. Remove any excess mastic projecting into the pipe after the joint is made. Backfill after the joint has been inspected and approved.
- 3.3.3. **Joints Using Rubber Gaskets.** Make the joint assembly according to the recommendations of the gasket manufacturer. Make joints watertight when using rubber gaskets. Backfill after the joint has been inspected and approved.
- 3.3.4. **Joints Using Pre-Formed Flexible Joint Sealants.** Install pre-formed flexible joint sealants in accordance with the manufacturer's recommendations. Place the joint sealer so no dirt or other deleterious materials come in contact with the joint sealing material. Pull or push home the pipe with enough force to properly seal the joint. Remove any joint material pushed out into the interior of the pipe that would tend to obstruct the flow. Store pre-formed flexible joint sealants in an area warmed naturally or artificially to above 70°F in an approved manner when the atmospheric temperature is below 60°F. Apply flexible joint sealants to pipe joints immediately before placing pipe in trench, and connect pipe to previously laid pipe. Backfill after the joint has been inspected and approved.
- 3.4. **Connections and Stub Ends.** Make connections of concrete pipe to existing pipes, pipe storm drains, or storm drain appurtenances as shown on the plans.

Mortar or concrete the bottom of existing structures if necessary to eliminate any drainage pockets created by the connections. Repair any damage to the existing structure resulting from making the connections.

Make connections between concrete pipe and corrugated metal pipe with a suitable concrete collar and a minimum thickness of 4 in. unless otherwise shown on the plans.

Finish stub ends for connections to future work not shown on the plans by installing watertight plugs into the free end of the pipe.

Fill lift holes with concrete, mortar, or precast concrete plugs after the pipe is in place.

4. MEASUREMENT

This Item will be measured by the foot. Measurement will be made between the ends of the pipe barrel along the flow line, not including safety end treatments. Safety end treatments will be measured in accordance with Item 467, "Safety End Treatment." Pipe that will be jacked, bored, or tunneled will be measured in accordance with Item 476, "Jacking, Boring, or Tunneling Pipe or Box." Measurement of spurs, branches, or new connecting pipe will be made from the intersection of the flow line with the outside surface of the pipe into which it connects. Where inlets, headwalls, catch basins, manholes, junction chambers, or other structures are included in lines of pipe, the length of pipe tying into the structure wall will be included for measurement, but no other portion of the structure length or width will be included.

For multiple pipes, the measured length will be the sum of the lengths of the barrels.

This is a plans quantity measurement Item. The quantity to be paid is the quantity shown in the proposal unless modified by Article 9.2., "Plans Quantity Measurement." Additional measurements or calculations will be made if adjustments of quantities are required.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Reinforced Concrete Pipe," "Reinforced Concrete Pipe (Arch)," or "Reinforced Concrete Pipe (Elliptical)" of the size and D-load specified or of the size and class specified. This price is full compensation for constructing, furnishing, transporting, placing, and joining pipes; shaping the bed; cutting pipes on skew or slope; connecting to new or existing structures; breaking back, removing, and disposing of portions of the existing structure; replacing portions of the existing structure; cutting pipe ends on skew or slope; and equipment, labor, tools, and incidentals.

Protection methods for excavations greater than 5 ft. deep will be measured and paid for as required under Item 402, "Trench Excavation Protection," or Item 403, "Temporary Special Shoring." Excavation, shaping, bedding, and backfill will be paid for in accordance with Item 400, "Excavation and Backfill for Structures." When jacking, boring, or tunneling is used at the Contractor's option, payment will be made under this Item. When jacking, boring or tunneling is required, payment will be made under Item 476, "Jacking, Boring or Tunneling Pipe or Box."

Item 492

Timber Preservative and Treatment



1. DESCRIPTION

Pressure-treat piles, posts, timbers, and lumber with preservative.

2. MATERIALS

Treating plants furnishing treated timber products must meet the requirements of AWP Standard M3. All treaters except those of structural glued laminated timber must be Department-approved. The Department's MPL has a list of approved treating plants. Treaters and suppliers of metal beam guard fence posts and blocks must enter into a stocking agreement with the Department. AWP standards govern materials and methods of treatments including seasoning, preservatives, and inspection for treatment. Provide the level of preservative shown in Table 1.

Table 1
AWPA Commodity Specification and Use Category by Product

Product	AWPA Commodity Specification ¹	AWPA Use Category ²
Round timber piling for land or freshwater use, including foundation piles	E	UC4C
Round timber piling for brackish or saltwater use—marine piles	G	UC5C
Round guard fence posts	B	UC4B
Rectangular guard fence posts	A	UC4B
Guard fence blocks	A	UC4A
Wire fence posts (round)	B	UC4A
Timber and lumber for land or freshwater use	A	UC4C
Timber and lumber for use in brackish or salt water	G	UC5C

1. For minimum preservative retention requirements, refer to this designated commodity specification for each product within Use Category System Standard U1 of AWP for the preservative and wood species combination provided. For preservative penetration and assay zone requirements, refer to this designated commodity specification for each product within Use Category System Standard T1 of AWP.
2. Refer to this designated use category for each product when locating the minimum preservative retention requirement in the pertinent commodity specification within Use Category System Standard U1 of AWP.

- 2.1. **Inspection.** Provide access for the Inspector to all parts of facilities used in the conditioning and treating of timber products in accordance with Article 6.5., "Plant Inspection and Testing." The supplier must provide necessary assistance for the proper inspection of the materials being furnished.
- 2.2. **Identification.** Each piece or bundle of treated timber products must have a legible brand mark or tag indicating the name of the treater, date of treatment or lot number, and AWP treatment specification symbol. Furnish a completed Department [Form 2148](#), "Certification of Compliance," with every shipment of treated timber products.
- 2.3. **Field Treatment.** When it is necessary to bore holes or to cut pressure-treated materials after treatment or when any treated surface is badly scarred, treat the hole, cut, or scarred surface in accordance with AWP Standard M4.

3. MEASUREMENT AND PAYMENT

The work performed, materials furnished, equipment, labor, tools, and incidentals will not be measured or paid for directly, but will be subsidiary to pertinent Items.

Item 500

Mobilization



1. DESCRIPTION

Establish and remove offices, plants, and facilities. Move personnel, equipment, and supplies to and from the project or the vicinity of the project site to begin work or complete work on Contract Items. Bonds and insurance are required for performing mobilization.

For Contracts with emergency mobilization, provide a person and method of contact available 24 hrs. a day, 7 days a week unless otherwise shown on the plans. The time of notice will be the transmission time of the written notice or notice provided orally by the Department's representative.

2. MEASUREMENT

This Item will be measured by the lump sum or each as the work progresses. Mobilization is calculated on the base bid only and will not be paid for separately on any additive alternate items added to the Contract.

3. PAYMENT

For this Item, the adjusted Contract amount will be calculated as the total Contract amount less the lump sum for mobilization. Except for Contracts with callout or emergency work, mobilization will be paid in partial payments as follows:

- Payment will be made upon presentation of a paid invoice for the payment or performance bonds and required insurance,
- Payment will be made upon verification of documented expenditures for plant and facility setup. The combined amount for all these facilities will be no more than 10% of the mobilization lump sum or 1% of the total Contract amount, whichever is less,
- When 1% of the adjusted Contract amount for construction Items is earned, 50% of the mobilization lump sum bid or 5% of the total Contract amount, whichever is less, will be paid. Previous payments under this Item will be deducted from this amount,
- When 5% of the adjusted Contract amount for construction Items is earned, 75% of the mobilization lump sum bid or 10% of the total Contract amount, whichever is less, will be paid. Previous payments under the Item will be deducted from this amount,
- When 10% of the adjusted Contract amount for construction Items is earned, 90% of the mobilization lump sum bid or 10% of the total Contract amount, whichever is less, will be paid. Previous payments under this Item will be deducted from this amount,
- Upon final acceptance, 97% of the mobilization lump sum bid will be paid. Previous payments under this Item will be deducted from this amount, and
- Payment for the remainder of the lump sum bid for "Mobilization" will be made after all submittals are received, final quantities have been determined and when any separate vegetative establishment and maintenance, test, and performance periods provided for in the Contract have been successfully completed.

For projects with extended maintenance or performance periods, payment for the remainder of the lump sum bid for "Mobilization" will be made 6 months after final acceptance.

For Contracts with callout or emergency work, "Mobilization," will be paid as follows:

- Payment will be made upon presentation of a paid invoice for the payment of performance bonds and required insurance,
- Mobilization for callout work will be paid for each callout work request, and
- Mobilization for emergency work will be paid for each emergency work request.

Item 644

Small Roadside Sign Assemblies



1. DESCRIPTION

- **Installation.** Furnish, fabricate, and erect small roadside sign assemblies or bridge mounted clearance sign assemblies consisting of the signs, sign supports, foundations (when required), and associated mounting hardware.
- **Relocation.** Relocate existing small roadside sign assemblies or bridge mounted clearance sign assemblies, and furnish and fabricate material as required.
- **Removal.** Remove existing small roadside sign assemblies or bridge mounted clearance sign assemblies.

2. MATERIALS

Furnish all materials unless otherwise shown on the plans. Furnish only new materials. Furnish and fabricate materials that comply with the following Items and details shown on the plans:

- Item 421, "Hydraulic Cement Concrete"
- Item 440, "Reinforcement for Concrete"
- Item 441, "Steel Structures"
- Item 442, "Metal for Structures"
- Item 445, "Galvanizing"
- Item 636, "Signs"
- Item 643, "Sign Identification Decals"
- Item 656, "Foundations for Traffic Control Devices"

Use galvanized steel, stainless steel, dichromate sealed aluminum, or other materials shown on the plans for pipe, bolts, nuts, washers, lock washers, screws, and other sign assembly hardware. When dissimilar metals are used, select or insulate metals to prevent corrosion.

3. CONSTRUCTION

Construct foundations in accordance with Item 656, "Foundations for Traffic Control Devices." Plumb sign supports. Do not spring or rake posts to secure proper alignment. Use established safety practices when working near underground or overhead utilities. Consult the appropriate utility company before beginning work.

- 3.1. **Fabrication.** Fabricate sign supports in accordance with Item 441, "Steel Structures." Ensure all components fit properly.

Verify the length of each post for each sign before fabrication to meet field conditions and sign-mounting heights shown on the plans.

Hot-dip galvanize fabricated parts in accordance with Item 445, "Galvanizing." Punch or drill any holes in steel parts or members before galvanizing. Repair galvanizing for any steel part or member damaged during assembly, transit, erection; or for any steel part or member welded, when permitted, after galvanizing. Perform all galvanizing repairs in accordance with Section 445.3.5., "Repairs."

- 3.2. **Installation.** Locate and install sign supports as shown on the plans, unless directed to shift the sign supports within design guidelines to secure a more desirable location or avoid conflict with utilities and underground appurtenances. Stake sign support locations for verification by the Engineer.
- Install stub posts of the type, spacing, orientation, and projection shown on the plans. Remove and replace posts damaged during installation at the Contractor's expense.
- Connect the upper post sections to the stub post sections as shown on the plans. Torque connection bolts as shown on the plans.
- Attach signs to supports in accordance with the plans and pertinent Items.
- 3.3. **Relocation.** Reuse the existing signs as required unless otherwise shown on the plans. Furnish and install new stub posts in new foundations for relocated sign assemblies. Erect the new supports on the new stub posts, and attach the existing signs to the supports in accordance with the plans and pertinent Items. Remove existing foundations to be abandoned in accordance with Section 644.3.4., "Removal."
- 3.4. **Removal.** Remove abandoned concrete foundations to 2 ft. below finish grade unless otherwise shown on the plans. Cut off and remove steel protruding from the remaining concrete. Backfill the remaining hole with material equal in composition and density to the surrounding area. Replace any surfacing with like material to equivalent condition.
- 3.5. **Handling and Storage.** Handle and store existing signs or portions of signs removed so they are not damaged. Prevent any damage to the various sign assembly components. Replace any portion of the sign damaged by the Contractor designated for reuse or salvage, including messages removed.
- Stockpile all removed sign components that will be reused or become the property of the Department at designated locations. Accept ownership of unsalvageable materials, and dispose of them in accordance with federal, state, and local regulations.
- 3.6. **Cleaning.** Wash the entire sign after installation with a biodegradable cleaning solution acceptable to the sign face materials manufacturer to remove dirt, grease, oil smears, streaks, finger marks, and other foreign materials.

4. MEASUREMENT

This Item will be measured as each small roadside assembly or bridge mounted clearance sign assembly installed, removed, or relocated.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Install Small Roadside Sign Assemblies" of the type specified, "Install Bridge Mounted Clearance Sign Assemblies" of the type specified, "Relocate Small Roadside Sign Assemblies" of the type specified, "Relocate Bridge Mounted Clearance Sign Assemblies" of the type specified, "Remove Small Roadside Sign Assemblies," or "Remove Bridge Mounted Clearance Sign Assemblies."

- 5.1. **Installation.** This price is full compensation for furnishing, fabricating, galvanizing, and erecting the supports; constructing foundations including concrete (when required); furnishing complete signs including sign connections and all hardware; attaching the signs to the supports; preparing and cleaning the signs; and materials, equipment, labor, tools, and incidentals.
- 5.2. **Relocation.** This price is full compensation for removing existing sign assemblies and related materials; furnishing and installing new stub posts and new sign supports; constructing foundations including concrete

(when required); and new hardware; reinstallation of signs; preparing and cleaning the signs; salvaging; disposal of unsalvageable materials; removing existing foundations, backfilling, and surface placement; and materials, equipment, labor, tools, and incidentals.

- 5.3. **Removal.** This price is full compensation for removing existing sign assemblies and related materials; salvaging; disposal of unsalvageable materials; removing existing foundations, backfilling, and surface placement; and materials, equipment, labor, tools, and incidentals.

Item 666

Retroreflectorized Pavement Markings



1. DESCRIPTION

Furnish and place retroreflectorized, non-retroreflectorized (shadow) and profile pavement markings.

2. MATERIALS

2.1. Type I Marking Materials. Furnish in accordance with [DMS-8220](#), "Hot Applied Thermoplastic."

Furnish pavement marking material used for Type I profile markings and shadow markings that have been approved by the Construction Division, and in accordance with [DMS-8220](#), "Hot Applied Thermoplastic."

2.2. Type II Marking Materials. Furnish in accordance with [DMS-8200](#), "Traffic Paint."

2.3. Glass Traffic Beads. Furnish drop-on glass beads in accordance with [DMS-8290](#), "Glass Traffic Beads" or as approved. Furnish a double-drop of Type II and Type III drop-on glass beads where each type bead is applied separately in equal portions (by weight), unless otherwise approved. Apply the Type III beads before applying the Type II beads.

2.4. Labeling. Use clearly marked containers that indicate color, mass, material type, manufacturer, and batch number.

3. EQUIPMENT

3.1. General Requirements. Use equipment that:

- is maintained in satisfactory condition,
- meets or exceeds the requirements of the National Board of Fire Underwriters and the Texas Railroad Commission for this application,
- applies beads by an automatic bead dispenser attached to the pavement marking equipment in such a manner that the beads are dispensed uniformly and almost instantly upon the marking as the marking is being applied to the road surface. The bead dispenser must have an automatic cut-off control, synchronized with the cut-off of the pavement marking equipment,
- has an automatic cut-off device with manual operating capabilities to provide clean, square marking ends,
- is capable of producing the types and shapes of profiles specified, and
- can provide continuous mixing and agitation of the pavement marking material. The use of pans, aprons, or similar appliances which the die overruns will not be permitted for longitudinal striping applications.

Provide a hand-held thermometer capable of measuring the temperature of the marking material when applying Type I material.

When pavement markings are required to meet minimum retroreflectivity requirements on the plans:

- Use a mobile retroreflectometer approved by the Construction Division and certified by the Texas A&M Transportation Institute Mobile Retroreflectometer Certification Program.
- Use a portable retroreflectometer that:
 - uses 30-meter geometry and meets the requirements described in ASTM E1710;

- has either an internal global positioning system (GPS) or the ability to be linked with an external GPS with a minimum accuracy rating of 16 ft. 5 in., in accordance with the circular error probability (CEP) method (CEP is the radius of the circle with its origin at a known position that encompasses 50% of the readings returned from the GPS instrument);
- can record and print the GPS location and retroreflectivity reading for each location where readings are taken.

3.2.

Material Placement Requirements. Use equipment that can place:

- at least 40,000 ft. of 4-in. solid or broken non-profile markings per working day at the specified thickness;
- at least 15,000 ft. of solid or broken profile pavement markings per working day at the specified thickness;
- linear non-profile markings up to 8 in. wide in a single pass;
- non-profile pavement markings other than solid or broken lines at an approved production rate;
- a centerline and no-passing barrier-line configuration consisting of 1 broken line and 2 solid lines at the same time to the alignment, spacing, and thickness for non-profile pavement markings shown on the plans;
- solid and broken lines simultaneously;
- white line from both sides;
- lines with clean edges, uniform cross-section with a tolerance of $\pm 1/8$ in. per 4 in. width, uniform thickness, and reasonably square ends;
- skip lines between 10 and 10-1/2 ft., a stripe-to-gap ratio of 10 to 30, and a stripe-gap cycle between 39-1/2 ft. and 40-1/2 ft., automatically;
- beads uniformly and almost instantly on the marking as the marking is being applied;
- beads uniformly during the application of all lines (each line must have an equivalent bead yield rate and embedment); and
- double-drop bead applications using both Type II and Type III beads from separate independent bead applicators, unless otherwise approved by the Engineer.

4.

CONSTRUCTION

Place markings before opening to traffic unless short-term or work zone markings are allowed.

4.1.

General. Obtain approval for the sequence of work and estimated daily production. Minimize interference to roadway operations when placing markings on roadways open to traffic. Use traffic control as shown on the plans or as approved. Protect all markings placed under open-traffic conditions from traffic damage and disfigurement.

Establish guides to mark the lateral location of pavement markings as shown on the plans or as directed, and have guide locations verified. Use material for guides that will not leave a permanent mark on the roadway.

Apply markings on pavement that is completely dry and passes the following tests:

- **Type I Marking Application**—Place a sample of Type I marking material on a piece of tarpaper placed on the pavement. Allow the material to cool to ambient temperature, and then inspect the underside of the tarpaper in contact with the pavement. Pavement will be considered dry if there is no condensation on the tarpaper.
- **Type II Marking Application**—Place a 1-sq. ft. piece of clear plastic on the pavement, and weight down the edges. The pavement is considered dry if, when inspected after 15 min., no condensation has occurred on the underside of the plastic.

Apply markings:

- that meet the requirements of [Tex-828-B](#),
- that meet minimum retroreflectivity requirements when specified on the plans (applies to Type I markings only),
- using widths and colors shown on the plans,
- at locations shown on the plans,
- in proper alignment with the guides without deviating from the alignment more than 1 in. per 200 ft. of roadway or more than 2 in. maximum,
- without abrupt deviations,
- free of blisters and with no more than 5% by area of holes or voids,
- with uniform cross-section, density and thickness,
- with clean and reasonably square ends,
- that are retroreflectorized with drop-on glass beads, and
- using personnel skilled and experienced with installation of pavement markings.

Remove all applied markings that are not in alignment or sequence as stated on the plans, or in the specifications, at the Contractor's expense in accordance with Item 677, "Eliminating Existing Pavement Markings and Markers," except for measurement and payment.

- 4.2. **Surface Preparation.** Prepare surfaces in accordance with this Section unless otherwise shown on the plans.
- 4.2.1. **Cleaning for New Asphalt Surfaces and Retracing of All Surfaces.** Air blast or broom the pavement surface for new asphalt surfaces (less than 3 years old) and for retracing of all surfaces to remove loose material, unless otherwise shown on the plans. A sealer for Type I markings is not required unless otherwise shown on the plans.
- 4.2.2. **Cleaning for Old Asphalt and Concrete Surfaces (Excludes Retracing).** Clean old asphalt surfaces (more than 3 years old) and all concrete surfaces in accordance with Item 678, "Pavement Surface Preparation for Markings," to remove curing membrane, dirt, grease, loose and flaking existing construction markings, and other forms of contamination.
- 4.2.3. **Sealer for Type I Markings.** Apply a pavement sealer to old asphalt surfaces (more than 3 years old) and to all concrete surfaces before placing Type I markings on locations that do not have existing markings, unless otherwise approved. The pavement sealer may be either a Type II marking or an acrylic or epoxy sealer as recommended by the Type I marking manufacturer unless otherwise shown on the plans. Follow the manufacturer's directions for application of acrylic or epoxy sealers. Clean sealer that becomes dirty after placement by washing or in accordance with Section 666.4.2.1., "Cleaning for New Asphalt Surfaces and Retracing of All Surfaces," as directed. Place the sealer in the same configuration and color (unless clear) as the Type I markings unless otherwise shown on the plans.
- 4.3. **Application.** Apply markings during good weather unless otherwise directed. If markings are placed at Contractor option when inclement weather is impending and the markings are damaged by subsequent precipitation, the Contractor is responsible for all required replacement costs.
- 4.3.1. **Type I Markings.** Place the Type I marking after the sealer cures. Apply within the temperature limits recommended by the material manufacturer. Flush the spray head if spray application operations cease for 5 min or longer by spraying marking material into a pan or similar container until the material being applied is at the recommended temperature.

Apply on clean, dry pavements passing the moisture test described in Section 666.4.1., "General," and with a surface temperature above 50°F when measured in accordance with [Tex-829-B](#).

- 4.3.1.1. **Non-Profile Pavement Markings.** Apply Type I non-profile markings with a minimum thickness of:
- 0.100 in. (100 mils) for new markings and retracing water-based markings on surface treatments involving Item 316, "Seal Coat,"
 - 0.060 in. (60 mils) for retracing on thermoplastic pavement markings, or
 - 0.090 in. (90 mils) for all other Type I markings.
- The maximum thickness for Type I non-profile markings is 0.180 in. (180 mils). Measure thickness for markings in accordance with [Tex-854-B](#) using the tape method.
- 4.3.1.2. **Profile Pavement Markings.** Apply Type I profile markings with a minimum thickness of:
- 0.060 in. (60 mil) for edgeline markings, or
 - 0.090 in. (90 mil) for gore and centerline/no-passing barrier line markings.
- In addition, at a longitudinal spacing indicated on the plans, the markings must be profiled in a vertical manner such that the profile is transverse to the longitudinal marking direction. The profile must not be less than 0.30 in. (300 mil) nor greater than 0.50 in. (500 mil) in height when measured above the normal top surface plane of the roadway. The transverse width of the profile must not be less than 3.25 in., and the longitudinal width not less than 1 in., when measured at the top surface plane of the profile bar. The profile may be either a 1 or 2 transverse bar profile. When the 2 transverse bar profile is used, the spacing between the bases of the profile bars must not exceed 0.50 in. The above transverse bar width is for each 4 in. of line width.
- 4.3.2. **Type II Markings.** Apply on surfaces with a minimum surface temperature of 50°F. Apply at least 20 gal. per mile on concrete and asphalt surfaces and at least 22 gal. per mile on surface treatments for a solid 4-in. line. Adjust application rates proportionally for other widths. When Type II markings are used as a sealer for Type I markings, apply at least 15 gal. per mile using Type II drop-on beads.
- 4.3.3. **Bead Coverage.** Provide a uniform distribution of beads across the surface of the stripe for Type I and Type II markings, with 40% to 60% bead embedment.
- 4.4. **Retroreflectivity Requirements.** When specified on the plans, Type I markings must meet the following minimum retroreflectivity values for edgeline markings, centerline or no passing barrier-line, and lane lines when measured any time after 3 days, but not later than 10 days after application:
- White markings: 250 millicandelas per square meter per lux (mcd/m²/lx)
 - Yellow markings: 175 mcd/m²/lx
- 4.5. **Retroreflectivity Measurements.** Use a mobile retroreflectometer for projects requiring minimum retroreflectivity requirements to measure retroreflectivity for Contracts totaling more than 200,000 ft. of pavement markings, unless otherwise shown on the plans. For Contracts with less than 200,000 ft. of pavement markings or Contracts with callout work, mobile or portable retroreflectometers may be used at the Contractor's discretion.
- 4.5.1. **Mobile Retroreflectometer Measurements.** Provide mobile measurements averages for every 0.1 miles unless otherwise specified or approved. Take measurements on each section of roadway for each series of markings (i.e., edgeline, center skip line, each line of a double line, etc.) and for each direction of traffic flow. Measure each line in both directions for centerlines on two-way roadways (i.e., measure both double solid lines in both directions and measure all center skip lines in both directions). Furnish measurements in compliance with Special Specification, "Mobile Retroreflectivity Data Collection for Pavement Markings," unless otherwise approved. The Engineer may require an occasional field comparison check with a portable retroreflectometer meeting the requirements listed above to ensure accuracy. Use all equipment in accordance with the manufacturer's recommendations and directions. Inform the Engineer at least 24 hr. before taking any measurements.

A marking meets the retroreflectivity requirements if:

- the combined average retroreflectivity measurement for a one-mile segment meets the minimum retroreflectivity values specified, and
- no more than 30% of the retroreflectivity measurement values are below the minimum retroreflectivity requirements value within the one-mile segment.

The Engineer may accept failing one-mile segments if no more than 20% of the retroreflectivity measurements within that mile segment are below the minimum retroreflectivity requirement value.

The one-mile segment will start from the beginning of the data collection and end after a mile worth of measurements have been taken; each subsequent mile of measurements will be a new segment. Centerlines with 2 stripes (either solid or broken) will result in 2 miles of data for each mile segment. Each centerline stripe must be tested for compliance as a stand-alone stripe.

Restripe at the Contractor's expense with a minimum of 0.060 in. (60 mils) of Type I marking if the marking fails retroreflectivity requirements. Take measurements every 0.1 miles a minimum of 10 days after this second application within that mile segment for that series of markings.

If the markings do not meet minimum retroreflectivity after 10 days of this second application, the Engineer may require removal of all existing markings, a new application as initially specified, and a repeat of the application process until minimum retroreflectivity requirements are met.

- 4.5.2. **Portable Retroreflectometer Measurements.** Take a minimum of 20 measurements for each 1-mi. section of roadway for each series of markings (i.e., edgeline, center skip line, each line of a double line, etc.) and direction of traffic flow when using a portable reflectometer. Measure each line in both directions for centerlines on two-way roadways (i.e., measure both double solid lines in both directions and measure all center skip lines in both directions). The spacing between each measurement must be at least 100 ft. The Engineer may decrease the mileage frequency for measurements if the previous measurements provide satisfactory results. The Engineer may require the original number of measurements if concerns arise.

Restripe once at the Contractor's expense with a minimum of 0.060 in. (60 mils) of Type I marking material if the average of these measurements fails. Take a minimum of 10 more measurements after 10 days of this second application within that mile segment for that series of markings. Restripe again at the Contractor's expense with a minimum of 0.060 in. (60 mils) of Type I marking material if the average of these measurements fall below the minimum retroreflectivity requirements. If the markings do not meet minimum retroreflectivity after this third application, the Engineer may require removal of all existing markings, a new application as initially specified, and a repeat of the application process until minimum retroreflectivity requirements are met.

- 4.5.3. **Traffic Control.** Provide traffic control, as required, when taking retroreflectivity measurements after marking application. On low volume roadways (as defined on the plans), refer to the figure, "Temporary Road Closure" in Part 6 of the *Texas Manual on Uniform Traffic Control Devices* for the minimum traffic control requirements. For all other roadways, the minimum traffic control requirements will be as shown on the Traffic Control Plan (TCP) standard sheets TCP (3-1) and TCP (3-2). The lead vehicle will not be required on divided highways. The TCP and traffic control devices must meet the requirements listed in Item 502, "Barricades, Signs, and Traffic Handling." Time restrictions that apply during striping application will also apply during the retroreflectivity inspections except when using the mobile retroreflectometer unless otherwise shown on the plans or approved.

- 4.6. **Performance Period.** All markings must meet the requirements of this specification for at least 30 calendar days after installation. Unless otherwise directed, remove pavement markings that fail to meet requirements, and replace at the Contractor's expense. Replace failing markings within 30 days of notification. All replacement markings must also meet all requirements of this Item for a minimum of 30 calendar days after installation.

5. MEASUREMENT

This Item will be measured by the foot; by each word, symbol, or shape; or by any other unit shown on the plans. Each stripe will be measured separately.

This is a plans quantity measurement item. The quantity to be paid is the quantity shown in the proposal unless modified by Article 9.2., "Plans Quantity Measurement." Additional measurements or calculations will be made if adjustments of quantities are required.

Acrylic or epoxy sealer, or Type II markings when used as a sealer for Type I markings, will be measured by the foot; by each word, symbol, or shape; or by any other unit shown on the plans.

6. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Pavement Sealer" of the size specified, "Retroreflectorized Pavement Markings" of the type and color specified and the shape, width, size, and thickness specified as applicable, "Retroreflectorized Pavement Markings with Retroreflective Requirements" of the types, colors, sizes, widths, and thicknesses specified or "Retroreflectorized Profile Pavement Markings" of the various types, colors, shapes, sizes, and widths specified.

This price is full compensation for application of pavement markings, materials, equipment, labor, tools, and incidentals.

Surface preparation of new concrete and asphalt concrete pavements more than 3 years old, where no stripe exists, will be paid for under Item 678, "Pavement Surface Preparation for Markings." Surface preparation of all other asphalt and old concrete pavement, except for sealing, will not be paid for directly but is subsidiary to this Item.

Work zone pavement markings (Type II, paint and beads) used as a sealer for Type I markings (thermoplastic) will be paid for under Item 662, "Work Zone Pavement Markings."

If the Engineer requires that markings be placed in inclement weather, repair or replacement of markings damaged by the inclement weather will be paid for in addition to the original plans quantity.

Item 668

Prefabricated Pavement Markings



1. DESCRIPTION

Furnish and place retroreflectorized or non-reflectorized (contrast) prefabricated pavement markings.

2. MATERIALS

Furnish prefabricated pavement marking materials in accordance with [DMS-8240](#), "Permanent Prefabricated Pavement Markings."

Furnish prefabricated pavement marking materials used for contrast markings in accordance with [DMS-8240](#), "Permanent Prefabricated Pavement Markings," with the exception that the color requirement for the black contrast portion does not have to meet the color requirements specified for white or yellow markings. Store all materials in a weatherproof enclosure and prevent damage during storage.

3. CONSTRUCTION

3.1. **General.** Obtain approval for the sequence of work and estimated daily production. Remove all waste generated from the jobsite before the end of each working day.

Establish guides to mark the lateral location of pavement markings as shown on the plans or as directed, and have guide locations verified. Use guide material that will not leave a permanent mark on the roadway.

Place pavement markings in alignment with the guides without deviating from the alignment more than 1 in. per 200 ft. of roadway or more than 2 in. maximum and with no abrupt deviations.

3.2. **Placement Limitations.** Do not place Type B pavement-marking materials between September 30 and March 1 unless otherwise directed.

3.2.1. **Moisture.** Apply material to pavement that is completely dry. Pavement will be considered dry if, on a sunny day after 15 min., no condensation occurs on the underside of a 1-sq. ft. piece of clear plastic that has been placed on the pavement and weighted on the edges.

3.2.2. **Temperature.** Follow pavement and ambient air temperature requirements recommended by the material manufacturer. Do not place material when the pavement temperature is below 60°F or above 120°F if the material manufacturer does not establish temperature requirements.

3.3. **Dimensions.** Place markings in accordance with the color, length, width, shape, and configuration shown on the plans. Locate alignment as shown on the plans or as directed.

3.4. **Methods.** Place all materials in accordance with the material manufacturer's instructions, as well as the surface condition, moisture and temperature requirements of this Item, unless otherwise directed.

3.5. **Surface Preparation.** Prepare surface by any approved cleaning method that effectively removes contaminants, loose materials, and conditions deleterious to proper adhesion. Abrasive or water-blast cleaning is not required unless shown on the plans. Blast clean, when required, in accordance with Item 678, "Pavement Surface Preparation for Markings." Prepare surfaces further after cleaning by sealing or priming as recommended by the pavement-marking material manufacturer or as directed. Use adhesive, when

required, of the type and quality recommended by the pavement-marking material manufacturer. Do not clean concrete pavement surfaces by grinding.

3.6. **Performance Requirements.**

3.6.1. **Adhesion.** Ensure markings do not lift, shift, smear, spread, flow, or tear by traffic action.

3.6.2. **Appearance.** Ensure markings present a neat, uniform appearance that is free of excessive adhesive, ragged edges, and irregular lines or contours.

3.6.3. **Visibility.** Ensure markings have uniform and distinctive retroreflectance when inspected in accordance with [Tex-828-B](#).

3.7. **Performance Period.** All markings must meet the requirements of this Item for at least 30 calendar days after installation. Remove and replace all pavement markings that fail to meet requirements at the Contractor's expense unless otherwise directed. Replace failing markings within 30 days of notification. All replacement markings must also meet all requirements of this Item for a minimum of 30 calendar days after installation.

4. **MEASUREMENT**

This Item will be measured by the foot or by each word, shape, or symbol.

This is a plans quantity measurement Item. The quantity to be paid is the quantity shown in the proposal, unless modified by Article 9.2., "Plans Quantity Measurement." Additional measurements or calculations will be made if adjustments of quantities are required.

5. **PAYMENT**

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Prefabricated Pavement Markings" of the type and color specified and the shape, width, and size specified as applicable. This price is full compensation for cleaning the pavement by any means other than required abrasive or water-blast cleaning or milling; furnishing and placing materials; and equipment, labor, tools, and incidentals.

Abrasive or water-blast cleaning and milling, when shown on the plans, will be paid for under Item 678, "Pavement Surface Preparation for Markings."

Item 672

Raised Pavement Markers



1. DESCRIPTION

Furnish and install raised pavement markers (RPMs).

2. MATERIALS

2.1. **Markers.** Furnish RPMs in accordance with the following Department Material Specifications:

- **Reflectorized Pavement Markers.** [DMS-4200](#), "Pavement Markers (Reflectorized)," types I-A, I-C, I-R, II-A-A, and II-C- R.
- **Traffic Buttons.** [DMS-4300](#), "Traffic Buttons," types I-A, I-C, I-R, II-A-A, II-C- R, W, Y and B. Round or oval unless otherwise specified on the plans.
- **Plowable Reflectorized Pavement Markers.** [DMS-4210](#), "Snowplowable Pavement Markers," types I-A, I-C, I-R, II-A-A, and II-C- R.

The following are descriptions for each type of RPM:

- **Type I-A.** The approach face must retro-reflect amber light. The body, other than the retro-reflective face, must be yellow.
- **Type I-C.** The approach face must retro-reflect white light. The body, other than the retro-reflective face, must be white or silver-white.
- **Type I-R.** The trailing face must retro-reflect red light. The body, other than the retro-reflective face, must be white or silver-white, except for I-R plowable markers which may be black.
- **Type II-A-A.** The 2 retro-reflective faces (approach and trailing) must retro-reflect amber light. The body, other than the retro-reflective faces, must be yellow.
- **Type II-C-R.** Contain 2 retro-reflective faces with an approach face that must retro-reflect white light and a trailing face that must retro-reflect red light. The body, other than the retro-reflective faces, must be white or silver-white.
- **Type W.** Must have a white body and no reflective faces.
- **Type Y.** Must have a yellow body and no reflective faces.
- **Type B.** Must have a black body and no reflective faces.

2.2. **Adhesives.** Furnish adhesives that conform to the following requirements:

- [DMS-6100](#), "Epoxy and Adhesives," Type II—Traffic Marker Adhesives.
- [DMS-6130](#), "Bituminous Adhesive for Pavement Markers."
- The Contractor may propose alternate adhesive materials for consideration and approval.

2.3. **Sampling.** The Engineer will sample in accordance with [Tex-729-I](#).

3. CONSTRUCTION

Remove existing RPMs in accordance with Item 677, "Eliminating Existing Pavement Markings and Markers," except for measurement and payment. Furnish RPMs for each class from the same manufacturer. Prepare all surfaces in accordance with Item 678, "Pavement Surface Preparation for Markings," when shown on the

plans. Ensure the bond surfaces are free of dirt, curing compound, grease, oil, moisture, loose or unsound pavement markings, and any other material that would adversely affect the adhesive bond.

Establish pavement marking guides to mark the lateral location of RPMs as shown on the plans and as directed. Do not make permanent marks on the roadway for the guides.

Place RPMs in proper alignment with the guides. Acceptable placement deviations are shown on the plans.

Remove RPMs placed out of alignment or sequence, as shown on the plans or stated in this specification, at Contractor's expense, in accordance with Item 677, "Eliminating Existing Pavement Markings and Markers" (except for measurement and payment).

Use the following adhesive materials for placement of reflectorized pavement markers, and traffic buttons unless otherwise shown on the plans:

- standard or flexible bituminous adhesive for applications on bituminous pavements, and
- epoxy adhesive or flexible bituminous adhesive for applications on hydraulic cement concrete pavements.

Use epoxy adhesive for plowable reflectorized pavement markers.

Apply enough adhesives to:

- ensure that 100% of the bonding area of RPMs is in contact with the adhesive, and
- ensure that RPMs, except for plowable markers, are seated on a continuous layer of adhesive and not in contact with the pavement surface.

Apply adhesives in accordance with manufacturer's recommendations unless otherwise required by this Article. Apply bituminous adhesive only when pavement temperature and RPM temperature are 40°F or higher. Do not heat bituminous adhesive above 400°F. Machine agitate bituminous adhesive continuously before application to ensure even heat distribution.

Machine-mix epoxy adhesive. Apply epoxy adhesive only when pavement temperature is 50°F or higher.

Furnish RPMs free of rust, scale, dirt, oil, grease, moisture, and contaminants that might adversely affect the adhesive bond.

Place RPMs immediately after the adhesive is applied and ensure proper bonding. Do not use adhesives or any other material that impairs the functional retro-reflectivity of the RPMs.

Provide a 30-day performance period that begins the day following written acceptance for each separate location. The date of written acceptance will be the last calendar day of each month for the RPMs installed that month for the completed separate project locations. This written acceptance does not constitute final acceptance.

Replace all missing, broken or non-reflective RPMs. Visual evaluations will be used for these determinations. Upon request, the Engineer will allow a Contractor representative to accompany the Engineer on these evaluations.

The Engineer may exclude RPMs from the replacement provisions of the performance, provided the Engineer determines the failure is a result of causes other than defective material or inadequate installation procedures. Examples of outside causes are extreme wear at intersections, damage by snow or ice removal, and pavement failure.

Replace all missing or non-reflective RPMs identified during the performance period within 30 days after notification. The end of the performance period does not relieve the Contractor from the performance deficiencies requiring corrective action identified during the performance period.

4. MEASUREMENT

This Item will be measured by each RPM.

This is a plans quantity measurement Item. The quantity to be paid is the quantity shown in the proposal, unless modified by Article 9.2., "Plans Quantity Measurement." Additional measurements or calculations will be made if adjustments are required.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Reflectorized Pavement Marker," "Traffic Button," or "Plowable Reflectorized Pavement Marker" of the types specified. This price is full compensation for removing existing markers; furnishing and installing RPMs; and materials, equipment, labor, tools, and incidentals.

No additional payment will be made for replacement of RPMs failing to meet the performance requirements.

Item 760

Cleaning and Reshaping Ditches



1. DESCRIPTION

Clean and reshape ditches.

2. WORK METHODS

Excavate and remove excess material from ditches and from around fixtures within the limits of the excavation or reshape by cleaning silt from the ditch and spreading on backslope as approved. Reshape ditches in conformance with the lines, grades, and typical cross-sections shown on the plans, or as directed. Dispose of excess material in accordance with applicable federal, state, and local regulations, or place on right of way, as directed. Maintain ditch drainage during cleaning and reshaping work.

3. MEASUREMENT

Measurement will be as follows:

- 3.1. **Foot.** By the foot, measured along the centerline of the ditch.
- 3.2. **Cubic Yard in Place.** By the cubic yard in its original position computed by the method of average end areas.
- 3.3. **Cubic Yard in Vehicle.** By the cubic yard in vehicles measured at the point of excavation.

4. PAYMENT

The work performed in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Ditch Reshaping (Foot)," "Ditch Cleaning and Reshaping (Cubic Yard in Place)," or "Ditch Cleaning and Reshaping (Cubic Yard in Vehicle)." This price is full compensation for excavation, disposal of removed materials, reshaping, equipment, labor, tools, and incidentals.

Special Specification 3075

Geogrid Base Reinforcement



1. DESCRIPTION

Use geogrid to reinforce the emulsion treated base placed on embankment material. Geogrid comprises of a synthetic planar structure formed by a regular network of integrally connected polymeric tensile elements with apertures designed to interlock with the base and the underlying material.

2. MATERIALS

- 2.1. Furnish Type 2 Geogrid meeting the requirements of Departmental Materials Specification DMS-6240, Geogrid for Base/Embankment Reinforcement. The Engineer will randomly select a roll from those delivered to the project and sample a piece of geogrid from the roll, approximately 10 ft. in length and 4 ft. in width. The Materials and Tests Division/Soils & Aggregates Section (MTD/SA) will test the geogrid sample to determine if it meets the material requirements listed in DMS-6240. Allow a minimum of 10 calendar days for MTD/SA to perform all testing.

When test results fail to meet any of the minimum requirements, the Engineer will reject the roll and randomly select an additional roll to sample and test. If the additional sample fails to meet any of the material requirements, the Engineer will reject the entire quantity of rolls represented by the samples tested.

- 2.2. **Packaging.** Package geogrid in rolls of the length and width shown on the plans or as approved. Package each roll in one continuous piece in a suitable sheath, wrapper, or container to protect the geogrid from damage due to ultraviolet light, moisture, storage and handling.

- 2.3. **Identification.** Identify each roll with a tag or label securely affixed to the outside of one end of the roll. List the following information on the label:

- Unique roll number, serially designated;
- Lot or control number;
- Name of producer;
- Style or catalog description of product; and
- Roll width and length.

3. CONSTRUCTION

Install geogrid in accordance with the lines and grades as shown on the plans. Do not operate tracked construction equipment on the geogrid until a minimum cover of 6 in. of flexible base backfill material is placed on the geogrid. Install the geogrid to avoid any deformation or damage to the underlying, compacted material below the geogrid. When the underlying, compacted material below the geogrid is damaged during installation, correct all areas to the satisfaction of the Engineer.

- 3.1. **Geogrid Placement.** Orient the geogrid length as unrolled parallel to the direction of roadway. Overlap geogrid sections as shown on the plans or as directed. Use plastic ties at overlap joints or as directed. When placing geogrid around corners, cutting and diagonal lapping may be required. Pin geogrid at the beginning of the backfill section as directed. Keep the geogrid taut and flat throughout backfilling but not restrained from stretching or flattening. Use a bulldozer to place the backfill material by cascading flexible base onto the geogrid with a minimum depth of 6 in. Spread and shape the flexible base into a uniform layer by gradually raising the bulldozer blade over the geogrid. Sufficiently compact the unbound buffer layer placed directly above the geogrid to achieve the required density in all subsequently constructed pavement layers.

Avoid any equipment from direct contact with the geogrid. When approved by the Engineer, rubber tired equipment may be operated directly on the geogrid. When allowed, only operate the rubber tired equipment at a maximum of 5 mph, do not turn tires on the geogrid, do not make sudden stops and starts on the geogrid, and do not distort the geogrid to create excessive deformation waves. Correct areas with distorted and excessive deformation waves to the satisfaction of the Engineer. When directed by the Engineer, adjust the geogrid installation and construction methods to minimize any distortion and deformation waves.

- 3.1.1. **Longitudinal Joints.** Overlap longitudinal joints by a minimum of 1 ft. Space longitudinal ties 10 ft. to 20 ft. or as directed.
- 3.1.2. **Transverse Joints.** Overlap transverse joints by a minimum of 1 ft. Space transverse ties 4 ft. to 5 ft. or as directed.
- 3.2. **Damage Repair.** Remove and replace contractor damaged or excessively deformed areas without additional compensation as directed. Lap repair areas a minimum of 3 ft. in all directions. Tie each side of repair grid in at least three locations but do not exceed normal construction spacing. The tie spacing for odd shapes will be as directed. Repair excessively deformed materials underlying the grid as directed

4. **MEASUREMENT**

Geogrid base reinforcement will be measured by the square yard of roadway placement as shown on the plans with no allowance for overlapping at transverse and longitudinal joints.

5. **PAYMENT**

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" are paid for at the unit bid price for "Geogrid Base Reinforcement" of the type specified. This price is full compensation for furnishing, preparing, hauling and placing materials including labor, materials, freight, tools, equipment and incidentals.



Geogrid for Base / Subgrade Reinforcement

Material Producer List

Materials and Tests Division
Soils & Aggregates Section
June 2024

Geogrid for Base / Subgrade Reinforcement

Products listed in Table 1 are pre-qualified in accordance with DMS-6240, "Geogrid for Base / Subgrade Reinforcement." Table 2 presents the suppliers/manufacturers contact phone numbers.

The Department reserves the right to conduct random sampling and testing of pre-qualified materials to verify performance and Specification compliance and to perform random audits of documentation. Department representatives may sample material from the project site and the warehouse.

For more information, contact the Materials and Tests Division/Soils and Aggregates Section at (512) 902-3746.

Table 1: Pre-qualified Geogrids for Base/Embankment Reinforcement.

SUPPLIER	TYPE	SUPPLIER PRODUCT NAME	MANUFACTURER	MANUFACTURER PRODUCT NAME
Industrial Fabrics	I	BX1	Industrial Fabrics	BX1
Industrial Fabrics	II	BX2	Industrial Fabrics	BX2
Hanes	II	SX2020	TMP America	GG2020
Tenax	II	LBO190	Tenax	LBO190
Tensar	I	SQ1515	Tensar	SQ1515
Hanes	I	SX1515	TMP America	GG1515
ADS	I	BX1515	Tensar	SQ1515
Tensar	II	SQ2020	Tensar	SQ2020
ADS	II	BX224	Tensar	BX2020
Tensar	II	Amerigrid BX2020	Tensar	Amerigrid BX2020
ADS	I	BX124	Tensar	BX1200
Tensar	I	Amerigrid BX1515	Tensar	Amerigrid BX1515
Tensar	II	TX120	Tensar	TX120

Table 2: Contact Information for Supplier/Manufacturer

SUPPLIER/MANUFACTURER	PHONE NUMBER
Industrial Fabrics	800-848-4500
Tensar	800-836-7271
Hanes	888-239-4539
TMP America	770-377-8078
ADS	320-241-6269
Tenax	410-960-5557



APPENDIX A – GEOTECHNICAL REPORT

GEOTECHNICAL ENGINEERING REPORT



SABINETOWN PARK DEVELOPMENT - PHASE 1

HEMPHILL, TEXAS

GEOTECHNICAL ENGINEERING REPORT

Sabinetown Park Development - Phase 1
Hemphill, Texas

Prepared by:



Riner Engineering, Inc., a UES Company

Prepared for:

Freese & Nichols, Inc.
10497 Town and Country Way, Suite 500
Houston, Texas

Attention: Mr. Bryan Janhsen

June 3, 2024

RINER Project No. 23-0711



Riner
Engineering

A UES Company

June 3, 2024

Mr. Bryan Janhsen, RLA
Freese & Nichols, Inc.
10497 Town and Country Way, Suite 500
Houston, Texas

Re: GEOTECHNICAL ENGINEERING REPORT
Sabinetown Park Development - Phase 1
Hemphill, Texas
RINER Project No. 23-0711

Dear Mr. Janhsen:

Riner Engineering, Inc. (RINER), a UES Company, is pleased to submit this Geotechnical Engineering Report for the referenced project. We appreciate the opportunity of working with you. Please contact us if you have any questions or require additional services.

Respectfully submitted,

Harry Nguyen, Ph.D., P.E.
Senior Project Engineer

Hamed Ardalan, Ph.D., P.E.
Director – Engineering Manager

TABLE OF CONTENTS

	<u>Page</u>
1.0 Introduction.....	1
2.0 Field Study	2
3.0 Laboratory Testing.....	3
4.0 Site Conditions.....	4
4.1 General	4
4.2 Geology	5
4.3 Soil	5
4.4 Groundwater	7
5.0 Analysis and Recommendations	7
5.1 Seismic Site Classification	7
5.2 Potential Vertical Rise (PVR)	7
5.3 Construction Excavations.....	10
5.4 Groundwater Control	11
5.5 Earthwork	11
5.5.1 Site Preparation	11
5.5.2 Proofroll.....	11
5.5.3 Grading and Drainage	12
5.5.4 Wet Weather/Soft Subgrade	12
5.5.5 Fill	12
5.5.6 Testing	13
5.6 Demolition Considerations	14
5.7 Loading on Buried Structures	15
5.8 Retaining Structures	15
5.9 Buried Pipe	16
5.10 Foundation System	17
5.10.1 Slab Foundation	18
5.10.2 Shallow Footings.....	19
5.10.3 Straight Shaft Drilled Piers	20
5.10.4 Driven Piles	22
5.11 Slab-on-Grade.....	24
5.12 Pavement	25
5.12.1 Rigid Pavement	26
5.12.2 Flexible Pavement.....	27
5.12.3 Pavement Subgrade.....	27
5.13 Boat Ramp Pavement	28
6.0 General Comments.....	29

APPENDICES

- Appendix A - Project Location Diagrams
- Appendix B - Boring Location Diagram
- Appendix C - Boring Logs and Laboratory Results
- Appendix D - Aerial Photographs
- Appendix E - USGS Topographic Map
- Appendix F - Site Photographs
- Appendix G - Geologic Information
- Appendix H - Unified Soil Classification System
- Appendix I - Axial Pile Load Carrying Capacities

GEOTECHNICAL ENGINEERING REPORT

Sabinetown Park Development - Phase 1
Hemphill, Texas

1.0 INTRODUCTION

Project Location. The project is located on Vantage Point and Bayou Fork Road in Hemphill, Texas. The general location and orientation of the site are provided in Appendix A - Project Location Diagrams.

Project Description. The project consists of three buildings and/or pavilion shelters, restrooms, boat ramp and fishing pier structure, parking and driving area.

Project Authorization. This geotechnical study was authorized by Mr. Stephanie Stephenson, Senior Contract Administrator, with Freese & Nichols, Inc. and performed in accordance with RINER Proposal No. P23-0794 dated July 11, 2023.

Purpose and Methodology. The principal purposes of this study were to evaluate the general soil conditions at the proposed site and to develop geotechnical engineering design recommendations. To accomplish its intended purposes, this study was conducted in the following phases:

1. Drill sample borings to evaluate the soil conditions at the boring locations and to obtain soil samples;
2. Conduct laboratory tests on selected samples recovered from the borings to establish the pertinent engineering characteristics of the soils; and
3. Perform engineering analyses, using field and laboratory data, to develop design criteria.

Required Review. Detailed design plans were not available at the time of preparation of this report. Recommendations in our report are contingent upon RINER reviewing and approving in writing the following design items prior to construction:

- Site grading plan, and
- Foundation plan, details, and related structural loads.

Cautionary Statement Regarding Use of this Report. As with any geotechnical engineering report, this report presents technical information and provides detailed technical recommendations for civil and structural engineering design and construction purposes. RINER, by necessity, has assumed the user of this document possesses the technical acumen to understand and properly utilize the information and recommendations provided herein. RINER strives to be clear in its presentation and, like the user, does not want potentially

detrimental misinterpretation or misunderstanding of this report. Therefore, we encourage any user of this report with questions regarding its content to contact RINER for clarification. Clarification will be provided verbally and/or issued by RINER in the form of a report addendum, as appropriate.

Report Specificity. This report was prepared to meet the specific needs of the client for the specific project identified. Recommendations contained herein should not be applied to any other project at this site by the client or anyone else without the explicit approval of RINER.

This Report is NOT a Specification. Recommendations in this report are not specifications. Geotechnical engineering requires significant experience and professional judgment. Conditions vary in the field which require and/or allow modification to recommendations provided herein at the discretion of the Geotechnical Engineer of Record.

2.0 FIELD STUDY

Subsurface study. The subsurface study for this project is summarized in the following table. Boring locations are provided in Appendix B - Boring Location Diagram.

Boring Nos.	Depth, feet bgs ¹	Date Drilled	Location ²
B-01 to B-13	10	1/4/2024	Paving and Boat Ramp Area
B-14 to B-16	20	1/4/2024	Building/Shelter/Restroom Area
B-17 and B-18	40	2/29/2024	Fishing Pier Structure Area
<u>Notes:</u> 1. bgs = below ground surface 2. Boring locations provided in Appendix B - Boring Location Diagram were not surveyed and should be considered approximate. Borings were located by recreational hand-held GPS unit. Horizontal accuracy of such units is typically on the order of 20-feet. 3. Water depth at the location of borings B-17 and B-18 was about 5-feet.			

Boring Logs. Subsurface conditions were defined using the sample borings. Boring logs generated during this study are included in Appendix C - Boring Logs and Laboratory Results. Borings were advanced between sample intervals using continuous flight auger drilling procedures.

Cohesive Soil Sampling. Cohesive soil samples were generally obtained using Shelby tube samplers in general accordance with American Society for Testing and Materials (ASTM) D1587. The Shelby tube sampler consists of a thin-walled steel tube with a sharp cutting edge connected to a head equipped with a ball valve threaded for rod connection. The tube is pushed into the undisturbed soils by the hydraulic pulldown of the drilling rig. The soil specimens were extruded from the tube in the field, logged, tested for consistency using a hand penetrometer, sealed and packaged to maintain "in situ" moisture content.

Consistency of Cohesive Soils. The consistency of cohesive soil samples was evaluated in the field using a calibrated hand penetrometer. In this test a 0.25-inch diameter piston is pushed into the undisturbed sample at a constant rate to a depth of 0.25-inch. The results of these tests are tabulated at the respective sample depths on the boring logs. When the capacity of the penetrometer is exceeded, the value is tabulated as 4.5+.

Granular Soil Sampling. Granular soil samples were generally obtained using split-barrel sampling procedures in general accordance with ASTM D1586. In the split-barrel procedure, a disturbed sample is obtained in a standard 2-inch outside diameter (OD) split barrel sampling spoon driven 18-inches into the ground using a 140-pound (lb) hammer falling freely 30 inches. The number of blows for the last 12-inches of a standard 18-inch penetration is recorded as the Standard Penetration Test resistance (N-value). The N-values are recorded on the boring logs at the depth of sampling. Samples were sealed and returned to our laboratory for further examination and testing.

Groundwater Observations. Groundwater observations are shown on the boring logs.

Borehole Plugging. Upon completion of the borings, the boreholes were backfilled from the top and plugged at the surface.

3.0 LABORATORY TESTING

RINER performs visual classification and any of a number of laboratory tests, as appropriate, to define pertinent engineering characteristics of the soils encountered. Tests are performed in general accordance with ASTM or other standards and the results included at the respective sample depths on the boring logs or separately tabulated, as appropriate, and included in Appendix C - Boring Logs and Laboratory Results. Laboratory tests and procedures routinely utilized, as appropriate, for geotechnical studies are tabulated in the following table.

Test Procedure	Description
ASTM D1140	Standard Test Methods for Amount of Material in Soils Finer than the No. 200 (75- μ m) Sieve
ASTM D2166	Standard Test Method for Unconfined Compressive Strength of Cohesive Soil
ASTM D2216	Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
ASTM D2217	Standard Practice for Wet Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants
ASTM D2487	Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D2488	Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)
ASTM D2850	Standard Test Method for Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soil
ASTM D2937	Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method
ASTM D4220	Standard Practices for Preserving and Transporting Soil Samples

Test Procedure	Description
ASTM D4318	Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils
ASTM D4546	Standard Test Methods for One-Dimensional Swell or Settlement Potential of Cohesive Soils
ASTM D4643	Standard Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method
ASTM D4647	Standard Test Method for Identification and Classification of Dispersive Clay Soils by the Pinhole Test
ASTM D4718	Standard Practice for Correction of Unit Weight and Water Content for Soils Containing Oversize Particles
Manufacturer's Instructions	Soil Strength Determination Using a Torvane

4.0 SITE CONDITIONS

4.1 General

Review of Aerial Photographs. Historical aerial photographs of the site were reviewed for potential past alterations to the site which could impact geotechnical design conditions. Specifically, aerial photographs were reviewed to visually assess obvious areas of significant past fill on site. Aerial photographs reviewed for this study are identified in the following table and are included in Appendix D - Aerial Photographs.

Aerial Photographs Reviewed	
Year	Observations Since Prior Aerial Photograph
1996	The site was undeveloped and wooded heavily.
2004	No visible changes were noted.
2009	No visible changes were noted.
2015	No visible changes were noted.
2021	No visible changes were noted.
2023	The site was mostly cleared from trees.

Site Fills. Our review of aerial photographs revealed no obvious areas of significant fill on-site.

Limitations. Due to the intermittent nature and relatively low resolution of aerial photographs, as well as our lack of detailed information regarding the past land use of the site, our review should not be interpreted as eliminating the possibility of cuts and/or fills on site which could detrimentally affect future construction.

Topography. A United States Geological Survey (USGS) topographic map of the site is provided in Appendix E - USGS Topographic Map.

Site Photographs. Representative photographs of the site at the time of this study are provided in "Appendix F - Site Photographs". Photographed conditions are consistent with the aerial photographs and topographic map.

4.2 Geology

Geologic Formation. Based on available surface geology maps and our experience, it appears this site is located within the Sparta Sand. A geologic atlas and USGS formation description are provided in “Appendix G - Geologic Information”. Soils within the Sparta Sand can generally be characterized the fine-grained quartz sand with some silt and clay.

Geologic Faults. A geologic fault study was beyond the scope of this study.

4.3 Soil

Stratigraphy. Descriptions of the various strata and their approximate depths and thickness per the Unified Soil Classification System (USCS) are provided on the boring logs included in “Appendix C - Boring Logs and Laboratory Results”. Terms and symbols used in the USCS are presented in “Appendix H - Unified Soil Classification System”. A summary of the stratigraphy indicated by the borings is provided in the following table.

Generalized Subsurface Conditions at Proposed Paving and Boat Ramp Location (Borings B-01 to B-13)			
Nominal Depth, feet bgs (Except as Noted)		General Description	Detailed Description of Soils/Materials Encountered
Top of Layer	Bottom of Layer		
0	5	FAT CLAY	Stiff to Hard High Plasticity CLAY (CH).
5	5 to 10	SAND, SANDY CLAY	Medium Dense CLAYEY SAND (SC), Firm SILTY CLAY (CH), Medium Dense SILTY SAND (SM) and Soft to Firm SANDY CLAY (CH).
Note: Boring Termination Depth = 10 feet bgs.			

Generalized Subsurface Conditions at Proposed Building/Shelter/Restroom Location (Borings B-14 to B-16)			
Nominal Depth, feet bgs (Except as Noted)		General Description	Detailed Description of Soils/Materials Encountered
Top of Layer	Bottom of Layer		
0	6 to 13	FAT CLAY/CLAYEY SAND	Firm to Very Stiff SANDY FAT CLAY (CH) / Very Stiff CLAYEY SAND (SC).
6 to 13	20	SILTY SAND	Very Dense SILTY SAND (SM).
Note: Boring Termination Depth = 20 feet bgs.			

Generalized Subsurface Conditions at Proposed Fishing Pier Structure Location (Borings B-14 to B-16)			
Nominal Depth, feet bgs (Except as Noted)		General Description	Detailed Description of Soils/Materials Encountered
Top of Layer	Bottom of Layer		
0	2 to 13	FAT CLAY	Hard LEAN CLAY WITH SAND (CL) / Medium Dense CLAYEY SAND (SC).
2 to 13	28	SAND	Medium Dense to Very Dense SILTY SAND (SM) / Very Dense POORLY GRADED SAND WITH SILT (SP-SM).
28	40	CLAYEY SAND	Very Dense CLAYEY SAND (SC).
Note: Boring Termination Depth = 20 feet bgs.			

Moisture Change Susceptibility of Near Surface Soils. The sandy soils encountered at and near the ground surface at this site are very susceptible to changes in moisture. The presence of surface water due to precipitation or groundwater may result in a decrease in the ability to compact and work with the soil. It is common for these soils to pump when subjected to high levels of moisture. In addition, these soils located at and near the ground surface will allow surface water to infiltrate until the water becomes perched on a less permeable layer at depth. Soils of this type are especially prone to requiring the implementation of wet weather/soft subgrade recommendations provided in this report.

Swell Potential based on Atterberg Limits. Atterberg (plastic and liquid) limits were performed on 24 shallow soil samples obtained at depths between 2- and 8-feet bgs. The plasticity index of the samples was between 15 and 77 with an average of 44 indicating that the soils have a high potential for shrinking and swelling with changes in soil moisture content.

Swell Tests. Swell tests were performed on selected clay soil samples. Swell test details are provided in "Appendix C - Boring Logs and Laboratory Results". The results of the tests are summarized in the following table.

Boring No.	Avg. Depth (ft.)	Initial Moisture Content, w, %	Liquid Limit, LL	Plasticity Index, PI	Applied Overburden Stress (psi)	Swell (%)
B-14	1	33	80	56	0.9	0.10
B-14	5	33	43	26	4.3	0.00
B-15	1	32	75	54	0.9	2.61
B-15	5	17	54	34	4.3	3.14
B-16	3	31	86	62	2.6	0.50
B-16	7	28	69	48	6.1	1.35

4.4 Groundwater

Groundwater Levels. The borings were advanced using auger drilling and intermittent sampling methods to observe groundwater seepage levels. Groundwater levels encountered in the borings during this study are identified in the following table.

Boring No.	Depth Groundwater Initially Encountered (feet, bgs)	Groundwater Depth after 15 Minutes (feet, bgs)
B-15	15.4	14.7
B-17 and B-18	Under Water	Under Water
All other borings	Not Encountered	Not Encountered

Long-term Groundwater Monitoring. Long-term monitoring of groundwater conditions via piezometers was not performed during this study and was beyond the scope of this study. Long-term monitoring can reveal groundwater levels materially different than those encountered during measurements taken while drilling the borings.

Groundwater Fluctuations. Future construction activities may alter the surface and subsurface drainage characteristics of this site. It is difficult to accurately predict the magnitude of subsurface water fluctuations that might occur based upon short-term observations. The groundwater level should be expected to fluctuate throughout the years with variations in precipitation.

5.0 ANALYSIS AND RECOMMENDATIONS

5.1 Seismic Site Classification

The seismic site classification is based on the 2018 International Building Code (IBC) and is a classification of the site based on the type of soils encountered at the site and their engineering properties. Per Table 20.3-1 of ASCE 7-10, the seismic site classification for this site is D.

5.2 Potential Vertical Rise (PVR)

Potential Vertical Rise. Potential Vertical Rise, PVR, is the calculated upward heave of the ground surface due to expansive soils related to weather-related changes in soil moisture in the active zone. PVR only applies to upward movement. The term settlement applies to downward movement related to loads on the soil.

Problem Discussion. Most clay soils swell when subjected to increases in moisture content. Swelling clay soils exert an outward pressure that can easily exceed 5,000 psf when subjected to moisture increases. Swell potential and swell pressures are a function of several factors including clay mineralogy and antecedent moisture condition. Generally, for a given clay soil, the drier the soil the greater its potential to swell and the higher its swell pressure. Conversely, wetter soils generally have a lower potential to swell and have lower swell pressures. The potential for a clay soil to swell is a variable and cannot be separated from its moisture condition.

The overburden pressure at a given depth above the groundwater table is calculated as the unit weight of the soil times the depth. For soil with a unit weight of 125 pcf, the overburden pressure at 10-feet would be 1250 psf ($125 \text{ pcf} \times 10\text{-feet}$). Thus, the swell pressure can exceed the overburden at depths of over 40-feet. This means soils at 40-feet exposed to changes in moisture can impact movements at the ground surface.

For clay soil to swell or shrink, it must be subjected to increases or decreases in moisture content, respectively. The predominant way clay soils are subjected to increases or decreases in moisture content is the weather. As would be expected, extended periods of wet weather cause soil to get wetter and extended dry weather causes soil to get drier. The longer the period of wet or dry weather, the deeper the influence of the weather. Vegetation also causes variations in soil moisture content. Shallow rooted grass and bushes have a shallower impact, deep rooted trees have a deeper impact.

For clay soil at a given depth to influence surface heave, two things must happen: (1) the soil must be subjected to an increase in moisture, and (2) the swell pressure of the soil must exceed the overburden pressure. Swell is typically calculated by assuming an “active” zone, a depth of soil impacted by weather which predominantly affects surface movements due to soil swell. Expansive soils below the active zone are typically ignored as they are assumed to be exposed to lower increases in moisture, experience higher overburden pressures, and have a less significant impact on the surface heave than the soils in the active zone.

“Deep-seated” soil movement is swelling of the clay soils below the active zone and above the equilibrium depth. The equilibrium depth is the depth at which the overburden pressure and clay swell pressure are equal. Deep-seated soil movement is caused by changes in moisture that are typically not related to weather or vegetation. They can be caused by man-made influences such as leaking deep water or sewer lines. They can be caused by natural influences such as fluctuations in soil moisture content or groundwater levels. They are notoriously hard to accurately predict and may or may not actually occur. Unless stated otherwise, we have not included the effects of deep-seated soil movement in our Potential Vertical Rise (PVR) calculation. The inclusion of deep-seated soil movement drastically increases the depth of the building pad preparation required and may make a slab-on-grade target PVR of 1-inch theoretically unattainable. The inclusion or exclusion of deep-seated soil movement is a matter of professional opinion, on which there is no consensus among consultants. It is also a matter of risk tolerance and cost, of which, the user of this report is being made aware.

As evidenced in this discussion, calculation of PVR is based on soil data, model assumptions, experience, and professional judgment. PVR is a calculated estimate and should not be construed to be an absolute number or a guarantee of performance. PVR can be higher or lower depending on actual site conditions. The PVR estimate we provide is our best estimate of what will be encountered and the user of this report with doubts is encouraged to get another professional opinion prior to using this report. However, based on this discussion, the reader understands variations between the model and reality can introduce significant differences in calculated PVR. The user of this report understands and accepts this risk. If this risk is intolerable, the user of this report should be prepared to utilize a structural slab suspended adequately above the subgrade surface and supported on deep foundations.

Differential swelling of clay soil is generally most pronounced around the perimeter of slabs or pavement where weather and/or vegetative influences are greatest. Unstiffened slabs or paving are generally prone to cracking around 5- to 10-feet from and parallel to the slab edge due to differential soil movements. If this expected cracking is unacceptable or needs to be minimized, the structural engineer should consider slab stiffening using grade beams and/or a flexible slab/wall connection design. We should be consulted by the structural engineer for clarifications and input regarding this type of slab movement if it is deemed critical.

Maintaining a consistent moisture content in the soil is the key to minimizing both heave and shrinkage related structural problems. Therefore, building maintenance and control of water are paramount in the performance of a slab-on-grade and shallow foundations.

PVR or Equivalent Calculations. The PVR or its equivalent can be estimated in several ways. RINER utilizes the TxDOT method, swell tests, and a Volflo analysis to provide the best possible understanding of expected PVR and its variability.

Calculated PVR using TxDOT Method Tex-124-E. PVR calculations were performed in general accordance with the Texas Department of Transportation (TxDOT) Method Tex-124-E. The Tex-124-E method is empirical and is based on the Atterberg limits and moisture content of the subsurface soils. The calculated PVR is an empirical estimate of a soil's potential for swelling based upon the soil's plasticity index, applied loading (due to structures or overburden), and antecedent moisture condition. The PVR calculated using TxDOT Method Tex-124-E is about 3- to 4-inches assuming an average antecedent moisture condition. The calculated PVR is consistent with soil moisture conditions at the time this study was conducted. An 8-foot zone of seasonal moisture variation was used in our analysis based on local experience.

Calculated PVR using Swell Test Results. The equivalent PVR based on the swell test results is about 1.5- to 3-inches. The PVR based on swell test results is dependent on the moisture conditions at the time of testing. An 8-foot zone of seasonal moisture variation was used in our analysis based on local experience.

Calculated PVR using Volflo Analysis. The equivalent PVR based on the Volflo analysis results is about 1.5- to 2.0-inches. The calculated PVR based on the Volflo analysis is dependent on the moisture conditions at the time of testing. An 8-foot zone of seasonal moisture variation was used in our analysis based on local experience.

Soil Moisture Confirmation Prior to Construction. The calculated PVR can vary considerably with prolonged wet or dry periods. We recommend the moisture content for the upper 8-feet (active zone) of soils within the building pad be assessed for consistency with this report prior to construction if: (1) an extended period of time has elapsed between the performance of this study and construction of the foundation, or (2) unusually wet or dry weather is experienced between the performance of this study and construction of the foundation.

5.3 Construction Excavations

Applicability. Recommendations in this section apply to short-term construction-related excavations for this project.

Sloped Excavations. All sloped short-term construction excavations on-site should be designed in accordance with Occupational Safety and Health Administration (OSHA) excavation standards. Borings from this study indicated that the soils may be classified per OSHA regulations as Type B from the ground surface to a depth of 10-feet bgs. Short-term construction excavations may be constructed with a maximum slope of 1:1, horizontal to vertical (H:V), to a depth of 10-feet bgs. If excavations are to be deeper than 10-feet, we should be contacted to evaluate the excavation. Recommendations provided herein are not valid for any long-term or permanent slopes on-site.

Shored Excavations. As an alternative to sloped excavations, vertical short-term construction excavations may be used in conjunction with trench boxes or other shoring systems. Shoring systems should be designed using an equivalent fluid weight of 85 pounds per cubic foot (pcf) above the groundwater table and 105 pcf below the groundwater table. Surcharge pressures at the ground surface due to dead and live loads should be added to the lateral earth pressures where they may occur. Lateral surcharge pressures should be assumed to act as a uniform pressure along the upper 10-feet of the excavation based on a lateral earth coefficient of 0.5. Surcharge loads set back behind the excavation at a horizontal distance equal to or greater than the excavation depth may be ignored. We recommend that no more than 200-feet of unshored excavation should be open at any one time to prevent the possibility of failure and excessive ground movement to occur. We also recommend that unshored excavations do not remain open for a period of time longer than 24-hours.

Limitations. Recommendations provided herein assume there are no nearby structures or other improvements which might be detrimentally affected by the construction excavation.

Before proceeding, we should be contacted to evaluate construction excavations with the potential to affect nearby structures or other improvements.

Excavation Monitoring. Construction excavations and their related safety are the responsibility of the Contractor. Excavations should be monitored and documented by a competent professional to confirm site soil conditions consistent with those encountered in the borings drilled as part of this study. Discrepancies in soil conditions should be brought to the attention of RINER for review and revision of recommendations, as appropriate.

5.4 Groundwater Control

Groundwater was initially encountered at depths as shallow as 15.4-feet bgs in borings during drilling and rose to depths as shallow as 14.7-feet within 15-minutes. If groundwater is encountered during excavation, dewatering to bring the groundwater below the bottom of excavations may be required. Dewatering could consist of standard sump pits and pumping procedures, which may be adequate to control seepage on a local basis during excavation. Supplemental dewatering will be required in areas where standard sump pits and pumping is not effective. Supplemental dewatering could include submersible pumps in slotted casings, well points, or eductors. The contractor should submit a groundwater control plan, prepared by a licensed engineer experienced in that type of work.

5.5 Earthwork

5.5.1 Site Preparation

In the area of improvements, all concrete, trees, stumps, brush, debris, septic tanks, abandoned structures, roots, vegetation, rubbish and any other undesirable matter should be removed and properly disposed. All vegetation should be removed and the exposed surface should be scarified to an additional depth of at least 6 inches. It is the intent of these recommendations to provide a loose surface with no features that would tend to prevent uniform compaction by the equipment to be used.

5.5.2 Proofroll

Building pad and paving subgrades should be proofrolled with a fully loaded tandem axle dump truck or similar pneumatic-tire equipment to locate areas of loose subgrade. In areas to be cut, the proofroll should be performed after the final grade is established. In areas to be filled, the proofroll should be performed prior to fill placement. Areas of loose or soft subgrade encountered in the proofroll should be removed and replaced with engineered fill, moisture conditioned (dried or wetted, as needed) and compacted in place.

5.5.3 *Grading and Drainage*

Every attempt should be made to limit the extreme wetting or drying of the subsurface soils because swelling and shrinkage of these soils will result. Standard construction practices of providing good surface water drainage should be used. A positive slope of the ground away from any foundation should be provided. Ditches or swales should be provided to carry the run-off water both during and after construction. Stormwater runoff should be collected by gutters and downspouts and should discharge away from the buildings.

Root systems from trees and shrubs can draw a substantial amount of water from the clay soils at this site, causing the clays to dry and shrink. This could cause settlement beneath grade-supported slabs such as floors, walks and paving. Trees and large bushes should be located a distance equal to at least one-half their anticipated mature height away from grade slabs.

Lawn areas should be watered moderately, without allowing the clay soils to become too dry or too wet.

5.5.4 *Wet Weather/Soft Subgrade*

Soft and/or wet surface soils may be encountered during construction, especially following periods of wet weather. Wet or soft surface soils can present difficulties for compaction and other construction equipment. If specified compaction cannot be achieved due to soft or wet surface soils, one of the following corrective measures will be required:

1. Removal of the wet and/or soft soil and replacement with select fill,
2. Chemical treatment of the wet and/or soft soil to improve the subgrade stability, or
3. If allowed by the schedule, drying by natural means.

Chemical treatment is usually the most effective way to improve soft and/or wet surface soils. RINER should be contacted for additional recommendations if chemical treatment is planned due to wet and/or soft soils.

5.5.5 *Fill*

Select Fill. Select fill should consist of soil with a liquid limit less than 35 and a Plasticity Index between 7 and 20. The select fill should be placed in loose lifts not exceeding 8-inches and should be compacted to at least 95 percent maximum dry density (per ASTM D-698) and at a moisture content between optimum and 4 percent above optimum moisture content. The subgrade to receive select fill should be scarified to a depth of 6 inches and compacted to 92 to 96 percent of the material's maximum standard Proctor dry density (ASTM D-698) at a workable moisture level at least 4 percentage points above optimum.

Lime-treated Native Clay Soil. Based on the laboratory testing conducted for this study, the native clay on-site soils will not meet requirements for select fill outlined in the section titled “Fill”. As an alternative to importing select fill, the native clay soil may be blended with lime to reduce the plasticity index to meet select fill requirements. Based on our experience, we expect that it will require between 4- and 8-percent lime (by dry unit weight) to reduce the plasticity index of the native clay soils to select fill requirements. Prior to selecting this alternative, lime series tests should be performed to assess the amount of lime required.

General Fill. General fill may be placed in improved areas outside of building pad areas. General fill should consist of material approved by the Geotechnical Engineer with a liquid limit less than 50. General fill should be placed in loose lifts not exceeding 8-inches and should be uniformly compacted to a minimum of 95 percent maximum dry density (per ASTM D-698) and within ± 2 percent of the optimum moisture content.

Fill Restrictions. Select fill and general fill should consist of those materials meeting the requirements stated. Select fill and general fill should not contain material greater than 4-inches in any direction, debris, vegetation, waste material, environmentally contaminated material, or any other unsuitable material.

Unsuitable Materials. Materials considered unsuitable for use as select fill or general fill include low and high plasticity silt (ML and MH), silty clay (CL-ML), organic clay and silt (OH and OL) and highly organic soils such as peat (Pt). This soil may be used for site grading and restoration in unimproved areas as approved by the Geotechnical Engineer. Soil placed in unimproved areas should be placed in loose lifts not exceeding 10-inches and should be compacted to at least 92 percent maximum dry density (per ASTM D-698) and at a moisture content within ± 4 percentage points of optimum.

Cautionary Note. It is extremely important that select fill placed within building pads be properly characterized using one or more representative proctor samples. The use of a proctor sample which does not adequately represent the select fill being placed can lead to erroneous compaction (moisture and density) results which can significantly increase the potential for swelling of the select fill. The plasticity index of select fill soils placed during construction should be checked every day to confirm conformance to the project requirements and consistency with the proctor being utilized.

5.5.6 *Testing*

Required Testing and Inspections. Field compaction and classification tests should be performed by RINER. Compaction tests should be performed in each lift of the compacted material. We recommend the following minimum soil compaction testing be performed: one test per lift per 2,500 square feet (SF) in the area of the building pad, one test per lift per 5,000 SF outside the building pad, and one test per lift per 100 linear feet of utility backfill. If the materials fail to meet the density or moisture content specified, the course should be reworked as necessary to obtain the specified compaction. Classification confirmation

inspection/testing should be performed daily on select fill materials (whether on-site or imported) to confirm consistency with the project requirements. The testing frequency recommended herein can be altered (increased or decreased) at the discretion of the geotechnical engineer of record.

Liability Limitations. Since proper field inspection and testing are critical to the design recommendations provided herein, RINER cannot assume responsibility or liability for recommendations provided in this report if construction inspection and/or testing is performed by another party.

5.6 Demolition Considerations

Applicability. Recommendations in this section apply to the removal of any existing foundations, utilities or pavement which may be present on this site.

General. Special care should be taken in the demolition and removal of existing floor slabs, foundations, utilities and pavements to minimize disturbance of the subgrade. Excessive disturbance of the subgrade resulting from demolition activities can have serious detrimental effects on planned foundation and paving elements.

Existing Foundations. Existing foundations are typically slabs, shallow footings, or drilled piers. If slab or shallow footings are encountered, they should be completely removed. If drilled piers are encountered, they should be cut off at an elevation at least 24-inches below proposed grade beams or the final subgrade elevation, whichever is deeper. The remainder of the drilled pier should remain in place. Foundation elements to remain in place should be surveyed and superimposed on the proposed development plans to determine the potential for obstructions to the planned construction. RINER should be contacted if drilled piers are to be excavated and removed completely. Additional earthwork activities will be required to make the site suitable for new construction if the piers are to be removed completely.

Existing Utilities. Existing utilities and bedding to be abandoned should be completely removed. Existing utilities and bedding may be abandoned in place if they do not interfere with planned development. Utilities which are abandoned in place should be properly pressure-grouted to completely fill the utility.

Backfill. Excavations resulting from the excavation of existing foundations and utilities should be backfilled in accordance with Section 5.5.5 - Fill.

Other Buried Structures. Other types of buried structures (wells, cisterns, etc.) could be located on the site. If encountered, RINER should be contacted to address these types of structures on a case-by-case basis.

5.7 Loading on Buried Structures

Uplift. Buried water-tight structures are subjected to uplift forces caused by differential water levels adjacent to and within the structure. Soils with any appreciable silt or sand content will likely become saturated during periods of heavy rainfall and the effective static water level will be at the ground surface. For design purposes, we recommend the groundwater level be assumed at the ground surface. Resistance to uplift pressure is provided by soil skin friction and the dead weight of the structure. Skin friction should be neglected for the upper 3 feet of soil. A skin friction of 200 pounds per square foot (psf) may be used below a depth of 3 feet.

Lateral Pressure. Lateral pressures on buried structures due to soil loading can be determined using an equivalent fluid weight of 105 pounds per cubic foot (pcf). This includes hydrostatic pressure but does not include surcharge loads. The lateral load produced by a surcharge may be computed as 50 percent of the vertical surcharge pressure applied as a constant pressure over the full depth of the buried structure. Surcharge loads located a horizontal distance equal to or greater than the buried structure depth may be ignored.

Vertical Pressure. Vertical pressures on buried structures due to soil loading can be determined using an equivalent fluid weight of 125 pcf. This does not include surcharge loads. The vertical load produced by a surcharge may be computed as 100 percent of the vertical surcharge pressure applied as a constant pressure over the full width of the buried structure.

5.8 Retaining Structures

Applicability. RINER was not notified of any specific retaining structures in conjunction with this project. Recommendations provided in this section are applicable to structures 5-feet or less in height. Retaining structures more than 5-feet should be brought to the attention of RINER for a more detailed assessment. *It is imperative that global stability be reviewed by RINER on any retaining structure more than 5-feet in height.*

At-Rest Lateral Pressure. Lateral pressures on retaining structures due to soil loading can be determined using an equivalent fluid weight of 85 pcf if fill behind the wall is free-draining and above the groundwater table and 105 pcf if fill behind the wall is not free draining or is below the groundwater table. This does not include surcharge loads. This also assumes a horizontal ground surface behind the structure. The lateral load produced by a surcharge may be computed as 50 percent of the vertical surcharge pressure applied as a constant pressure over the full depth of the buried structure. Surcharge loads set back behind the retaining structure at a horizontal distance equal to or greater than the structure height may be ignored.

Lateral Resistance. Resistance to lateral loads may be provided by the soil adjacent to the structure. We recommend using an equivalent fluid weight of 180 pcf for lateral resistance. The passive resistance should be ignored if the material in front of the wall will be excavated at any time in the future. A coefficient of sliding friction of 0.25 between the retaining structure concrete footings and underlying soil may be combined with the passive lateral resistance. Appropriate safety factor should be utilized by the structural engineer for external stability analyses of the retaining structures.

Bearing Capacity. Assuming a minimum embedment depth of 24-inches into competent undisturbed native soil, an allowable bearing capacity of 2,000 psf may be used for retaining structure footings (using a Factor of Safety of 3).

5.9 Buried Pipe

Applicability. Recommendations in this section are applicable to the design of buried piping placed by open cut methods associated with this project.

Pressure on Buried Pipe. Design recommendations provided in the “Loading on Buried Structures” section of this report apply to buried piping.

Thrust Restraints. Resistance to lateral forces at thrust blocks will be developed by friction developed along the base of the thrust block and passive earth pressure acting on the vertical face of the block. We recommend a coefficient of base friction of 0.25 along the base of the thrust block. Passive resistance on the vertical face of the thrust block may be calculated using the allowable passive earth pressures presented in the following table.

Allowable Passive Earth Pressure by Material Type	
Material	Allowable Passive Pressure (psf)
Sand	100 x Depth in Feet
Native Clay and Clayey Sand	2,000
Compacted Clay Fill	1,500
<u>Note:</u> Passive resistance should be neglected for any portion of the thrust block within 3 feet of the final site grade. The allowable passive resistance for native clays and clayey sand is based on the thrust block bearing directly against vertical, undisturbed cuts in these materials.	

Bedding and Backfill. Pipe bedding and pipe-zone backfill for the water and sanitary sewer piping should be in accordance with TxDOT standard specification Item 400 or the local equivalent. The pipe-zone consists of all materials surrounding the pipe in the trench from six (6) inches below the pipe to 12 inches above the pipe.

Trench Backfill. Excavated site soils will be utilized to backfill the trenches above the pipe-zone. Backfilled soil should be placed in loose lifts not exceeding 8-inches and should be compacted to at least 95 percent maximum dry density (per ASTM D-698) and at a moisture content between

optimum and 4 percent above optimum moisture content.

Trench Settlement. Settlement of backfill should be anticipated. Even for properly compacted backfill, fills are still subject to settlements over time of up to 2 percent of the total fill thickness. This level of settlement can be significant for fills beneath streets. Therefore, close coordination and monitoring should be performed to reduce the potential for future movement.

5.10 Foundation System

Appropriate Foundation Types. The following foundation types are appropriate to the site based on the geotechnical conditions encountered:

- Restrooms - Slab foundation,
- Buildings - Slab foundation or shallow foundation,
- Pavilions - Shallow foundation or straight shaft drilled piers, and,
- Boat Ramp and Fishing Pier Structure - Driven piles.

Foundation Determination. We have assumed that structural loads will be typical for the type and size of building proposed. Recommendations for the foundation types are presented below. Final determination of the foundation type to be utilized for this project should be made by the Structural Engineer based on loading, economic factors, and risk tolerance.

Avoidance of Mixing Foundation Types. Mixing of foundation types for a given structure should be avoided. Where mixing different foundation types is required for a given structure, we should be contacted to review the foundation plans prepared by the Structural Engineer prior to construction. Different foundation types can have incompatible movement characteristics.

Foundations Adjacent to Slopes. Foundations placed too close to adjacent slopes steeper than 5H:1V may experience reduced bearing capacities and/or excessive settlement. Recommendations provided herein assume foundations are not close enough to adjacent slopes in excess of 5H:1V to be detrimentally affected. Therefore, foundations closer than 5 times the depth of adjacent slopes, pits, or excavations in excess of 5H:1V should be brought to our attention in order that we may review the appropriateness of our recommendations.

Assumed Maximum Cut/Fill Depth. We have also assumed that cut/fill of less than 1-foot will be required to bring the site to grade. In the event cut/fill in the building pad exceed 1-foot, we should be notified and allowed to review the design to assess the suitability of the foundation recommendations provided. ***RINER must be allowed to review the finalized grading plan to assess the appropriateness of our recommendations.***

Foundation Plans Review. Our office should be contacted to review the foundation plans, details and related structural loads, prior to finalizing the design to check conformance with the recommendations presented herein.

5.10.1 Slab Foundation

General. The proposed restrooms and buildings may be supported on a reinforced ground-supported slab foundation if recommendations in the section entitled “Slab-on-Grade” are followed. The slab foundation should be conventionally reinforced or post-tension reinforced. The slab foundation should be designed with exterior and interior grade beams adequate to provide sufficient rigidity to the foundation system to sustain the vertical soil movements expected at this site as described above. All grade beams and floor slabs should be adequately reinforced with steel to minimize cracking as normal movements occur in the foundation soils.

Bearing Capacity. The slab should be designed using a net dead load plus sustained live load bearing pressure of 1,500 psf or a net total load pressure of 2,250 psf, whichever condition results in a larger bearing surface. These bearing pressures are based on a safety factor of 3 and 2, respectively, against shear failure of the foundation bearing soils.

Foundation Depth. Grade beams should be found a minimum of 18 inches below surrounding grade (supported on native soils, select fill, depending on the subgrade treatment implemented). The bottom of the beam trenches should be free of any loose or soft material prior to the placement of the concrete.

PTI Recommendations. A slab constructed on-grade will be subject to potential slab movements of about 4-inches based upon the information gathered during this investigation. Subgrade treatment (excavation of natural ground and replacement with select fill) shall be performed to reduce the PVR. Subgrade treatment recommendations are provided in the section titled “Slab-on-Grade”. ***The allowable PVR for the project should be determined by the Structural Engineer.*** The recommended foundation design parameters based on information published in the Post Tensioning Institute (PTI) Design of Post-Tensioned Slabs-on-Ground, 3rd Edition, are as follows:

Allowable PVR in Inches (per Structural Engineer)	Foundation Design Parameters per PTI 3 rd Edition			
	Edge Moisture Variation Distance (feet)		Differential Soil Movement (inches)	
	Center Lift	Edge Lift	Center Lift	Edge Lift
1.0	8.3	4.8	0.8	0.6
1.5	8.3	4.8	1.0	0.8
2.0	8.3	4.8	1.5	1.1

IMPORTANT: The above foundation design parameters assume the suggested subgrade treatment provided in the Slab-on-Grade section has been performed. The recommended foundation design parameters are applicable to climate-controlled soil conditions only.

These parameters are not applicable when non-climate related factors, such as vegetation, landscaping, trees, drainage, construction methods, land use, or other factors, may influence soil movement. RINER should be contacted to evaluate the effect of non-climate related factors.

Deflection Analysis. Slab deflections should be analyzed per recommendations provided in Section 5.11 - Slab-on-Grade.

5.10.2 Shallow Footings

General Requirement. Shallow strip and spread footing foundations may be used for support of the proposed buildings/pavilions if recommendations in the section entitled “Slab-on-Grade” are followed.

Foundation Depth. Shallow strip and spread footing foundations should bear on select fill or native soil at a minimum depth of 3-feet below the surrounding grade.

Bearing Capacity. Continuous strip footings can be proportioned using a net dead load plus sustained live load bearing pressure of 2,000 psf or a net total load bearing pressure of 3,000 psf, whichever condition results in a larger bearing surface. Individual spread footings can be proportioned using a net dead load plus sustained live load bearing pressure of 2,600 psf or a net total load bearing pressure of 3,900 psf, whichever condition results in a larger bearing surface. These bearing pressures are based on a safety factor of 3 and 2, respectively.

Geometry. Individual spread footings should be at least 30 inches wide and continuous strip footing foundations should be at least 16 inches wide.

Settlement. Settlement of footing foundations is influenced by several factors, including load (pressure), soil consolidation properties, depth to groundwater, geometry (width and length), depth, spacing, and quality of construction. Although a detailed settlement analysis is beyond the scope of this study, settlement for foundations, with a maximum horizontal dimension of 10-feet, constructed as described above should be about 1 inch or less. We should be allowed to review foundations larger than 10-feet to assess their settlement. Our settlement estimate assumes that proper construction practices are followed and there are no overlapping stresses due to adjacent footings. To mitigate any overlapping stresses due to adjacent footings, we recommend a minimum clear spacing of one footing width (width of larger footing) between adjacent footings.

Lateral Resistance. Resistance to lateral loads may be provided by the soil adjacent to the footings. We recommend using an equivalent fluid weight of 180 pcf for lateral resistance. A coefficient of sliding friction of 0.25 between the concrete footings and underlying soil may be combined with the passive resistance. Appropriate safety factor should be utilized by the structural engineer for lateral stability of the shallow footings.

Construction and Observation. The geotechnical engineer should monitor foundation construction to verify conditions are as anticipated and that the materials encountered are suitable for support of foundations. Soft or unsuitable soils encountered at the foundation bearing level should be removed to expose suitable, firm soil. Foundation excavations should be dry and free of loose material. Excavations for foundations should be filled with concrete before the end of the workday or sooner if necessary to prevent deterioration of the bearing surface. Prolonged exposure or inundation of the bearing surface with water will result in changes in strength and compressibility characteristics. If delays occur, the excavation should be deepened as necessary and cleaned, to provide a fresh bearing surface. If more than 24 hours of exposure of the bearing surface is anticipated in the excavation, a “mud slab” should be used to protect the bearing surfaces. If a mud slab is used, the foundation excavations should initially be over-excavated by approximately 4 inches and a lean concrete mud slab of approximately 4 inches in thickness should be placed in the bottom of the excavation immediately following exposure of the bearing surface by excavation. The mud slab will protect the bearing surface, maintain more uniform moisture in the subgrade, facilitate dewatering of excavations if required and provide a working surface for the placement of formwork and reinforcing steel.

5.10.3 Straight Shaft Drilled Piers

Applicability. Straight shaft drilled pier foundations as described in this section may be used for support of the proposed pavilions if recommendations in the section entitled “Slab-on-Grade” are followed.

Axial Resistance. For design of the drilled shaft foundations, we recommend the following geotechnical parameters:

Depth (feet) ⁽¹⁾	Soil Type	Effective Soil Unit Weight (pcf)	Allowable Skin Friction (psf) ⁽²⁾	Allowable End Bearing Capacity (psf) ^(3,4)
0 - 8	CLAY/CLAYEY SAND	120	ignor	ignor
8 - 20	SAND	55	300	4,000
<p>(1) Depth below existing grade.</p> <p>(2) Effective soil unit weight based on assumed groundwater depth of 8-feet bgs.</p> <p>(3) Allowable Skin Friction based on a factor of safety = 2.</p> <p>(4) Allowable End Bearing Capacity based on a factor of safety = 3.</p> <p>(5) Recommendations assume the foundation depth is greater than or equal to 4 times the foundation width.</p>				

Uplift. The uplift force on the piers due to swelling of the active clays can be approximated by assuming a uniform uplift pressure of 1,000 psf acting over the perimeter of the shaft to a depth of 8 feet. The shafts should contain enough full-length reinforcing steel to resist uplift forces.

Lateral Resistance. For resistance of lateral loads straight shaft drilled piers, we recommend the following LPILE design parameters.

Depth (feet bgs) ¹	LPILE Parameters
0 - 3	Soil Type: Clay/Clayey Sand Effective Soil Unit Weight: 120 pcf Undrained Cohesion: Ignore Strain @ ½ Peak Strength (ϵ_{50}): Ignore p-y Modulus (k): Ignore
3 - 8	Soil Type: Stiff Clay/Clayey Sand Effective Soil Unit Weight: 120 pcf Undrained Cohesion: 1,500 psf Strain @ ½ Peak Strength (ϵ_{50}): 0.007 p-y Modulus (k): 300 pci (static), 150 pci (cyclic)
8 - 20	Soil Type: Medium Dense to Very Dense Submerged Sand Effective Soil Unit Weight: 60 pcf Effective Friction Angle: 35° p-y Modulus (k): 125 pci
<u>Note:</u> (1) Depth below existing ground surface. (2) Effective soil unit weight based on assumed groundwater depth of 8-feet.	

Pier Spacing. Piers should not be spaced closer than three shaft diameters center to center to use the above recommended bearing capacities (diameter of larger shaft). A reduction factor of 75 percent should be used for piers placed 2 to 3 diameters apart, measured center to center. A reduction factor of 40 percent should be used for piers placed less than 2 shaft diameters apart, measured center to center. The reduction factors should be applied to allowable end bearing and allowable skin friction.

Settlement. Foundation settlement for drilled piers constructed as described herein should be less than 1-inch.

Groundwater. Groundwater was not encountered up to 20-feet during dry augering of the borings. Groundwater may be encountered during pier excavation and the risk of groundwater seepage is increased during or after periods of precipitation. Submersible pumps may be capable of controlling seepage in the pier excavation to allow for concrete placement. **If water-bearing granular soil layers are encountered, temporary casing and/or slurry displacement method will likely be required for drilled shafts.**

Applicable TxDOT Standards. Drilled pier foundations should be constructed in accordance with the requirements of TxDOT Item 416 (standard specification for construction of drilled pier foundations). **This specification includes requirements for construction using casing or the slurry displacement method, as appropriate.**

Construction Observation. The construction of all piers should be observed to verify compliance with design assumptions and to verify:

1. the bearing stratum;
2. the removal of all smear zones and cuttings;
3. that groundwater seepage, when encountered, is correctly handled;
4. that the shafts are vertical (within acceptable tolerance); and
5. ensure that the top of the shafts in contact with clay are not enlarged (mushroom shaped).

Concrete Placement. Concrete should be placed immediately after the excavation has been completed. In no event should a pier excavation be allowed to remain open for more than 8 hours. Concrete should have a slump of 5- to 7-inches and should not be allowed to strike the shaft sidewall or steel reinforcement during placement.

Drilling Spoils. Due to previous remediation activities on the property, drill spoils may have to be handled and disposed as environmentally affected media.

5.10.4 Driven Piles

General Requirement. The proposed boat launch ramp and fishing pier structure may be supported using a system of driven steel pipe piles or concrete piles.

Axial Resistance. Analyses were performed to determine the estimated single pile load capacities for driven open-end steel pipe piles and square concrete piles in 18-inch and 24-inch diameters. Results of our analyses are provided in Appendix I - Axial Pile Load Carrying Capacities. A safety factor of 2 was used for pile skin friction and pile end bearing has been ignored. The allowable axial load capacities neglect the capacity within the upper 5-feet bgs to account for scour. Final determination of the foundation type to be utilized for this project should be made by the Structural Engineer based on loading, economic factors, and risk tolerance. ***We should be contacted if other sizes or types of piles are considered.*** The contractor should make an independent interpretation of the boring logs in this report to determine installation requirements.

Structural Capacity. The analyses for pile capacities are based only on the soil-pile relationship. Therefore, the structural capacity of each pile and any connections to transmit load should be determined by the structural engineer.

Pile Spacing: Piles should have a minimum center-to-center spacing of at least 3 pile widths. Closer pile spacing should be reviewed by RINER on a case-by-case basis and will result in lower individual pile capacities. An evaluation of lateral group effects may also be required.

Settlement: Foundation settlement for driven piles constructed as described herein should be less than 1-inch.

Precast Concrete Pile Requirements. We recommend the precast concrete piles meet the requirements outlined in the Texas Department of Transportation Standard Specifications Item 409 “Prestressed Concrete Piling”.

Steel Pipe Pile Requirements. Proposed steel pipe piles for the project should be designed and constructed in accordance with the TxDOT Geotechnical Manual and the TxDOT Standard Specifications, Item 407, “Steel Piling”.

Pile Driving and Quality Control. We recommend the pile driving operations and quality control during piles driving operations should confirm to the specifications provided in the Texas Department of Transportation Standard Specifications Item 404 “Driving Piling”. Close field supervision should be maintained by experienced personnel to ensure proper procedures are followed and accurate records are kept during all pile driving operations. The driving record should include the hammer model, driving energy, pile type, overall length, pile size (side dimensions), and number of blows per foot of penetration. An accurate driving record is especially important to verify all piles are installed to the required tip embedment and to give an indication of any unusual driving characteristics which may indicate pile breakage.

Lateral Resistance

For resistance of lateral loads on driven piles, we recommend the following LPILE design parameters.

Depth (feet bgs) ⁽¹⁾	LPILE Parameters
0 - 5	Soil Type: Submerged Sand Effective Soil Unit Weight: 55 pcf Undrained Cohesion: Ignore Strain @ ½ Peak Strength (ϵ_{50}): Ignore p-y Modulus (k): Ignore
5 - 40	Soil Type: Medium Dense to Very Dense Submerged Sand Effective Soil Unit Weight: 55 pcf Effective Friction Angle: 35° p-y Modulus (k): 125 pci
(1) Depth below mudline.	

5.11 Slab-on-Grade

Assumed Maximum Cut/Fill Depth. We have also assumed that cut/fill of less than 1-foot will be required to bring the site to grade. In the event cut/fill in the building pad exceed 1-foot, we should be notified and allowed to review the design to assess the suitability of the recommendations provided in this section. ***RINER must be allowed to review the finalized grading plan to assess the appropriateness of our recommendations.***

Potential Vertical Slab Movements. Based on the information gathered during this study, a slab constructed on-grade will be subject to potential vertical slab movements of up to about 4-inches.

Subgrade Treatment Using Select Fill. The depth of subgrade treatment is dependent on desired post-construction PVR. The following table presents recommended depth of subgrade treatment for various allowable post-construction PVR levels (as determined by Structural Engineer).

Subgrade Treatment - Select Fill Option		
PVR (inches)	Minimum Thickness of Select Fill Soil (feet, bgs) ¹	Thickness of Compacted Subgrade below Select Fill (inches) ²
1.0	5	6
1.5	3.5	6
2.0	2.5	6
Note: 1. Depth measured below bottom of the slab-on-grade, 2. The subgrade to receive select fill soil should be scarified to a depth indicated above. The scarified subgrade should be compacted to 92 to 96 percent of the material's maximum standard Proctor dry density (ASTM D-698) at a workable moisture level at least 4 percentage points above optimum and placed in loose lifts not exceeding 9 inches.		

Subgrade treatment should extend at least 5-feet horizontally beyond the perimeter of the building.

Subgrade Treatment at Exterior Doorways. Subgrade treatment should extend beneath sidewalk areas that abut exterior doorways to the building. Failure to perform subgrade treatment in these areas can increase the probability of differential heaving between exterior sidewalks and doorways, resulting in exterior doors that will not or have difficulty opening outward due to “sticking” caused by heaving sidewalk slabs. Sidewalks tied to pavements and other flatworks that extend beyond the subgrades treated for PVR reduction may be subjected to movements similar to those experienced for untreated subgrades.

Subgrade Moisture. The slab subgrade is prone to drying after being exposed and should be kept moist prior to slab placement.

Moisture Barrier. A moisture barrier should be used beneath the slab foundation in areas where floor coverings will be utilized (such as, but not limited to, wood flooring, tile, linoleum, and carpeting).

Slab Deflection Analysis. Coefficient of subgrade reaction, k , values are soil, load, and settlement dependent. Upon request by the Structural Engineer for this project, k value recommendations will be provided for the specific loading application in question.

Fill Related Slab Settlement. Fill will settle under its own weight. A properly constructed fill will generally settle up to 2% of the fill thickness due to its own weight and independent of external loads. That settlement begins as soon as lift placement begins. The time required for settlement to occur is a function of soil type, pore water, and drainage path conditions and therefore can vary widely. As a result, fill-related settlement should be expected before AND after construction of the slab. Slab movement related to settling fill can be reduced by allowing as much time as possible between the time the fill is placed and construction of the slab. Furthermore, we recommend survey monitoring of constructed fills be performed to verify the rate and magnitude of settlement has been reduced to an acceptable level prior to construction of slabs on the fill.

Load Related Slab Settlement. Slabs on grade will settle when subjected to load. Slab settlement is a function of soil type, load intensity, load geometry, and other factors. Upon request by the Structural Engineer for this project, settlement estimates will be provided for the specific loading application in question.

Movement Risk. Recommendations have been provided to mitigate the effects of soil movement. Some soil movement and related structural cracking and floor unevenness should be expected even after following recommendations in this report. The elimination of risk related to soil movement is typically not feasible. We would be happy to discuss other, more expensive, movement-related risk mitigation alternatives upon request.

5.12 Pavement

Pavement design is the responsibility of the project Civil Engineer. We have recommended preliminary pavement sections based on geotechnical information and assumed/available traffic information. The applicability of our assumptions should be reviewed and approved by the project Civil Engineer before the pavement section is finalized. The recommended pavement sections assume good drainage quality prevails over the life of the pavement and that the pavement subgrade is exposed to moisture levels approaching saturation less than 25 percent of the time. Therefore, it is critical that the project Civil Engineer provide appropriate pavement drainage design to assure validity of the assumed drainage conditions.

Recommendations for rigid and flexible pavement and preparation of the pavement subgrade are provided in the following sections. A traffic study indicating the number and type of vehicles on which to base the pavement design was not provided. Therefore, our recommendations are based upon our experience with similar projects assuming normal vehicular loading. Any unusual loading conditions should be brought to our attention prior to finalizing the pavement design so that we may assess and modify our recommendations as necessary.

Flexible asphaltic pavements subjected to soil-related shrinking and swelling do not perform as well as rigid pavements. As a result, the lifespan of flexible asphaltic pavement can be reduced substantially when compared to rigid pavement. The need for increased maintenance of flexible asphaltic pavements should be considered prior to its selection.

5.12.1 Rigid Pavement

Portland cement concrete (PCC) with a minimum 28-day compressive strength of 3,500 pounds per square inch (psi) should be utilized for rigid pavement. Grade 60 reinforcing steel should be utilized in the transverse and longitudinal directions. The following pavement thicknesses and reinforcing are recommended:

Paving Use	Thickness (inches)	Reinforcing
Parking Areas for Automobiles and Light Trucks	5	No. 3 bars spaced on 22-inch intervals
Drive Lanes and Areas Subjected to Light to Medium Trucks	6	No. 3 bars spaced on 18-inch intervals
Areas Receiving Heavy Trucks and Dumpsters	7	No. 3 bars spaced on 16-inch intervals
Note: 1. Recommended pavement reinforcement is in accordance with ACI guidelines. 2. Pavement subgrade should be chemically stabilized per Section 5.12.3.		

Alternate Pavement Thickness. Concrete pavement thicknesses provided above can be increased an extra 1-inch (corresponding reinforcing requirements must be changed) as a substitution for stabilization of the pavement subgrade, provided a passing proof-roll is achieved prior to placement of reinforcing steel at the pavement subgrade areas.

Pavement Joints. Contraction joints should be spaced at about 24 times the pavement thickness up to a maximum of 15 feet in any direction. Saw cut control joints should be cut within 6 to 12 hours of concrete placement. Expansion joints should be spaced at locations as necessary and should be placed where the pavement abuts any structure. Dowels should have a diameter equal to $\frac{1}{8}$ the slab thickness, be spaced on 12-inch intervals, and be embedded at least 9-inches. Appropriate joint sealant is recommended to keep water from saturating the pavement subgrade and to prevent the introduction of incompressible material into the

joints. Routine monitoring and maintenance of joint sealants are recommended. Where not specified herein, concrete pavement should comply with Texas Department of Transportation (TxDOT) Standard Specifications, Item 360, "Concrete Pavement", or local equivalent.

5.12.2 Flexible Pavement

The following Hot Mix Asphalt (HMA) paving sections are recommended:

Paving Use	Asphalt Thickness (inches)	Aggregate Base Thickness (inches)	TxDOT Type 2 Geogrid Under Base ¹	Stabilized Subgrade Thickness (inches) ²
Parking and Drive Areas for Automobiles and Light Trucks	2	8	Not Required	6 inches
	2	8	YES	Not Required
	2	4	YES	6 inches
Fire Lane and Drive Lanes Subjected to Light to Medium Trucks	2.5	10	Not Required	6 inches
	2.5	10	YES	Not Required
	2.5	6	YES	6 inches
Note: 1. The subgrade should pass proofroll before placing geogrid. 2. Pavement subgrade should be chemically stabilized per Section 5.12.3.				

Asphaltic concrete pavement should comply with TxDOT Standard Specifications, Item 340, "Dense-Graded Hot-Mix Asphalt (Method)", or local equivalent. The flexible base course should comply with TxDOT Standard Specifications, Item 247, Grade 1-2, Type A or D, "Flexible Base", or equivalent.

5.12.3 Pavement Subgrade

Potential Vertical Soil Movements. We have assumed that site treatment as recommended in Section 5.11 - Slab-on-Grade will not be performed within the pavement areas for this project. As a result, pavements will be subjected to the calculated PVR for this site. Based on the information gathered during this study, a pavement constructed on-grade will be subject to potential vertical movements of about 4-inches. Because heave is generally associated with a source of water, it can occur differentially. Edge lift, excessive cracking, corner breaks, and poor ride quality are just a few of the many examples of pavement issues that can occur when in-situ PVR values are high. We should be contacted to provide PVR mitigation strategies to help reduce potential movements if desired. Strategies available for reducing potential soil movements include soil stabilization with lime or cement, removal of the on-site expansive soils and replacement with select fill.

Subgrade Preparation. Fat clay and clayey sand are expected to be encountered or exposed at pavement subgrade. The pavement subgrade should be placed in loose lifts not exceeding 8-inches and should be uniformly compacted to a minimum of 95 percent maximum dry

density (per ASTM D-698) and within ± 2 percent of the optimum moisture content. We recommend the subgrade be stabilized using the following:

Reagent	Application Rate (pounds per square yard)	Application Depth (inches)
Lime	27	6

Lime stabilization should be performed in accordance with TxDOT Standard Specifications, Item 260, "Lime Stabilized Subgrade", or local equivalent.

Cautionary Note Regarding Stabilized Subgrades. Stabilized subgrades are not suitable for supporting heavy construction traffic. Stabilized subgrades that have been subjected to heavy construction traffic should be re-inspected and re-stabilized as necessary prior to the construction of overlying pavement.

5.13 Boat Ramp Pavement

General. We recommend design and construction of the proposed boat ramp should follow U.S. Army Corps of Engineers' design manual EM 1110-2-410, "Design of Recreation Areas -. Access and Circulation", dated December 31, 1982.

Concrete Pavement. Based on the information provided by the client, we understand that the proposed boat ramp surface will be concrete pavement. In addition, we also understand that the predominant use of the ramp pavement will be recreational fishing boats with trailers and F250 trucks or equivalent. Therefore, the following pavement thicknesses and reinforcing are recommended:

Paving Use	Concrete Thickness (inches)	Reinforcing	Minimum Aggregate Base Layer Thickness (inches) ¹
Boat Ramp	6	No. 4 bars spaced on 12-inch intervals	3
<u>Notes:</u> <ol style="list-style-type: none"> 1. The granular base should be in accordance with U.S. Army Corps of Engineers' design manual EM 1110-2-410, "Design of Recreation Areas -. Access and Circulation", dated December 31, 1982. 2. The subgrade should pass proofroll before placing the base material. 3. A Mirafi 1100 N filter fabric or equivalent should be place under granular base layer. 			

Portland cement concrete (PCC) with a minimum 28-day compressive strength of 4,000 pounds per square inch (psi) should be utilized for boat ramp pavement. Grade 60 reinforcing steel should be utilized in the transverse and longitudinal directions.

Drainage and Erosion Control. Surface runoff should be directed away from ramps at intervals which will eliminate erosion of ramp shoulders. Particular attention should be given to turning the runoff in roadside ditches of ramp access roads away from the ramp. Interceptors and

diversion ditches may be used where needed for protecting boat ramps from erosion by surface runoff. For erosion protection from wave attack, riprap should be used. The use of riprap should be in accordance with the TxDOT's specification, Item 432 – Riprap, or local equivalent.

6.0 GENERAL COMMENTS

Data Assumptions. By necessity, geotechnical engineering design recommendations are based on a limited amount of information about subsurface conditions. In the analysis, the geotechnical engineer must assume subsurface conditions are similar to those encountered in the borings. The analyses, conclusions and recommendations contained in this report are based on site conditions as they existed at the time of the field study and on the assumption that the exploratory borings are representative of the subsurface conditions throughout the site; that is, the subsurface conditions everywhere are not significantly different from those disclosed by the borings at the time they were completed. As a result, estimated movements provided in this study are not guarantees of performance. Actual movements may be more or less than estimates provided in this study.

Subsurface Anomalies. Anomalies in subsurface conditions are often revealed during construction. If during construction, different subsurface conditions from those encountered in our borings are observed, or appear to be present in excavations, we must be advised promptly so that we can review these conditions and reconsider our recommendations where necessary.

Change of Conditions. If there is a substantial lapse of time between submission of this report and the start of the work at the site, if conditions have changed due either to natural causes or to construction operations at or adjacent to the site, or if structure locations, structural loads or finish grades are changed, we should be promptly informed and retained to review our report to determine the applicability of the conclusions and recommendations, considering the changed conditions and/or time lapse.

Design Review. Recommendations in our report are contingent upon RINER reviewing and approving in writing the following design items prior to construction:

- Site grading plan, and
- Foundation plan, details, and related structural loads.

Construction Materials Testing and Inspection. RINER should be retained to observe earthwork and foundation installation and perform materials evaluation and testing during the construction phase of the project. This enables RINER's geotechnical engineer to stay abreast of the project and to be readily available to evaluate unanticipated conditions, to conduct additional tests if required and, when necessary, to recommend alternative solutions

to unanticipated conditions. It is proposed that construction phase observation and materials testing commence by the project geotechnical engineer (RINER) at the outset of the project. Experience has shown that the most suitable method for procuring these services is for the owner to contact directly with the project geotechnical engineer. This results in a clear, direct line of communication between the owner and the owner's design engineers and the geotechnical engineer.

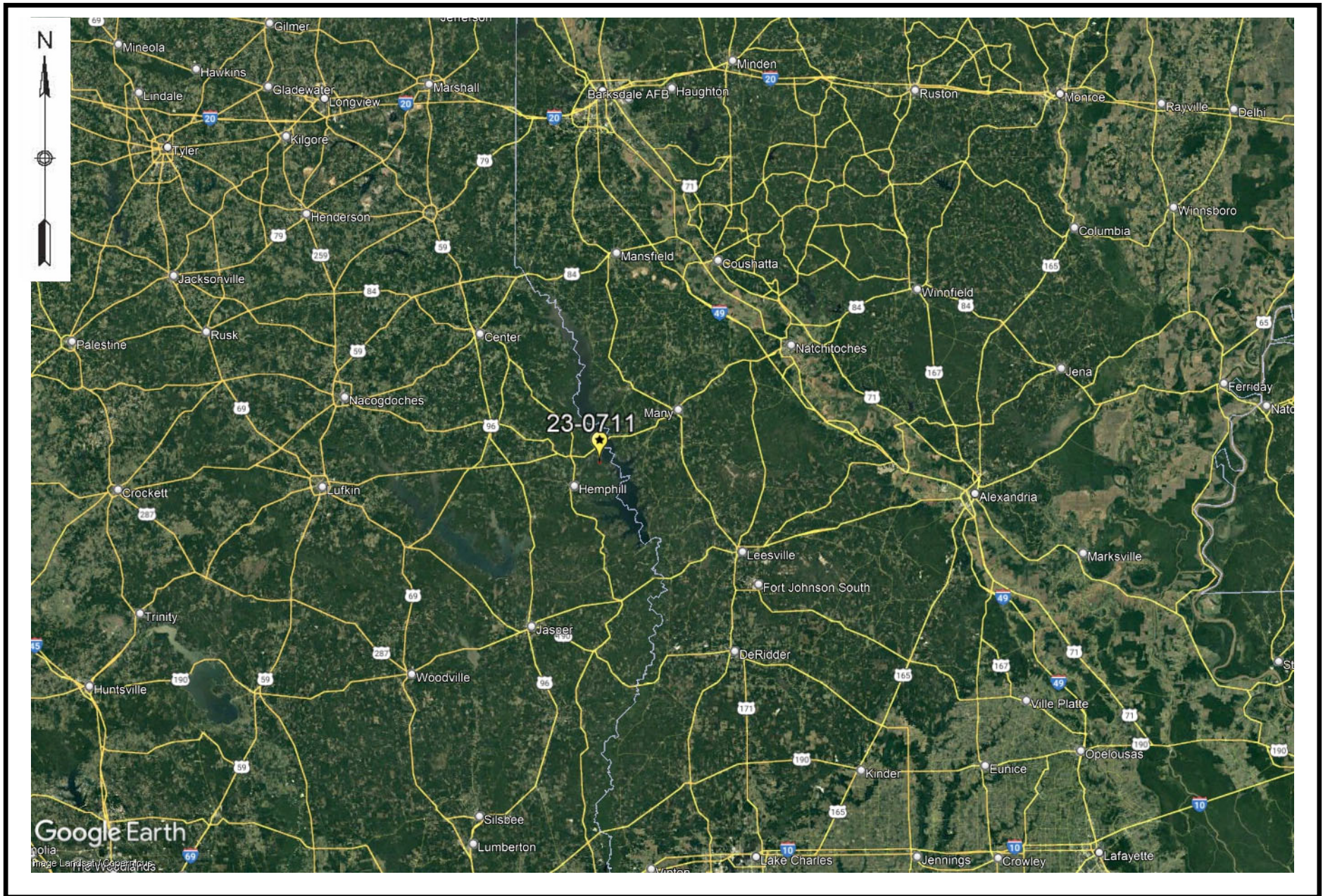
Report Recommendations are Preliminary. Until the recommended construction phase services are performed by RINER, the recommendations contained in this report on such items as final foundation bearing elevations, final depth of undercut of expansive soils for non-expansive earth fill pads and other such subsurface-related recommendations should be considered as preliminary.

Liability Limitation. RINER cannot assume responsibility or liability for recommendations provided in this report if construction inspection and/or testing recommended herein is performed by another party.

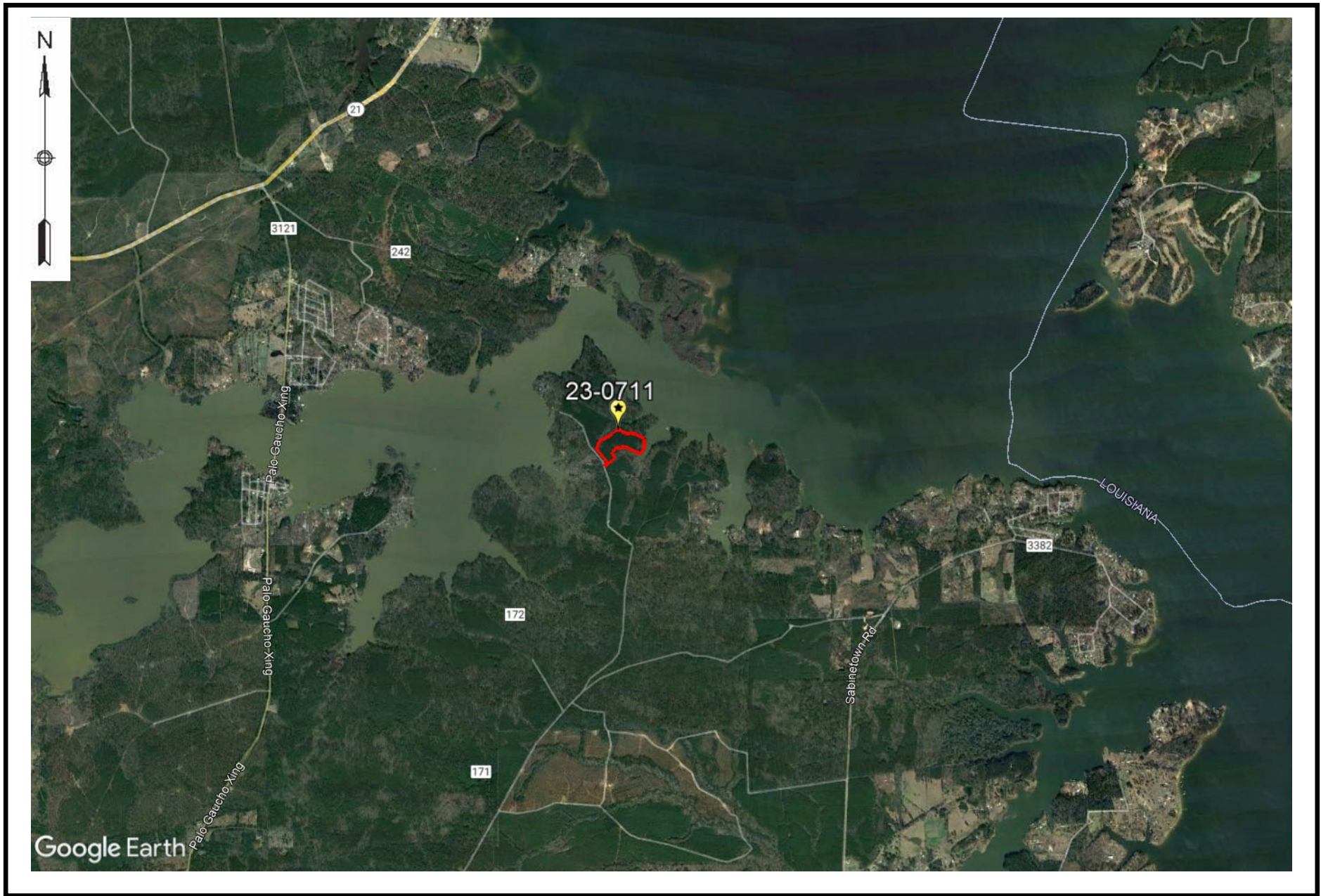
Warranty. This report has been prepared for the exclusive use of the Client and their designated agents for specific application to design of this project. We have used that degree of care and skill ordinarily exercised under similar conditions by reputable members of our profession practicing in the same or similar locality. No other warranty, expressed or implied, is made or intended.

Appendix A - Project Location Diagrams

PROJECT LOCATION DIAGRAM - GENERAL



PROJECT LOCATION DIAGRAM - LOCAL



Appendix B - Boring Location Diagram

CELL TOWER CLEARING PLAN

CONTRACTOR TO START CLEARING LIMITS EARLY FOR TOWER REMOVAL PRIOR TO BEGINNING WORK.

PROPOSED PARKING LOT

PROPOSED DRIVE (FUTURE)

PROPOSED IMPROVEMENTS SHOWN FOR INFORMATION ONLY

PROPOSED CONSTRUCTION ENCLOSURE

TOURNAMENT FISHING FACILITY PARKING LOT CLEARING PLAN

SCALE 1"=100'

LEGEND

- CLEARING BOUNDARY
- POINT COORDINATES
- CURVE DATA
- EXISTING CONTOURS
- PROPOSED CONTOURS
- LENGTH OF CLEARING
- PROPERTY LINE

POINT TABLE

PT	NORTHING	EASTING
1	1018145.36	439975.81
2	1018145.36	439975.81
3	1018145.36	439975.81
4	1018145.36	439975.81
5	1018145.36	439975.81
6	1018145.36	439975.81
7	1018145.36	439975.81
8	1018145.36	439975.81
9	1018145.36	439975.81
10	1018145.36	439975.81
11	1018145.36	439975.81
12	1018145.36	439975.81
13	1018145.36	439975.81
14	1018145.36	439975.81
15	1018145.36	439975.81
16	1018145.36	439975.81
17	1018145.36	439975.81
18	1018145.36	439975.81
19	1018145.36	439975.81
20	1018145.36	439975.81
21	1018145.36	439975.81
22	1018145.36	439975.81
23	1018145.36	439975.81
24	1018145.36	439975.81
25	1018145.36	439975.81
26	1018145.36	439975.81
27	1018145.36	439975.81
28	1018145.36	439975.81
29	1018145.36	439975.81
30	1018145.36	439975.81
31	1018145.36	439975.81
32	1018145.36	439975.81
33	1018145.36	439975.81

CURVE TABLE

PT	NORTHING	EASTING	STATIONING	CURVE LENGTH	BEARING	CHORD
1	1018145.36	439975.81	1018145.36	1018145.36	439975.81	1018145.36
2	1018145.36	439975.81	1018145.36	1018145.36	439975.81	1018145.36
3	1018145.36	439975.81	1018145.36	1018145.36	439975.81	1018145.36
4	1018145.36	439975.81	1018145.36	1018145.36	439975.81	1018145.36
5	1018145.36	439975.81	1018145.36	1018145.36	439975.81	1018145.36
6	1018145.36	439975.81	1018145.36	1018145.36	439975.81	1018145.36
7	1018145.36	439975.81	1018145.36	1018145.36	439975.81	1018145.36
8	1018145.36	439975.81	1018145.36	1018145.36	439975.81	1018145.36
9	1018145.36	439975.81	1018145.36	1018145.36	439975.81	1018145.36
10	1018145.36	439975.81	1018145.36	1018145.36	439975.81	1018145.36
11	1018145.36	439975.81	1018145.36	1018145.36	439975.81	1018145.36
12	1018145.36	439975.81	1018145.36	1018145.36	439975.81	1018145.36
13	1018145.36	439975.81	1018145.36	1018145.36	439975.81	1018145.36
14	1018145.36	439975.81	1018145.36	1018145.36	439975.81	1018145.36
15	1018145.36	439975.81	1018145.36	1018145.36	439975.81	1018145.36
16	1018145.36	439975.81	1018145.36	1018145.36	439975.81	1018145.36
17	1018145.36	439975.81	1018145.36	1018145.36	439975.81	1018145.36
18	1018145.36	439975.81	1018145.36	1018145.36	439975.81	1018145.36
19	1018145.36	439975.81	1018145.36	1018145.36	439975.81	1018145.36
20	1018145.36	439975.81	1018145.36	1018145.36	439975.81	1018145.36
21	1018145.36	439975.81				



BORING LOCATION DIAGRAM WITH SITE OVERLAY



Appendix C - Boring Logs and Laboratory Results



Riner Engineering, Inc.
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CLIENT Freese & Nichols

PROJECT NUMBER 23-0711

DATE STARTED 1/4/24 COMPLETED 1/4/24

CONTRACTOR RINER

METHOD Auger 0 - 10-feet

LOGGED BY J.CH. CHECKED BY H.N.

NOTES _____

PROJECT NAME Sabinetown Park Development - Phase 1

PROJECT LOCATION Hemphill, TX

GROUND ELEVATION _____ NORTHING _____

GROUND WATER LEVELS: _____ EASTING _____

INITIALLY ENCOUNTERED Not Encountered

AFTER 15 MIN. Not Measured

AFTER ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	TORVANE (tsf)	Compressive Strength (tsf)	Confining Pressure (psi)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
												LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0.0		FAT CLAY (CH) / FAT CLAY WITH SAND (CH) - Stiff to hard, reddish brown.													
			ST			4.50+	1.9				31	80	24	56	87
2.5			ST			4.50+	1.8				27				
5.0			ST			4.00	1.3				29	89	24	65	83
		With iron nodules below 6 feet.	ST			4.00	0.3				33				
7.5															
		Brown below 8 feet.	ST			3.00	0.5								
10.0															

Bottom of hole at 10.0 feet.

TEST ONLY 2 23-0711.GPJ NEW GINT TEMP.GDT 3/13/24



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BORING NUMBER B-02

PAGE 1 OF 1

CLIENT Freese & Nichols

PROJECT NAME Sabinetown Park Development - Phase 1

PROJECT NUMBER 23-0711

PROJECT LOCATION Hemphill, TX

DATE STARTED 1/4/24 COMPLETED 1/4/24

GROUND ELEVATION _____ NORTHING _____

CONTRACTOR RINER

GROUND WATER LEVELS: _____ EASTING _____

METHOD Auger 0 - 10-feet

INITIALLY ENCOUNTERED Not Encountered

LOGGED BY J.CH. CHECKED BY H.N.

AFTER 15 MIN. Not Measured

NOTES _____

AFTER ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	TORVANE (tsf)	Compressive Strength (tsf)	Confining Pressure (psi)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
												LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0.0															
		FAT CLAY (CH) - Hard, reddish brown.	ST			4.50+	2.4				29				
2.5			ST			4.50+	2.2				26	104	27	77	95
5.0			ST			4.50+	2.4				26				
		With iron nodules below 6 feet.	ST			4.50+	2.0				35	91	27	64	89
7.5			ST			4.50+	0.8								
10.0															

Bottom of hole at 10.0 feet.

TEST ONLY 2 23-0711.GPJ NEW GINT TEMP.GDT 3/13/24

CLIENT Freese & Nichols

PROJECT NAME Sabinetown Park Development - Phase 1

PROJECT NUMBER 23-0711

PROJECT LOCATION Hemphill, TX

DATE STARTED 1/4/24 **COMPLETED** 1/4/24

GROUND ELEVATION NORTHING

CONTRACTOR RINER

GROUND WATER LEVELS: EASTING

METHOD Auger 0 - 10-feet

INITIALLY ENCOUNTERED Not Encountered

LOGGED BY F.C. CHECKED BY H.N.

AFTER 15 MIN. Not Measured

NOTES

AFTER ---

[illegible]

Bottom of hole at 10.0 feet.

TEST ONLY 2 23-0711.GPJ NEW GINT TEMP.GDT 3/13/24



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CLIENT Freese & Nichols

PROJECT NUMBER 23-0711

DATE STARTED 1/4/24 COMPLETED 1/4/24

CONTRACTOR RINER

METHOD Auger 0 - 10-feet

LOGGED BY F.C. CHECKED BY H.N.

NOTES _____

PROJECT NAME Sabinetown Park Development - Phase 1

PROJECT LOCATION Hemphill, TX

GROUND ELEVATION _____ NORTHING _____

GROUND WATER LEVELS: EASTING _____

INITIALLY ENCOUNTERED Not Encountered

AFTER 15 MIN. Not Measured

AFTER ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	TORVANE (tsf)	Compressive Strength (tsf)	Confining Pressure (psi)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
												LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0.0															
		CLAYEY SAND (SC) - Stiff, reddish brown, with iron nodules.	ST			3.00					23	49	15	34	42
2.5		SANDY FAT CLAY (CH) / FAT CLAY WITH SAND (CH) - Stiff to hard, reddish brown, with iron nodules.	ST			3.00					29				
5.0			ST			4.50+					38	87	23	64	54
		Light brown below 6 feet.	ST			4.50+					48				
7.5			ST			4.50+									
10.0			ST			4.50+									

Bottom of hole at 10.0 feet.

TEST ONLY 2 23-0711.GPJ NEW GINT TEMP.GDT 3/13/24

CLIENT Freese & Nichols

PROJECT NAME Sabinetown Park Development - Phase 1

PROJECT NUMBER 23-0711

PROJECT LOCATION Hemphill, TX

DATE STARTED 1/4/24 **COMPLETED** 1/4/24

GROUND ELEVATION NORTHING

CONTRACTOR RINER

GROUND WATER LEVELS: EASTING

METHOD Auger 0 - 10-feet

INITIALLY ENCOUNTERED Not Encountered

LOGGED BY F.C. CHECKED BY H.N.

AFTER 15 MIN. Not Measured

NOTES

AFTER ---

[illegible]

Bottom of hole at 10.0 feet.

TEST ONLY 2 23-0711.GPJ NEW GINT TEMP.GDT 3/13/24



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CLIENT Freese & Nichols

PROJECT NUMBER 23-0711

DATE STARTED 1/4/24 COMPLETED 1/4/24

CONTRACTOR RINER

METHOD Auger 0 - 10-feet

LOGGED BY F.C. CHECKED BY H.N.

NOTES _____

PROJECT NAME Sabinetown Park Development - Phase 1

PROJECT LOCATION Hemphill, TX

GROUND ELEVATION _____ NORTHING _____

GROUND WATER LEVELS: _____ EASTING _____

INITIALLY ENCOUNTERED Not Encountered

AFTER 15 MIN. Not Measured

AFTER ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	TORVANE (tsf)	Compressive Strength (tsf)	Confining Pressure (psi)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
												LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0.0															
		CLAYEY SAND (SC) - Stiff, reddish brown, with iron nodules.	ST			2.50					23	41	16	25	33
2.5		FAT CLAY (CH) / FAT CLAY WITH SAND (CH) - Very stiff, reddish brown, with iron nodules.	ST			4.50					28				
5.0			ST			4.50					24				
7.5			ST			4.50					25				
10.0			ST			4.50									

Bottom of hole at 10.0 feet.

TEST ONLY 2 23-0711.GPJ NEW GINT TEMP.GDT 3/13/24



Riner Engineering, Inc.
4641 Kennedy Commerce Drive, Houston, TX 77032
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CLIENT Freese & Nichols

PROJECT NUMBER 23-0711

DATE STARTED 1/4/24 COMPLETED 1/4/24

CONTRACTOR RINER

METHOD Auger 0 - 10-feet

LOGGED BY R.M CHECKED BY H.N.

NOTES _____

PROJECT NAME Sabinetown Park Development - Phase 1

PROJECT LOCATION Hemphill, TX

GROUND ELEVATION _____ NORTHING _____

GROUND WATER LEVELS: _____ EASTING _____

INITIALLY ENCOUNTERED Not Encountered

AFTER 15 MIN. Not Measured

AFTER ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	TORVANE (tsf)	Compressive Strength (tsf)	Confining Pressure (psi)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
												LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0.0															
		CLAYEY SAND (SC) - Very stiff, reddish brown, with iron nodules.	ST			3.50					19	50	19	31	45
2.5		FAT CLAY (CH) / FAT CLAY WITH SAND (CH) - Very stiff, reddish brown, with iron nodules.	ST			4.50					35				
5.0			ST			4.50					31				
7.5			ST			4.50					32				
10.0			ST			4.50									

Bottom of hole at 10.0 feet.

TEST ONLY 2 23-0711.GPJ NEW GINT TEMP.GDT 3/13/24



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PROJECT NUMBER 23-0711

DATE STARTED 1/4/24 COMPLETED 1/4/24

CONTRACTOR RINER

METHOD Auger 0 - 10-feet

LOGGED BY R.M CHECKED BY H.N.

NOTES _____

PROJECT NAME Sabinetown Park Development - Phase 1

PROJECT LOCATION Hemphill, TX

GROUND ELEVATION _____ NORTHING _____

GROUND WATER LEVELS: _____ EASTING _____

INITIALLY ENCOUNTERED Not Encountered

AFTER 15 MIN. Not Measured

AFTER ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	TORVANE (tsf)	Compressive Strength (tsf)	Confining Pressure (psi)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
												LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0.0															
		CLAYEY SAND (SC) - Stiff, reddish brown, with iron nodules.	ST			2.00					26	48	20	28	47
2.5		FAT CLAY (CH) / FAT CLAY WITH SAND (CH) - Very stiff, reddish brown, with iron nodules.	ST			4.50					36				
5.0			ST			4.50					29				
7.5			ST			4.00					35				
10.0			ST			4.00									

Bottom of hole at 10.0 feet.

TEST ONLY 2 23-0711.GPJ NEW GINT TEMP.GDT 3/13/24



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DATE STARTED 1/4/24 COMPLETED 1/4/24

CONTRACTOR RINER

METHOD Auger 0 - 10-feet

LOGGED BY R.M CHECKED BY H.N.

NOTES _____

PROJECT NAME Sabinetown Park Development - Phase 1

PROJECT LOCATION Hemphill, TX

GROUND ELEVATION _____ NORTHING _____

GROUND WATER LEVELS: _____ EASTING _____

INITIALLY ENCOUNTERED Not Encountered

AFTER 15 MIN. Not Measured

AFTER ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	TORVANE (tsf)	Compressive Strength (tsf)	Confining Pressure (psi)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
												LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0.0															
		CLAYEY SAND (SC) - Stiff, reddish brown, with iron nodules.	ST			2.50					27	39	18	21	35
2.5		SANDY FAT CLAY (CH) / FAT CLAY WITH SAND (CH) - Very stiff, reddish brown, with iron nodules.	ST			3.50					25				
5.0			ST			3.50					28	93	20	73	62
7.5			ST			4.50					34				
10.0			ST			4.50									

Bottom of hole at 10.0 feet.

TEST ONLY 2 23-0711.GPJ NEW GINT TEMP.GDT 3/13/24



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DATE STARTED 1/4/24 COMPLETED 1/4/24

CONTRACTOR RINER

METHOD Auger 0 - 10-feet

LOGGED BY R.M CHECKED BY H.N.

NOTES _____

PROJECT NAME Sabinetown Park Development - Phase 1

PROJECT LOCATION Hemphill, TX

GROUND ELEVATION _____ NORTHING _____

GROUND WATER LEVELS: _____ EASTING _____

INITIALLY ENCOUNTERED Not Encountered

AFTER 15 MIN. Not Measured

AFTER ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	TORVANE (tsf)	Compressive Strength (tsf)	Confining Pressure (psi)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
												LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0.0															
		CLAYEY SAND (SC) - Reddish brown.	ST								24	44	23	21	31
2.5		SANDY FAT CLAY (CH) / FAT CLAY WITH SAND (CH) - Very stiff, reddish brown, with iron nodules and root fibers.	ST			4.50					32				
5.0			ST			4.50					32				
7.5			ST			4.50					29				
10.0			ST			4.50									

Bottom of hole at 10.0 feet.

TEST ONLY 2 23-0711.GPJ NEW GINT TEMP.GDT 3/13/24



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Telephone: 281-469-3347; Fax: 281-469.3594

CLIENT Freese & Nichols

PROJECT NUMBER 23-0711

DATE STARTED 1/4/24 COMPLETED 1/4/24

CONTRACTOR RINER

METHOD Auger 0 - 10-feet

LOGGED BY F.C. CHECKED BY H.N.

NOTES _____

PROJECT NAME Sabinetown Park Development - Phase 1

PROJECT LOCATION Hemphill, TX

GROUND ELEVATION _____ NORTHING _____

GROUND WATER LEVELS: _____ EASTING _____

INITIALLY ENCOUNTERED Not Encountered

AFTER 15 MIN. Not Measured

AFTER ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	TORVANE (tsf)	Compressive Strength (tsf)	Confining Pressure (psi)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
												LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0.0															
		SANDY FAT CLAY (CH) / FAT CLAY WITH SAND (CH) - Stiff to hard, reddish brown, with iron nodules.	ST			3.00					25	51	16	35	51
2.5			ST			3.00					27				
5.0			ST			3.00					31				
7.5			ST			4.50					30				
10.0			ST			4.50									

Bottom of hole at 10.0 feet.

TEST ONLY 2 23-0711.GPJ NEW GINT TEMP.GDT 3/13/24



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CONTRACTOR RINER

METHOD Auger 0 - 10-feet

LOGGED BY R.M CHECKED BY H.N.

NOTES _____

PROJECT NAME Sabinetown Park Development - Phase 1

PROJECT LOCATION Hemphill, TX

GROUND ELEVATION _____ NORTHING _____

GROUND WATER LEVELS: _____ EASTING _____

INITIALLY ENCOUNTERED Not Encountered

AFTER 15 MIN. Not Measured

AFTER ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	TORVANE (tsf)	Compressive Strength (tsf)	Confining Pressure (psi)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
												LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0.0															
		CLAYEY SAND (SC) - Stiff, reddish brown, with iron nodules.	ST			2.50					18	28	13	15	26
2.5		SANDY FAT CLAY (CH) / FAT CLAY WITH SAND (CH) - Stiff to very stiff, reddish brown, with iron nodules and root fibers.	ST			2.50					31				
5.0			ST			4.50					24				
7.5			ST			4.50					23				
10.0			ST			4.50									

Bottom of hole at 10.0 feet.

TEST ONLY 2 23-0711.GPJ NEW GINT TEMP.GDT 3/13/24



Riner Engineering, Inc.
4641 Kennedy Commerce Drive, Houston, TX 77032
Telephone: 281-469-3347; Fax: 281-469.3594

BORING NUMBER B-13

PAGE 1 OF 1

CLIENT	Freese & Nichols	PROJECT NAME	Sabinetown Park Development - Phase 1
PROJECT NUMBER	23-0711	PROJECT LOCATION	Hemphill, TX
DATE STARTED	1/4/24	COMPLETED	1/4/24
CONTRACTOR	RINER	GROUND ELEVATION	NORTHING
METHOD	Auger 0 - 10-feet	GROUND WATER LEVELS:	EASTING
LOGGED BY	F.C.	CHECKED BY	H.N.
NOTES	INITIALLY ENCOUNTERED Not Encountered		
		AFTER 15 MIN. Not Measured	
		AFTER ---	

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	TORVANE (tsf)	Compressive Strength (tsf)	Confining Pressure (psi)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
												LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0.0															
		SANDY FAT CLAY (CH) - Very stiff, reddish brown, with iron nodules.	ST			4.50					25	60	22	38	55
2.5			ST			4.50					22				
5.0		CLAYEY SAND (SC) - Very stiff, reddish brown, with iron nodules.	ST			4.50					12	43	14	29	34
7.5			ST			4.50					17				
10.0			ST												

Bottom of hole at 10.0 feet.

TEST ONLY 2 23-0711.GPJ NEW GINT TEMP.GDT 3/13/24



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BORING NUMBER B-14

PAGE 1 OF 1

CLIENT Freese & Nichols

PROJECT NAME Sabinetown Park Development - Phase 1

PROJECT NUMBER 23-0711

PROJECT LOCATION Hemphill, TX

DATE STARTED 1/4/24 COMPLETED 1/4/24

GROUND ELEVATION NORTHING

CONTRACTOR RINER

GROUND WATER LEVELS: EASTING

METHOD Auger 0 - 20 feet

INITIALLY ENCOUNTERED 15.4 ft

LOGGED BY F.C. CHECKED BY H.N.

AFTER 15 MIN. 14.7 ft

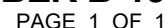
NOTES

AFTER ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	TORVANE (tsf)	Compressive Strength (tsf)	Confining Pressure (psi)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
												LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0															
		CLAYEY SAND (SC) - Very stiff, reddish brown, with iron nodules.	ST			2.00					32	80	24	56	38
			ST			3.50					22				
5			ST			2.00					19	43	17	26	32
		SILTY SAND (SM) - Very dense, brown and gray.	SS		50/6"						5				
			SS		38-50/5"										
10			SS		25-50/3"										
15			SS		38-50/3"										
20			SS		38-50/3"										

Bottom of hole at 20.0 feet.

TEST ONLY 2 23-0711.GPJ NEW GINT TEMP.GDT 3/13/24



AFTER ---

TEST ONLY 2 23-0711.GPJ NEW GINT TEMP.GDT 3/13/24

Bottom of hole at 20.0 feet.



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BORING NUMBER B-16

PAGE 1 OF 1

CLIENT Freese & Nichols

PROJECT NAME Sabinetown Park Development - Phase 1

PROJECT NUMBER 23-0711

PROJECT LOCATION Hemphill, TX

DATE STARTED 1/4/24 COMPLETED 1/4/24

GROUND ELEVATION _____ NORTHING _____

CONTRACTOR RINER

GROUND WATER LEVELS: _____ EASTING _____

METHOD Auger 0 - 20 feet

INITIALLY ENCOUNTERED Not Encountered

LOGGED BY R.M CHECKED BY H.N.

AFTER 15 MIN. Not Measured

NOTES _____

AFTER ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	TORVANE (tsf)	Compressive Strength (tsf)	Confining Pressure (psi)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
												LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0															
		SANDY FAT CLAY (CH) - Firm to very stiff, reddish brown, with iron nodules.	ST			1.50					19				
			ST			4.50					30	86	24	62	68
5			ST			4.50					23				
			ST			4.50					28	69	21	48	51
			ST			4.50		1.7		100	24				
10															
		SILTY SAND (SM) - Reddish brown.	ST												
15															
			ST												
20															

Bottom of hole at 20.0 feet.

TEST ONLY 2 23-0711.GPJ NEW GINT TEMP.GDT 3/13/24



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Telephone: 281-469-3347; Fax: 281-469.3594

BORING NUMBER B-17

PAGE 1 OF 1

CLIENT Freese & Nichols

PROJECT NAME Sabinetown Park Development - Phase 1

PROJECT NUMBER 23-0711

PROJECT LOCATION Hemphill, TX

DATE STARTED 2/29/24

COMPLETED 2/29/24

GROUND ELEVATION

NORTHING

CONTRACTOR D.A.S.

GROUND WATER LEVELS:

EASTING

METHOD Auger 0 - 40 feet

INITIALLY ENCOUNTERED 5 feet under Water














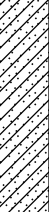





LOGGED BY J.CH.

CHECKED BY H.N.

AFTER 15 MIN. 5 feet under Water

NOTES 5 feet under Water

AFTER ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	TORVANE (tsf)	Compressive Strength (tsf)	Confining Pressure (psi)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS				FINES CONTENT (%)
												LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX		
0																
5		CLAYEY SAND (SC) - Medium dense, tan and brown.	 ST								25	56	17	39	29	
			 ST													
			 ST													
			 SS													
10		LEAN CLAY WITH SAND (CL) - Hard, gray	 ST			10-11-15 (26)					26				21	
15		SILTY SAND (SM) - Medium dense to very dense, brown and tan.	 SS			34-46-49 (95)										
			 SS													
20						6-12-15 (27)					25					13
25			 SS			16-36-42 (78)										
30		CLAYEY SAND (SC) - Very dense, gray.	 SS			25-42- 50/5"					23	31	12	19	40	
35			 SS			12-15-36 (51)										
40			 SS			15-30-45 (75)										

Bottom of hole at 40.0 feet.

TEST ONLY 2 23-0711.GPJ NEW GINT TEMP.GDT 3/13/24



CLIENT Freese & Nichols

PROJECT NAME Sabinetown Park Development - Phase 1

PROJECT NUMBER 23-0711

PROJECT LOCATION Hemphill, TX

DATE STARTED 2/29/24 COMPLETED 2/29/24

GROUND ELEVATION _____ NORTHING _____

CONTRACTOR D.A.S.

GROUND WATER LEVELS: EASTING _____

METHOD Auger 0 - 40 feet

INITIALLY ENCOUNTERED 5 feet under Water

LOGGED BY J.CH. CHECKED BY H.N.

AFTER 15 MIN. 5 feet under Water

NOTES 5 feet under Water

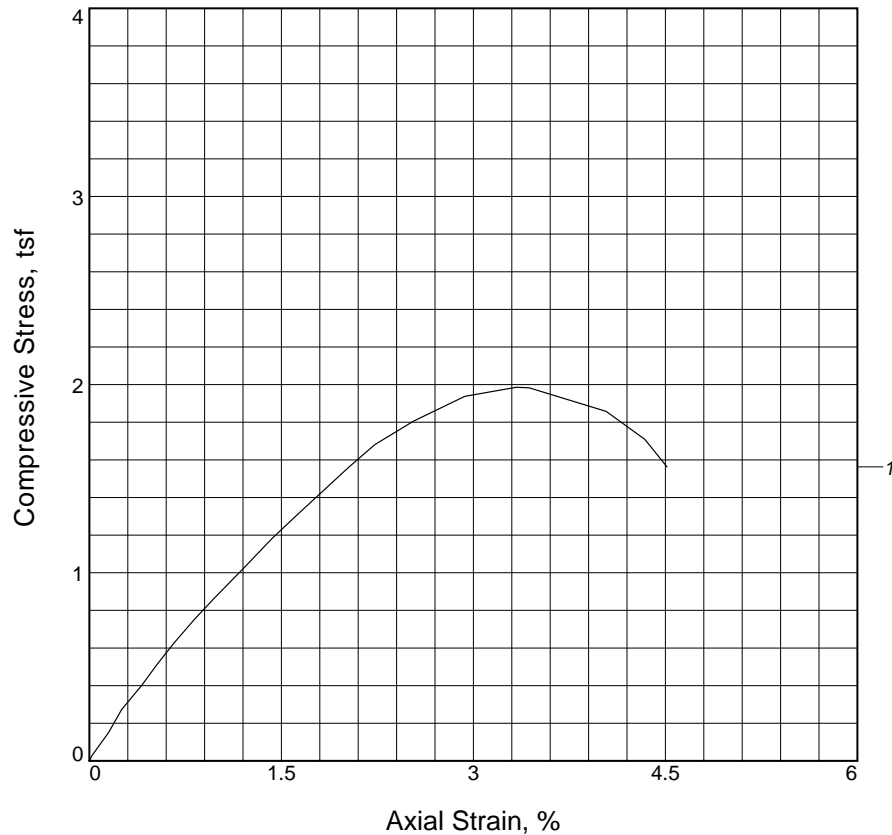
AFTER ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	TORVANE (tsf)	Compressive Strength (tsf)	Confining Pressure (psi)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
												LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0															
		CLAYEY SAND (SC) - Soft, tan and brown.	ST			0.50					29	38	14	24	34
		SILTY SAND (SM) - Medium dense to very dense, brown and tan.	ST								25				18
5			SS		8-10-14 (24)										
			SS		18-32-43 (75)					24					21
10			SS		10-16-12 (28)										
15			SS		16-28-39 (67)										
20		POORLY GRADED SAND WITH SILT (SP-SM) - Very dense, tan and gray.	SS		23-38-45 (83)						27				5
25			SS		19-29-42 (71)										
30		CLAYEY SAND (SC) - Very dense, gray.	SS		30-38- 44/5"						21	29	12	17	35
35			SS		18-29-39 (68)						26				37
40			SS		20-38- 50/5"										

Bottom of hole at 40.0 feet.

TEST ONLY 2 23-0711.GPJ NEW GINT TEMP.GDT 3/13/24

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, tsf	1.986			
Undrained shear strength, tsf	0.993			
Failure strain, %	3.3			
Strain rate, %/min.	1.00			
Water content, %	18.9			
Wet density, pcf	127.5			
Dry density, pcf	107.3			
Saturation, %	88.1			
Void ratio	0.5832			
Specimen diameter, in.	2.78			
Specimen height, in.	5.75			
Height/diameter ratio	2.07			

Description: Reddish brown CLAYEY SAND (SC)

LL = **PL =** **PI =** **Assumed GS=** 2.72 **Type:** Shelby Tube

Project No.: 23-0711
Date Sampled: 1/4/24
Remarks:

Client: H2B Engineers

Project: Trinity Episcopal Church

Location: Boring B-15

Sample Number: 5 **Depth:** 8' - 10'

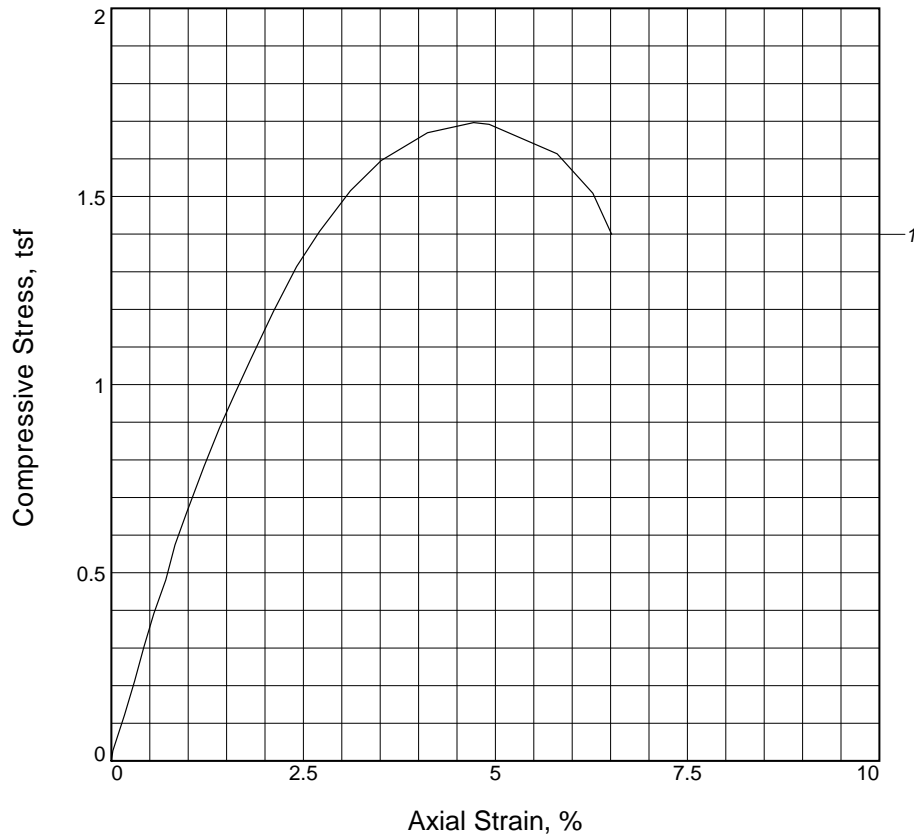
UNCONFINED COMPRESSION TEST

Riner Engineering, Inc.
Houston, Texas

Figure _____

Tested By: A.C. **Checked By:** H.N.

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, tsf	1.696			
Undrained shear strength, tsf	0.848			
Failure strain, %	4.7			
Strain rate, %/min.	1.00			
Water content, %	23.7			
Wet density, pcf	123.8			
Dry density, pcf	100.0			
Saturation, %	92.5			
Void ratio	0.6977			
Specimen diameter, in.	2.76			
Specimen height, in.	5.75			
Height/diameter ratio	2.08			

Description: Reddish brown SANDY FAT CLAY (CH)

LL =	PL =	PI =	Assumed GS= 2.72	Type: Shelby Tube
-------------	-------------	-------------	-------------------------	--------------------------

Project No.: 23-0711
Date Sampled: 1/4/24
Remarks:

Client: H2B Engineers

Project: Trinity Episcopal Church

Location: Boring B-16

Sample Number: 5 **Depth:** 8' - 10'

UNCONFINED COMPRESSION TEST

Riner Engineering, Inc.
Houston, Texas

Figure _____

Tested By: A.C. **Checked By:** H.N.

ABSORPTION SWELL TEST (ASTM D4546) RESULTS

Boring No.	B-14	B-14	B-15	B-15	B-16	B-16
Average Sample Depth (ft)	1	5	1	5	3	7
Sample Height (in)	0.8	0.8	0.8	0.8	0.8	0.8
Sample Diameter (in)	2.5	2.5	2.5	2.5	2.5	2.5
Initial Sample Volume (cu in)	3.93	3.93	3.93	3.93	3.93	3.93
Initial Sample Weight (gr)	117.5	124.3	120.0	125.4	126.9	127.0
Initial Moisture (%)	33	33	32	17	31	28
Final Moisture (%)	35	38	34	28	34	32
Initial Wet Unit Weight (pcf)	114	121	116	122	123	123
Initial Dry Unit Weight (pcf)	86	91	88	103	94	96
Applied Over Burden (psi)	0.9	4.3	0.9	4.3	2.6	6.1
Initial Dial Reading (in)	0.0264	0.0483	0.0148	0.0305	0.0059	0.0234
Final Dial Reading (in)	0.0272	0.0483	0.0357	0.0556	0.0099	0.0342
Swell (%)	0.10	0.00	2.61	3.14	0.50	1.35

Appendix D - Aerial Photographs

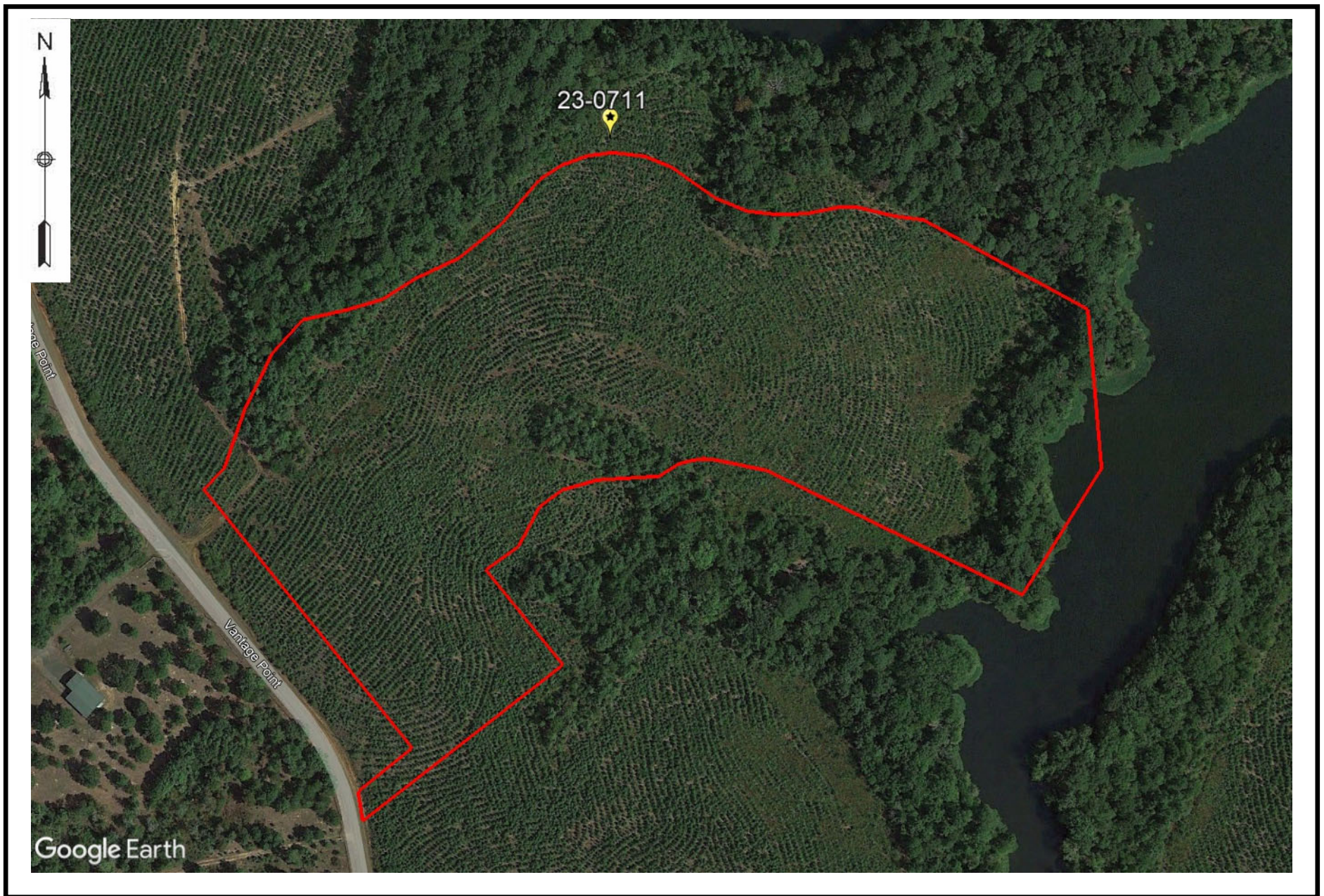
AERIAL PHOTOGRAPH - 2023



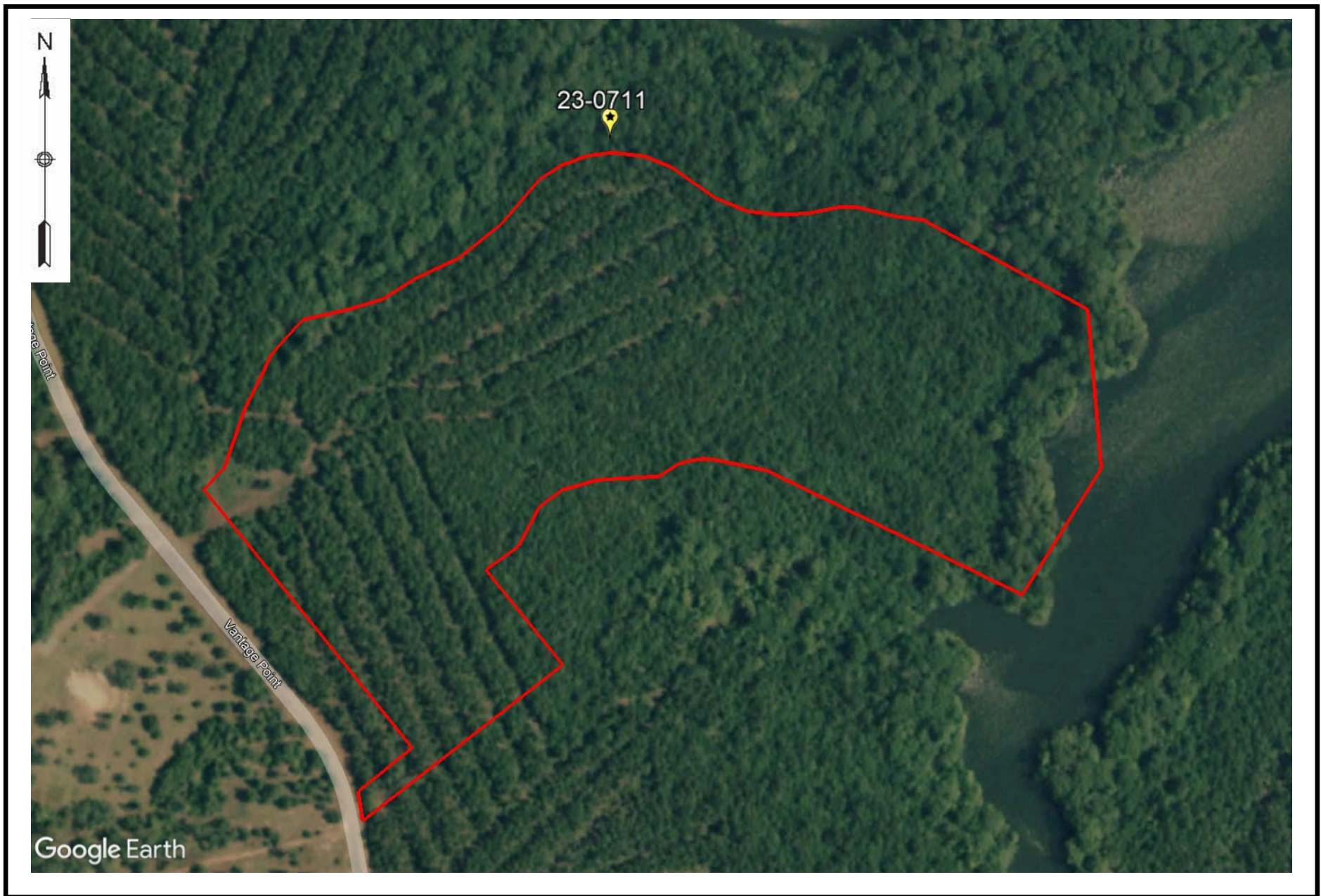
AERIAL PHOTOGRAPH - 2021



AERIAL PHOTOGRAPH - 2015



AERIAL PHOTOGRAPH - 2009



AERIAL PHOTOGRAPH - 2004

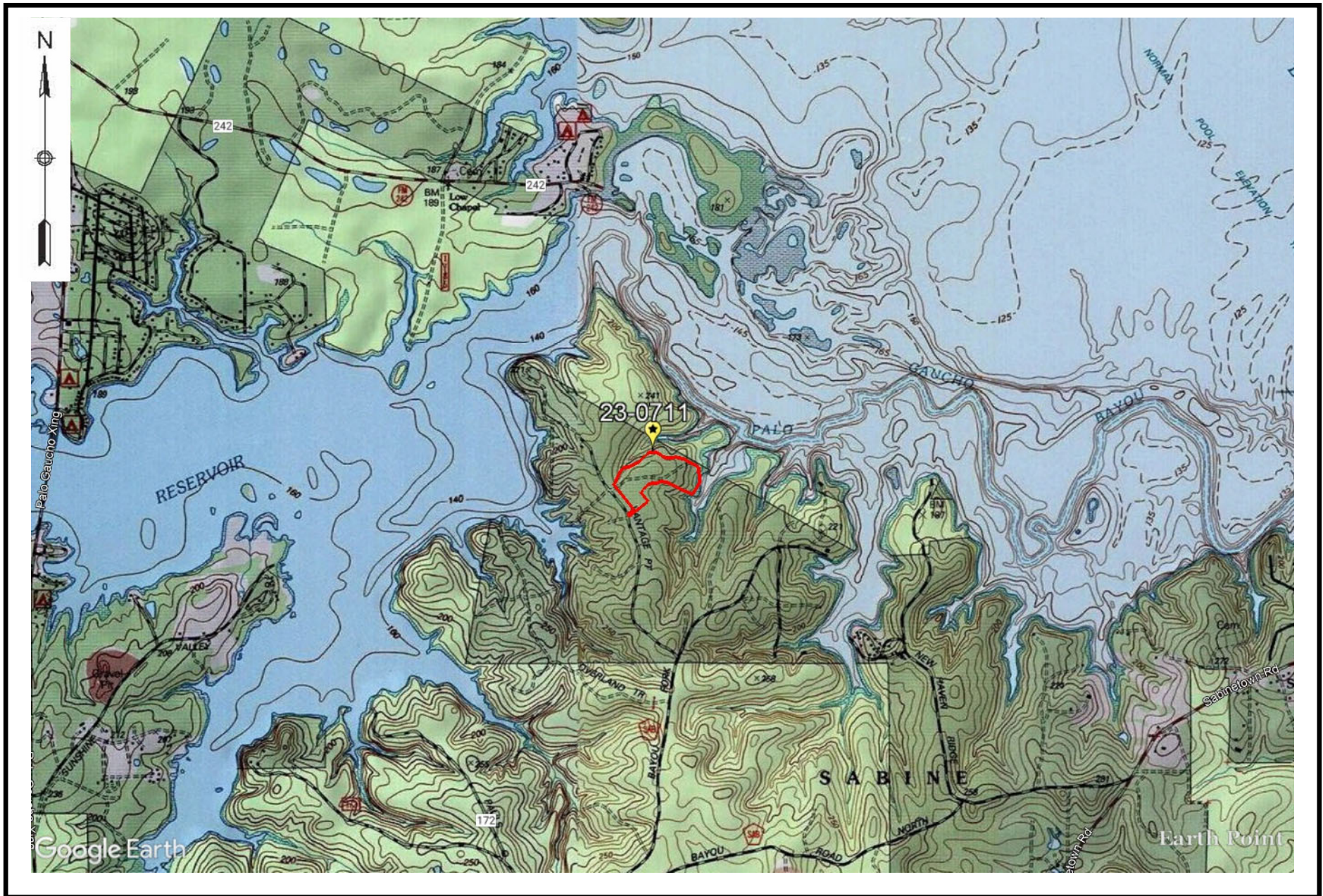


AERIAL PHOTOGRAPH - 1996



Appendix E - USGS Topographic Map

USGS TOPOGRAPHIC MAP



Appendix F - Site Photographs

SITE PHOTOGRAPHS



Boring B-03 Facing South



Boring B-07 Facing Northeast



Boring B-06 Facing East



Boring B-09 Facing Southwest

SITE PHOTOGRAPHS



Boring B-13 Facing Southwest



Boring B-14 Facing West



Boring B-12 Facing Northeast



Boring B-15 Facing Northwest

SITE PHOTOGRAPHS



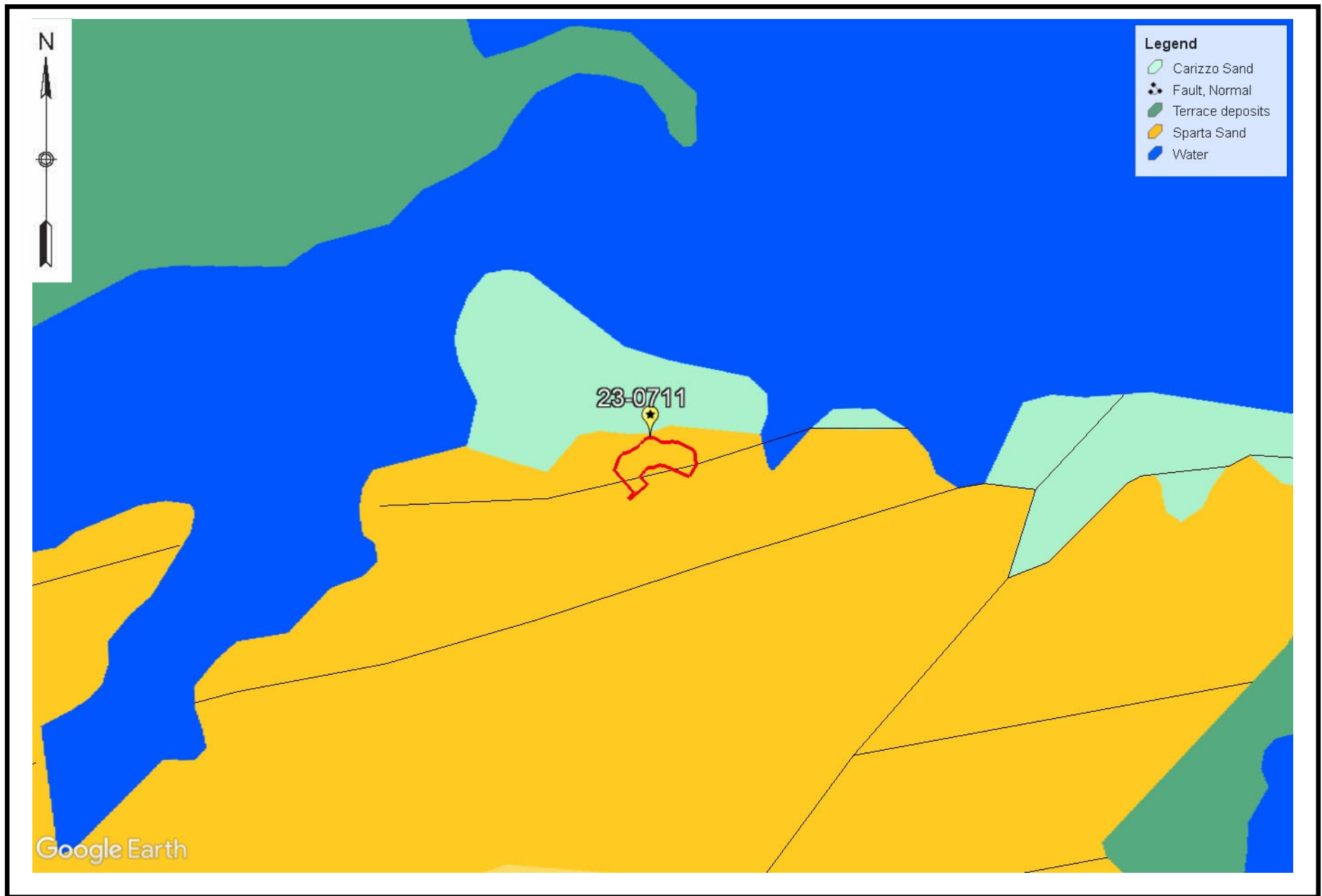
Boring B-17 Facing West



Boring B-18 Facing Northwest

Appendix G - Geologic Information

GEOLOGIC ATLAS



[XML](#)[JSON](#)

Sparta Sand

Sparta Sand

State	Texas
Name	Sparta Sand
Geologic age	Eocene
Lithologic constituents	<div>Major<div>Sedimentary > Clastic > Sandstone (Bed)</div>Minor<div>Sedimentary > Clastic > Mudstone > Claystone (Bed)</div><div>Sedimentary > Clastic > Siltstone (Bed)</div>Incidental<div>Sedimentary > Coal (Bed)</div></div>
Comments	Quartz sand, v. fine to fine grained, lt. gray, v. pale orange, grayish-brn to brownish-gray, sl. cohesive from silt and clay matrix, massive, locally crossbedded, well sorted, micaceous, interbeds of sandy or silty clay, locally carbonaceous; some hard, brown ferruginous sandstone near base; lignite beds locally present near top, 130 +/-ft thick in San Antonio Sheet (1974), 130-150 ft in Seguin Sheet (1974), 150-250 ft in Crystal City-Eagle Pass Sheet (1976)170 +/-ft thick in Tyler Sheet (1964), 50+- ft in Texarkana Sheet (1966)..
References	<div>Bureau of Economic Geology, 1974, San Antonio Sheet, Geologic Atlas of Texas, University of Texas, Bureau of Economic Geology, scale 1:250,000.</div> <div>Bureau of Economic Geology, 1974, Seguin Sheet, Geologic Atlas of Texas, University of Texas, Bureau of Economic Geology, scale 1:250,000.</div> <div>Bureau of Economic Geology, 1976, Crystal City-Eagle Pass Sheet, Geologic Atlas of Texas, University of Texas, Bureau of Economic Geology, scale 1:250,000.</div> <div>Bureau of Economic Geology, 1965, Tyler sheet, Geologic Atlas of Texas, Bureau of Economic Geology, University of Texas at Austin,</div>

scale 1:250,000.
Bureau of Economic Geology, 1966, Texarkana Sheet, Geologic Atlas of Texas, University of Texas, Bureau of Economic Geology, scale 1:250,000.
Bureau of Economic Geology, 1967, Palestine Sheet, Geologic Atlas of Texas, Bureau of Economic Geology, University of Texas at Austin, scale 1:250,000.
Bureau of Economic Geology, 1992, Geologic Map of Texas: University of Texas at Austin, Virgil E. Barnes, project supervisor, Hartmann, B.M. and Scranton, D.F., cartography, scale 1:500,000.

**NGMDB
product**

[NGMDB product page for 68390](#)

Counties

[Anderson](#) - [Angelina](#) - [Atascosa](#) - [Bastrop](#) - [Blanco](#) - [Brazos](#) - [Burleson](#) - [Camp](#) - [Cass](#) - [Cherokee](#) - [Fayette](#) - [Frio](#) - [Gillespie](#) - [Gonzales](#) - [Harrison](#) - [Henderson](#) - [Houston](#) - [Kimble](#) - [Lee](#) - [Leon](#) - [Marion](#) - [Mason](#) - [Menard](#) - [Milam](#) - [Morris](#) - [Nacogdoches](#) - [Robertson](#) - [Rusk](#) - [Sabine](#) - [San Augustine](#) - [Shelby](#) - [Smith](#) - [Upshur](#) - [Van Zandt](#) - [Wilson](#) - [Wood](#)

Appendix H - Unified Soil Classification System

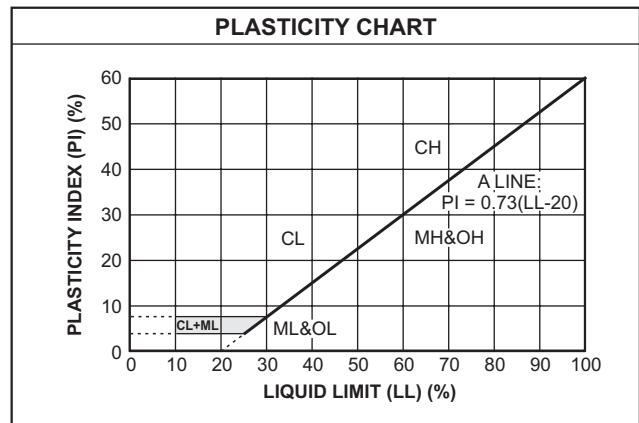
UNIFIED SOIL CLASSIFICATION SYSTEM

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART		
COARSE-GRAINED SOILS (more than 50% of material is larger than No. 200 sieve size.)		
GRAVELS More than 50% of coarse fraction larger than No. 4 sieve size	Clean Gravels (Less than 5% fines)	
	GW	Well-graded gravels, gravel-sand mixtures, little or no fines
	GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
	Gravels with fines (More than 12% fines)	
	GM	Silty gravels, gravel-sand-silt mixtures
	GC	Clayey gravels, gravel-sand-clay mixtures
SANDS 50% or more of coarse fraction smaller than No. 4 sieve size	Clean Sands (Less than 5% fines)	
	SW	Well-graded sands, gravelly sands, little or no fines
	SP	Poorly graded sands, gravelly sands, little or no fines
	Sands with fines (More than 12% fines)	
	SM	Silty sands, sand-silt mixtures
	SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (50% or more of material is smaller than No. 200 sieve size.)		
SILTS AND CLAYS Liquid limit less than 50%	ML	Inorganic silts and very fine sands, rock flour, silty of clayey fine sands or clayey silts with slight plasticity
	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
	OL	Organic silts and organic silty clays of low plasticity
SILTS AND CLAYS Liquid limit 50% or greater	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
	CH	Inorganic clays of high plasticity, fat clays
	OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS	PT	Peat and other highly organic soils

LABORATORY CLASSIFICATION CRITERIA		
GW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
GP	Not meeting all gradation requirements for GW	
GM	Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
GC	Atterberg limits above "A" line with P.I. greater than 7	
SW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
SP	Not meeting all gradation requirements for GW	
SM	Atterberg limits below "A" line or P.I. less than 4	Limits plotting in shaded zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols.
SC	Atterberg limits above "A" line with P.I. greater than 7	

Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

Less than 5 percent GW, GP, SW, SP
 More than 12 percent GM, GC, SM, SC
 5 to 12 percent Borderline cases requiring dual symbols

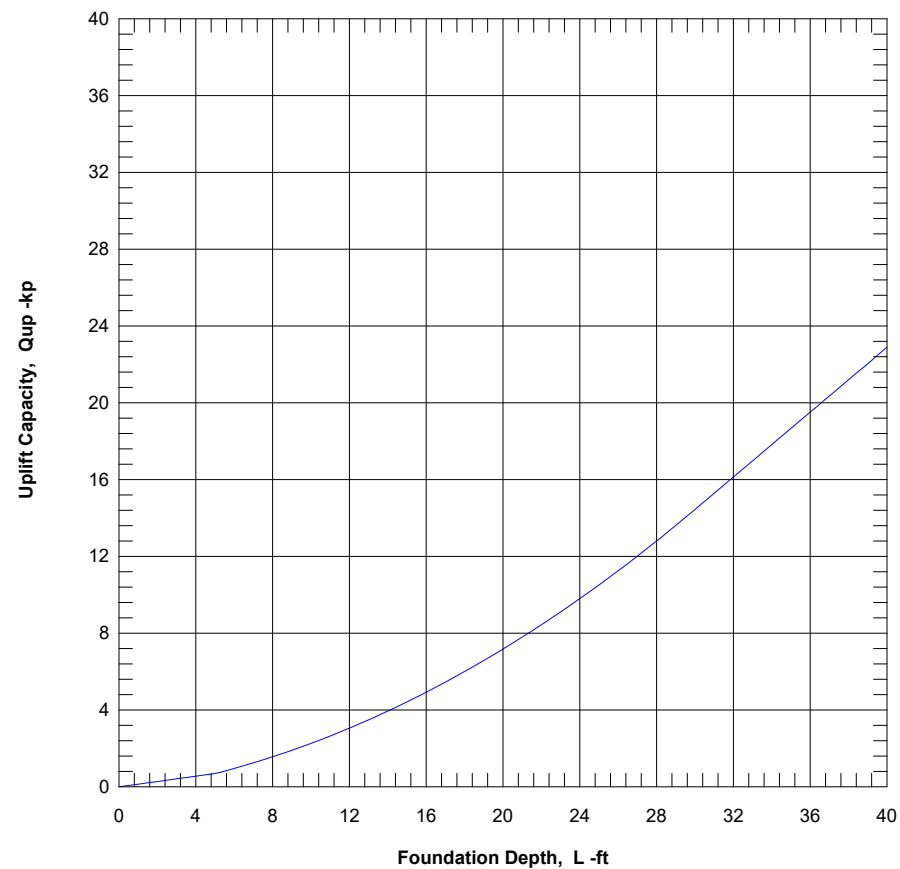
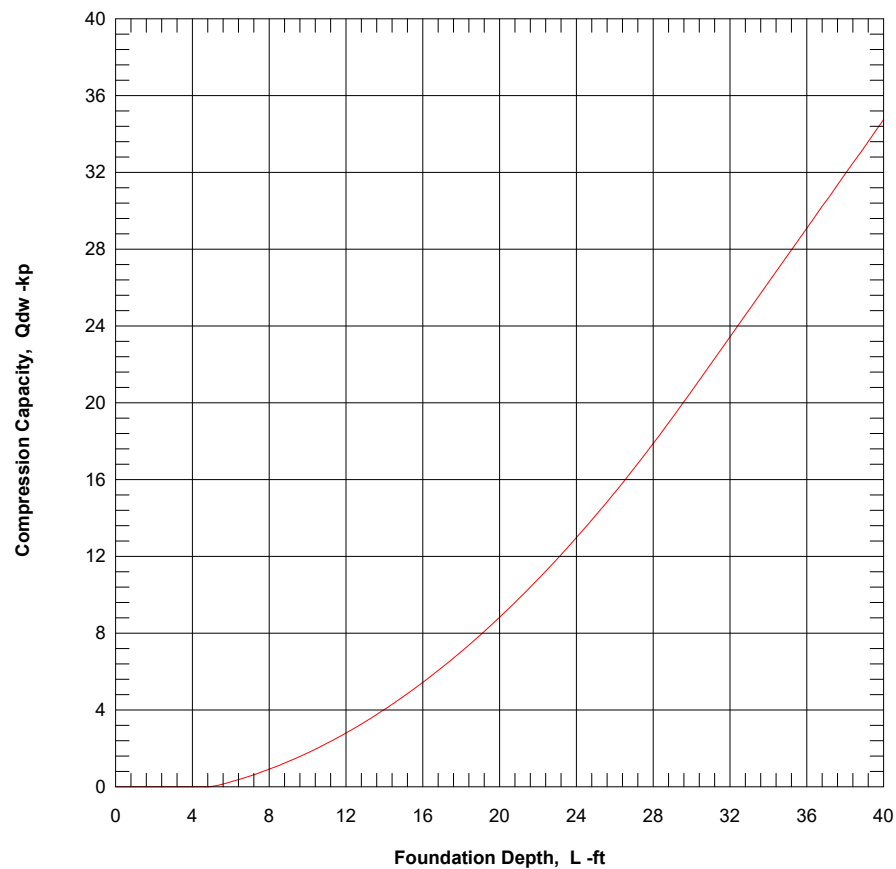


TERMS DESCRIBING SOIL CONSISTENCY				
Fine Grained Soils		Coarse Grained Soils		
Description	Penetrometer Reading (tsf)	Penetration Resistance (blows/ft)	Description	Relative Density
Soft	0.0 to 1.0	0 to 4	Very Loose	0 to 20%
Firm	1.0 to 1.5	4 to 10	Loose	20 to 40%
Stiff	1.5 to 3.0	10 to 30	Medium Dense	40 to 70%
Very Stiff	3.0 to 4.5	30 to 50	Dense	70 to 90%
Hard	4.5+	Over 50	Very Dense	90 to 100%

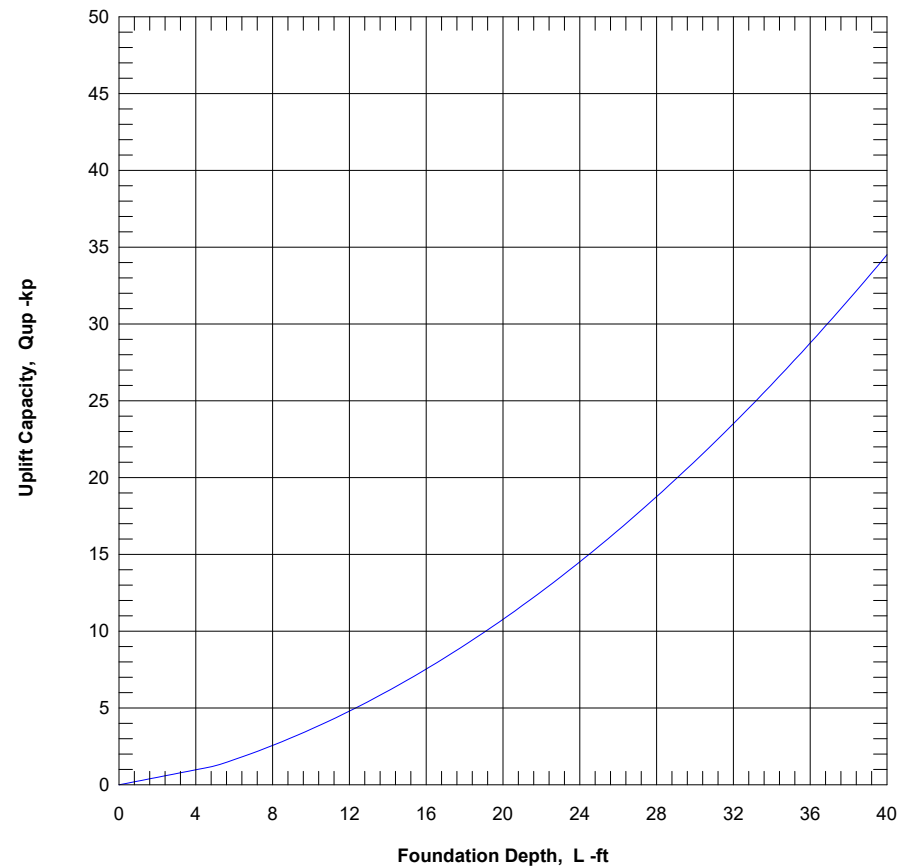
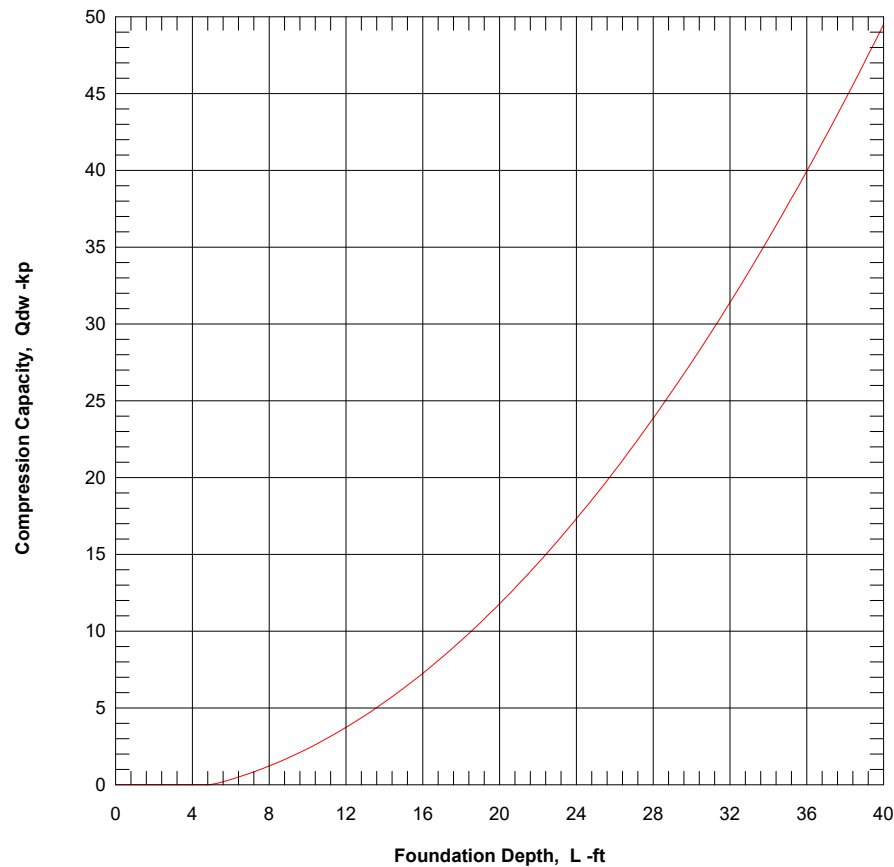
Appendix I - Axial Pile Load Carrying Capacities

DRIVING OPEN END STEEL PIPE PILES

ALLOWABLE CAPACITY vs FOUNDATION DEPTH

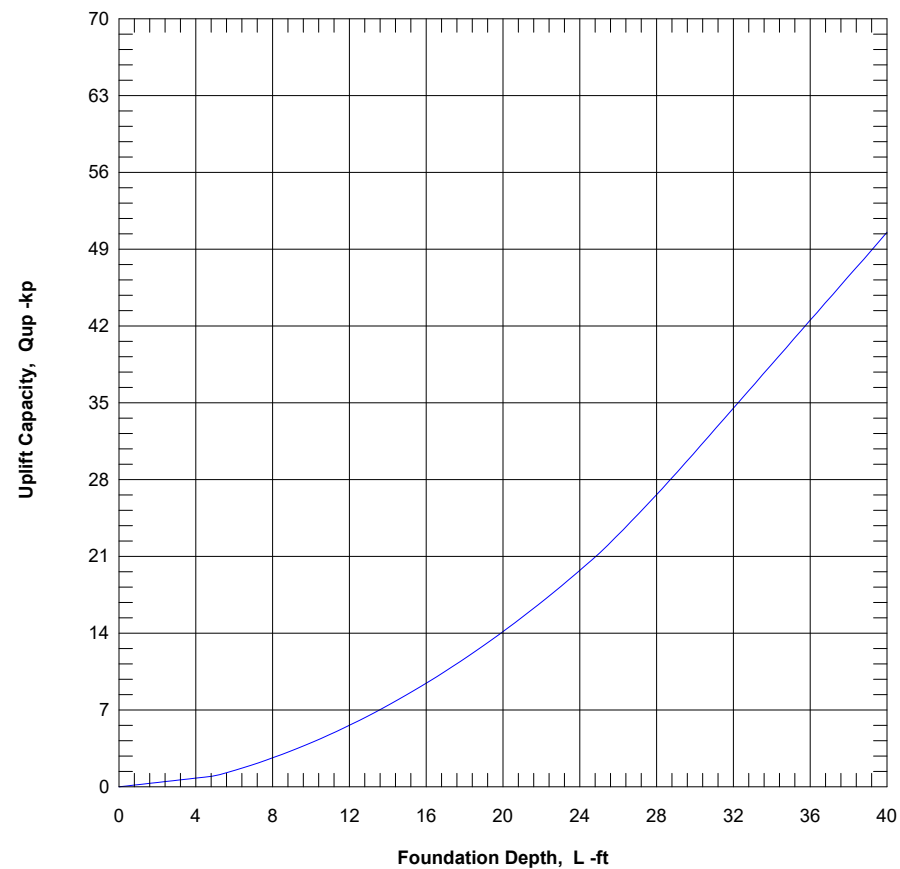
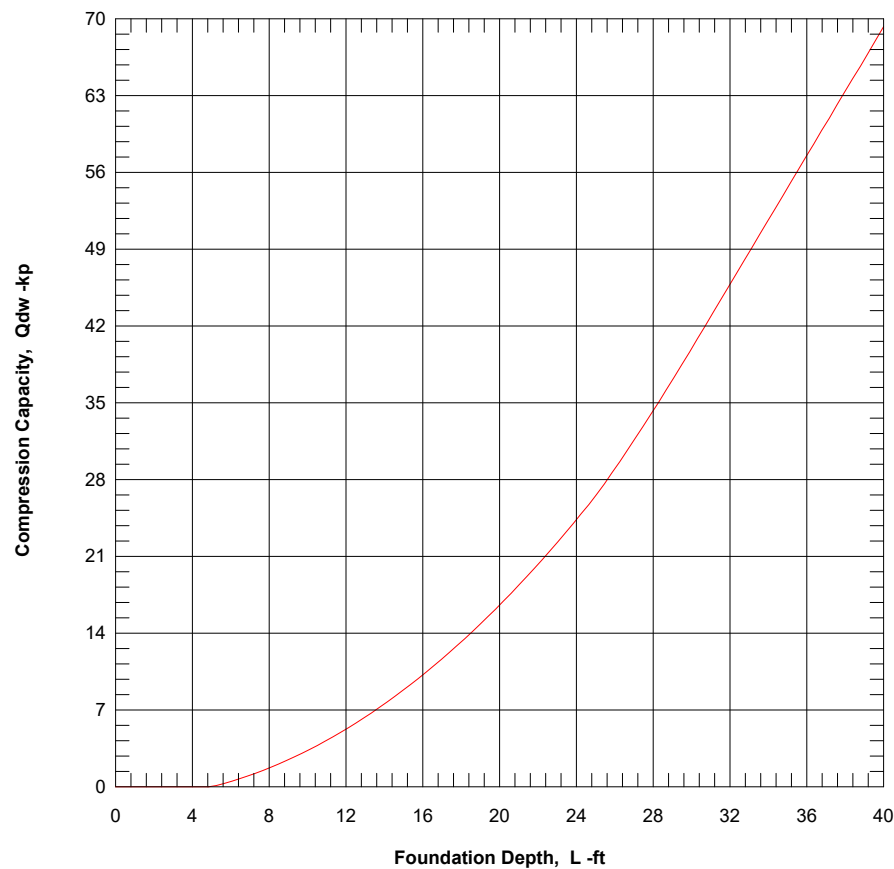


ALLOWABLE CAPACITY vs FOUNDATION DEPTH

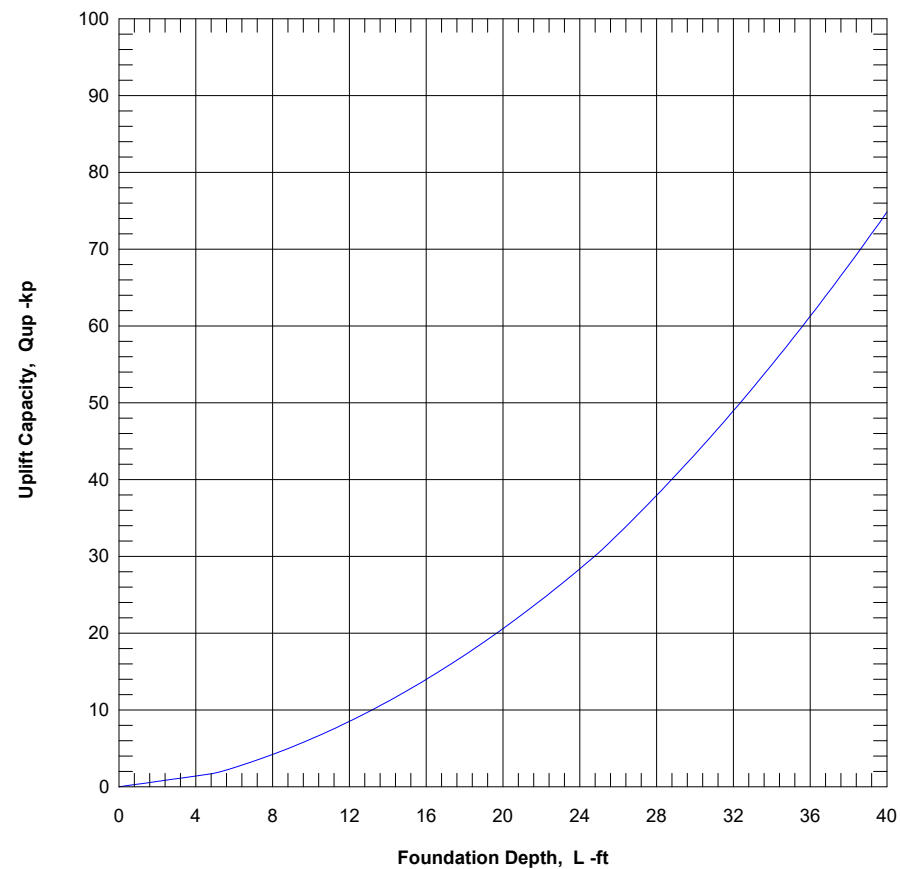
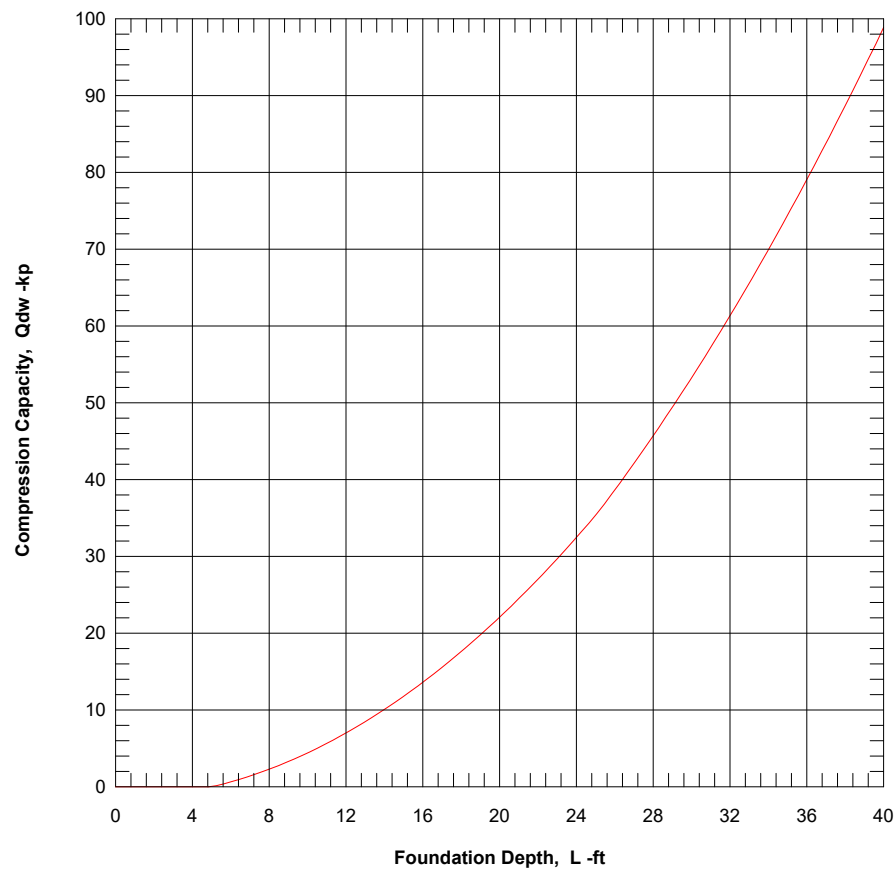


DRIVING CONCRETE PILES

ALLOWABLE CAPACITY vs FOUNDATION DEPTH



ALLOWABLE CAPACITY vs FOUNDATION DEPTH





Riner
Engineering

A UES Company

June 26, 2024

Mr. Bryan Janhsen, RLA
Freese & Nichols, Inc.
10497 Town and Country Way, Suite 500
Houston, Texas

**Re: Addendum 1 to Geotechnical Engineering Report
Sabinetown Park Development - Phase 1
Hemphill, Texas
RINER Project No. 23-0711**

Dear Mr. Janhsen:

As requested by the client, provided herein are our recommendations for the proposed retaining wall surrounding the proposed pavilion. Based on the provided drawings, we understand the maximum height of the proposed retaining wall will be approximately 10 feet.

Retaining Wall Recommendation

Recommended Safety Factors. The proposed retaining wall should be designed for minimum safety factors as provided in the following table.

Recommended Minimum Safety Factors	
Condition	Minimum Safety Factor
Sliding along the Base	1.5
Overturning about the Toe	2.0
Bearing Capacity	2.0
Global Stability (Short-Term Condition)	1.3
Global Stability (Long-Term Condition)	1.5
Global Stability (Rapid Drawdown Condition)	1.25

NOTE: Wall external stability (i.e., sliding, overturning, and bearing capacity) should be checked by the wall designer. RINER should be contacted to review retaining wall plans and profiles, once available. **It is imperative that global stability of the proposed retaining wall be reviewed by RINER.**

Lateral Earth Pressures. The proposed retaining wall should be designed to resist the expected lateral earth pressure. The design of walls should be performed based on equivalent fluid pressure values provided herein. The equivalent fluid pressure values provided in this section assumes a horizontal ground surface extending back from the top of walls. *The values provided herein are not applicable to inclined backfill. Any walls with inclined backfill should be designed for an additional equivalent fluid pressure of 1 pcf for every 1 degree of slope inclination.*

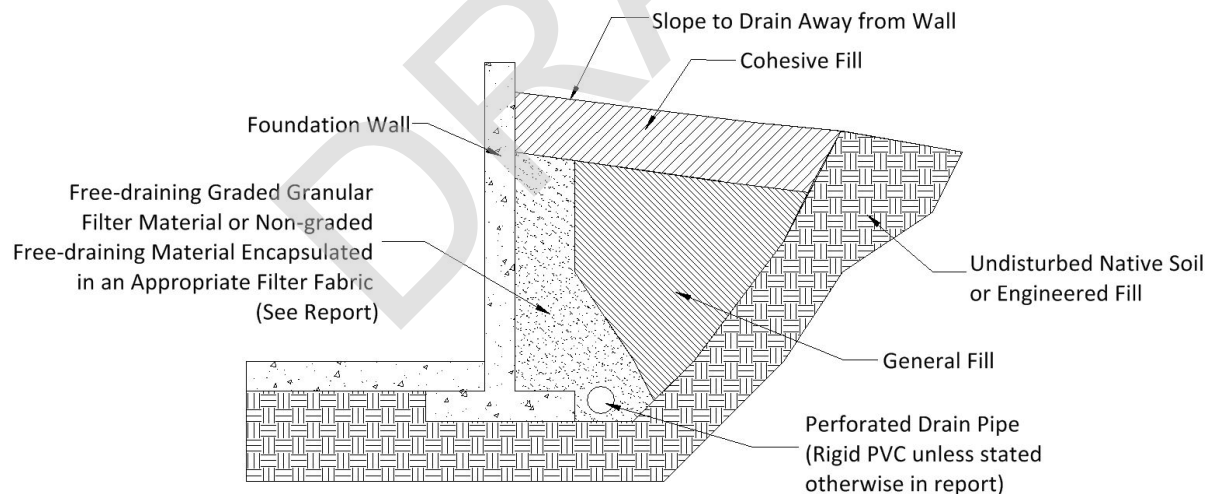
Equivalent Fluid Pressure - Horizontal Ground Surface Extending Backward from the Top of the Wall				
Type of Backfill ⁽³⁾	Active Pressure (pcf) ^{(1) & (2)}		At-Rest Pressure (pcf) ^{(1) & (2)}	
	Above Water Table and Free-Draining	Below Water Table or Not Free-Draining	Above Water Table and Free-Draining	Below Water Table or Not Free-Draining
On-site Clay and General Fill free of organics and other deleterious material that is compacted to at least 95 percent of the Standard Proctor Density (ASTM D698) and within two percentage points of the optimum moisture content. Unit Weight 125 pcf and Friction Angle of 20° $k_a = 0.49$; $k_o = 0.66$	60	95	85	105
Select Fill – Select Fill free of organics and other deleterious material that is compacted to at least 95 percent of the Standard Proctor Density (ASTM D698) and within two percentage points of the optimum moisture content. Unit Weight 125 pcf and Friction Angle of 27° $k_a = 0.38$; $k_o = 0.55$	50	85	70	95
Granular Fill – Sands with less than 15% passing no. 200 sieve and compacted to at least 95 percent of the Standard Proctor Density (ASTM D698) Unit Weight 120 pcf and Friction Angle of 34° $k_a = 0.28$; $k_o = 0.44$	35	80	55	90
Notes: (1) The active earth pressure assumes that the top of the walls are not rigidly restrained, and the walls are not sensitive to some movement. For active earth pressure, the wall must rotate about the base, with top lateral movements of about 0.002H to 0.004H, where H is the wall height. The at-rest condition assumes the walls are restrained at top. (2) The values provided are to the nearest 5 pcf. (3) k_a = Coefficient of Active Earth Pressure; k_o = Coefficient of At-Rest Earth Pressure.				

The above lateral pressures include hydrostatic water pressure but do not include surcharge loads. The lateral load produced by a surcharge may be computed as 50 percent of the vertical surcharge pressure applied as a constant pressure over the full depth of pile wall. Surcharge loads set back from the back face of the pile wall at a horizontal distance equal to or greater than the pile wall height may be ignored.

Backfill. Backfill placed against retaining structures may be granular fill, select fill, or general fill. **For the granular fill and select fill values to be valid, the granular or select fill must extend out from the base of the wall at an angle of at least 45 degrees from the vertical.**

Lateral Resistance. Resistance to lateral loads may be provided by the soil adjacent to the structure. We recommend using an equivalent fluid weight of 200 pcf for lateral resistance. ***The Passive resistance should be neglected to a depth of 2-feet below the finish grade at the toe of the wall or the scour depth whichever is deeper.*** Also, the passive resistance should be ignored if the material in front of the wall will be excavated at any time in the future. We recommend a coefficient of sliding friction of 0.3 between the retaining structure concrete footing and the underlying soil.

Drainage. A perforated drain line installed behind the base of the walls that extend below adjacent grade is recommended to prevent hydrostatic loading on the walls as shown on the diagram below. The invert of the drain line around a below-grade building area or exterior retaining wall should be placed near the foundation bearing level. The drain line should be sloped to provide positive gravity drainage to a sump pit and pump. The drain line should be surrounded by clean, free-draining granular material have less than 5 percent passing the No. 200 sieve. The free-draining aggregate should be encapsulated in a filter fabric. The granular fill should extend to within 2 feet of final grade, where it should be capped with cohesive fill to reduce infiltration of surface water into the drain system.



Alternative Drainage. As an alternative to free-draining granular fill, a pre-fabricated drainage system may be used. A pre-fabricated drainage system may be a plastic drainage core or mesh system which is covered with a filter fabric to prevent soil intrusion and is fastened to the wall prior to placing backfill.

Bearing Capacity. Assuming a minimum embedment depth of 24-inches below the finish grade at the toe of the wall or the scour depth, whichever is deeper, an allowable bearing capacity of

2,000 psf may be used for retaining structure footings (using a Factor of Safety of 2). **Additional embedment depth may be required based on our global stability analysis.**

All other recommendations provided in our original geotechnical engineering report remain unchanged.

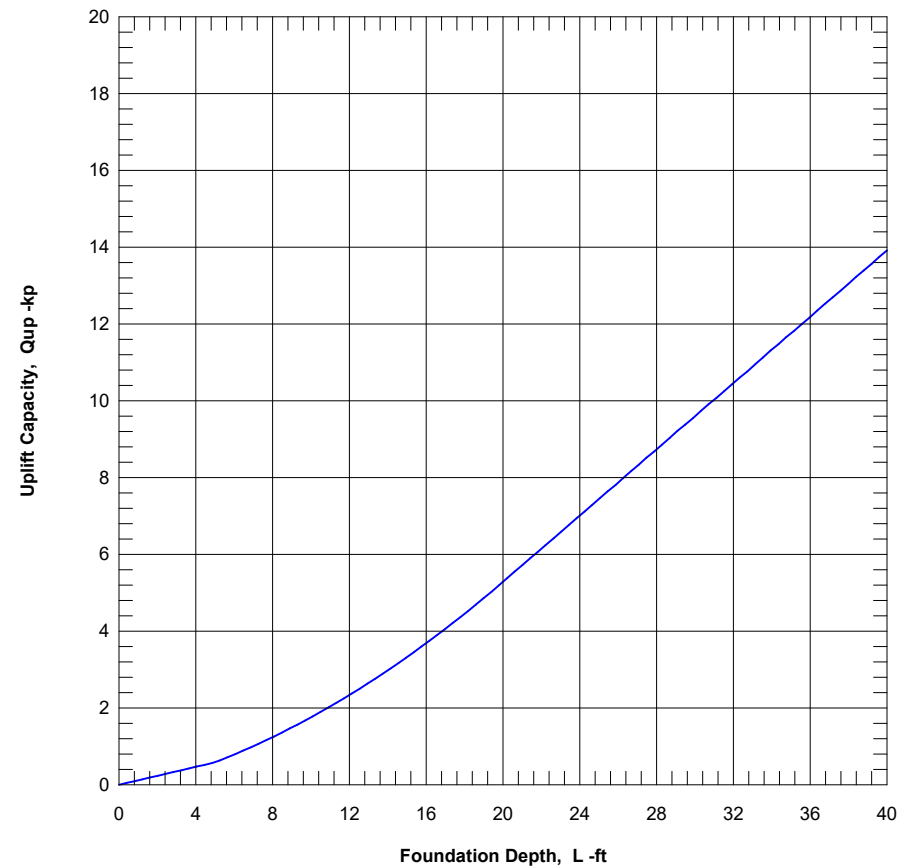
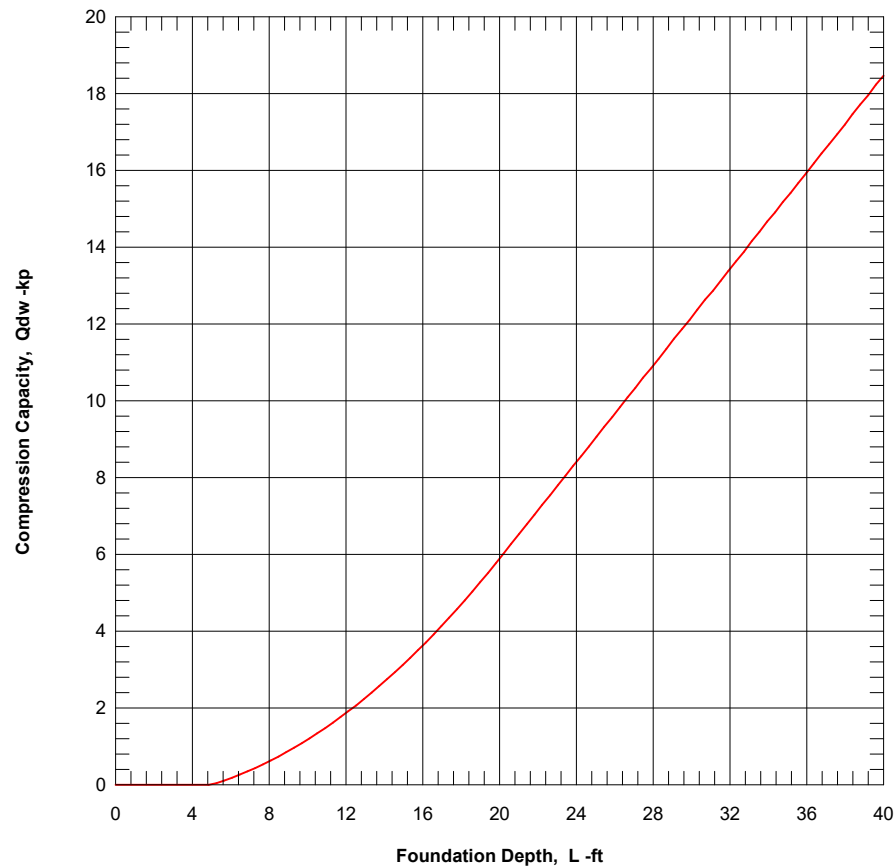
Respectfully submitted,
Riner Engineering, Inc.

Hai (Harry) Minh Nguyen, Ph.D., P.E.
Senior Project Engineer

Hamed Ardalan, Ph.D., P.E.
Vice President – Engineering Director

Riner Engineering, Inc. – Texas Engineering Firm Registration No. F-17076

ALLOWABLE CAPACITY vs FOUNDATION DEPTH





***APPENDIX B – ONSITE SEWAGE FACILITY
DESIGN PACKAGE***

On-Site Sewage Facility Design Package

Sabinetown Park
Park and Fishing Facility
Hemphill, TX 75948

On-Site Sewage Facility
Application / Affidavit

**ALL PERMIT FEES ARE
NON-REFUNDABLE
ONE PERMIT PER SYSTEM**

On-Site Sewage Facilities Permit Application

Permit Number _____	
Date _____	
Amount Paid _____	Receipt # _____

Authorized Agent: _____

Property Owners Name: _____
(Last) (First) (Middle) (Spouse/Other)

Mailing Address: _____
(# & Street Name (or) P.O. Box # & Route # & Box #) (City) (Zip)

Telephone Number: _____
(Home) and (Work) and/or (Other)

Site Address: _____
(Address Required) (# & Street Name (or) P.O. Box # & Route # & Box #) (City) (Zip)

Lot _____, Block _____, Subdivision _____, Unit # _____

Acreage _____, Survey Name _____, Abstract _____, Deed Volume _____, Page _____

Tract _____, Section _____, GEO Number: _____

Water Usage Rate "Q"(gallons per day): _____ Water saving devices: ☐ Yes ☐ No

Source of Water: ☐ Private Well ☐ Public Water Supply – Name: _____

☐ Single Family Residence: Number of Bedrooms _____ Square Footage Living Area _____

☐ Commercial/Institutional/Multi-Family: Type: _____

Name of Business: _____

No. of Employees/Occupants/Units: _____ Days Occupied Per Week: _____

Site Evaluator: _____ Registration Number & Type: _____

Designer: _____ Registration Number & Type: _____

Address: _____ Telephone: _____

Installer: _____ Registration Number & Type: _____

Address: _____ Telephone: _____

(Street, P.O. Box, or Route/City/Zip)

I hereby certify that under penalty of law that this application and any attachments contain no willful or negligent misrepresentation or falsification and that the information is true, accurate, and complete to the best of my knowledge. I understand that any misrepresentation or falsification may result in denial of my application. Authorization is hereby granted for the Permitting Authority to enter the above described property for the purpose of lot evaluation and inspection of on-site sewage facility and related activities. A permit to operate the facility will be granted following a successful inspection of the system.

(Signature of Owner)

(Date)

(ATC) AUTHORIZATION TO CONSTRUCT GRANTED BY: _____

LICENSE NO.: _____ DATE: _____

A COPY OF THIS APPLICATION WITH APPROVAL SIGNATURE ON LINE (ATC) BY THE DESIGNATED REPRESENTATIVE SHALL SERVE AS **"AUTHORIZATION TO CONSTRUCT"**, BASED ON PLANNING MATERIALS RECEIVED BY THIS DATE.

(AO) INSPECTED AND APPROVAL TO OPERATE GRANTED BY: _____

LICENSE NO.: _____ DATE: _____

A COPY OF THIS APPLICATION WITH APPROVAL SIGNATURE ON LINE (AO) BY THE DESIGNATED REPRESENTATIVE SHALL SERVE AS **"NOTICE OF APPROVAL TO OPERATE"**, BASED ON FINAL SYSTEM INSPECTION, TO INCLUDE ANY APPROVED CHANGES OR MODIFICATIONS MADE AFTER RELEASE OF AUTHORIZATION TO CONSTRUCT.

On-Site Sewage Facility Maintenance Initial Warranty Contract

Installation Location: _____
System Owner: _____ Installation Co: _____
Permitting Authority: _____
Name / Address of Maintenance Co: _____
Maintenance Co. Phone Number: _____
Installation Date: _____
Brand Name: _____ Model Number: _____ Serial Number: _____
Other System Information: _____

INITIAL POLICY

This policy is included in the original purchase price and shall provide an Inspection / Service Call once every four (4) months for a two (2) year period from the date that a final permit is issued by the permitting authority. If no chlorine is found in the chlorinator, chlorine shall be added to obtain a residual at owner's expense. If an improper operation is observed which cannot be corrected at that time, the user shall be notified immediately in writing of the conditions and the estimated date of correction and cost, if applicable. The following items shall be checked at time of each site visit (if applicable):

- 1) Aerator/s
- 2) Surface application and or disposal field pumps
- 3) Recirculation pumps
- 4) Disinfection device
- 5) Chlorine Residual measurement
- 6) Electrical circuits
- 7) Distribution system
- 8) Filters
- 9) Spray field or disposal field vegetation
- 10) Settled sludge depth in the pretreatment and aerobic tanks

Any call or request for service outside the routine service provided under this contract will be responded to within _____ hours and if the problem encountered is not covered under warranty of product or workmanship, there will be a service charge of \$_____ per hour with a minimum of _____ hours per call. All additional charges shall be authorized by the owner.

VIOLATIONS OF WARRANTY including shutting off the electric current to the system for more than 24 hours, disconnecting the alarm system, restricting ventilation to the aerator, overloading the system above its rated capacity, of introducing excessive amounts of harmful matter into the system, or any other form of unusual abuse may void warranty of system components.

Chlorine supply for the chlorinator is to be maintained by _____

Homeowner has received and agrees to "Operation Tips". _____ (Intl.)

THIS POLICY DOES NOT INCLUDE PUMPING SLUDGE FROM UNIT IF NECESSARY

I agree to abide by the service policy as stated above:

Service Company Employee Certified by Manufacturer: _____

License Type and License No.: _____

Accepted by: _____ (Owner) Date: _____

Accepted by: _____ (Service Company Representative) Date: _____

AFFIDAVIT

THE COUNTY OF _____

STATE OF TEXAS

CERTIFICATION OF OSSF REQUIRING MAINTENANCE

According to Texas Commission on Environmental Quality Rules for On-Site Sewage Facilities, this document is filed in the Deed Records of _____ County Texas.

I.

The Texas Health and Safety Code, Chapter 366 authorizes the Texas Commission on Environmental Quality (commission) to regulate on-site sewage facilities (OSSFs). Additionally, the Texas Water Code (TWC), § 5.012 and § 5.013, gives the commission primary responsibility for implementing the laws of the State of Texas relating to water and adopting rules necessary to carry out its powers and duties under the TWC. The commission, under the authority of the TWC and the Texas Health and Safety Code, requires owners to provide notice to the public that certain types of OSSFs are located on specific pieces of property. To achieve this notice, the commission requires a recorded affidavit. Additionally, the owner must provide proof of the recording to the OSSF permitting authority. This recorded affidavit is not a representation or warranty by the commission or the Permitting Authority of the suitability of this OSSF, nor does it constitute any guarantee by the commission or the Permitting Authority that the appropriate OSSF was installed.

II.

An OSSF requiring a maintenance contract, according to 30 Texas Administrative Code §285.91(12) will be installed on the property described as the following:

Lot(s) _____, Block _____, Subdivision _____, Unit # _____

Acreage _____, Survey Name _____, Abstract _____, Deed Volume _____, Page _____

Tract _____, Section _____, GEO Number: _____

The property is owned by (insert owner's full name): _____

This OSSF shall be covered by a continuous service policy for the first two years. After the initial two-year service policy, the owner of an aerobic treatment system for a single family residence shall either obtain a maintenance contract within 30 days or maintain the system personally.

If this OSSF is located on two or more separate legal tracts of land, (as noted above) the tracts cannot be sold separately. This document must be recorded with each tract's property deed affected by the OSSF.

Upon sale or transfer of the above-described property, the permit for the OSSF shall be transferred to the buyer or new owner. A copy of the planning materials for the OSSF may be obtained from the Permitting Authority.

WITNESS BY HAND(S) ON THIS ____ DAY OF _____, _____.

(Owner signature(s))

(Owner(s)signature(s))

SWORN TO AND SUBSCRIBED BEFORE ME ON THIS ____ DAY OF _____, _____.

Notary Public, State of Texas

Notary's Printed Name

My Commission Expires:

NOTARY SEAL BELOW:

On-Site Sewage Facility Design Package

Sabinetown Park
Park and Fishing Facility
Hemphill, TX 75948

Design Report

Nathan Miller, P.E.
LICENSED PROFESSIONAL ENGINEER NO. 123211
WAVECREST DESIGN, LLC
TEXAS REGISTERED FIRM NO. F-23292

1502 Rosewood Dr.
Keller, Texas 76248

Email: nathan.miller@wavecrestdesign.com

Phone: (713) 376-1225

June 17, 2024

To:

Bryan Janhsen, RLA
Freese and Nichols, Inc.
(832) 456-4735

RE: Sabinetown Park, Sabine County, On Site Sewer Facility Plan

Restroom Facility at Sabinetown Park Fishing Facility
Sabinetown Park
Vantage Point, Hemphill, Sabine County, TX 75948

This letter and attachments will serve as the design document for the proposed On-Site Sewage Facility (OSSF) at the above referenced site. Prior to system installation, this Submittal Package shall be submitted to the Sabine River Authority of Texas – Toledo Bend Division, Route 1 Box 270, Burkeville, TX, 75932 for review and permitting.

This document includes the design for the treatment system and effluent disposal system only. The collection system design is by others.

Recommendations contained herein are representative of those presented in the Texas Commission on Environmental Quality (TCEQ) document Title 30, Texas Administrative Code, Chapter 285, On-Site Sewage Facilities. A copy of Title 30 TAC. Chapter 285 is available from the TCEQ, Austin, Texas.

This design is representative of the current “State of the Art” in effluent disposal system design. It should function within normal limits and expectations without causing significant threat or harm to existing water supply systems, the public health or the threat of pollution or nuisance conditions. However, due to the vagaries of both nature and man, no warranty of this design performance is expressed or implied.

The approximate location of the Proposed Effluent Disposal System is shown in the attached **Drawing Set (Appendix 1)**. “Water saving devices” either are installed or are to be installed in this residence, reducing the estimated daily flow from 1200 gallons/day to 960 gallons/day.

A Geotechnical Investigation was conducted, and a Report created as recommended in §285.30 (Site Evaluation of the above referenced Title 30 TAC) Chapter 285) and is attached (**Appendix 2**).

The area proposed for OSSF Treatment and effluent dispersal does not lie within a current 100-year Floodplain. A copy of the relevant FEMA Flood Risk Report for Toledo Bend Reservoir Watershed is included (**Appendix 3**).

The following Design Parameters apply:

- 1) OSSF Treatment System: The Design Effluent (Q) of **960 gallons/day** is conservatively estimated by taking the highest value between the applicable Usage Rate Categories in table in Title 30 TAC. Chapter 285.91(3) – Wastewater Usage Rates. The Usage Rate Categories that are potentially applicable to this facility are Parks (without bathhouse per person) or Stores (per washroom). The below calculations determine the conservative value in this case to be **960gpd**.
 - a. Parks (without bathhouse per person)
 - i. (8gpd per Person) x (100 persons) = **800gpd**
 - b. Stores (per washroom)
 - i. (160gpd per Washroom) x (6 Washrooms) = **960gpd**
- 2) The treated effluent will be dispersed on the site via a subsurface drip disposal system listed by TCEQ under “TCEQ-Approved Products for On-Site Sewage Facilities.”
- 3) This design is based on Class IV soil. A loading rate of 0.1 gpd/ft² will be used for drip dispersal. No strong evidence of a seasonal high-water table was found during any of the soil boring activities. Site slope in the proposed disposal area will be <15%.
- 4) Positive Drainage away from the OSSF on all sides is necessary to ensure proper OSSF function. The area shall be graded to provide drainage of any rainfall that falls on the completed field. No “low-spot” or other areas, which will accumulate runoff, shall be allowed in the area of the completed field. Low areas that develop over the OSSF trenches shall be brought back to grade with TCEQ Class III material.
- 5) The proposed OSSF effluent disposal area shall be 25’ from the edge of any pond, creek, or proposed detention pond. Per FEMA Flood Risk report for Toledo Bend Reservoir Watershed HUC-8 12010004, effective July 2023, this site does not lie within a 100-year Floodplain.
- 6) “Water saving devices” are to be present or installed for all plumbing fixtures. Plumbing and Collection System by others.

Based upon these data the site may be deemed suitable for the installation of an Aerobic, Subsurface Drip Application OSSF.

The following paragraphs will address the requirements of TITLE 30 TAC CHAPTER 285 as previously cited.

APPLICATION REQUIREMENTS

a) Technical Report:

Refer to attached design data tables.

SYSTEM DESIGN PARAMETERS

Aerobic On-Site Subsurface Drip Irrigation System

Table 1

<u>Basis of Design</u>	
Facility Type	Stores (per washroom)
Water Saving Devices (Yes/No)	Yes
Daily Flow per Unit (Qea)	160 gpd (per washroom)
Number of Washrooms	6
Total Daily Flow (Q)	960 gpd
Soil Class	IV Silty Clay and Clay Soils
Max Loading Rate	0.1 gal/SF/day (See 285.91 Table 1, TITLE 30 TAC Chapter 285)
Total Req. Absorptive Area (ft ²)	9600 SF

Table 2

<u>Materials and Equipment</u>	
Total Daily Flow (Q)	960 gpd
Min ATU Size (gal)	960 gal
Total Design Absorptive Area (ft ²)	2500 sqft
Aerobic Treatment Unit	ProFlo 1500S ATU Or Equivalent
Pretreatment Chamber	1125 min (Separate) gal
Aeration Chamber	1657 gal
Clarifier Chamber	735 gal
Pump Chamber	Separate
Chlorinator	PVC "T" Stackable - Free Flowing OR Liquid Chlorination NSF Approved Chlorinator installed inside pump tank for disinfection
Pretreatment Tank (if separate)	QCP 1500 PreTreat Tank
Pretreatment Chamber	1500 gal
Pump Tank (if separate)	QCP 1500 Pump Tank
Pump Tank Capacity	1500 gal
Pump Tank Controls	
Effluent Pump	20-25 gpm @ 25 psi (2 fps flushing velocity)
Pump Tank gal/in Height	29.0 gal/in
Min. Capacity between Alarm-On and Inlet	320 gal (11.04in below Inlet)
Min. Capacity between Pump-On and Alarm-On	960 gal (33.12in below Alarm-On)
Alarm On Setting	12 in below Inlet
Pump On Setting	46 in below Inlet
Capacity between Alarm-On and Inlet	347.9 gal
Capacity between Pump-On and Alarm-On	985.6 gal
Capacity between Pump-On and Empty	507.3 gal
Pump Tank Control Panel	Control panel shall govern pump operation. Control panel shall contain a timer to govern pump-on duration times
Disc Filter Required:	Yes (refer to Equipment Specifications) Filter maintenance shall be as specified per manufacturer
Drip Dispersal System Filter	Drip-Tech ACT C200S filter units
Air/Vacuum Breakers Required	Yes (refer to Equipment Specifications) Installed above the highest emitter line in each disposal field.
Flush Valve Required	Yes (refer to Equipment Specifications)
Cleanouts Required	Yes, Install two-way cleanout between structure and each tank
Gravity Piping to Tank Inlet	4" SCH 40 PVC influent piping from structure to tank Min. slope from Structure to Tank shall be 1/8-inch per ft.
Supply Line Piping	1.5" SCH 40 PVC, RCW, Purple effluent piping
Return Line Piping	1.5" SCH 40 PVC, RCW, Purple effluent piping

Table 3

Design Calculations	
Total Daily Flow (Q)	960 gal/day
Req'd Absorptive Area (ft²)	9,600 sqft
Req'd Length of Emitter Line	4,800 ft (2 sqft per ft length)
Number of Absorption Zones	1 Zones
<u>Zone 1</u>	
Avg. Absorptive Area per Zone	12,160 sf per zone
Emitter Spacing (in)	24 in.
Emitter Line Spacing	2' c-c ft.
Total Length of Emitter Line per zone	6,080 ft (2 sqft per ft length)
Total # of Emitters	3,040 emitters (4 sqft per emitter)
# of Lateral Lines	19 lines
Avg. Length of Emitter Line	320 ft
Emitter Line Type	Netafim Bioline® Wastewater Drip Tubing
Emitter Flow Rate	0.61 gal/hr
Total Flow	30.9 gal/min.
Daily Pump Time	31 min.
Daily Pump Cycles	6 cycles
Dosing Volume	6 cycles @ 5.18 minute cycles/day @ 160.00 gallons/cycle

b) **Site Drawing – See Appendix 1**

c) **Landscape Plan** - The area to be irrigated by the system is shown on **Appendix 1**. Un-vegetated areas shall be sodded or seeded with an appropriate grass type prior to system start-up. Before system start-up, the vegetation shall be capable of growth. There shall be nothing in the absorption area which will interfere with the uniform application of effluent.

d) **(e)/(f) Maintenance Requirements/Maintenance Contract/On-going Maintenance** - Prior to system operation an acceptable maintenance contract must be in effect between the system owner and a valid maintenance company. All maintenance contract requirements shall meet the minimum requirements set forth in §285.7 (para. d, e, f) §285.39 and §285.64 of the previously cited TITLE 30 TAC CHAPTER 285.

g) It should be noted that paragraph (g) of § 285.7 requires that an “Affidavit to The Public” be on file with the County Cleric’s office and added to the Real Property Deed for the property on which the system is located. An example of such an Affidavit is included in TITLE 30 TAC CHAPTER 285 (cf §285.90, Figure 2).

h) **Testing and Reporting** - The maintenance company employed shall inspect the system as directed by the Testing and Reporting Schedule as included in TITLE 30 TAC CHAPTER 285 (cf §285.91, Table IV). A recommended Sample Testing and Reporting Record form is included in TITLE 30 TAC CHAPTER 285 (cf §285.90, Figure 3). The maintenance company shall report any responses to owner complaints and the results of its maintenance findings to the Tarrant County Public Health Department within ten days of the specified reporting frequency.

MATERIALS AND EQUIPMENT

Existing OSSF – Any existing OSSF found on the property shall be properly abandoned according to TITLE 30 TAC CHAPTER 285.

Prevention of Unauthorized Access to On-Site Sewage Facilities (OSSFs) - The methods and materials employed to prevent unauthorized access to this proposed OSSF shall comply with TITLE 30 TAC CHAPTER 285 §285.38.

Water Meters — In order that water use may be verified, each facility and RV shall be equipped with a dedicated water meter.

Water Saving Devices —In order to limit effluent flow “water saving devices” shall be required for all plumbing fixtures.

Tank Waterproofing, Risers, Backfill Around Tanks — Tanks shall be waterproof. Risers shall be provided on the tank tops to permit access for tank pumping or pump maintenance/replacement. A minimum of four (4) inches of sand, sandy loam, clay loam or pea gravel, free of rock larger than 0.5” diameter shall be placed under and around all tanks. Class IV soils and gravel larger than 0.5” diameter shall not be used as backfill material.

Pretreatment Chamber – A minimum 1500-gal Pretreatment Tank Chamber shall collect nonbiodegradable solids prior fluid transfer to the aerobic treatment chamber.

Aerobic Treatment Units – “Class I System” Combined Aerobic Treatment Unit (or equal). Install new ATUs listed on the above list of approved systems. The ATU shall have a minimum daily capacity of 1500 gallons/day. The ATU should be installed according to manufacturer recommendations. All connections shall be watertight.

Pump Chamber – A separate 1500-gallon pump tank shall store the treated effluent until a dosing cycle is chosen. The pump chamber volume shall be capable of holding the minimum daily capacity of the ATU plus one-third of the daily capacity with an alarm wired on a separate circuit from the pumps and provide warning of pump failure or tripped circuit breaker.

Effluent Disinfection – Treated Effluent shall be disinfected prior to subsurface disposal. A National Sanitation Foundation (NSF) Standard 46 Disinfection Device is required. The efficiency of the disinfection procedure will be established by monitoring either the chlorine residual or fecal coliform count from representative grab samples as directed in TITLE 30 TAC CHAPTER 285 (cf §285.38, Table IV).

Pump and Alarm System – The pump may be either submersible or non-submersible type, capable of producing a minimum flow of 20 gallons/minute at 25 psi. Pump controls shall include an automatic, water level activated pump control switch, a high-water alarm/pump activation system and a manual override switch.

The alarm system shall be on a separate circuit than the pump and shall be connected to a placarded warning device (audio and visual) located in a prominent place near the residence area and shall be capable of detecting and, issuing an alert for the following conditions:

- 1) Pump Failure
- 2) Pump Tank High Water Condition
- 3) Aerobic Unit aerator/compressor failure

Control Panel / Pump Timer – A control panel shall govern pump operation. This control panel shall contain a timer that will govern pump-on activation/duration operation times for treated effluent dosing as specified above.

Emitter Line – The emitter line shall be installed approximately as shown in **Appendix 1**. The line shall have pressure emitters spaced @ 24 inches c-c (Netafim Bioline® Dripperline 0.61 gph drip dispersal tubing, or equivalent).

Air/Vacuum Breaker (Pressure Relief Valves) – Air/vacuum breakers (relief valves) shall be installed above the highest emitter line the Emitter field (approximately as shown in **Appendix 1**). These valves serve to evacuate air from the system prior to pressurization and to relieve vacuum at shutdown. These valves shall seal effectively between 5 and 110 psi. A typical installation is shown in the Drip System Details Sheet of **Appendix 1**.

Filtration Unit – A TuffTiger T125 Filtration Unit (with optional manual flush line) shall be installed. Filter maintenance shall be as described below under SYSTEM MAINTENANCE/TESTING REQUIREMENTS.

Pipes, Fittings and Connections – With the exception of the emitter line, Schedule 40 PVC pipe shall be used in the installation. All distribution piping, fittings, valve cover boxes shall be permanently colored purple in order to identify the system as a reclaimed water system. A union connection shall be installed in the supply line to provide or pump maintenance/replacement. All emitter line connections shall be made with “barb” or compression type connections.

Electrical Components — All wiring shall conform to TITLE 30 TAC CHAPTER 285 (cf § 285.34 (c)). Information on example electrical components including electrical demands and performance curves are included in Appendix 4.

Water Softener – If so equipped, the residence water softener must comply with TITLE 30 TAC CHAPTER 285§ 285.37. In accordance with this paragraph, the water softener drain line must bypass the treatment system and connect directly to the pump tank.

Site Drainage – Positive Drainage away from the OSSF on all sides is necessary to ensure proper OSSF function. The area shall be graded to provide drainage of any rainfall that falls on the completed field. No “low-spot” or other areas, which will accumulate runoff, shall be allowed in the area of the completed field. Low areas that develop over the OSSF trenches shall be brought back to grade with TCEQ Class III material.

SYSTEM INSTALLATION

- 1) The system shall be located approximately as shown in **Appendix 1**. Slight system realignment (+/- 5 feet) is allowable to accommodate site topography. A two-foot (minimum) separation of Pressure Emitter Lines shall be maintained.

- 2) Install the Supply Lines approximately as shown on Exhibit 1. Slight system realignment (+/- 5 feet) is allowable to accommodate site topography.
- 3) Install the emitter lines at a depth of approximately 18 inches. Emitter' Line c-c spacing shall be approximately two (2) feet. The line may be installed by means of hand trenching, oscillating or vibrating plow, trenching machine or backhoe.
- 4) Connect the emitter lines to the Supply Line and Flush Lines by means of 'tees" and compression adapters.
- 5) Fill the Pump Tanks with fresh water and install the pump.
- 6) Turn on the pump. Check that water flows from each Emitter Line. Flush the system for approximately 5 minutes. Shut off the pump and protect the ends of the Emitter Lines from the intrusion of foreign material.
- 7) Install the Flush Line approximately as shown in **Appendix 1**. Flush Line depth shall be approximately 12 inches.
- 8) As was done with the Supply Line, connect the Emitter Lines to the Flush Line by means of "tees" and compression adapters.
- 9) Install the Air/Vacuum Breakers (Relief Valves) at the ends of the Supply and Flush Lines approximately as shown in **Appendix 1**.
- 10) Connect the Flush Return Line back to the Pump Tank, open the flush valve and turn on the pump and check for leaks.
- 11) Install/connect the Pump Controls and Alarm System in the Pump Tank. Install and set the Pump Timer and float levels.
- 12) Grade the site to prevent the accumulation of rainfall and control drainage across the site.
- 13) Sod/seed with an appropriate grass to aid in effluent transpiration and to control site erosion.
- 14) Prior to OSSF installation, all underground utilities shall be located and staked.

SYSTEM MAINTENANCE/TESTING REQUIREMENTS

The Treatment Unit shall be inspected every four months for system compliance with effluent standards as set forth in TITLE 30 TAC CHAPTER 285 (cf § 285.32 (e)).

The operation and settings shall be check annually (minimum) or as required to ensure effective system operation.

The following procedures are required (at the specified interval):

- 1) Remove, inspect, and clean or replace the disc filters as specified by the Filtration Unit manufacturer.
- 2) Open the Manual Flush Valve. Manually activate the Pump. Flush the system for five minutes (every six months).

- 3) Remove and clean the Air/Vacuum Breakers (Relief Valves) (every six months).
- 4) Manually operate the emergency alarm switch to verify alarm activation (every four months).
- 5) Sludge accumulation in the tanks should be monitored and pumped as required (yearly).
- 6) System operation and maintenance should be in accordance with the manufacturer's recommendations.

ADDITIONAL REQUIREMENTS

- 1) No vehicular traffic shall be allowed on the system. Landscape mowers with low impact tires only.
- 2) No sprinkler system shall be installed in the system limits.
- 3) No subsurface construction shall be permitted within the system limits. Puncturing of the OSSF lines may possibly result.

CHANGED CONDITIONS:

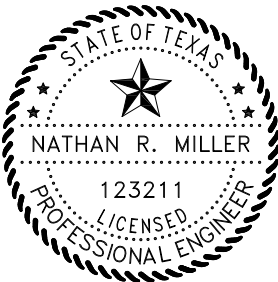
In the event that construction activities reveal any conditions which might call the validity of these recommendations into question or require a re-positioning of any significant OSSF component, this office shall be notified so that the conditions may be evaluated as to their effect upon this design. In the event that any significant changes are required, it may be necessary that further field work/engineering work be performed as an ADDENDUM to this proposal issued.

I trust that this design will meet the requirements of your site. If you have any questions, or if I may be of further service, please call 713.376.1225.

Sincerely,

Nathan Miller, P.E.

Wavecrest Design, Firm Registration No. F-23292



On-Site Sewage Facility Design Package

Sabinetown Park
Park and Fishing Facility
Hemphill, TX 75948

Appendix 1 – Drawing Set

SEE CONSTRUCTION DRAWINGS
SHEETS P1 THROUGH P3

On-Site Sewage Facility Design Package

Sabinetown Park
Park and Fishing Facility
Hemphill, TX 75948

Appendix 2 – Geotechnical Report

SEE APPENDIX A - GEOTECHNICAL REPORT

On-Site Sewage Facility Design Package

Sabinetown Park
Park and Fishing Facility
Hemphill, TX 75948

Appendix 3 – FEMA Floodplain Map



The Sabine RFPG chose to utilize public comments collected through the online survey to identify additional flood prone areas outside of the compiled flood hazard areas. The source of flood prone areas were comments on an ArcGIS Online web map where the public could report areas of flooding. Existing conditions are on the left and future conditions are on the right.

Region 4 Sabine RFP - Web Map - Flood Hazard

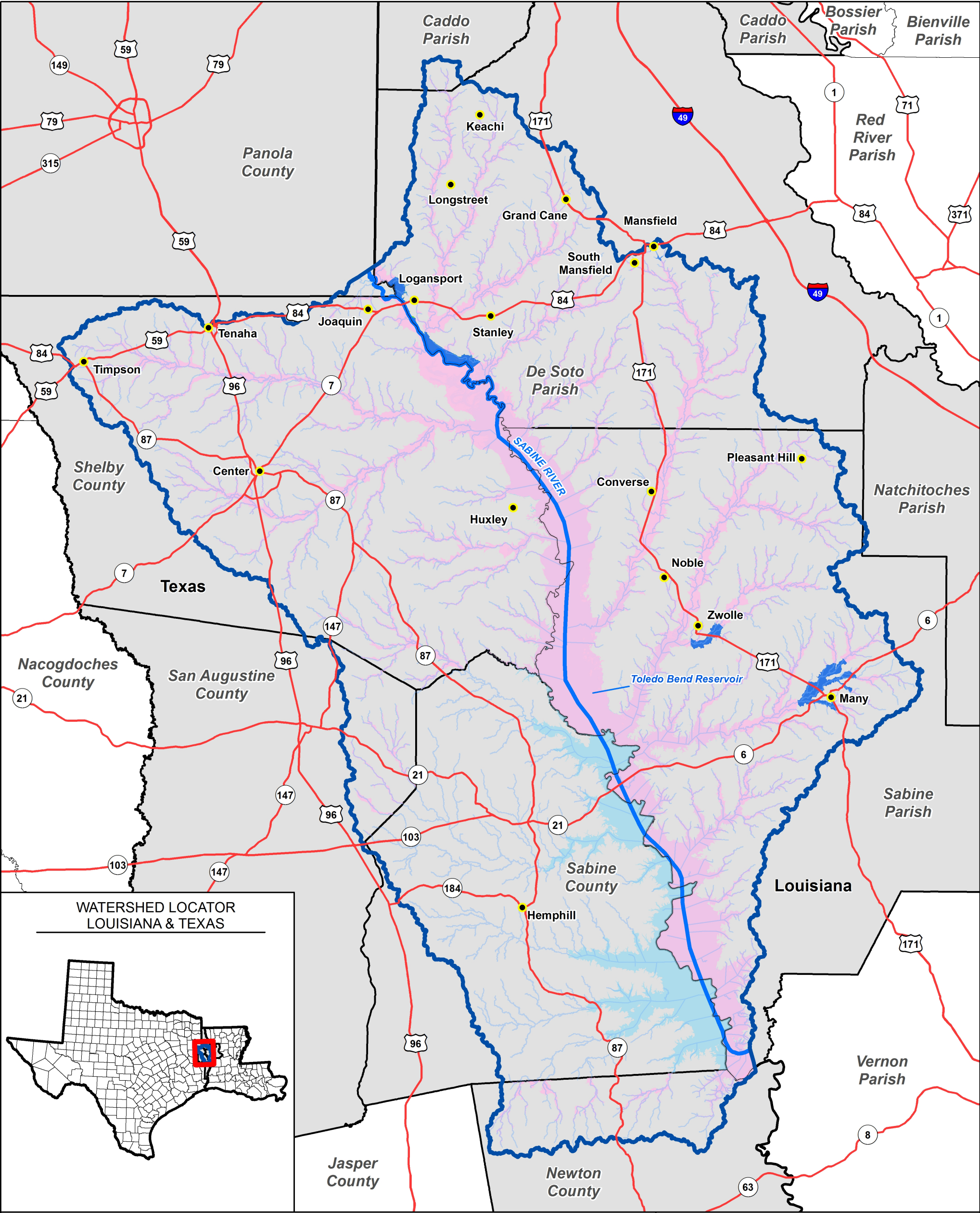
Existing Flood Hazard

FldHazard

r04ExFldHazard

Flood Frequency

	0.2
	1
	4
	10
	Prone

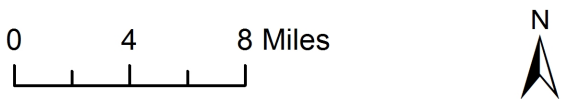


Map Symbolology

- Cities
- Sabine River
- Other Streams
- Major Highways
- Watershed Boundary: HUC-8
- Lake
- States Boundary
- Discovery Parish/County Boundary
- Other Parish/County Boundary

- Effective FEMA Floodplains (2021)
- Zone AE, AO (100-Year,
 - Zone A (100-Year,
 - Zone X(500-Year or Depth <1 Foot)

Figure 8:
Effective Floodplains
TOLEDO BEND RESERVOIR WATERSHED
September 16, 2022



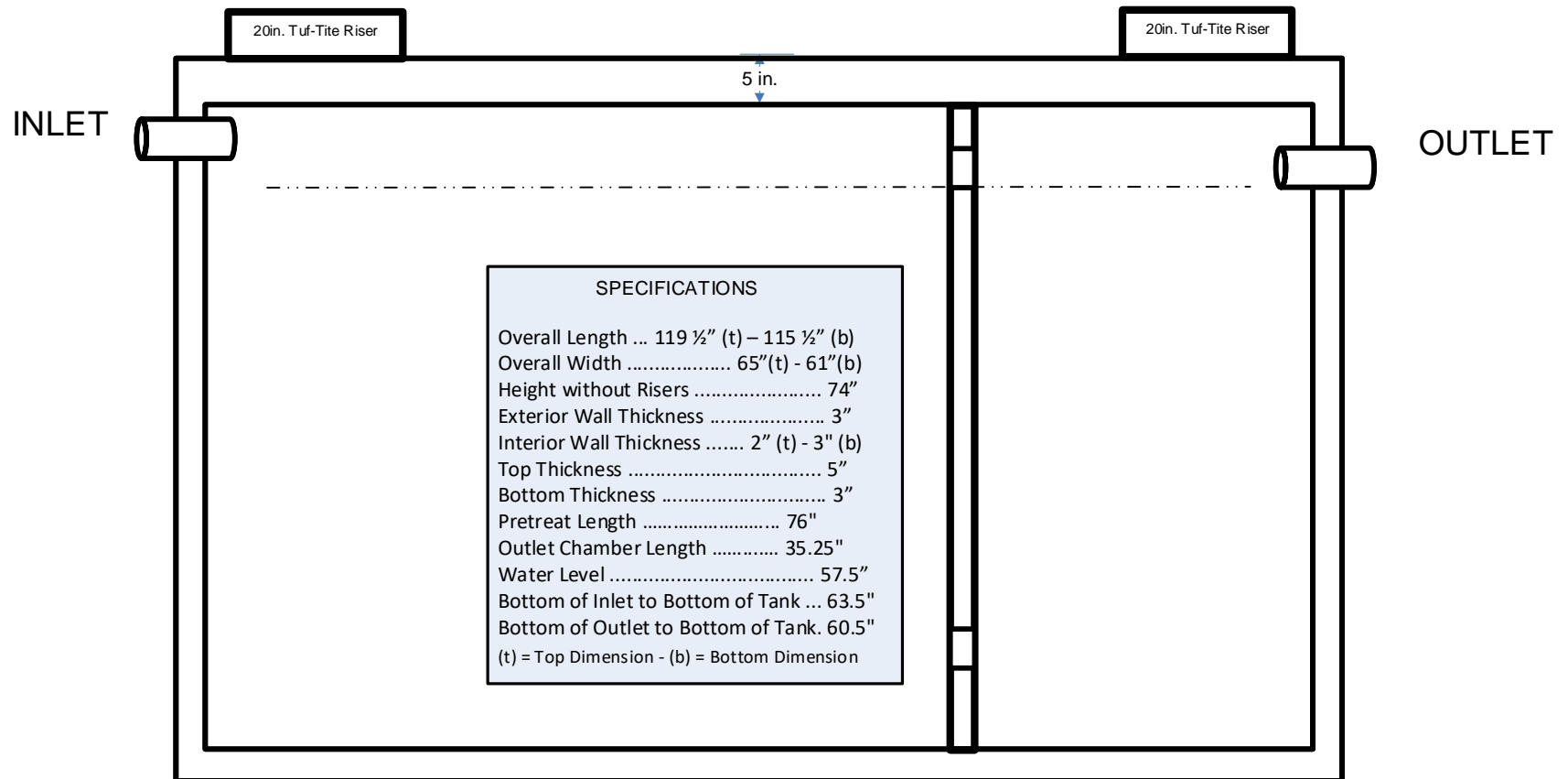
On-Site Sewage Facility Design Package

Sabinetown Park
Park and Fishing Facility
Hemphill, TX 75948

Appendix 4 – Aerobic Treatment Unit Equipment

Quality Concrete Products
QCP 1500 Pre-Treat
(1000 x 500-Gallon Compartments)

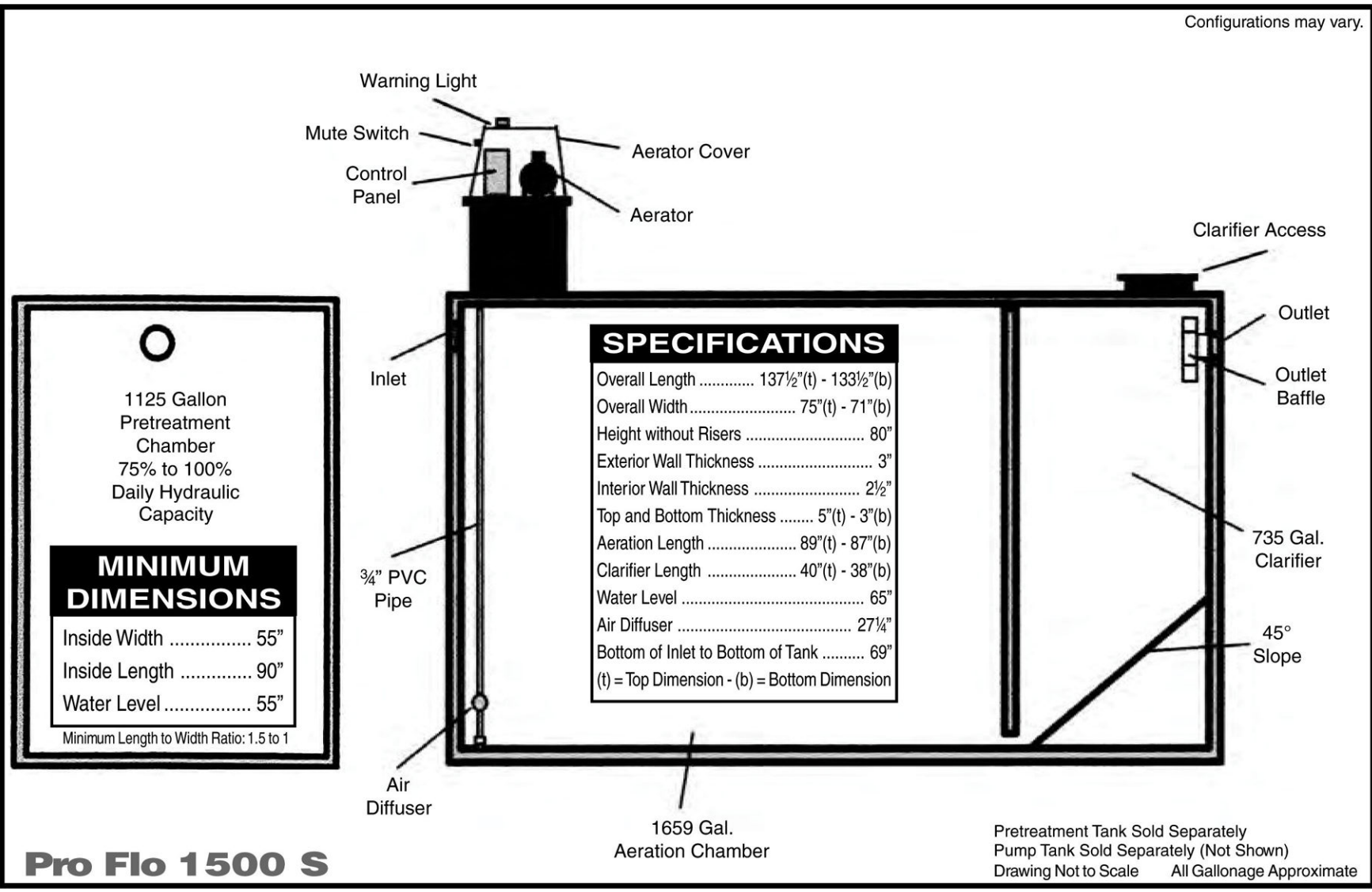
4/9/2019



(angle of the walls not shown)

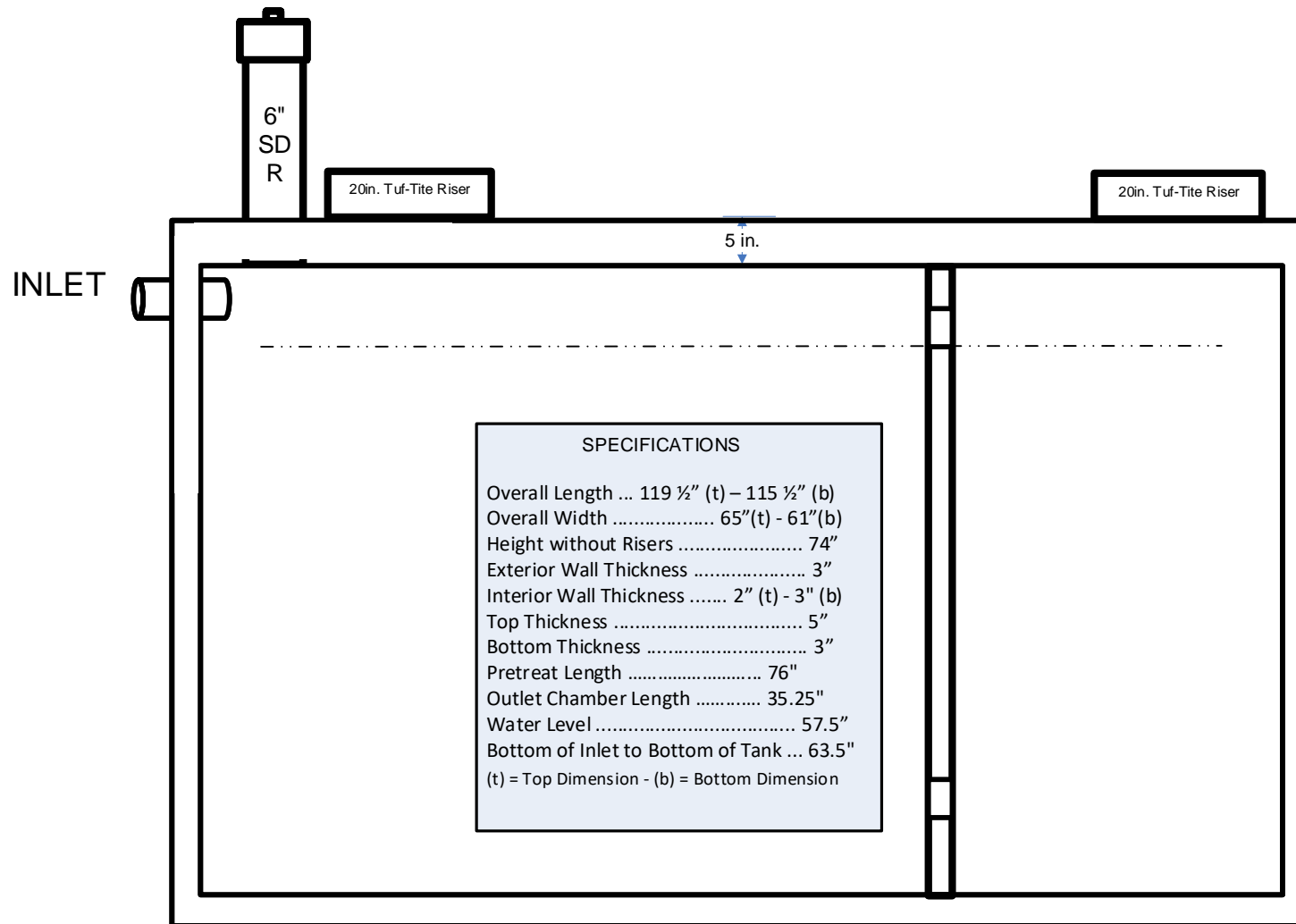
Pro Flo 1500 S System Diagram

Configurations may vary.



Quality Concrete Products
QCP 1500 Pump
(1000 x 500-Gallon Compartments)

10/3/2017



(angle of the walls not shown)

Installer Friendly Series®

SJE Rhombus® Type IFS

Installation Instructions and Operation/Troubleshooting Manual



This control panel must be installed and serviced by a licensed electrician in accordance with the National Electric Code NFPA-70, state and local electrical codes.

All conduit running from the sump or tank to the control panel must be sealed with conduit sealant to prevent moisture or gases from entering the panel. **NEMA 4X enclosures are for indoor or outdoor use**, primarily to provide a degree of protection against corrosion, windblown dust and rain, splashing water and hose-directed water. **Cable connectors must be liquid-tight in NEMA 4X enclosures.**

Installation

This Installer Friendly Series® (IFS) control panel was designed to control pump(s). The controller records pump status, number of cycles, elapsed run time, current float status, and float error counts.

Mounting the Control Panel

Note: The control panel should not be mounted in a location that may be subject to submersion.

1. Determine mounting location for panel. If distance exceeds the length of either the float cables or the pump power cables, splicing will be required. For outdoor or wet installation, we recommend the use of an SJE Rhombus® liquid-tight junction box with liquid-tight connectors to make required connections. **You must use conduit sealant to prevent moisture or gases from entering the panel.**
2. Mount control panel with mounting devices furnished.
3. Determine conduit entrance locations on control panel. Check local codes and schematic for the number of power circuits required. **(Float cables require separate conduit from power and pump cables.)**

Note: Be sure the proper power supply voltage, amperage, and phase meet the requirements of the pump motor(s) being installed. If in doubt, see the pump identification plate for voltage/phase requirements.

4. Drill proper size holes for type of connectors being used.

Note: If using conduit, be sure that it is of adequate size to pull the pump cable(s) through.

5. Attach cable connectors and/or conduit connectors to control panel.

**FOR INSTALLATION REQUIRING
A SPLICE, FOLLOW STEPS 6-10;
FOR INSTALLATION WITHOUT A
SPLICE, GO TO STEP 11.**

6. Determine location for mounting junction box according to local code requirements. **Do not** mount the junction box inside the sump or basin.
7. Mount junction box to proper support.
8. Run conduit to junction box. Drill proper size holes for the type of conduit used.

pg.031

Warranty void if panel is modified.

Call factory with servicing questions:

1-800-RHOMBUS
(1-800-746-6287)

Manufactured by:



SJE RHOMBUS®

Technical support: +1-800-746-6287
techsupport@sjeinc.com
www.sjrhombus.com

Installation Instructions

9. Identify and label each wire before pulling through conduit into control panel and junction box. Make wire splice connections at junction box.
10. Firmly tighten all fittings on junction box.
11. If a junction box is not required, pull cables through conduit into control panel.
12. Connect pump wires per wiring diagram or schematic and float wires to the proper terminals as shown on the schematic.
13. Connect pump, control, and alarm incoming power conductors to proper position on terminals. See schematic for terminal connections.

VERIFY CORRECT OPERATION OF CONTROL PANEL AFTER INSTALLATION IS COMPLETE.

Installation of Floats

CAUTION: If control switch cables are not wired and mounted in the correct order, the pump system will not function properly. Control switches need to run in separate conduit from pump and power lines.

WARNING: Turn off all power before installing pump wires in pump chamber. Failure to do so could result in serious or fatal electrical shock.

1. Determine your normal operating level and desired float configuration, as illustrated in **Figures 2-5**.
 2. Mount float switches at appropriate levels. Be sure that floats have free range of motion without touching each other or other equipment in the basin.
 3. For mounting clamp installation: place the cord into the clamp as shown in **Figure 1**. Locate the clamp at the desired activation level and secure the clamp to the discharge pipe as shown in **Figure 1**.
- NOTE:** Do not install cord under hose clamp.
4. Tighten the hose clamp using a screwdriver. Over tightening may result in damage to the plastic clamp. Make sure the float cable is not allowed to touch the excess hose clamp band during operation.

NOTE: All hose clamp components are made of 18-8 stainless steel material. See your SJE Rhombus® supplier for replacements.

5. If using an optional redundant off float, mount slightly below the timer enable float.
6. The alarm float can be positioned anywhere that the alarm level is desired.

Figure 1

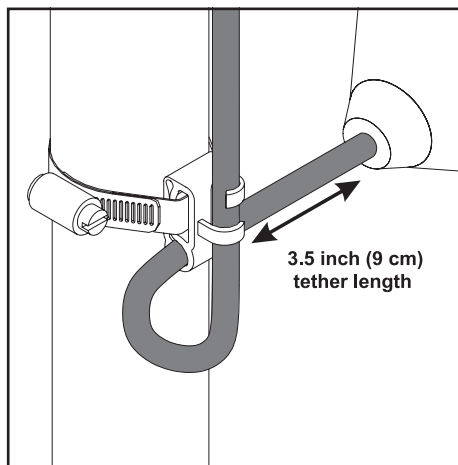


Figure 2
Simplex/Duplex Timed Dose

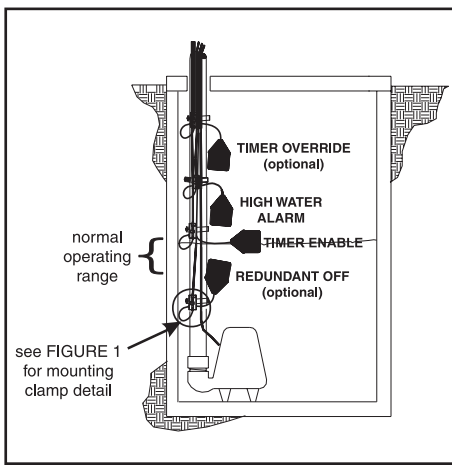


Figure 3
Simplex Demand

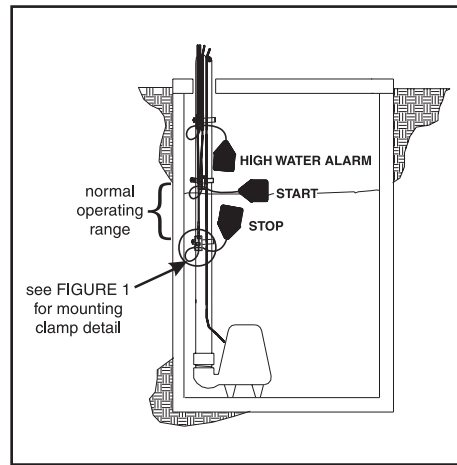


Figure 4
Duplex Demand 3 Float

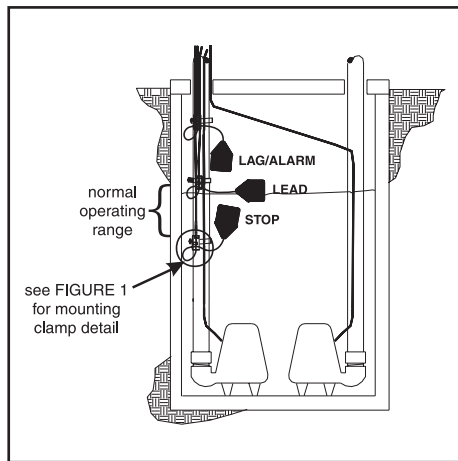
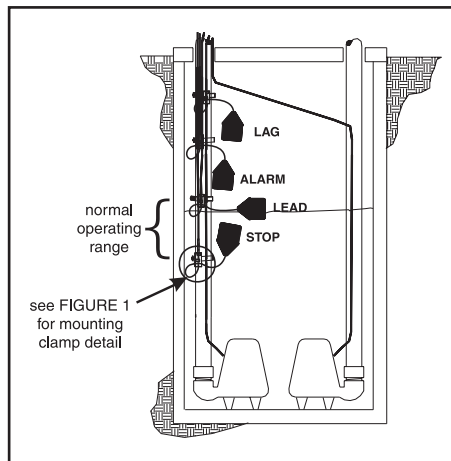


Figure 5
Duplex Demand 4 Float



Operations

The Installer Friendly Series® (IFS) control panel uses float switches to continuously monitor and control the liquid level in the tank.

Hand Operation - The stop/redundant off float must be raised to put panel in HAND operation. To override the stop/redundant off float, press and hold the HAND button. The pump runs until the HAND button is released. The panel then returns to the AUTO mode. If the stop/redundant off float is raised and the panel is placed in the HAND mode, and left in the HAND mode, the pump continues to run until the stop/redundant off float lowers. The panel then returns to the AUTO mode.

Off Operation - The panel is in the OFF mode.

Auto Operation - In time dose (t-dose) mode, when the panel is in the AUTO mode, the timer controls pump ON and OFF time as long as the low level float is raised. In demand (d-dose) mode, the stop and start floats control the pump.

Alarm Count - Shown on display as "AL-Ctr", counts the number of times the alarm is activated. Note: Alarm counter does not include testing operations in the total count. High alarm, floats out of sequence & auxiliary alarm add to count.

Green Control and Alarm Power Indicators - (mounted on interior circuit board) Illuminates when control power and alarm power is present. If the control fuse needs replacing, the panel sounds an alarm.

Display - Will turn off after one minute of non-use.

Float Indicators - Illuminates if the float is raised. If the float is out of sequence, the panel goes into alarm mode and display shows "FE" float error.

Timer Override Float - Overrides the OFF time and pump will run for full dose ON time. (timed dose only, optional)

Float Error Count - Shown on the display as "FE-Ct". Counts the number of times floats are out of sequence.

Timer Override Count - Shown on the display as "tO-Ct". Counts the number of times the timer override float is activated. (timed dose only)

Time left in "On" time cycle - Shown on the display as "t-On". Counts down the time left in the "On" cycle. (timed dose only)



Time left in "Off" time cycle - Shown on the display as "t-OFF". Counts down the time left in the "Off" cycle. (timed dose only)



Auxiliary alarm count- Shown on the display as "AL1Ctr" or "AL2Ctr". Counts optional auxiliary alarm counts for single phase models. Counts Pump 1 and Pump 2 fail counts for three phase models and single phase models with overloads.



Viewing Panel Settings

With control power supplied to panel:



Press  button. The display will show  for timed dose applications, or  for demand applications.



Press  button. The display will show  count in hh:mm.



Press  button. The display will show  count.



Press  button. The display will show  count. Cycle count for Duo Alarm 1 option for single phase models. **OR** Cycle count for Pump 1 Fail for three phase models and single phase models with overloads.



Press  button. The display will show  count (pump 2) in hh:mm. (duplex panels only)



Press  button. The display will show  count. (pump 2) (duplex panels only)



Press  button. The display will show  count. Cycle count for Duo Alarm 2 option for single phase models. **OR** Cycle count for Pump 2 Fail for three phase models and single phase models with overloads.




Press  button. The display will show  alarm count.

Press  button. The display will show  float error count.

Press  button. The display will show  timer override count. (timed dose mode only)



Press  button, The display will flash , then the ON time in hh:mm:ss. (timed dose mode only)


Press  button. The display will flash , then the OFF time in hh:mm:ss. (timed dose mode only)

Press  button. The display will flash either  or , then the time left in the ON or OFF cycle. (timed dose mode only)

Program Timer On & Off Times


With control power supplied to panel:


Press and hold  button for 3 seconds until  is displayed.

The display will flash , then the time in hh:mm:ss.

Setting pump ON (follow Section A)

Section A

Press  button to display time in hh:mm:ss.

Press  button until desired digit flashes


Press  button until desired time is achieved.



Repeat process pressing  and  buttons until desired time is reached.

Press  button to save.

Operations

Setting pump OFF times

Press  button. The display will flash OFF and show the OFF time in hh:mm:ss. **Repeat the instructions in Section A to set OFF times.**

Press and hold  button for 3 seconds until  is displayed.






Timer programming is complete.





Program Pump Sequence

Program Pump sequence "Alt", "2-1" or "1-2" (duplex only)

With control power supplied to panel:

Press and hold  button for 3 seconds until  is displayed.

Press  button until  flashes with either , , or  flashing.

Press  button to display , , .

Press  button until desired sequence is achieved.

Press and hold  button for 3 seconds until  is displayed.

Pump sequence programming is complete.

Selecting Time Dose or Demand Dose -Panels in the field

To set the panel to either Timed Dose or Demand Dose in the field:

1. Turn the control/alarm power off to the control panel.
2. Turn the pump power off to the control panel.
3. Place a small screwdriver or pen into the slot in the label on the inner door marked "DEMAND DOSE TIMED DOSE".
 - Move the dip switch (up) for demand dose
 - Move the dip switch (down) for Timed dose
4. Turn the control/alarm power on to the control panel. After the display goes blank press the "NEXT" switch.
 - The display will show d-dose for demand dose.
 - The display will show t-dose for timed dose.

WARNING: Changing the dip switch positions will change the operation of the panel.

WARNING: If changing to timed dose, be sure to set the off and on times.

5. Turn on the pump power after all the settings are changed.
6. **WARNING:** Check the panel for correct operation before leaving the site.

Troubleshooting

Float Controls

1. Check the floats during their entire range of operation. Clean, adjust, replace and repair damaged floats.
2. Measure the float resistance to determine if the float is operating properly.

To measure float resistance:

- a. Isolate the float by disconnecting one or both of the float leads from the float terminals.
- b. Place one ohmmeter lead on one of the float wires, and the other ohmmeter lead on the other float wire.
- c. Set the ohmmeter dial to read ohms and place on the R X 1 scale. With the float in the "off" position, the scale should read infinity (high resistance), if not replace the float.

With the float in the "on" position, the scale should read close to zero, if not replace the float. **Readings may vary depending on the accuracy of the measuring device.**

Fuse

To check the continuity of the fuse, pull the fuse out of the fuse holder. With the ohmmeter on the R X 1 scale, measure resistance. A reading of infinity (high resistance) indicates a blown fuse that must be replaced with a fuse of the same type, voltage, and amp rating.

Alarm Light

With power on, hold the test/normal/silence switch in the "test" position. The alarm light should turn on. If not, replace the light with that of the same type.

Alarm Horn

With power on, hold the test/normal/silence switch in the "test" position. The alarm horn should turn on. If not, replace the horn with that of the same type.

SJE Rhombus® Five-Year Limited Warranty

For complete terms and conditions, please visit www.sjerrhombus.com.

NOTICE!

Products returned must be cleaned, sanitized, or decontaminated as necessary prior to shipment to ensure that employees will not be exposed to health hazards in handling said material. All applicable laws and regulations shall apply.



Technical support: +1-800-746-6287
techsupport@sjerinc.com • www.sjerrhombus.com

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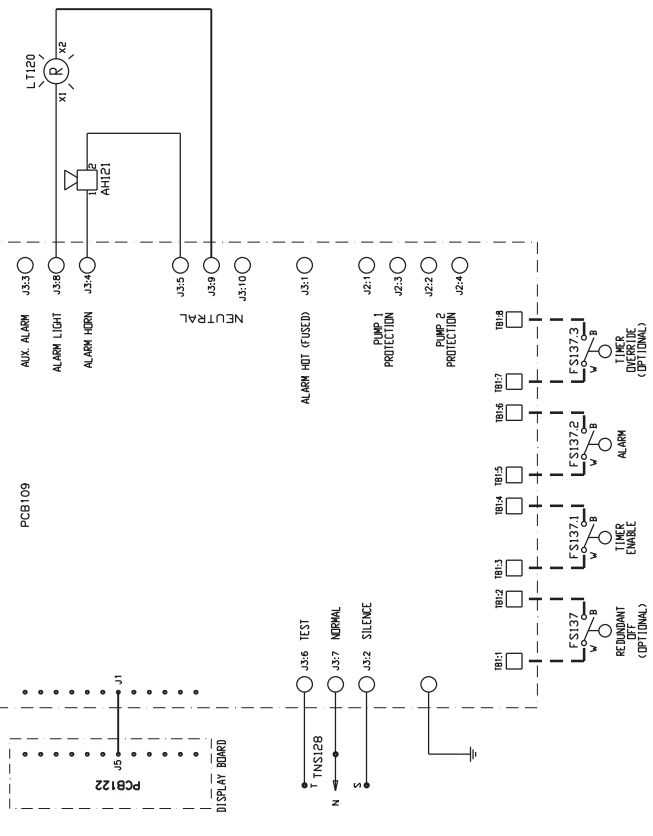
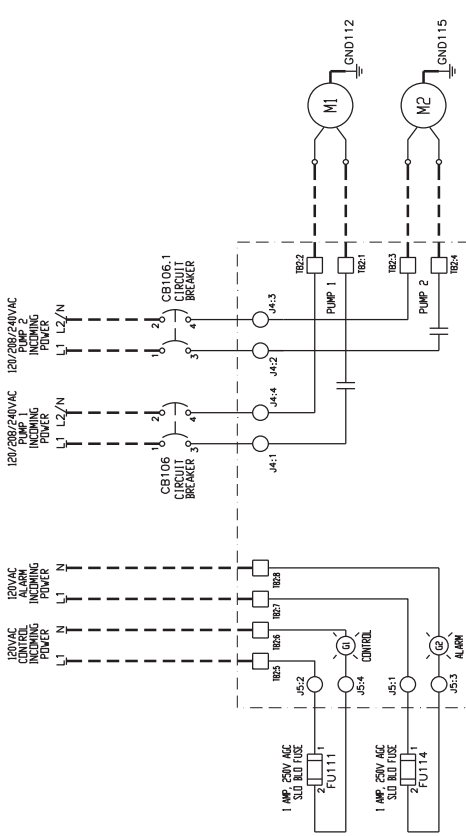
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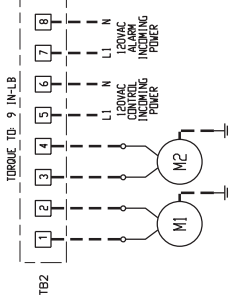
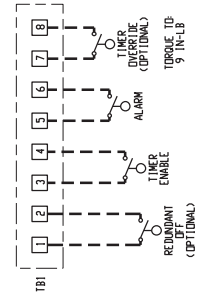
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Float Operation



THE USE OF SEPARATE POWER SOURCES FOR PUMP AND ALARM ARE RECOMMENDED

BRANCH CIRCUIT PROTECTION, OVERLOAD PROTECTION AND WATT DISCONNECT PROVIDED BY OTHERS AND MUST BE SIZED ACCORDING TO PUMP/MOTOR MANUFACTURING SPECIFICATIONS.

TEMPERATURE RATING OF FIELD INSTALLED CONDUCTORS MUST BE AT LEAST 140 DEG. F. (60 DEG. C.). TERMINAL STRIPS AND GROUND LUG USE COPPER CONDUCTORS ONLY.

CONNECT GROUND LUG IN PANEL TO A SECURE EARTH GROUND

DASHED LINES REPRESENT FIELD WIRING

FIELD WIRING SECTION

INSTALLATION
INST. BY: _____ DATE: _____
TELEPHONE: _____

FLOAT HEIGHT (1D)
RED. OFF: _____ FT
TMR EN: _____ FT
ALARM: _____ FT
TIMER: _____ FT
(OPTIONAL)

PUMP 2 SPECIFICATIONS
BRAND: _____
MODEL: _____
SERIAL #: _____
VAC: _____ FLA: _____ HP: _____
DRAWDOWN: _____
SQUIRT: _____

PUMP 1 SPECIFICATIONS
BRAND: _____
MODEL: _____
SERIAL #: _____
VAC: _____ FLA: _____ HP: _____
DRAWDOWN: _____
SQUIRT: _____

ACTUAL MODEL NUMBER ORDERED

EDIT THIS TEXT FOR MODEL NUMBER

NOTICES: THIS DRAWING CONTAINS PROPRIETARY INFORMATION AND IT SHALL NOT BE USED OR REPRODUCED OR ITS CONTENTS DISCLOSED IN WHOLE OR IN PART, WITHOUT PRIOR WRITTEN CONSENT.									
REV	DATE	BY	DATE	APPD BY	DATE	REV	DATE	BY	DATE
1	01/11/08	PHS	01/11/08	PHS	01/11/08	1	01/11/08	PHS	01/11/08
2	01/11/08	PHS	01/11/08	PHS	01/11/08	2	01/11/08	PHS	01/11/08
3	01/11/08	PHS	01/11/08	PHS	01/11/08	3	01/11/08	PHS	01/11/08
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79	01/11/08	PHS	01/11/08	PHS	01/11/08	79	01/11/08	PHS	01/11/08
80	01/11/08	PHS	01/11/08	PHS	01/11/08	80	01/11/08	PHS	01/11/08
81	01/11/08	PHS	01/11/08	PHS	01/11/08	81	01/11/08	PHS	01/11/08

SJE Rhombus

SJE MEGAMASTER™ Control Switch

Mechanically-activated, narrow-angle float switch designed for level control of municipal wastewater pumping stations.

Mechanically-activated, narrow-angle, internally weighted municipal float switch designed for level control in municipal sewage pumping stations. The internal switching mechanism contains unique gold cross-point contacts, providing precision and reliable control signals up to 1 amp.

The SJE MegaMaster™ control switch can be wired to work in either normally open or normally closed applications. It is not sensitive to rotation.

When wired as Normally Open (high level)

The control switch turns on (closes) when the switch tips slightly **above** horizontal signaling a high level, and turns off (opens) when the switch drops slightly below horizontal.

When wired as Normally Closed (low level)

The control switch turns on (closes) when the switch tips slightly **below** horizontal signaling a low level, and turns off (opens) when the switch tips slightly above horizontal.



FEATURES

- Internally weighted
- 3 wire cable - SPDT (**S**ingle **P**ole, **D**ouble **T**hrow) can be wired as normally open or normally closed. Wire color: Common (white), N.O. (black), N.C. (red).
- Large twin wall tear drop shape design offers increased buoyancy.
- Two-color housing allows for easy identification of float position.
- Unique gold cross-point contacts provide precision and reliable control signals up to 1 amp.
- Excellent solution for applications with high grease content.
- CSA Certified.
- Five-year limited warranty.



SPECIFICATIONS

CABLE: flexible 18 gauge, 3 conductor (UL) SJOW, water-resistant (CPE)

FLOAT: 4.03 inch diameter x 6.62 inch long (10.2 x 16.8 cm) high impact, corrosion resistant, polypropylene housing for use in sewage and water up to 140° F (60° C)

MAXIMUM WATER DEPTH: 30 feet (9 meters), 13 PSI (90 kPa)

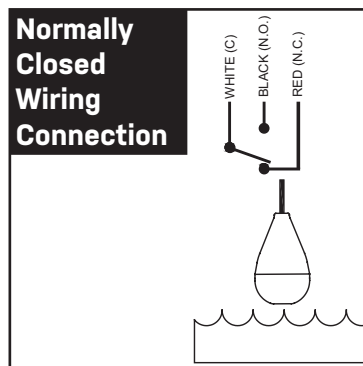
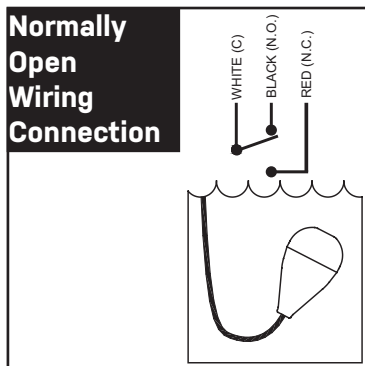
ELECTRICAL:

Maximum Electrical Load:

1 amp, 125 VAC

Minimum Electrical Load:

1 mA, 4 VDC



OPTIONS

This switch is available:

- as a CE Certified unit upon request.
- with a float bracket.
- in standard cable lengths of 25, 50, 75, or 100 feet (approximately 7, 15, 22, or 30 meters).

California Prop 65 requires the following: **WARNING** Cancer and Reproductive Harm - www.P65Warnings.ca.gov

SEE REVERSE SIDE FOR ORDERING INFORMATION.



SJE RHOMBUS.

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1-218-847-4617 Fax

email: customer.service@sjeinc.com

www.sjerrhombus.com pg.036 **G.5**

SJE MEGAMASTER™ Control Switch

Mechanically-activated, narrow-angle float switch designed for level control of municipal wastewater pumping stations.

ORDERING INFORMATION

Normally Open or Normally Closed		Shipping Weight
Part#	Description	
1046500	25MGMS PDT	3.53 lbs.
1046501	50MGMS PDT	5.06 lbs.
1046502	75MGMS PDT	6.65 lbs.
1046503	100MGMS PDT	8.21 lbs.

Can be wired to work in either pump down (normally open) or pump up (normally closed) applications.
SEE PRICE BOOK FOR LIST PRICE.

OPTIONS

PACKAGING
Bagged - standard.



Options		Shipping Weight
Part#	Description	
1009432	4 Float Bracket With Mounting Device	2.22 lbs.

SPECIFICATIONS

CABLE: flexible 18 gauge, 3 conductor (UL) SJOW, water-resistant (CPE)

FLOAT: 4.03 inch diameter x 6.62 inch long (10.2 x 16.8 cm) high impact, corrosion resistant, polypropylene housing for use in sewage and water up to 140° F (60° C)

MAXIMUM WATER DEPTH: 30 feet (9 meters), 13 PSI (90 kPa)

ELECTRICAL:

Maximum Electrical Load:

1 amp, 125 VAC

Minimum Electrical Load:

1 mA, 4 VDC

OTHER INFORMATION

NORMALLY OPEN (high level) OPERATION

The control switch closes (turns on) when the float tips slightly **above** horizontal signaling a high level, and opens (turns off) when the float drops slightly **below** horizontal in water or sewage applications.

NORMALLY CLOSED (low level) OPERATION

The control switch closes (turns on) when the float tips slightly **below** horizontal signaling a low level, and opens (turns off) when the float tips slightly **above** horizontal in water or sewage applications.



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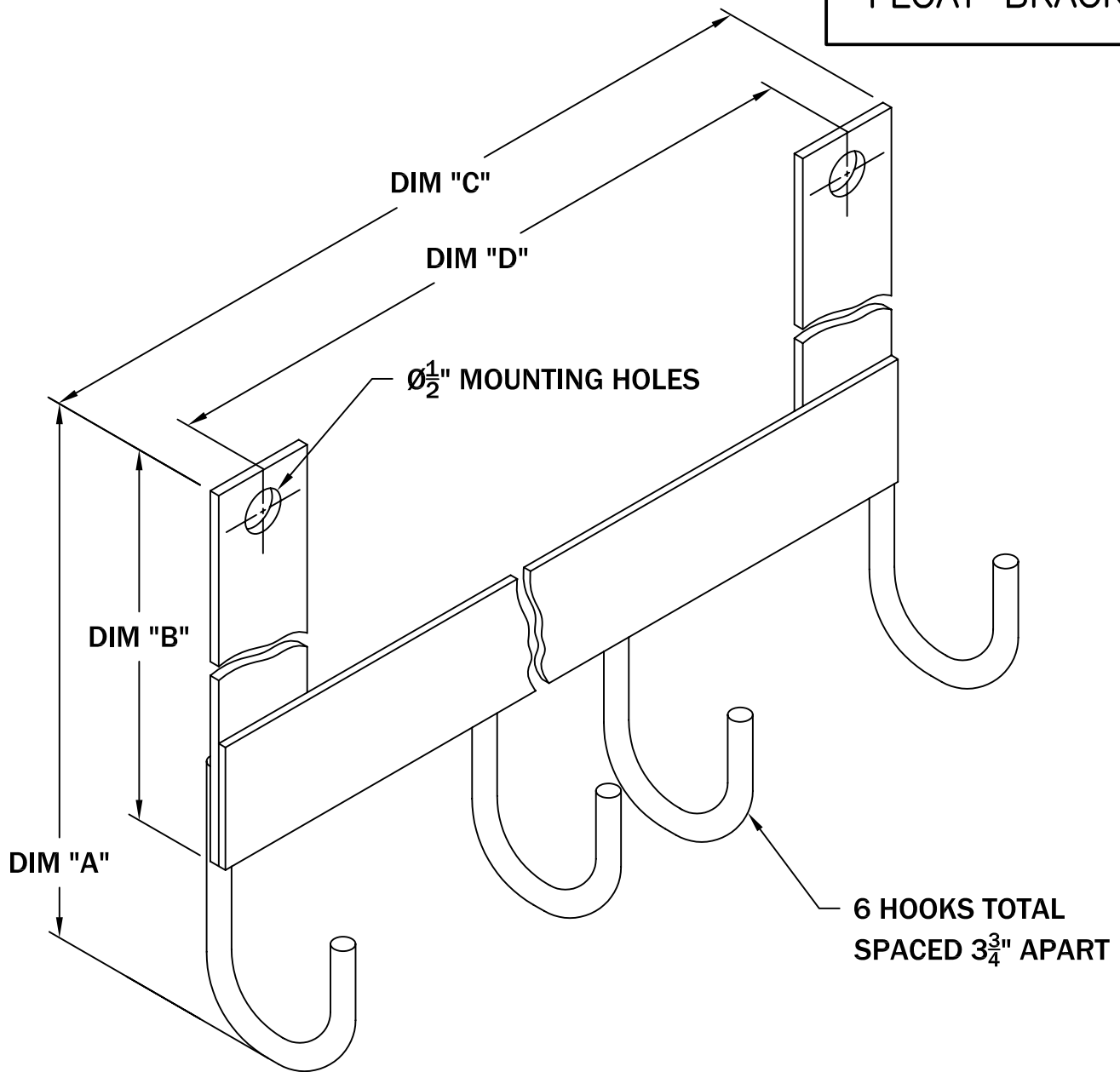
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Product offering and pricing are subject to change without notice.

6AHB MODEL

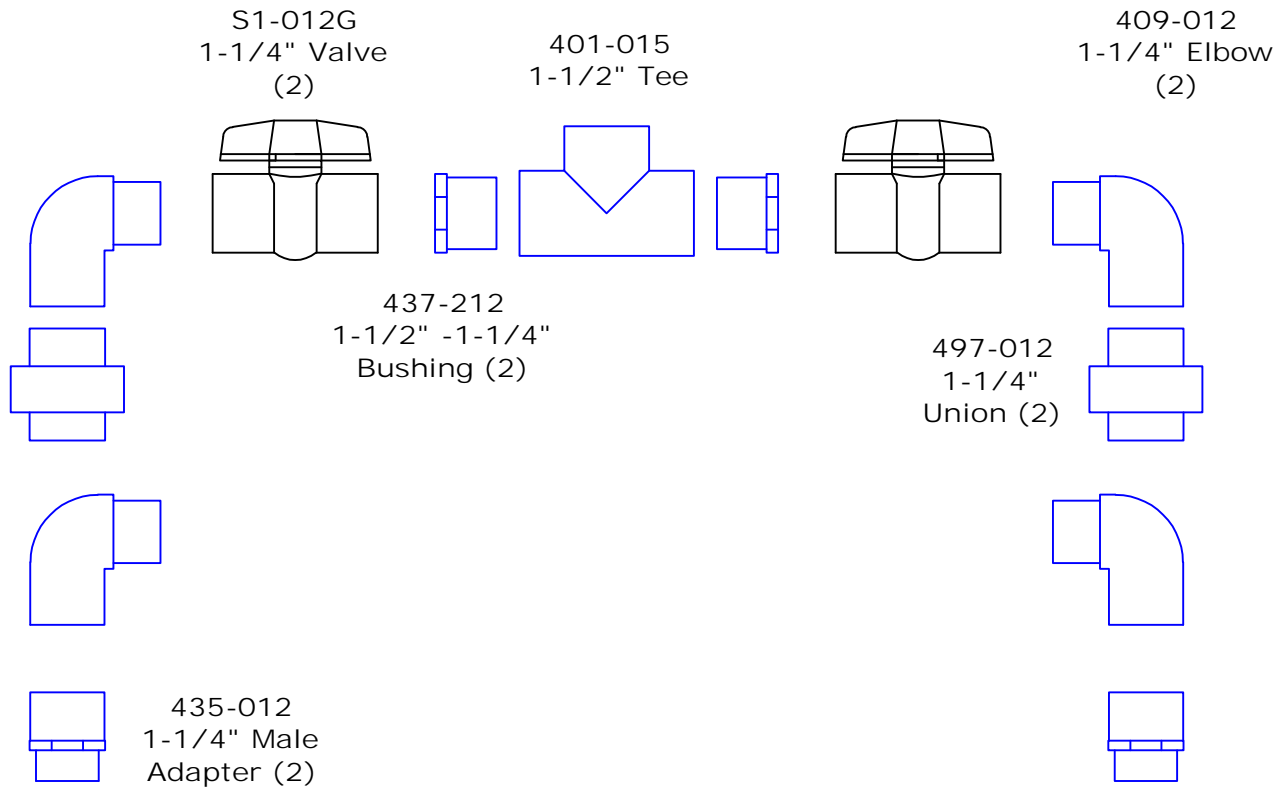
FLOAT BRACKET

PAGE
1

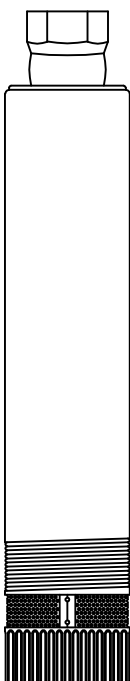


MODEL NO.	DIA. "A"	DIM "B"	DIM "C"	DIM "D"	HOOK SPACING
6AHB	9"	7"	19 1/4"	18"	3 3/4"
ALL INFORMATION CONTAINED IN THIS DRAWING IS CONFIDENTIAL AND PROPRIETARY TO CONERY MFG, INC.				<div></div>	
CHANGES		TOLERANCES	DRAWN BY	DATE	SPECIFICATION SHEET DIMENSIONAL DATA
F		DECIMALS .xxx = ±.005 .xx = ±.010 FRACTIONAL x/x = ±.1/64 ANGLES x° = ±1/2°	D. MIDDLETON	03/22/04	
E			MATERIAL SPECIFICATION: 300 SERIES SST		
D					
C					
B					
A			SCALE:	PART NO.	
		HALF	6AHB		

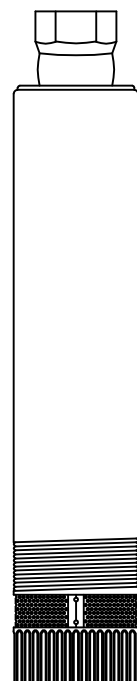
1-1/4" Duplex Pump Kit 1-1/2" Discharge



Pumps for Illustration
Purposes
1-1/4" PVC Pipe by others



Do NOT hang pumps from
pump kit. Pumps must set on
bottom of tank or be supported



STA-RITE® ST.E.P Plus D Series

4" multi-stage submersible effluent pumps



The ST.E.P Plus D Series 4" submersible pump in 10, 20 and 30 GPM models dominate with superior "draw-down" capability.

The ST.E.P Plus D Series 4" submersible pump dominates with reduced amp draw.

The ST.E.P Plus D Series 4" submersible pump dominates with cooler and quieter operation.

APPLICATIONS

Clean and Gray Water... for residential, commercial, and agricultural use.

SPECIFICATIONS

Motor – Available in 115 or 230 volt versions. Dry-wound, double ball-bearing, double-seal and thermal overload protected, UL and CSA approved.

Shell – Stainless steel (300 grade)

Discharge – 1-1/4" Fiberglass-reinforced thermoplastic

Discharge Bearing – Nylatron®

Impellers – Acetel

Diffusers – Polycarbonate

Suction Caps – Polycarbonate with stainless steel wear ring

Thrust Pads – Proprietary spec.

Shaft and Coupling – Stainless steel 300 grade

Intake – Fiberglass-reinforced thermoplastic

Intake Screen – Stainless steel

Jacketed Cord – 600 Volt "SJOW" jacketed 10' leads, 2-wire with ground

Agency Listing – CSA

FEATURES

ST.E.P. Plus DOMINATES with a...

Proven Stage System – The proven SignaSeal staging system utilizes a patented ceramic wear surface. When incorporated with STA-RITE's "true" independent floating impellers, dominates with 1st-in-class performance, superior sand handling, and a thrust management staging system with industry exclusive "dry-run" capabilities.

Superior "draw-down" capability – The ST.E.P. Plus Dominates in this class with the lowest draw-down of 4-1/2" (a standard 4" NEMA submersible only draws-down to 13-1/2").

Reduced amp draw – The ST.E.P. Plus Dominates in this class with less energy consumption – over 25% less amp draw (9.5 amps vs. 12.7 amps, 115 volt) than a 4" NEMA submersible, reducing operating costs and extending the service life of float switch contacts.

Cooler and quieter operation – The ST.E.P. Plus Dominates by using the pumped liquid to cool the motor as it passes over the motor. The water passing over the motor dampens the motor noise, eliminating expensive "flow-inducer sleeves" required when using a standard 4" NEMA submersible.

Impellers – Precision molded for perfect balance... ultra smooth for the highest performance and efficiency. Allows for .080" solids.

Shaft – Positive drive, hexagonal 7/16" – 300-grade stainless steel shaft offers generous impeller drive surfaces.

Shaft bearing – Exclusive self-lubricating Nylatron® bearing resists wear surface from sand and abrasives.

Shell – Corrosion resistant 300-grade stainless steel.

ORDERING INFORMATION

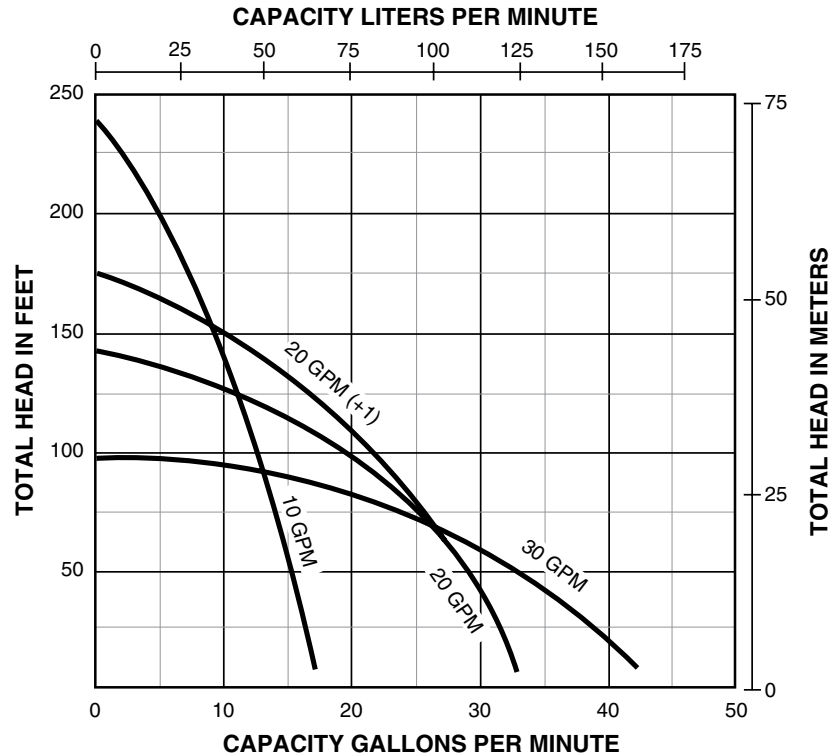
CATALOG NUMBER	HP	MAX. LOAD AMPS	VOLTS	PHASE/ CYCLES	CORD LENGTH	PALLET QUANTITY	WEIGHT (LBS.)
10DOM05221	1/2	5.5	230	1/60	10'	80	16
10DOM05121	1/2	11.0	115	1/60	10'	80	16
20DOM05221	1/2	4.6	230	1/60	10'	80	16
20DOM05121	1/2	9.5	115	1/60	10'	80	16
30DOM05221	1/2	4.6	230	1/60	10'	80	16
30DOM05121	1/2	9.5	115	1/60	10'	80	16
20DOM05221+1	1/2	5.3	230	1/60	10'	80	16
20DOM05121+1	1/2	10.6	115	1/60	10'	80	16

In order to provide the best products possible, specifications are subject to change.

STA-RITE® ST.E.P Plus D Series

4" multi-stage submersible effluent pumps

PUMP PERFORMANCE



PUMP PERFORMANCE (CAPACITY IN GALLONS PER MINUTE)

PUMP MODEL	FLOW RATE (GPM)	PSI											
		0	10	20	30	40	50	60	70	80	90	100	110
10DOM05221	10			15.0	13.7	12.7	11.5	10.2	8.4	6.5	4.3	1.0	
10DOM05121	10			15.0	13.7	12.7	11.5	10.2	8.4	6.5	4.3	1.0	
20DOM05221	20			30.0	26.0	21.5	14.2	4.4					
20DOM05121	20			30.0	26.0	21.5	14.2	4.4					
30DOM05221	30		38.5	33.3	25.8	16							
30DOM05121	30		38.5	33.3	25.8	16							
20DOM05221+1	20 + 1			30	27.5	24	20	13.5	6				
20DOM05121+1	20 + 1			30	27.5	24	20	13.5	6				

PUMP PERFORMANCE (CAPACITY IN LITERS PER MINUTE)

PUMP MODEL	FLOW RATE (LPM)	BAR											
		.69	1.38	2.07	2.76	3.45	4.13	4.82	5.51	6.20	6.89	7.58	110
10DOM05221	37.85			56.8	51.9	48.1	43.5	38.6	31.8	24.6	16.3	3.8	
10DOM05121	37.85			56.8	51.9	48.1	43.5	38.6	31.8	24.6	16.3	3.8	
20DOM05221	75.7			113.6	98.4	81.4	53.7	16.7					
20DOM05121	75.7			113.6	98.4	81.4	53.7	16.7					
30DOM05221	113.55		145.7	126.0	97.7	60.6							
30DOM05121	113.55		145.7	126.0	97.7	60.6							
20DOM05221+1	75.7 + 1			113.4	103.9	90.7	75.6	51.0	22.6				
20DOM05121+1	75.7 + 1			113.4	103.9	90.7	75.6	51.0	22.6				

SENSOR FLOAT® Control Switch

Mercury-activated, narrow-angle float switch designed to activate pump control panels and alarms.

This narrow-angle sensing device is used to accurately monitor liquid levels in sewage and non-potable water applications. The Sensor Float® control switch is not sensitive to rotation and is suitable for use with intrinsically safe circuits. Contact SJE Rhombus regarding specific intrinsically safe applications.

Normally Open Model (high level)

The control switch turns on (closes) when the switch tips slightly **above** horizontal signaling a high level, and turns off (opens) when the switch drops slightly below horizontal.

Normally Closed Model (low level)

The control switch turns on (closes) when the switch drops slightly **below** horizontal signaling a low level, and turns off (opens) when the switch tips slightly above horizontal.



FEATURES

- Suitable for use with intrinsically safe circuits.
- Not sensitive to rotation.
- Control differential of .5 inches (1 cm) above or below horizontal.
- UL Listed for use in non-potable water and sewage.
- CSA Certified.
- Five-year limited warranty.



OPTIONS

This switch is available:

- for normally open (high level) applications or normally closed (low level) applications.
- in standard cable lengths of 10, 15, 20, or 30 feet and 3, 5, 6, or 10 meters (longer lengths available).
- with three mounting options that allow for flexibility in installation:

Mounting Clamp: for applications where the switch can be attached to a discharge pipe or similar mounting device.

Internally Weighted: for applications where the switch can be suspended from above.

Externally Weighted: for applications where the switch can be suspended from above.

SPECIFICATIONS

CABLE: flexible 18 gauge, 2 conductor (UL, CSA) SJOW, water-resistant (CPE)

FLOAT: 3.38 inch diameter x 4.55 inch long (8.58 cm x 11.56 cm), high-impact, corrosion resistant, PVC housing for use in sewage and non-potable water up to 140°F (60°C)

MAXIMUM WATER DEPTH: 30 feet (9 meters), 13 PSI (90 kPa)

MERCURY TILT SWITCH: single pole, single throw, mercury-to-mercury contacts, hermetically sealed in a steel capsule and epoxy sealed in the float housing

ELECTRICAL: 5 amp, 120/230 VAC, 50/60 Hz



SJE RHOMBUS

PO Box 1708, Detroit Lakes, MN 56502

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1-218-847-4617 Fax

email: customer.service@sjeinc.com

www.sjerrhombus.com

G.15

**SEE REVERSE SIDE FOR ORDERING INFORMATION.
SEE PRICE BOOK FOR LIST PRICE.**

SENSOR FLOAT® Control Switch

Mercury-activated, narrow-angle float switch designed to activate pump control panels and alarms.

ORDERING INFORMATION

Normally Open		Normally Closed		Shipping Weight
Part #	Description	Part #	Description	
1002108	10PCNO	1002111	10PCNC	1.29 lbs.
1002072	10SWINO	1002075	10SWINC	1.85 lbs.
1002143	10SWENO	1002146	10SWENC	2.66 lbs.
1002117	15PCNO	1002120	15PCNC	1.64 lbs.
1002080	15SWINO	1002083	15SWINC	2.22 lbs.
1002152	15SWENO	1002155	15SWENC	2.90 lbs.
1002125	20PCNO	1002128	20PCNC	1.99 lbs.
1002089	20SWINO	1002092	20SWINC	2.59 lbs.
1002161	20SWENO	1002164	20SWENC	3.27 lbs.
1002134	30PCNO	1002137	30PCNC	2.13 lbs.
1002098	30SWINO	1002101	30SWINC	3.28 lbs.
1002170	30SWENO	1002173	30SWENC	3.88 lbs.

PC = Pipe Clamp WI = Weighted Internally WE = Weighted Externally

NO = Normally Open NC = Normally Closed

NOTE: Descriptions are grouped by cable length measured in feet (10, 15, 20, 30).

SEE PRICE BOOK FOR LIST PRICE.

SPECIFICATIONS

CABLE: flexible 18 gauge, 2 conductor (UL, CSA) SJOW, water-resistant (CPE) jacket

FLOAT: 3.38 inch diameter x 4.55 inch long (8.58 cm x 11.56 cm), high impact, corrosion resistant, PVC housing for use in sewage and non-potable water up to 140°F (60°C)

MAXIMUM WATER DEPTH: 30 feet (9 meters), 13 psi

MERCURY SWITCH: single pole, single throw, mercury-to-mercury contacts, hermetically sealed in a steel capsule and epoxy sealed in the float housing

ELECTRICAL: 5 amp 120-/230 VAC, 50/60 Hz

NOTE: Suitable for use with intrinsically safe circuits

Contact SJE Rhombus regarding specific intrinsically safe applications.

OPTIONS

PACKAGING

Bagged - standard

Boxed - optional

Bulk - optional

ADDITIONAL CABLE

Longer cable lengths available. Please call for details.

UL Listed for
Water & Sewage



OTHER INFORMATION

NORMALLY OPEN (HIGH LEVEL)

OPERATION

The control switch closes (turns on) when the float tips slightly **above** horizontal signaling a high level, and opens (turns off) when the float drops slightly **below** normal.

NORMALLY CLOSED (LOW LEVEL)

OPERATION

The control switch closes (turns on) when the float drops slightly **below** horizontal signaling a low level, and opens (turns off) when the float tips slightly **above** horizontal.



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Call or fax your order!

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Product offering and pricing are subject to change without notice.
Please visit www.sjerrhombus.com for the most current information.

Sim/Tech Filter
1455 Lexamar Drive
Boyne City, MI 49712
Office: 231-582-1020



Website: www.gag-simtech.com
Email: sales@gag-simtech.com
Fax: 231-582-7324
Toll Free: 888-999-3290

Sim/Tech Filter Introduces the **No Vault Pump Filter**



Main Features

- ◆ 41% open area (139 square inches of open area on the 6" x 18" screen model)
- ◆ Fits most turbine pumps (also known as deep well pumps)
- ◆ Adds only 1/4" of height to pump making it easy to retrofit to existing systems
- ◆ Has 3" sludge shield at the bottom of the filter
- ◆ Disassembles for thorough cleaning if needed
- ◆ Easy to clean surface
- ◆ Made of PVC plastic so will not corrode
- ◆ Self adjusting seal
- ◆ Very light in weight so it does not make pump insertion or removal difficult
- ◆ Screen available from 18" to 42" long
- ◆ Made in the USA
- ◆ Also available with 316L stainless steel screen

Cut-Away View



Solutions

We offer free CAD detail drawings in DXF format to cover our complete product line.

For the protection and performance of wastewater systems by

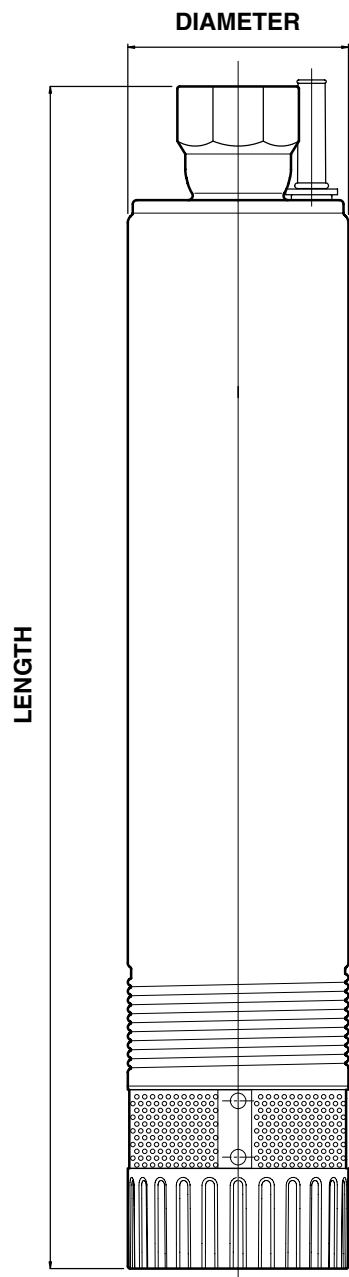
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SIM/TECH
FILTER

STA-RITE® ST.E.P Plus D Series

4" multi-stage submersible effluent pumps

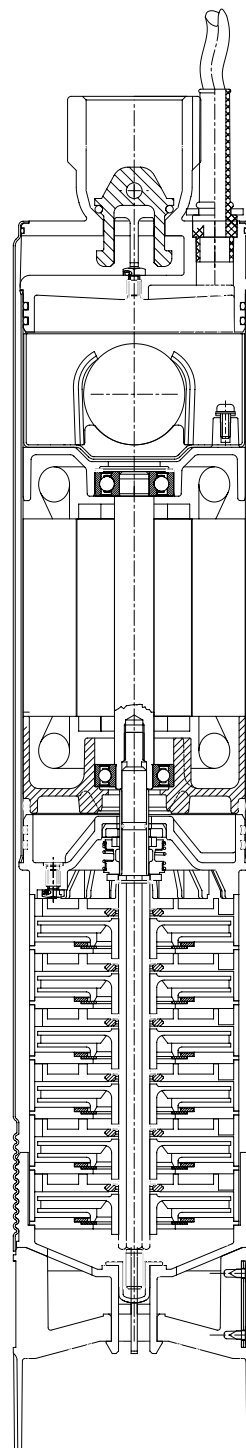
OUTLINE DIMENSIONS



GPM	LENGTH	DIAMETER
10	21.6" (549 mm)	3.86" (98 mm)
20	20.8" (529 mm)	3.86" (98 mm)
30	20.6" (523 mm)	3.86" (98 mm)
20+1	22.3" (567 mm)	3.86" (98 mm)

Dimensions are for estimating purposes only.

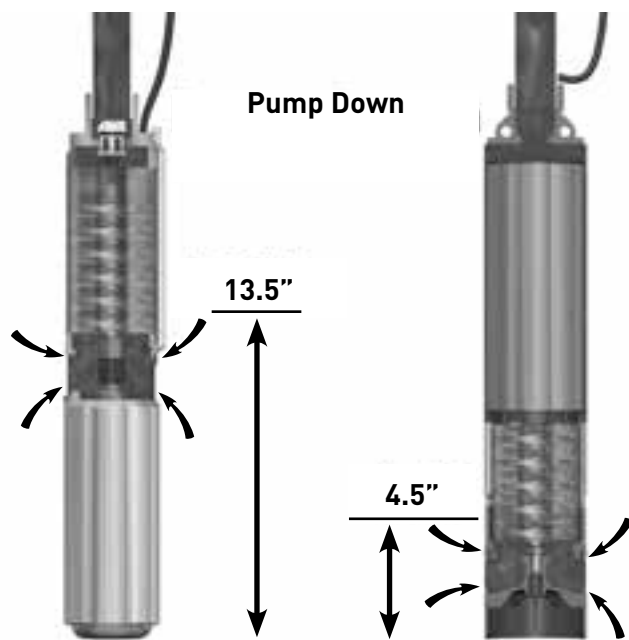
CROSS SECTION



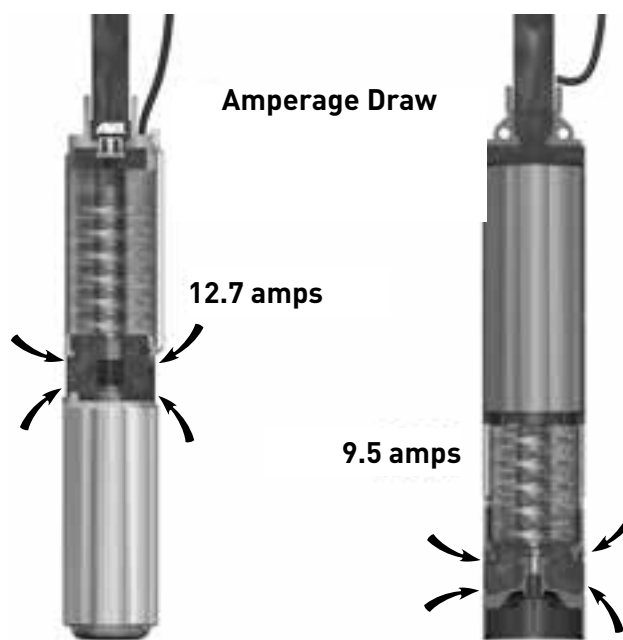
STA-RITE® ST.E.P Plus D Series

4" multi-stage submersible effluent pumps

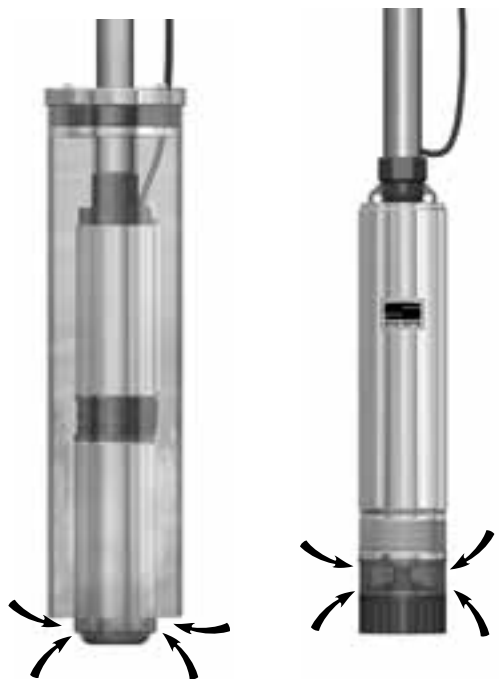
INCREASED DRAWDOWN



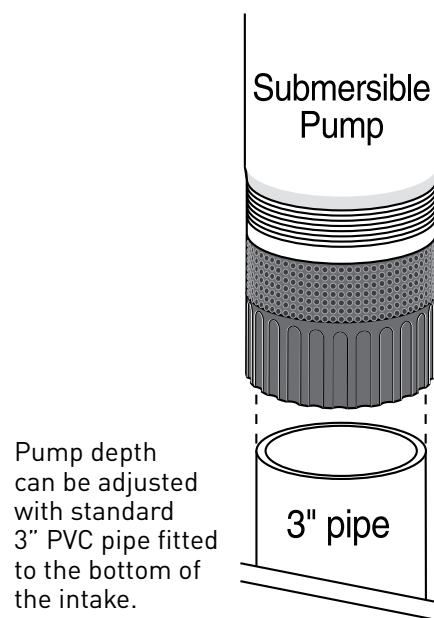
REDUCED AMP DRAW



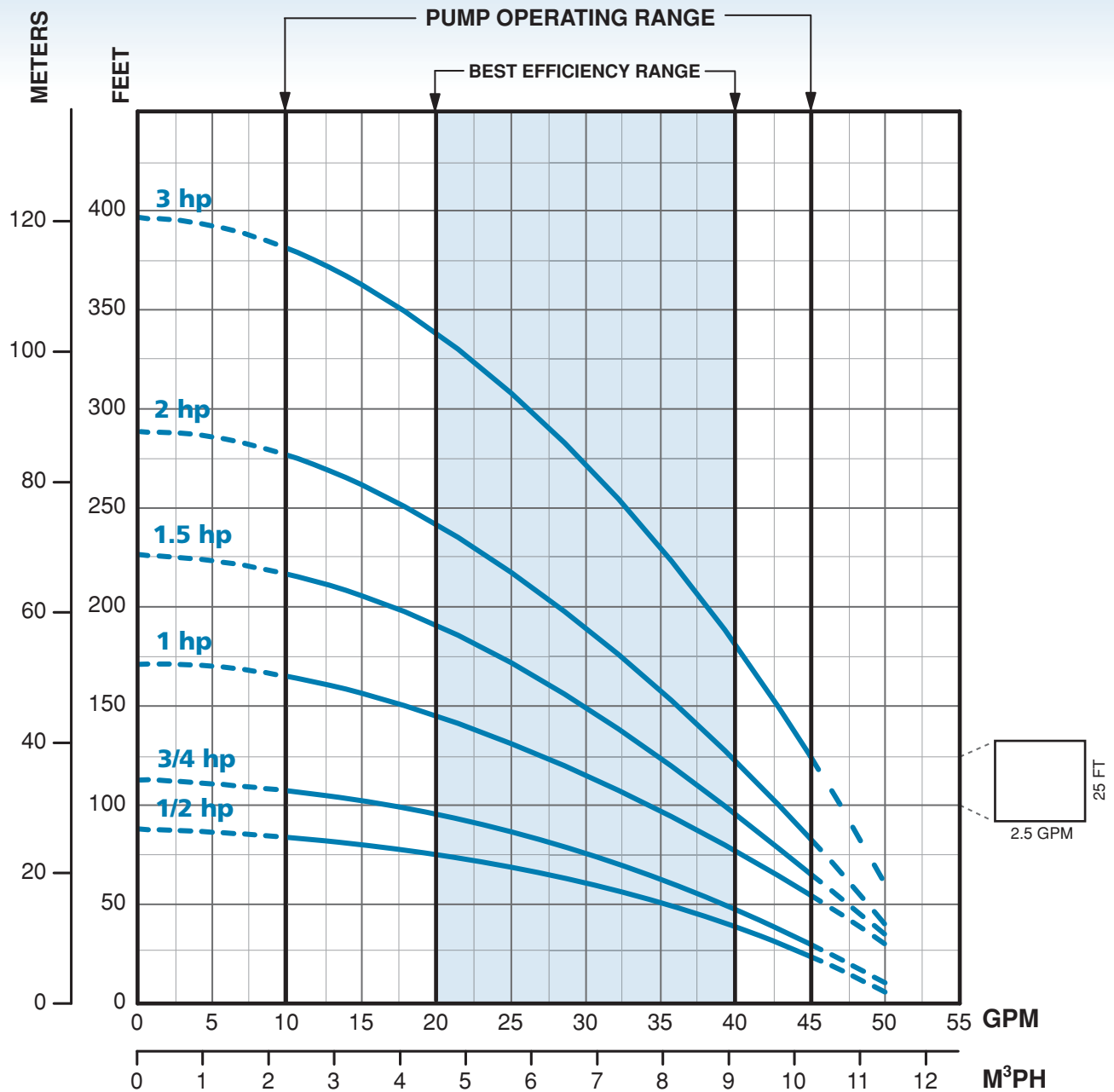
ELIMINATES FLOW-INDUCER



ADJUSTABLE DEPTH SETTING



4" E-Series Environmental Pumps 35 gpm Performance Curves



FM/1 Series Time Switches



TECHNICAL DATA

Supply Voltage:	24, 120 and 240VAC, 60Hz models Quartz: 24V AC/DC, 120 and 240VAC 50/60 Hz
Switch Type:	SPDT
Switch Rating:	21A/250VAC resistive 1350 watt tungsten 1HP @ 125VAC 2HP @ 240VAC
Power Consumption:	24V: 0.1VA; 120V: 0.5VA; 240V: 1.0VA
Ambient Temp. Range:	-40°F to 180°F, synchronous units -20°F to 140°F, quartz units
Terminals:	1/4" spade terminals
Reserve Carryover:	7 days for quartz units
Weight:	Approximately 3 oz.

NOTE: 24V quartz unit will operate on 6VDC, 12VDC, or 24VDC

APPLICATIONS

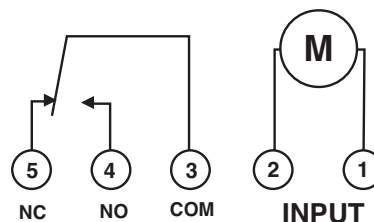
The FM/1 series of time switches are designed for control of heating, ventilating, air conditioning, refrigeration, lighting, security, circulating pumps, spas or any electrical load requiring 24-hour or 7-day scheduling.

WIRING

Verify input voltage stated on back of unit. Use 1/4" quick connects and make connections in accordance with the wiring diagram shown and applicable code requirements. When using 24V units, it is important to use transformers that will supply the required 24 volts AC to terminals 1 & 2.

Terminal Connections

Contacts shown in "Off" position (trippers pushed inward)
"On" position (trippers pushed outward) will close contacts 3 & 4

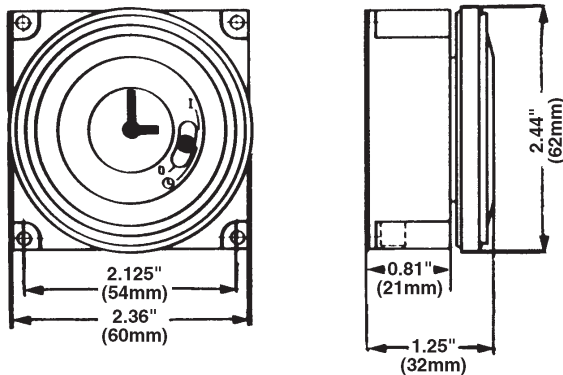


MOUNTING

The standard FM/1 units can be flush mounted (mounting kit with screws available) or surface mounted inside a panel. A printed circuit board mounting base is also available. An indoor or outdoor enclosure is available for stand-alone mounting. In addition, unit is also available in DIN housing for flush or surface mounting (see MIL72, Digi 20 or Digi 42 data sheets). Optional clear plastic dust cover is available.

Dimensions

FM/1 synchronous/quartz



TIME SETTING

TO SET THE CURRENT TIME (AND DAY OF WEEK ON 7 DAY UNITS), TURN THE MINUTE HAND CLOCKWISE. DO NOT SET THE TIME BY ROTATING "OUTER" DIAL.

Turn the minute hand clockwise until the day of the week (7-day timer) and the time of day on the outer dial is aligned with the triangle marker on the inner dial (two o'clock position).

Example for 7-day program dial Monday 10:30 AM. Turn the minute hand clockwise until Monday 10:30 AM is aligned with the triangle on the inner dial. The hour and minute hand will show exactly 10:30.

Example for 24-hour program dial 10:30 AM. Turn the minute hand clockwise until 10:30 AM is aligned with the triangle on the inner dial. The hour and the minute dial will show exactly 10:30.

PROGRAMMING

7-Day (SW, QRW Models)

The weekly program dial reflects the seven days of the week and AM/PM imprints for each day.

The time switch is programmed by pushing the captive trippers to the outer ring position for the entire period that the load is to be turned "ON", i.e., two hours for each tripper on the 7-Day dial. When the tripper is pushed to the inside, the switch is in the "OFF" position.

24-Hour (ST, QRT Models)

The 24-Hour dial has quarter-hour divisions and AM/PM indications.

The time switch is programmed by pushing the captive trippers to the outer ring position for the entire period that the load is to be turned "ON", i.e., fifteen minutes for each tripper on the 24-Hour dial. When the tripper is pushed to the inside, the switch is in the "OFF" position.

PROGRAMMING WITH MANUAL OVERRIDE SWITCH

AUTOMATIC MODE

In order to operate the time switch module in the automatic mode, the manual switch must be in the center position (automatic) - see diagram.

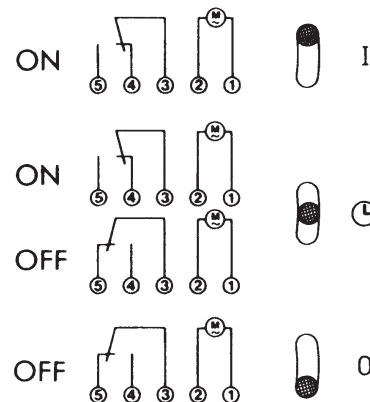
MANUAL MODE

With the manual switch selector lever the selected programs can be overridden. In the lower position, marked "O", terminals 3 and 5 are permanently closed. In the upper position, marked "I", terminals 3 and 4 are permanently closed (see diagram).

Override Mode

3-way manual
override switch

I = permanent ON
⌚ = automatic
O = permanent OFF



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- David S. Mitchell,
President N.R. Mitchell
Company

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Alternating Relays

Price:

Select Model:

Alternating Relays (ALT-120-10S) - \$69.30

[Add to Cart](#)

Ohio Electric Control Alternating Relays are designed for applications where two loads are alternately powered. This provides equal run time on the pumps. Output contacts will change state each time the control switch opens.

The control switch may be a float, thermostat, pressure switch, or timer.

The option lead/lag selector switch allows you to lock the relay in position for servicing while allowing the remaining pump to operate.

Features

- UL listed/Recognized; File #E130593
- Optional Lead/Lag Selector Switch
- Solid-State Dependability
- Full LED Indication
- Lexan Case

Specifications

- Supply Voltage 24VAC or 120VAC
- Power Consumption < 2 watts
- Transient Protection 2500 VRWS for 10 ms
- Contact Rating 10A @ 120VAC
- Operating Temperature -20°C to +60°C

[« Back to Products](#)

Contactors and Starters

Product Selection
Non-reversing Contactors

34



Frame B



Frame C



Frame D



Frame F



Frame F

Table 34-49. Full Voltage Non-reversing 3-Pole Contactors, Frame B – Frame G

UL/CSA Ratings								IEC Ratings				Maximum kW Ratings AC-3				Aux. Contacts	Catalog Number — Screw Terminals ①②	Price U.S. \$	
								AC-3 I _e (A)	AC-1 (40°C) I _e = I _{th} (A)	3-Phase Motors 50 – 60 Hz								AC Coil	DC Coil
UL General Purpose Amp Rating	1-Phase hp Ratings		3-Phase hp Ratings																
	115V	200V	230V	200V	230V	460V	575V					220/230V	380/400V	415V	660/690V				
Frame B																			
20	1/4	3/4	1	1-1/2	2	3	5	7	22			2.2	3	4	3.5	1NO	XTCE007B10_		
20	1/4	3/4	1	1-1/2	2	3	5	7	22			2.2	3	4	3.5	1NC	XTCE007B01_		
20	1/2	1	1-1/2	3	3	5	7-1/2	9	22			2.5	4	5.5	4.5	1NO	XTCE009B10_		
20	1/2	1	1-1/2	3	3	5	7-1/2	9	22			2.5	4	5.5	4.5	1NC	XTCE009B01_		
20	1	2	2	3	3	10 ③	10	12	22			3.5	5.5	7	6.5	1NO	XTCE012B10_		
20	1	2	2	3	3	10 ③	10	12	22			3.5	5.5	7	6.5	1NC	XTCE012B01_		
20	1	2	3	5	5	10 ③	10	15.5	22			4	7.5	8	7	1NO	XTCE015B10_		
20	1	2	3	5	5	10 ③	10	15.5	22			4	7.5	8	7	1NC	XTCE015B01_		
Frame C																			
40	2	2	3	5	5	10 ③	15	18	40			5	7.5	10	11	1NO	XTCE018C10_		
40	2	2	3	5	5	10 ③	15	18	40			5	7.5	10	11	1NC	XTCE018C01_		
40	2	3	5	7-1/2	10	15	20	25	45			7.5	11	14.5	14	1NO	XTCE025C10_		
40	2	3	5	7-1/2	10	15	20	25	45			7.5	11	14.5	14	1NC	XTCE025C01_		
40	3	5	5	10	10	20	25	32	45			10	15	18	17	1NO	XTCE032C10_		
40	3	5	5	10	10	20	25	32	45			10	15	18	17	1NC	XTCE032C01_		
Frame D																			
63	3	5	7-1/2	10	15	30	40	40	60			12.5	18.5	24	23	—	XTCE040D00_		
63	3	5	7-1/2	10	15	30	40	40	60			12.5	18.5	24	23	1NO-1NC	XTCE040DS1_		
80	3	7-1/2	10	15	20	40	50	50	80			15.5	22	30	30	—	XTCE050D00_		
80	3	7-1/2	10	15	20	40	50	50	80			15.5	22	30	30	1NO-1NC	XTCE050DS1_		
88	5	10	15	20	25	50	60	65	98			20	30	39	35	—	XTCE065D00_		
88	5	10	15	20	25	50	60	65	98			20	30	39	35	1NO-1NC	XTCE065DS1_		
88	5	10	15	20	25	50	60	72	98			22	37	41	35	—	XTCE072D00_		
88	5	10	15	20	25	50	60	72	98			22	37	41	35	1NO-1NC	XTCE072DS1_		
Frame F																			
125	7-1/2	15	15	25	30	60	75	80	110			25	37	48	63	—	XTCE080F00_		
125	7-1/2	15	15	25	30	60	75	80	110			25	37	48	63	1NO-1NC	XTCE080FS1_		
125	7-1/2	15	15	25	40	75	100	95	130			30	45	57	75	—	XTCE095F00_		
125	7-1/2	15	15	25	40	75	100	95	130			30	45	57	75	1NO-1NC	XTCE095FS1_		
Frame G																			
160	10	25	25	40	50	100	100	115	160			37	55	70	90	—	XTCE115G00_		
160	10	25	25	40	50	100	100	115	160			37	55	70	90	1NO-1NC	XTCE115GS1_		
180	10	25	30	40	60	125	125	150	190			48	75	91	96	—	XTCE150G00_		
180	10	25	30	40	60	125	125	150	190			48	75	91	96	1NO-1NC	XTCE150GS1_		
225 ④	10	25	30	40	60	125	125	170	275 ⑤			52	90	100	96	—	XTCE170G00_		
225 ④	10	25	30	40	60	125	125	170	275 ⑤			52	90	100	96	1NO-1NC	XTCE170GS1_		

- ① Underscore (_) indicates magnet coil suffix required. See Table 34-58, Page 34-38.
- ② For Spring Cage Terminals, insert **C** after the fourth digit of the Catalog Number.
Example: XTCEC007B10A. For 7 – 12A XTCEC Contactors, the power, auxiliary and coil terminals are spring cage. For 18 – 32A XTCEC Contactors, the auxiliary and coil terminals are spring cage. For 40 – 150A XTCEC Contactors, the coil terminals only are spring cage.
- ③ For electrical life contactor application data, see Table 34-51, Page 34-35.
- ④ For 180 – 225A, use 2 x 3/0 AWG wire.
- ⑤ For 225 – 275A, use 2 x 70 mm² wire.

Notes:

The 7 – 32A XTCE Contactors have positively driven contacts between the integrated auxiliary contact and the auxiliary contact module as well as within the auxiliary contact modules.

The 40 – 65A XTCE Contactors have positively driven contacts within the auxiliary contact module. 6 auxiliary contacts are possible with a combination of side mounted and front mount auxiliary contacts.

DC operated contactors (Frames B – G, 7 – 150A) have a built-in suppressor circuit.

Frame B – C contactors with 1NC built-in auxiliary are mirror contacts (XTCE...B01_ – XTCE...C01_).

Contact Sequence (Circuit Symbols)	Page 34-35
Coil Voltage Chart	Page 34-38
Accessories	Page 34-49
Dimensions	Page 34-91
Overload Relays	Page 34-104
Discount Symbol	1CD7

Contactors and Starters

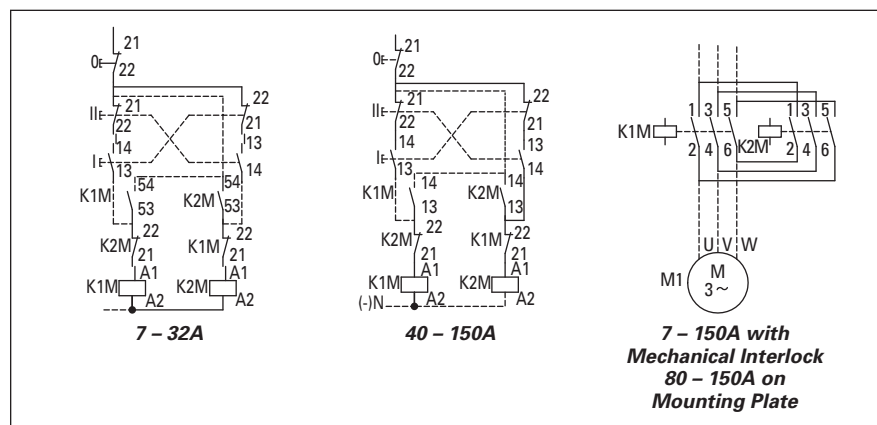
Table 34-58. Magnet Coil Suffix

Coil Voltage	Suffix Code
Frame A – B	
110V 50 Hz, 120V 60 Hz	A
220V 50 Hz, 240V 60 Hz	B
230V 50 Hz	F
24V 50/60 Hz	T
24V DC	TD
415V 50 Hz, 480V 60 Hz	C
550V 50 Hz, 600V 60 Hz	D
208V 60 Hz	E
190V 50 Hz, 220V 60 Hz	G
240V 50 Hz, 277V 60 Hz	H
380V 50 Hz, 440V 60 Hz	L
400V 50 Hz	N
380V 60 Hz	P
12V 50/60 Hz	R
24V 50 Hz	U
42V 50 Hz, 48V 60 Hz	W
48V 50 Hz	Y
120V DC	AD
220V DC	BD
12V DC	RD
48V DC	WD

Coil Voltage	Suffix Code
Frame C – F	
110V 50 Hz, 120V 60 Hz	A
220V 50 Hz, 240V 60 Hz	B
230V 50 Hz	F
24V 50/60 Hz	T
24 – 27V DC	TD
415V 50 Hz, 480V 60 Hz	C
550V 50 Hz, 600V 60 Hz	D
208V 60 Hz	E
190V 50 Hz, 220V 60 Hz	G
240V 50 Hz, 277V 60 Hz	H
380V 50 Hz, 440V 60 Hz	L
400V 50 Hz	N
380V 60 Hz	P
12V 50/60 Hz	R
24V 50 Hz	U
42V 50 Hz, 48V 60 Hz	W
48V 50 Hz	Y
110 – 130V DC	AD
200 – 240V DC	BD
12 – 14V DC	RD ^①
48 – 60V DC	WD

Coil Voltage	Suffix Code
Frame G	
100 – 120V 50/60 Hz	A
190 – 240V 50/60 Hz	B
24V 50/60 Hz	T
24 – 27V DC	TD
480 – 500V 50/60 Hz	C
380 – 440V 50/60 Hz	L
42 – 48V 50/60 Hz	W
110 – 130V DC	AD
200 – 240V DC	BD
48 – 60V DC	WD
Frame L – N	
110 – 250V 40 – 60 Hz/DC	A
250 – 500V 40 – 60 Hz	C
48 – 110V 40 – 60 Hz/DC	Y
24 – 48V DC	TD ^②
Frame L – M, S-Series	
110 – 120V 50/60 Hz	A
220 – 240V 50/60 Hz	B
Frame P – R	
220 – 250V 50 – 60 Hz/DC	B

^① Frame C – D only.

^② Frame L – M only.

Figure 34-34. 7 – 150A XTCR Reversing Contactor Wiring Diagram

Accessories **Page 34-49**
 Dimensions **Page 34-91**
 Overload Relays **Page 34-104**

Catalog Number Selection

Table 34-48. XTIEC Contactors & Starters — Catalog Numbering System

XT		CE	C	007	B	01	AD	P16																									
<div>Designation</div> <div>XT = XT Line of IEC Control</div>								<div>XTAE, XTAS and XTAR Starters Only — Maximum Overload Relay</div> <div>XTOB Maximum Overload Rating</div> <div><div><div>Frame B</div><div>P16 = 0.1 – 0.16A P24 = 0.16 – 0.24A P40 = 0.24 – 0.4A P60 = 0.4 – 0.6A 001 = 0.6 – 1A 1P6 = 1.0 – 1.6A 2P4 = 1.6 – 2.4A 004 = 2.4 – 4A 006 = 4 – 6A 010 = 6 – 10A 012 = 9 – 12A 016 = 12 – 16A</div></div><div><div>Frame C</div><div>P16 = 0.1 – 0.16A P24 = 0.16 – 0.24A P40 = 0.24 – 0.4A P60 = 0.4 – 0.6A 001 = 0.6 – 1A 1P6 = 1.0 – 1.6A 2P4 = 1.6 – 2.4A 004 = 2.4 – 4A 006 = 4 – 6A 010 = 6 – 10A 016 = 10 – 16A 024 = 16 – 24A 032 = 24 – 32A</div></div><div><div>Frame D</div><div>010 = 6 – 10A 016 = 10 – 16A 024 = 16 – 24A 040 = 24 – 40A 057 = 40 – 57A 065 = 50 – 65A 075 = 65 – 75A</div></div><div><div>Frame F</div><div>035 = 25 – 35A 050 = 35 – 50A 070 = 50 – 70A 100 = 70 – 100A</div></div><div><div>Frame G</div><div>035 = 25 – 35A 050 = 35 – 50A 070 = 50 – 70A 100 = 70 – 100A 125 = 95 – 125A 150 = 120 – 150A 175 = 145 – 175A</div></div><div><div>Frame L</div><div>070 = 50 – 70A 100 = 70 – 100A 125 = 95 – 125A 160 = 120 – 160A 220 = 160 – 220A 250 = 200 – 250A</div></div></div>																									
<div>Type</div> <div>CE = 3-Pole FVNR IEC Contactor CS = 3-Pole FVNR S Series IEC Contactor CF = 4-Pole FVNR IEC Contactor CR = 3-Pole FVR IEC Contactor CC = IEC Capacitor Contactor AE = FVNR IEC Starter AS = FVNR S-Series IEC Starter AR = FVR IEC Starter</div>		<div>Terminations</div> <div>Blank = Screw Terminals (6 – 65A); 5 mm (80 – 150A); No Lugs (185 – 2000A) Spring Cage Terminals C = (6 – 32A); Spring Cage Coil Terminals Only (185 – 500A)</div>		<div>Current Ratings, AC-3</div> <div><table><tr><td>007 = 7A 009 = 9A 012 = 12A 015 = 15A</td><td>B = 45 mm</td><td rowspan="2">01 = 1NC 10 = 1NO</td></tr><tr><td>018 = 18A 025 = 25A 032 = 32A</td><td>C = 45 mm</td></tr><tr><td>040 = 40A 050 = 50A 065 = 65A 072 = 72A</td><td>D = 55 mm</td><td rowspan="2">00 = 0NO-0NC S1 = 1NO-1NC Side-mount Auxiliary S2 = 2NO-2NC Side-mount Auxiliary</td></tr><tr><td>080 = 80A 095 = 95A</td><td>F = 90 mm</td></tr><tr><td>115 = 115A 150 = 150A 170 = 170A</td><td>G = 90 mm</td><td rowspan="2">11 = 1NO-1NC Top-mount Auxiliary</td></tr><tr><td>185 = 185A 225 = 225A 250 = 250A</td><td>L = 140 mm</td></tr><tr><td>300 = 300A 400 = 400A 500 = 500A 570 = 580A</td><td>M = 160 mm</td><td rowspan="2">22 = 2NO-2NC</td></tr><tr><td>580 = 580A 650 = 650A 750 = 750A 820 = 820A C10 = 1000A</td><td>N = 250 mm</td></tr><tr><td>C14 = 1400A, AC-1</td><td>P = 260 mm</td><td></td></tr><tr><td>C16 = 1600A, AC-3 C20 = 2000A, AC-1</td><td>R = 515 mm</td><td></td></tr></table></div>		007 = 7A 009 = 9A 012 = 12A 015 = 15A	B = 45 mm	01 = 1NC 10 = 1NO	018 = 18A 025 = 25A 032 = 32A	C = 45 mm	040 = 40A 050 = 50A 065 = 65A 072 = 72A	D = 55 mm	00 = 0NO-0NC S1 = 1NO-1NC Side-mount Auxiliary S2 = 2NO-2NC Side-mount Auxiliary	080 = 80A 095 = 95A	F = 90 mm	115 = 115A 150 = 150A 170 = 170A	G = 90 mm	11 = 1NO-1NC Top-mount Auxiliary	185 = 185A 225 = 225A 250 = 250A	L = 140 mm	300 = 300A 400 = 400A 500 = 500A 570 = 580A	M = 160 mm	22 = 2NO-2NC	580 = 580A 650 = 650A 750 = 750A 820 = 820A C10 = 1000A	N = 250 mm	C14 = 1400A, AC-1	P = 260 mm		C16 = 1600A, AC-3 C20 = 2000A, AC-1	R = 515 mm		<div>Coil Codes See Table 34-58.</div>	
007 = 7A 009 = 9A 012 = 12A 015 = 15A	B = 45 mm	01 = 1NC 10 = 1NO																															
018 = 18A 025 = 25A 032 = 32A	C = 45 mm																																
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185 = 185A 225 = 225A 250 = 250A	L = 140 mm																																
300 = 300A 400 = 400A 500 = 500A 570 = 580A	M = 160 mm	22 = 2NO-2NC																															
580 = 580A 650 = 650A 750 = 750A 820 = 820A C10 = 1000A	N = 250 mm																																
C14 = 1400A, AC-1	P = 260 mm																																
C16 = 1600A, AC-3 C20 = 2000A, AC-1	R = 515 mm																																

Dimensions

XTCE Contactors (3-Pole)

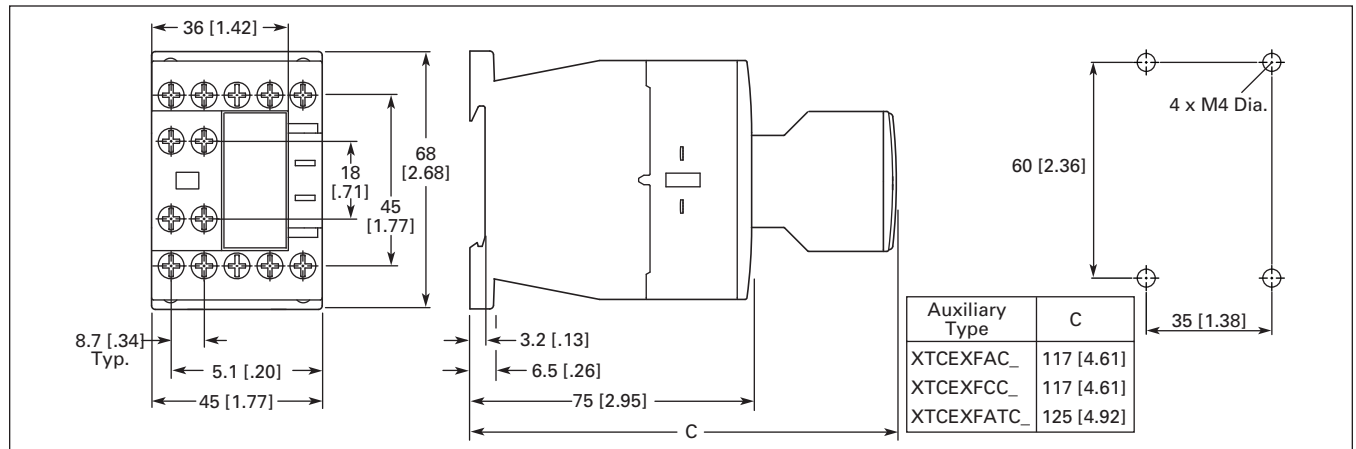


Figure 34-46. Frame B, XTCE007B and XTCE015B Contactors with Screw Terminals (7 – 15A) XTCE020B — Approximate Dimensions in mm [in]

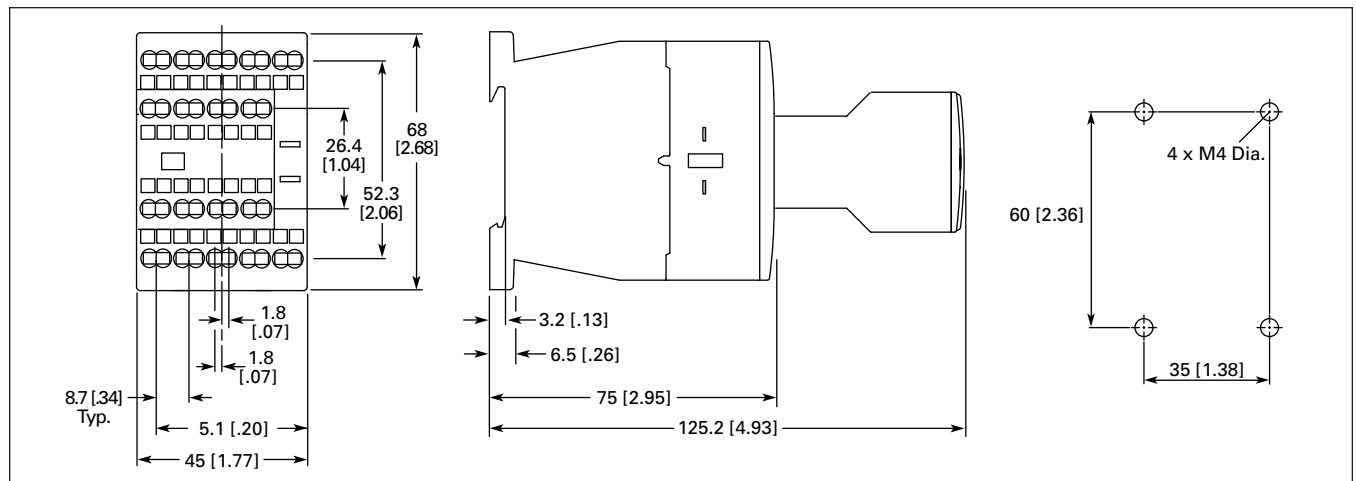


Figure 34-47. Frame B, XTCEC007B – XTCEC012B Contactors with Spring Cage Terminals (7 – 12A) — Approximate Dimensions in mm [in]

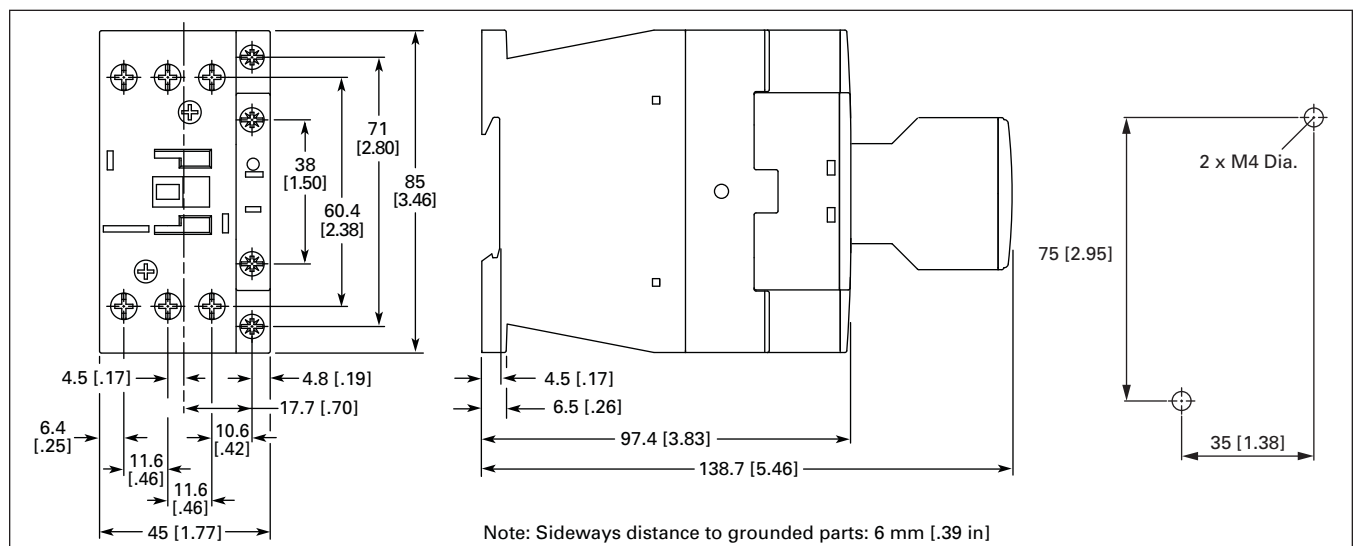


Figure 34-48. Frame C, XTCE018C – XTCE032C Contactors (18 – 32A) — Approximate Dimensions in mm [in]

VLT® AQUA Drive specifications

Mains supply (L1, L2, L3):

Supply voltage	200–240 V $\pm 10\%$
Supply voltage	380–480 V $\pm 10\%$
Supply voltage	525–690 V $\pm 10\%$
Supply frequency	50/60 Hz
Max. imbalance temporary between line phases	3.0% of rated supply voltage
Displacement Power Factor ($\cos\phi$)	near unity (> 0.98)
True power factor (λ)	≥ 0.9
Switching on input supply L1, L2, L3	1–2 times/min.

Output data (U, V, W):

Output voltage	0–100% of supply voltage
Output frequency	0–120 Hz
Rated motor frequency	50/60 Hz
Switching on output	Unlimited
Ramp times	1–3600 sec.
Closed loop	0–132 Hz
Maximum motor cable length	1000 ft.

VLT AQUA Drive can provide 110% current for 1 minute. Higher overload rating is achieved by oversizing the drive.

Torque Characteristics:

Starting torque	maximum 110% for 1 min.*
Starting torque maximum	120% up to 0.5 sec.*
Overload torque	maximum 110% for 1 min.*

*Percentage relates to the nominal torque for the VLT AQUA Drive.

Control Characteristics:

Resolution of output frequency at 0–120 Hz	: ± 0.003 Hz
System response time (terminals 18, 19, 27, 29, 32, 33)	: ≤ 2 ms
Speed control range (open-loop)	1:100 of synchronous speed
Speed accuracy (open-loop)	30 - 4000 rpm: Maximum error of ± 8 rpm

All control characteristics are based on a 4-pole asynchronous motor.

Digital inputs:

Programmable digital inputs (standard)	6**
Additional digital inputs available with MCB 101 general purpose I/O card (option)	3
Logic	PNP or NPN
Voltage level	0–24 V DC

** 2 can be used as digital outputs

Analog inputs:

Analog inputs (standard)	2
Additional analog inputs available with MCB 101 general purpose I/O card (option)	2
Additional analog inputs available with MCB 109 advanced analog I/O card (option)	3
Modes	Voltage or current
Voltage level	0 to +10 V (scaleable)
Current level	0/4 to 20 mA (scaleable)

VLT® AQUA Drive specifications

Pulse inputs:

Programmable pulse inputs (standard)	2 [†]
Additional pulse inputs available with MCB 101 general purpose I/O card (option)	3 [†]
Voltage level	0–24 V DC (PNP positive logic)
Pulse input accuracy	(0.1–110 kHz)

[†] Some of the digital inputs can be used as pulse inputs

Analog output:

Programmable analog outputs (standard)	1
Additional analog outputs available with MCB 101 general purpose I/O card (option)	1
Additional analog outputs available with MCB 109 advanced analog I/O card (option)	3
Current range at analog output	0/4–20 mA

Digital outputs:

Programmable digital/pulse outputs (standard)	2
Additional digital outputs available with MCB 101 general purpose I/O card (option)	2
Voltage level at digital/frequency output	0 - 24 V
Max. output current (sink or source)	40 mA
Max. load at frequency output	1 kΩ
Max. capacitive load at frequency output	10 nF
Minimum output frequency at frequency output	0 Hz
Maximum output frequency at frequency output	32 kHz
Accuracy of frequency output	Max. error: 0.1% of full scale
Resolution of output frequency	12 bit

Relay outputs:

Programmable relay outputs (standard)	2 ^{††}
Additional relay outputs available with MCB 105 relay card (option)	3 ^{††}

^{††} (240 VAC, 2 A and 400 VAC, 2 A)

Control card performance:

Scan interval	5 ms
24V DC output max. load	200 mA
10V DC output voltage	10.5 V ±0.5 V
10V DC output max. load	15 mA

Control card, USB serial communications:

USB standard	1.1 (Full speed)
USB plug	USB type B "device" plug

Fieldbus communication:

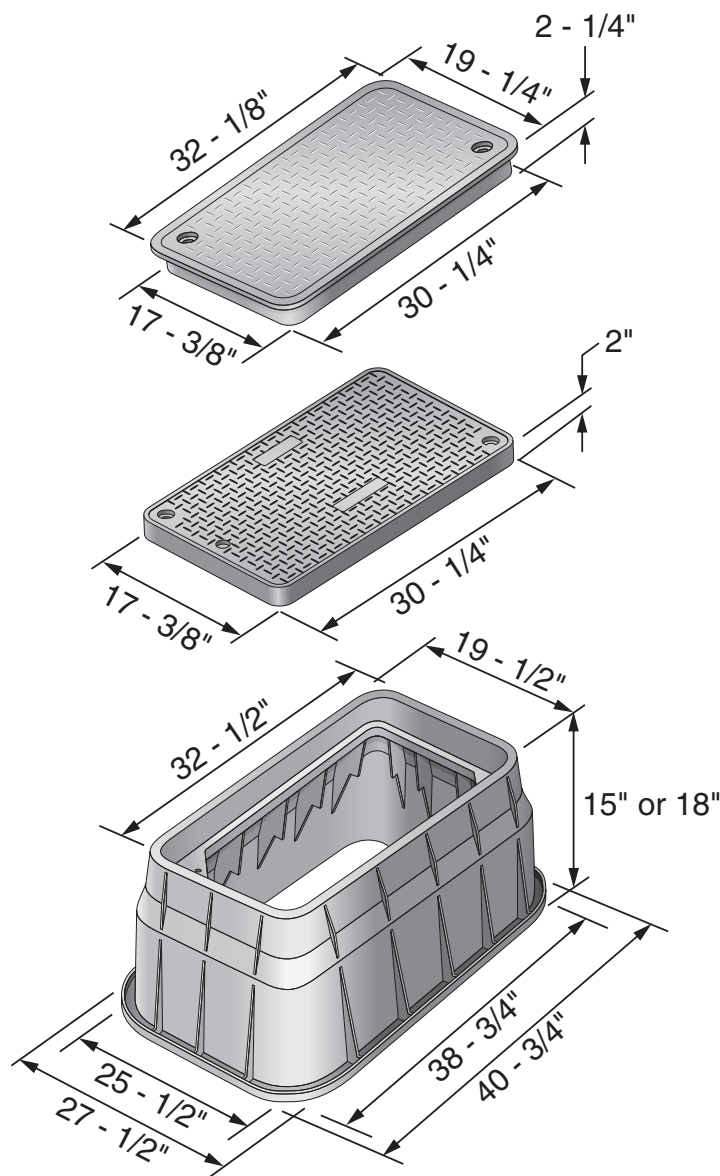
Standard, built in	FC Protocol, Modbus RTU
Optional modules (field-installable)	Profibus, DeviceNet, LonWorks

Ambient temp:

up to 50° C

NDS Pro Series 17"x 30" Rectangular Valve Boxes

Specifications: The NDS PRO SERIES 17"x30" valve boxes and covers are injection molded of structural foam polyethylene material with a melt index between 10-12. Coloring and UV stabilizers are added, along with processing lubricants when needed. The 17"x30" body shall be tapered and have a minimum wall thickness of .320". The body shall have a double wall at the top cover seat area with a minimum thickness of .320". The cover seat area shall have 20 structural support ribs on the underside of the seat, each with a minimum thickness of .250". The bottom of the body shall have a 1.000" flange. The 17"x30" cover shall have an average thickness of .350".



Part Number	Box Description	Cover Description - Marking	Color (Box/Cover)	Pallet Qty	Weight Ea
Box & Cover					
224BCB	17"x30"x15" Box	Overlapping Bolt-Down Cover - ICV	Green/Green	12	28.00
226BCB	17"x30"x18" Box	Overlapping Bolt-Down Cover - ICV	Green/Green	10	37.00
224BCDB	17"x30"x15" Box	Drop-in Bolt-Down Cover - ICV	Green/Green	12	28.00
226BCDB	17"x30"x18" Box	Drop-in Bolt-Down Cover - ICV	Green/Green	10	37.00
226PBCRB	17"x30"x18" Box	Overlapping Cover - Reclaimed Water	Purple/Purple	10	37.00
224BCDB ELEC	17"x30"x15" Box	Drop-in Cover - Electric	Gray/Gray	12	28.00
226BCDB ELEC	17"x30"x18" Box	Drop-in Cover - Electric	Gray/Gray	10	36.90
Cover Only					
223C		17"x30" Overlapping Cover - ICV	Green	75	11.00
223CD		17"x30" Drop-in Cover - ICV	Green	75	11.00
223CR		17"x30" Overlapping Cover - Reclaimed Water	Purple	75	11.00
223CDR		17"x30" Drop-in Cover - Reclaimed Water	Purple	75	11.00
223CD ELEC		17"x30" Drop-in Cover - Electric	Gray	75	11.00
Box Only					
224B	17"x30"x15" Box		Green	12	20.00
224B GRAY	17"x30"x15" Box		Gray	12	20.00
226B	17"x30"x18" Box		Green	10	23.00
226B GRAY	17"x30"x18" Box		Gray	10	23.00

Call for additional options and availability

Properties of Unfoamed Resin

	ASTM Test Method	Polyolefin
Tensile Strength, Yield	ASTM D 638	3100-4400 PSI
Density	ASTM D 792	.900-.956
Notched Izod Impact Strength	ASTM D 256	4-15 ft. lbs/in.
Heat Deflection Temperature @ 66 PSI, Degrees F.	ASTM D 648	165-212 degrees F.

Shipping Configuration

	Box	Cover
Pallet	12	125
Pieces per Stack	6	25
Stack per Pallet	12	5
Pallet Dimensions	40"x55"x52 1/2"	39"x42"x62"



NDS Customer Service

851 N. Harvard Ave
Lindsay, CA 93247
Phone: (800) 726-1994
(559) 562-9888
Fax: (800) 726-1998
(559) 562-4488

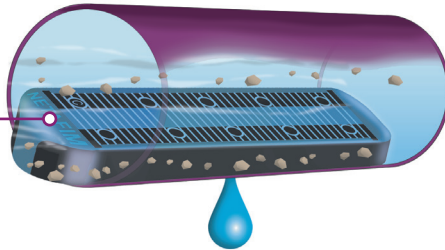
www.NDSPRO.com

BIOLINE® DRIPPERLINE

THE WORLD'S MOST ADVANCED CONTINUOUS
SELF-CLEANING, PRESSURE COMPENSATING
DRIPPERLINE SPECIFICALLY DESIGNED FOR WASTEWATER

CROSS SECTION OF BIOLINE DRIPPERLINE

Bioline dripper inlets are positioned in the center of flow where water is the cleanest



PRODUCT ADVANTAGES

- Pressure compensation - all drippers deliver equal flow, even on sloped or rolling terrain.
- Unique flow path - Turbonet technology provides more control of water and a high resistance to clogging.
- Continuous self-flushing dripper design - flushes debris, as it is detected - throughout operation, not just at the beginning or end of a cycle. Ensures uninterrupted dripper operation.
- Single hole dripper outlet from tubing:
 - Better protection against root intrusion
 - Allows the dripperline to be used in subsurface applications without need for chemical protection
- Drippers capture water flow from the center of the tubing - ensures that only the cleanest flow enters the dripper.
- Built-in physical root barrier - drippers are protected from root intrusion without the need for chemical protection. Water exits dripper in one location while exiting the tubing in another.
- Three dripper flow rates - provides the broadest range of flow rates available. Allows the designer to match the dripperline to any soil or slope condition.
- Bioline tubing is completely wrapped in purple - easily identifying it for non-potable use, regardless of how the tubing is installed.
- Anti-bacterial-impregnated drippers - prevents buildup of microbial slime.
- Can be used subsurface - Bioline can be installed on-surface, under cover or subsurface.
- No special storage requirements - does not degrade if stored outdoors.
- Techfilter compatible - an optional level of protection, provides a limited lifetime warranty against root intrusion.

APPLICATIONS

- Typically installed following a treatment process
- Can be used with domestic septic tank effluent with proper design, filtration and operation
- Reuse applications including municipally treated effluent designated for irrigation and other disinfected and non-disinfected water sources.

SPECIFICATIONS

- Dripper flow rates: 0.4, 0.6 or 0.9 GPH
- Dripper spacings: 12", 18" or 24" dripper spacings and blank tubing
- Pressure compensation range: 7 to 70 psi (stainless steel clamps recommended above 50 psi)
- Maximum recommended system pressure: 50 psi
- Tubing diameter: 0.66" OD, 0.57" ID
- Tubing color: Purple color indicates non-potable
- Coil lengths: 500' or 1,000' (Blank tubing in 250')
- Recommended filtration: 120 mesh
- Bending radius: 7"
- UV resistant
- Tubing material: Linear low-density polyethylene

Additional spacing and pipe sizes available by special order. Please contact Netafim USA Customer Service for details.

BIOLINE DRIPPERLINE

MAXIMUM LENGTH OF A SINGLE LATERAL WITH 3.0 fps FLUSH VELOCITY ADDITIONAL FLOW OF 2.3 GPM REQUIRED PER LATERAL TO ACHIEVE 3 fps

DRIPPER SPACING		12"			18"			24"		
DRIPPER FLOW RATE (GPH)		0.4 GPH	0.6 GPH	0.9 GPH	0.4 GPH	0.6 GPH	0.9 GPH	0.4 GPH	0.6 GPH	0.9 GPH
INLET PRESSURE	15	102	94	84	136	127	113	161	151	137
	25	151	136	118	203	184	161	245	223	197
	35	193	171	146	260	232	200	315	283	245
	40	211	186	158	286	254	218	347	311	267
	45	228	200	169	310	274	233	377	335	287
Flow per 100' (GPM / GPH)		0.67/40	1.02/61	1.53/92	0.44/26.67	0.68/41	1.02/61	0.34/20	0.51/31	0.77/46

Lateral lengths are based on flows allowing for a 3 fps flushing/scouring velocity

MAXIMUM LENGTH OF A SINGLE LATERAL WITH 2.5 fps FLUSH VELOCITY ADDITIONAL FLOW OF 2.0 GPM REQUIRED PER LATERAL TO ACHIEVE 2.5 fps

DRIPPER SPACING		12"			18"			24"		
DRIPPER FLOW RATE (GPH)		0.4 GPH	0.6 GPH	0.9 GPH	0.4 GPH	0.6 GPH	0.9 GPH	0.4 GPH	0.6 GPH	0.9 GPH
INLET PRESSURE	15	128	115	100	172	155	136	205	187	165
	25	183	161	137	248	220	188	301	268	231
	35	228	198	166	310	272	229	379	333	283
	40	248	214	178	338	295	247	413	362	305
	45	266	229	190	364	316	263	447	389	327
Flow per 100' (GPM / GPH)		0.67/40	1.02/61	1.53/92	0.44/26.67	0.68/41	1.02/61	0.34/20	0.51/31	0.77/46

Lateral lengths are based on flows allowing for a 2.5 fps flushing/scouring velocity

MAXIMUM LENGTH OF A SINGLE LATERAL WITH 2.0 fps FLUSH VELOCITY ADDITIONAL FLOW OF 1.6 GPM REQUIRED PER LATERAL TO ACHIEVE 2.0 fps

DRIPPER SPACING		12"			18"			24"		
DRIPPER FLOW RATE (GPH)		0.4 GPH	0.6 GPH	0.9 GPH	0.4 GPH	0.6 GPH	0.9 GPH	0.4 GPH	0.6 GPH	0.9 GPH
INLET PRESSURE	15	161	141	119	217	191	164	263	233	201
	25	221	190	157	302	261	218	369	321	270
	35	269	229	187	370	316	260	455	391	324
	40	290	246	200	399	340	278	493	421	347
	45	310	261	212	427	362	296	527	449	369
Flow per 100' (GPM / GPH)		0.67/40	1.02/61	1.53/92	0.44/26.67	0.68/41	1.02/61	0.34/20	0.51/31	0.77/46

Lateral lengths are based on flows allowing for a 2 fps flushing/scouring velocity

MAXIMUM LENGTH OF A SINGLE LATERAL WITH 1.5 fps FLUSH VELOCITY ADDITIONAL FLOW OF 1.2 GPM REQUIRED PER LATERAL TO ACHIEVE 1.5 fps

DRIPPER SPACING		12"			18"			24"		
DRIPPER FLOW RATE (GPH)		0.4 GPH	0.6 GPH	0.9 GPH	0.4 GPH	0.6 GPH	0.9 GPH	0.4 GPH	0.6 GPH	0.9 GPH
INLET PRESSURE	15	201	171	140	275	235	194	337	289	241
	25	266	222	179	366	308	251	453	383	313
	35	316	262	210	437	365	295	543	455	369
	40	337	280	223	469	391	313	583	487	393
	45	358	296	235	497	413	331	619	517	415
Flow per 100' (GPM / GPH)		0.67/40	1.02/61	1.53/92	0.44/26.67	0.68/41	1.02/61	0.34/20	0.51/31	0.77/46

Lateral lengths are based on flows allowing for a 1.5 fps flushing/scouring velocity

MAXIMUM LENGTH OF A SINGLE LATERAL WITH 1.0 fps FLUSH VELOCITY ADDITIONAL FLOW OF 0.8 GPM REQUIRED PER LATERAL TO ACHIEVE 1.0 fps

DRIPPER SPACING		12"			18"			24"		
DRIPPER FLOW RATE (GPH)		0.4 GPH	0.6 GPH	0.9 GPH	0.4 GPH	0.6 GPH	0.9 GPH	0.4 GPH	0.6 GPH	0.9 GPH
INLET PRESSURE	15	248	205	163	344	285	228	427	355	285
	25	315	258	203	440	361	286	549	453	359
	35	367	299	234	513	419	331	643	527	417
	40	389	316	248	545	445	350	683	559	441
	45	409	332	260	574	468	367	721	589	463
Flow per 100' (GPM / GPH)		0.67/40	1.02/61	1.53/92	0.44/26.67	0.68/41	1.02/61	0.34/20	0.51/31	0.77/46

Lateral lengths are based on flows allowing for a 1 fps flushing/scouring velocity

MAXIMUM LENGTH OF A SINGLE LATERAL WITH 0.5 fps FLUSH VELOCITY ADDITIONAL FLOW OF 0.4 GPM REQUIRED PER LATERAL TO ACHIEVE 0.5 fps

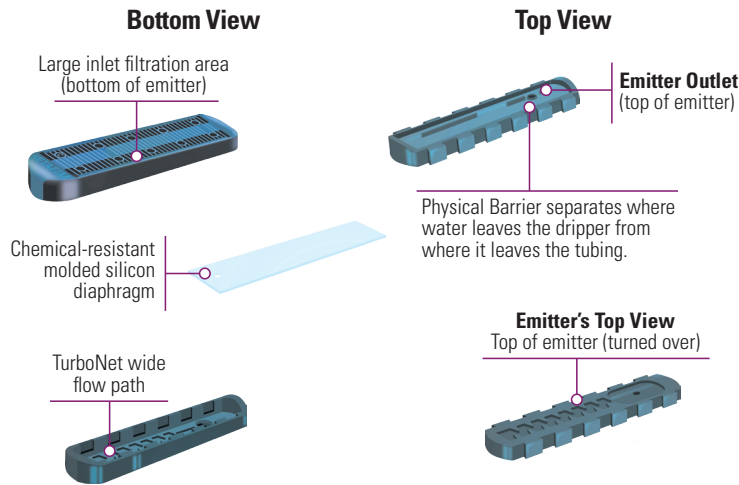
DRIPPER SPACING		12"			18"			24"		
DRIPPER FLOW RATE (GPH)		0.4 GPH	0.6 GPH	0.9 GPH	0.4 GPH	0.6 GPH	0.9 GPH	0.4 GPH	0.6 GPH	0.9 GPH
INLET PRESSURE	15	301	242	188	422	341	265	531	429	335
	25	369	296	228	520	418	323	655	527	409
	35	421	337	260	595	476	368	749	603	467
	40	443	354	273	626	501	387	790	635	491
	45	464	371	285	656	524	404	829	665	513
Flow per 100' (GPM / GPH)		0.67/40	1.02/61	1.53/92	0.44/26.67	0.68/41	1.02/61	0.34/20	0.51/31	0.77/46

Lateral lengths are based on flows allowing for a 0.5 fps flushing/scouring velocity

Netafim recommends flushing velocities capable of breaking free any accumulated bioslimes and debris in the piping network.

- Notes:
1. Refer to local regulations for information on flushing velocities that may be written into codes.
 2. Netafim does not endorse a specific flushing velocity.
 3. Flushing velocities should be determined based on regulations, quality of effluent, and type of flushing control.
 4. Using a flushing velocity less than 1 fps does not provide turbulent flow as defined by Reynolds Number.
 5. Higher flushing velocities provide more aggressive flushing.

EXPLODED VIEW OF BIOLINE EMITTER



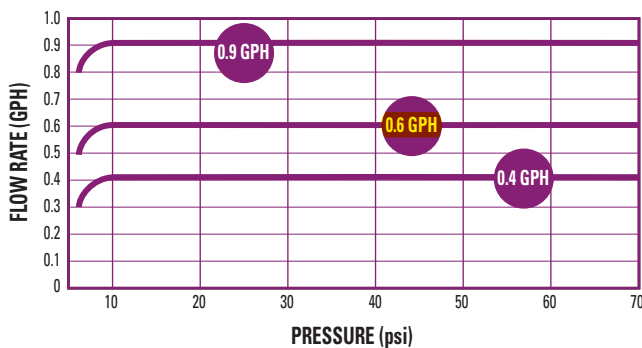
BIOLINE EMITTER OPERATION

Bioline® dripperline emitters are pressure compensating - delivering the water uniformly into the soil for further treatment or for reuse by the landscape. These unique emitters allow the tubing to be installed on flat topography or steep slopes.

Bioline emitters are protected against microbial slime. Each emitter is impregnated with an antimicrobial agent to resist biological build-up.

Netafim emitters are continuously self-cleaning during operation, not just at the beginning and end of a cycle. The result is dependable, clog-free operation, year after year.

DRIPPER FLOW RATE VS. PRESSURE



Between 0 and 7 psi, the dripper functions as a turbulent flow emitter, ensuring that the nominal design flow is not exceeded at system start-up.

FLOW PER 100 FEET

DRIPPER SPACING	0.4 GPH DRIPPER		0.6 GPH DRIPPER		0.9 GPH DRIPPER	
	GPH	GPM	GPH	GPM	GPH	GPM
12"	40.0	0.67	61.0	1.02	92.0	1.53
18"	26.7	0.44	41.0	0.68	61.0	1.02
24"	20.0	0.34	31.0	0.51	46.0	0.77

SPECIFYING INFORMATION

SAMPLE MODEL NUMBER

08WRAM.6-24 V

A Bioline Dripperline = 08WRAM

1 DRIPPER FLOW RATE
0.4 GPH = .4
0.6 GPH = .6
0.9 GPH = .9

2 DRIPPER SPACING
12" = 12
18" = 18
24" = 24

3 COIL LENGTH
500' = V500
1,000' = V

BLANK Tubing Model Number: 250' = 08WRAM-250

ORDERING INFORMATION

FLOW RATE	DRIPPER SPACING	COIL LENGTH	MODEL NUMBER
0.4 GPH	12"	1,000' 500'	08WRAM.4-12V 08WRAM.4-12V500
0.4 GPH	18"	1,000' 500'	08WRAM.4-18V 08WRAM.4-18V500
0.4 GPH	24"	1,000' 500'	08WRAM.4-24V 08WRAM.4-24V500
0.6 GPH	12"	1,000' 500'	08WRAM.6-12V 08WRAM.6-12V500
0.6 GPH	18"	1,000' 500'	08WRAM.6-18V 08WRAM.6-18V500
0.6 GPH	24"	1,000' 500'	08WRAM.6-24V 08WRAM.6-24V500
0.9 GPH	12"	1,000' 500'	08WRAM.9-12V 08WRAM.9-12V500
0.9 GPH	18"	1,000' 500'	08WRAM.9-18V 08WRAM.9-18V500
0.9 GPH	24"	1,000' 500'	08WRAM.9-24V 08WRAM.9-24V500
Blank Tubing 17mm		250'	08WRAM-250

BIOLINE FITTINGS

FITTING APPLICATIONS

- Fits Bioline Dripperline

FITTING SPECIFICATIONS

- Barbed fittings for a secure fit
- Easy installation without glue or tools
- Maximum recommended system pressure without clamps: 50 psi
- Allows for easy on-site inspection of proper fitting installation



TLCOUP
Insert Coupling



TLELL
Insert Elbow



TLTEE
Insert Tee



TLCROS
Insert Cross



TL050MA
1/2" Male Adapter



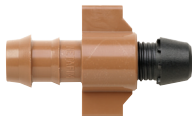
TL075MA
3/4" Male Adapter



TL075FTEE
Combination Tee
Ins x Ins x 3/4" FPT



TL2W075MA
2-Way Insert
3/4" MPT x Insert



TLIAPE-B
Insert Adapter for 1" or
Larger PE (Requires 11mm
or 7/16" drill or punch)



TLIAPVC-B
Insert Adapter with Grommet
1 1/2" or larger PVC Pipe



TDBIT16.5
Drill Bit for TLIAPVC
Fitting (16.5mm or 21/32")



TLFIG8
Figure 8 Line End



TLS6
6" Soil Staple

FITTING DEFINITIONS

FPT = Female Pipe Thread
MPT = Male Pipe Thread
Ins x Ins = Insert by Insert



TLSOV
Shut-Off Valve
Ins x Ins

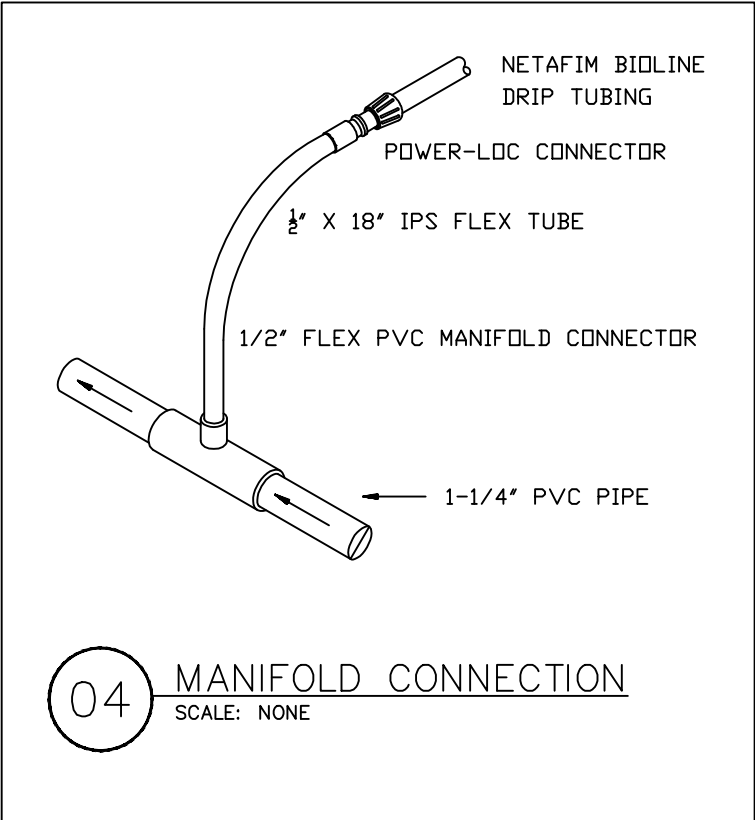
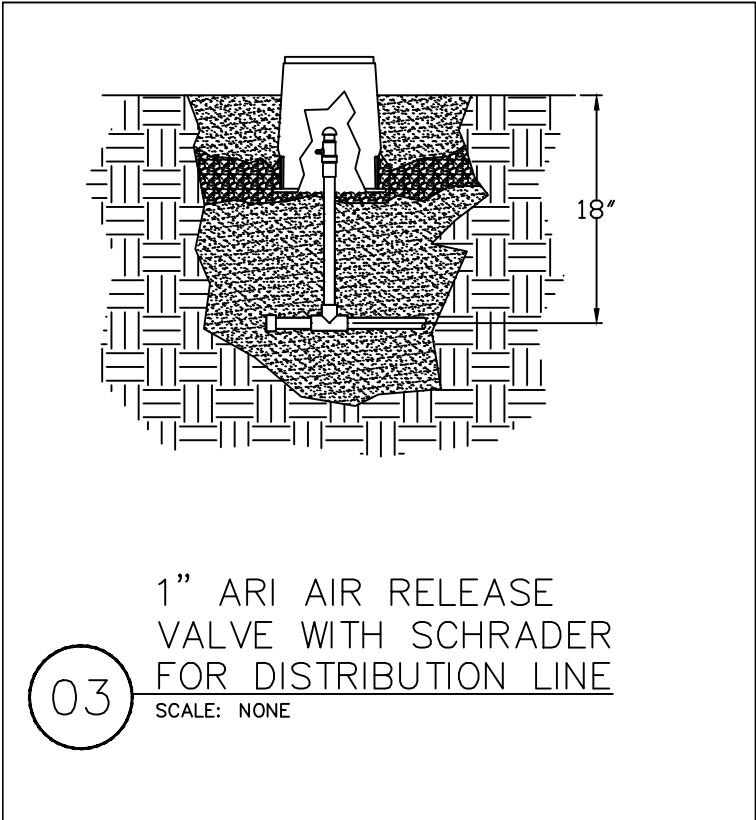
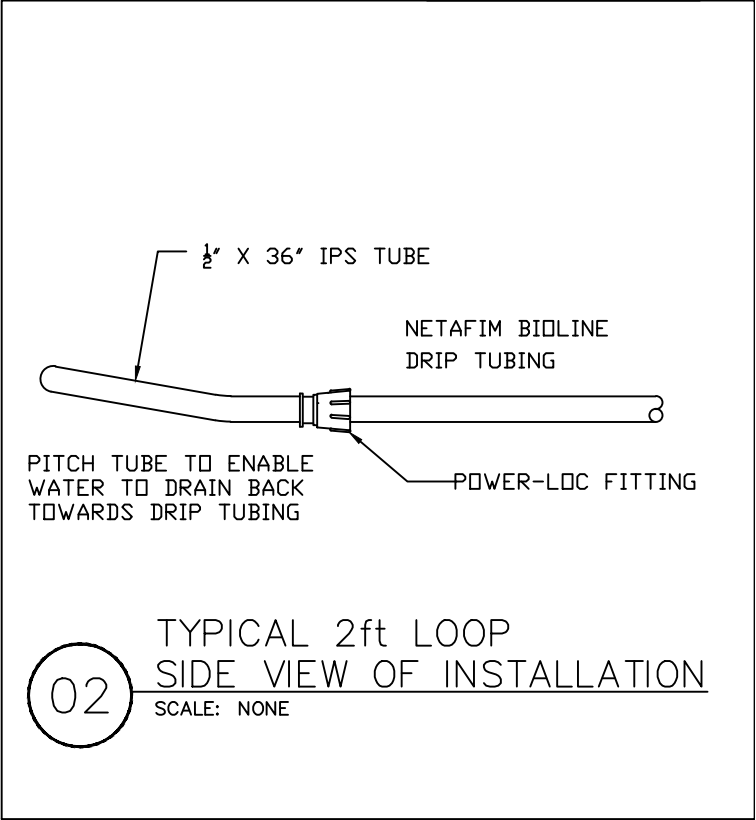
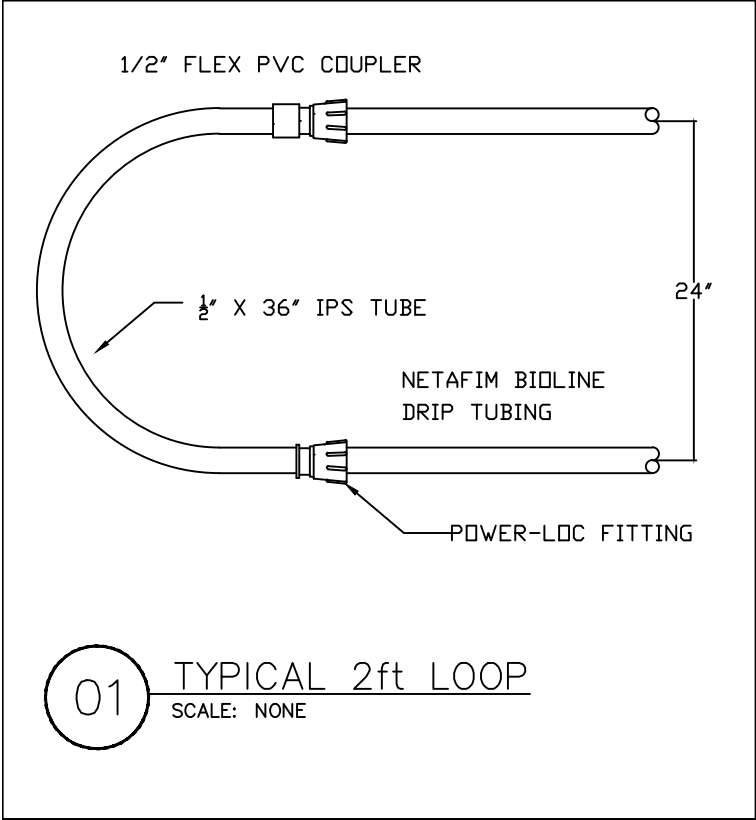


TLCV
Inline Check Valve

- Flow Range: 0.9 to 4.4 GPM
- Opening Pressure: 10.2 psi
- Closing Pressure: 5.8 psi
(13.4 Feet Column of Water)



NETAFIM USA
5470 E. Home Ave.
Fresno, CA 93727
CS 888 638 2346
F 800 695 4753
www.netafimusa.com



ACT

Water Filtration Systems

Preliminary

c200s



Water Source

- Well Water
- Surface Water
- City water supplies
- Primary and secondary strength waste water

Advantages

- Capable of using internal and external sources of backflush water
- Uses proven **RING DISC FILTRATION TECHNOLOGY**
 - Self-cleaning filter for low flow applications (1-40 GPM)
 - Requires low back flushing flow rates (12-15 GPM)
 - Corrosion-free plastic filter, manifold, and stand
 - Compact design ready for immediate hookup
 - Easily change filtration level by replacing disc rings with desired micron level (400-20 microns)

Applications

- Suited for Residential, Light Industrial and Commercial Use
 - HVAC
 - Potable water treatment systems
 - Wastewater treatment and reuse
- Landscapes
 - Micro-irrigation in isolated landscaped settings
 - Subsurface drip irrigation of turf grass areas
 - Tree and shrub systems
- Greenhouse and Nursery Irrigation
 - Micro sprinklers and drippers
- Mister systems

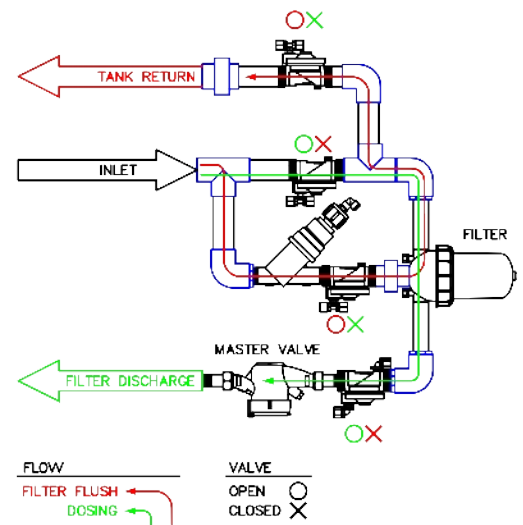
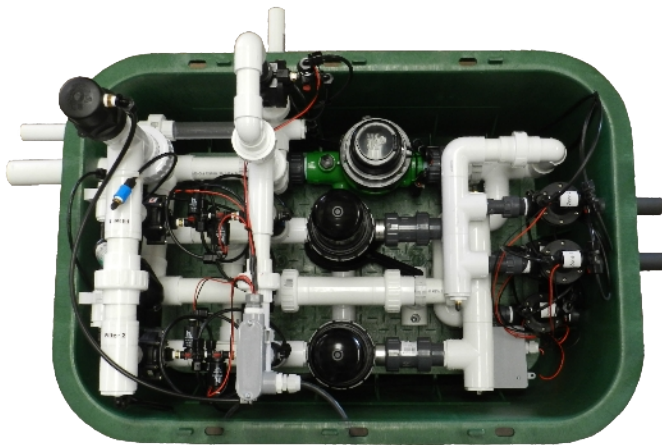
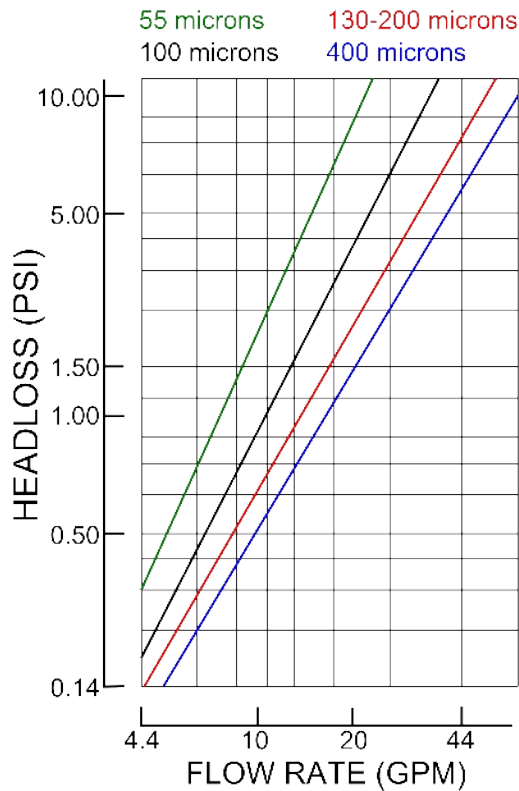


Specifications

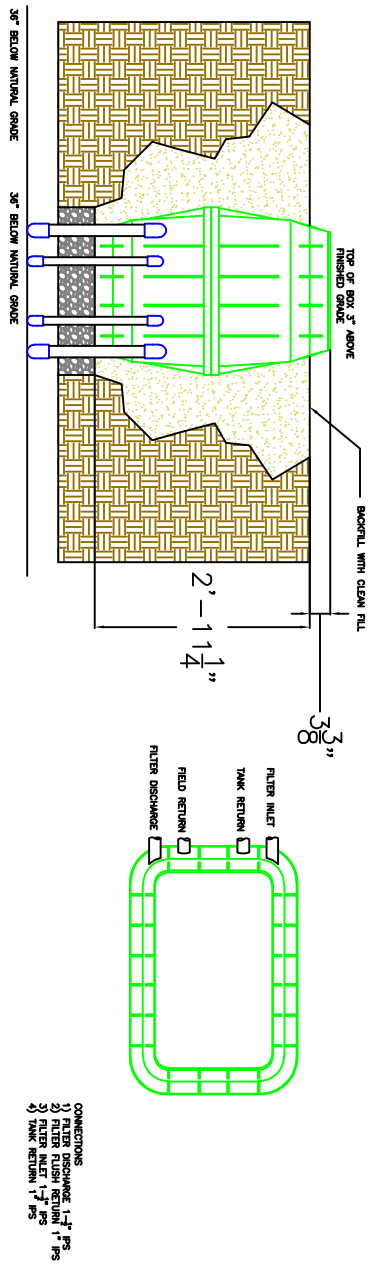
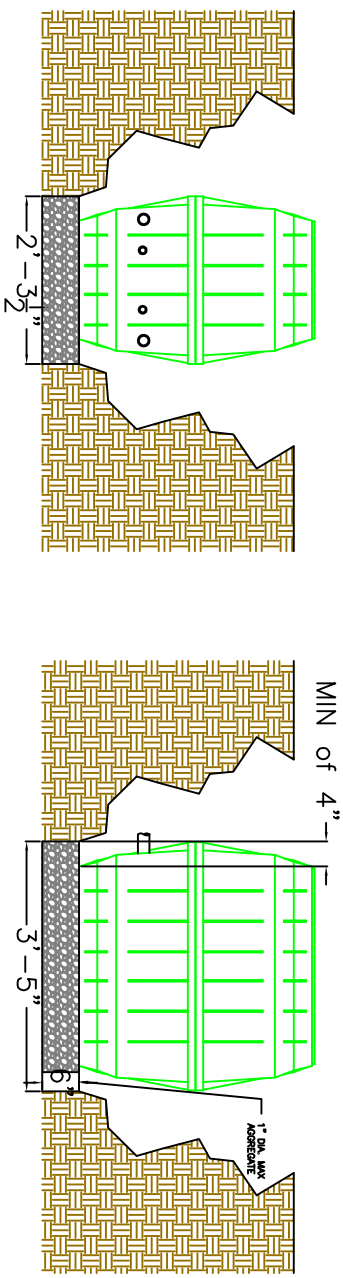
Max Operating Pressure	— 100 PSI
Min Pressure for Backflush	— 40 PSI
Min Flow for Backflush	— 12 GPM
Dimensions	— 41" x 28" x 39"
Flow Range	— 1-40 GPM
Flush Return	— 1"
Inlet	— 1½"
Outlet	— 1½"

Components

- Our Patented ACT Backflush Filter
- Arad Flow Meter with Master Valve
- PVC Sch. 40 Manifold Piping
- Baccara Solenoids
- Dorot Valves



C200-S DRIP DISPERSAL HEADWORKS



1
SCALE: NONE
INSTALLATION OF ACT C200 FILTRATION SYSTEM



ARKAL 1" FILTER

CATALOG NO. 1100-0

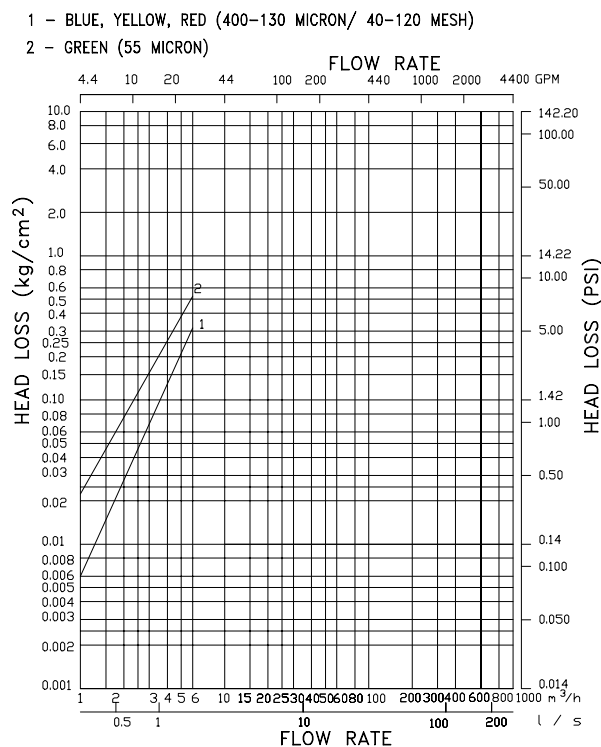
FEATURES

- ❑ A "T" SHAPED FILTER WITH TWO 1" MALE THREADS.
- ❑ A "T" VOLUME FILTER FOR IN-LINE INSTALLATION ON 1" PIPELINES.
- ❑ THE FILTER PREVENTS CLOGGING DUE TO ITS ENLARGED FILTERING AREA THAT COLLECTS SEDIMENTS AND PARTICLES.
- ❑ MANUFACTURED ENTIRELY FROM FIBER REINFORCED PLASTIC.
- ❑ A CYLINDRICAL COLUMN OF GROOVED RINGS CONSTITUTES THE FILTER ELEMENT.
- ❑ A SEALING SPRING KEEPS THE RINGS COMPRESSED.
- ❑ SCREW-ON FILTER COVER.
- ❑ FILTER RINGS ARE AVAILABLE IN SIX OPTIONAL FILTERING DEGREES.



TECHNICAL DATA

Inlet/outlet diameter	1" BSPT (male)	1" BSPT (male)
	25.0 mm – nominal diameter	
	33.6 mm – pipe diameter (O. D.)	
Recommended maximum pressure	10 atm	145 psi
Maximum flow rate	6 m ³ /h (1.7 l/sec)	26 gpm
General filtering area	308 cm ²	48 in ²
Filtering volume	370 cm ³	22 in ³
Filter length	233 mm	8 7/8"
Filter width	130 mm	5 1/8"
Distance between end connections	158 mm	6 7/32"
Weight	1.1 kg	2.4 lbs.





INSTALLATION

1. FILTER MAY BE INSTALLED EITHER VERTICALLY OR HORIZONTALLY.
2. USE TEFLON TAPE ON FILTER END CONNECTIONS.
3. NEVER USE SPANNERS FOR TIGHTENING THE FILTER COVER.

MAINTENANCE

IF THE FILTER RINGS ARE COVERED WITH LIME DEPOSITS THEN REMOVE THE ELEMENT AND TREAT WITH CHLORIC ACID.

DISMANTLING

1. TURN OFF THE WATER.
2. MAKE SURE THAT THE PRESSURE IS RELEASED FROM THE FILTER.
3. UNSCREW THE COVER FROM THE FILTER BODY.
4. PULL OUT THE FILTER ELEMENT.
5. MOVE THE SEALING RING TO THE END OF THE SPINE.
6. FLUSH THE RINGS WITH THE WATER JET.

ASSEMBLY

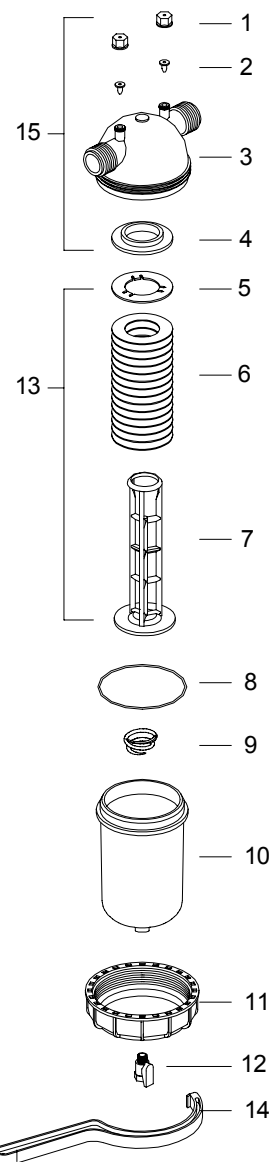
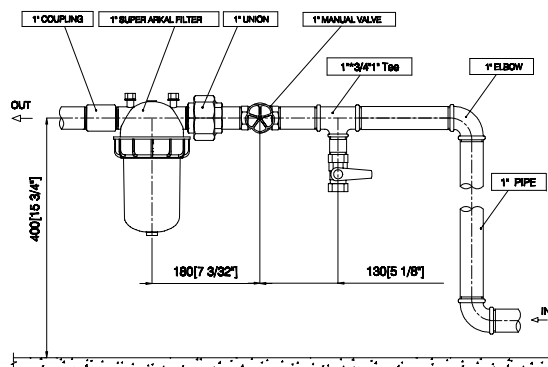
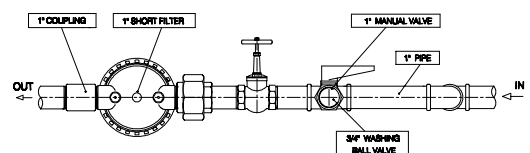
1. VERIFY THAT THE TIGHTENING SPRING IS PLACED AT THE BOTTOM OF THE FILTER COVER.
2. ASSEMBLE IN REVERSE ORDER.
3. TIGHTEN THE COVER BY TURNING THE FIXING NUT CLOCKWISE AND DON'T OVER TIGHTEN.

PART LIST

NO.	CAT. NO.	DESCRIPTION	MATERIALS
1	2511 0103	GAUGE PORT NUT (SINGLE UNIT)	R.P.P.
2	5006 0004	GAUGE PORT SEAL (SINGLE UNIT)	EPDM
3	2500 0100	FILTER BODY (BSP)	R.P.A.
	2500 0101	FILTER BODY (NPT)	R.P.A.
4	2507 0100	FILTER ADAPTOR RING	R.P.A.
5	2507 0102	ELEMENT RETAINING RING	PBT
6	2010 1___	DISC SET	P.P.
7	2502 0100	SPINE	R.P.A.
8	5002 9004	90x4 O-RING	N.R.
9	5044 0010	COMPRESSION SPRING	S.S.
10	2501 0100	FILTER COVER	R.P.A.
	2501 9110	TRANSPARENT COVER	P.C.
11	2506 0100	FIXING NUT	R.P.A.
12	5054 0008	1/4" TAP (*)	BRASS
13	2110 1___	FILTER ELEMENT	
14	2530 0115	1"-1 1/2" FILTER WRENCH	R.P.A.
15	2208 0001	FILTER BODY COMPLEX BSP	
	2208 0002	FILTER BODY COMPLEX NPT	

MATERIALS:

R.P.P. – REINFORCED POLYPROPYLENE
R.P.A. – REINFORCED POLYAMIDE
S.S. – STAINLESS STEEL
P.P. – POLYPROPYLENE
N.R. – NITRILE RUBBER
P.C. – POLYCARBONAT





***APPENDIX C – ACCUDOCK FLOATING BOAT
DOCK AND GANGWAY SYSTEM SPECIFICATIONS***



AccuDock Floating Boat Dock Scope:

- (2) 12' x 80' x 24" Aluminum Frame Floating Dock:
 - Each dock is made up of (4) 12' x 20' x 24" sections, connect together by 12' float-to-float hinges
- Wolf PVC Decking on the standing surface and on the side skirting for fenders
- (36) 10" S-Style Aluminum Cleats
 - 9 on each side of the docks, pre-installed
- (8) Interior Piling Hoop Brackets – ID TBD by contractor *Piles not provided by AccuDock*
 - 4 Staggered on each dock
- (2) Exterior Piling Hoop Brackets – ID TBD by contractor *Piles not provided by AccuDock*
 - 1 on each dock
- (2) 5' x 30' ADA Aluminum Gangway. Hinge on land, Roll on AccuDock

AccuDock Floating Boat Dock Specs:

Heavy Duty systems will be built using an aluminum C-Channel frame system with .125" wall thickness, with height of 8" C-Channel. Aluminum will be 6061-T6 marine grade. Spacing of cross member(s) will be no greater than 16" center to center. All sections will have corner strength gussets, and sections are pre-drilled for ease of field installation.

Each AccuDock float section shall be composed of hand welded High-Density Polyethylene (HDPE) sheet plastic, using non-rotationally molded floats. AccuDock sections are manufactured using individual sheets for sides, ends, bottoms, and tops. With a 100% guaranteed universal wall thickness of .150 inches (min.), and completely encapsulated expanded polystyrene (EPS) foam.

Completely encapsulated EPS shall be 100% virgin material and be of a closed cell nature allowing no more than 3% water penetration. This specification will ensure all AccuDock sections will never sink. Floatation shall not be accomplished by use of air pockets in any form.

All EPS foam blocks used in the manufacturing process will be pre-cut and hand trimmed to exact size, then hand loaded into each float section to ensure 100% foam filled, air-tight encapsulation.

Floatation will be lag bolted into the bottom of the C-Channel with 3/8" x 1-1/2" stainless steel lag bolts. All heavy duty sections are bolted together with 3/8" x 5" stainless steel 304 series hardware.

The percentage of the footprint of floatation to the overall footprint of the dock surface area will be no less than 75% to maximize overall stability.

The walking surface and sides utilizes Wolf PVC deck boards measuring 1-inch-thick x 5.5 inches wide with a solid cross section and an embossed simulated wood grain non-skid pattern surface on both sides of each individual deck board. Wolf PVC deck boards are ICC code approved - CCRR - 0141 and are rated for a uniform live load of 100 lbs./ft² where structural performance has been demonstrated for a temperature range from -20°F to 125°F. Deck boards are coated with an ASA cap stock resin which helps retain its



original color under prolonged exposure to sun and weather. Additionally, Wolf PVC Decking has a 25-year stain and fade warranty.

10" Aluminum S Cleats are supplied with ½" mounting hardware. 2" x 2" x .125" Framing system will allow cleats to be installed anywhere along the perimeter of the floating dock system.

AccuDock ADA Aluminum Gangway Specs:

AccuDock Aluminum ADA Gangways are built with 6005-T5 marine grade aluminum. AccuDock ADA Gangways are built to withstand a 50 pounds per square foot live load rating. Typically, ADA Gangway construction will be as follows:

Core Fabrication will be 3" x .125" aluminum square ribbed tubing. AccuDock ADA Gangway sides are built as a truss, where the center stanchions are typically 5' center to center and they are built into the structure of the design and take a pre-stressed arch shape for additional strength. Underneath support trusses are included as needed, where the stanchions are composed of the same aluminum square tube as the core structure and the stringer is 3" x 3" x .375" architectural angle. Additional 45o square tube gussets are built in on the AccuDock ADA Gangway ends where extra structural stability is needed.

Standard Decking will be 1" x 12" 6005-T5 aluminum ribbed and knurled non-skid aggressive surface, with decking supports at no more than 24" on centers. On each end of the deck boards, the boards will be supported by a 1" x 1" x .125" architectural angle which spans the distance of the AccuDock ADA Gangway. All decking members will be welded to these pieces of angle, and thus will be welded to the structure of the AccuDock ADA Gangway. No deck screws will be used to attach standard aluminum decking.

Intermediate Handrails will be made with 1-1/4" schedule 40 aluminum pipe with a minimum clearance of 36" above the AccuDock ADA Gangway deck surface, and they will follow the arch shape of the gangway to ensure this distance remains constant throughout the length of the gangway. Intermediate handrails will have a minimum inside clearance of 36" between the inside edges of each railing and will be machine welded to 2-1/2" x 3-7/8" centerline projected handrail brackets allowing a minimum 1-1/2" clearance between the handrail and the edge of the AccuDock ADA Gangway. The handrail brackets will be located at each center stanchion of the AccuDock ADA Gangway truss (Approximately 5' center to center). Intermediate handrail will also extend out 12" from the end of the AccuDock ADA Gangway on each side and return to the stanchion at the end of the AccuDock ADA Gangway 12" below with a 180o and 150mm radius bend. Aluminum Kick Plate will be composed of 2" x 4" x 1/8" architectural angle that will be machine welded into the structure of the AccuDock ADA Gangway with the 4" side in the vertical direction and the 2" side in the horizontal direction, and it will run the length of the AccuDock ADA Gangway on both sides. The AccuDock ADA Gangway decking will rest on the 2" side of the angle, therefore the kick plate will extend 3" above the deck surface.

The Landside Hinge Attachment is a piano hinge design made up of various lengths of knuckles welded to the face of a piece of flat bar and with a 1-1/4" SCH 80 aluminum pipe hinge pin with a PVC pipe bushing.



Hinges to have no more than 1/8" gap between knuckles horizontally, and to have smooth transition as to not create a trip hazard. Landside of hinge material is typically 6" x .375" flat bar or 8" x .375" flat bar.

The Dockside Hinge Attachment is a piano hinge design made up of various lengths of dock connector welded to the face of a piece of flat bar and with a 1-1/4" SCH 80 aluminum pipe hinge pin with a PVC pipe bushing. Hinges to have no more than 1/8" gap between knuckles (dock connector) horizontally, and to have smooth transition as to not create a trip hazard. Dockside hinge material will typically be either 3" x 3" x .25" structural angle or 9" x .375" flat bar depending on the specific type of AccuDock system that the gangway or ramp is being attached. The gangway or ramp side of the hinge material is typically 3" x .5" flat bar or 4" x .5" flat bar depending on the size of the gangway or ramp.

All materials used in the AccuDock fabrication process is 100% sourced in the United States.



***APPENDIX D – CXT PREFABRICATED RESTROOM
BUILDING SPECIFICATIONS***



SPECIFICATIONS

TAOS BUILDING STYLE

1.0 SCOPE

This specification covers the construction and placing of the Taos flush precast concrete building as produced by CXT® Incorporated.

2.0 SPECIFICATIONS

ASTM C33	Concrete Aggregates
ASTM C39	Method of Test for Compressive Strength of Cylindrical Concrete Specimens
ASTM C94	Standard Specification for Ready-Mixed Concrete
ASTM C143	Method of Test for Slump of Concrete
ASTM C150	Standard Specification for Portland Cement
ASTM C172	Standard Practice for Sampling Freshly Mixed Concrete
ASTM A185	Standard Specification for Steel Welded Wire Reinforcement, Plain, or Concrete
ASTM C192	Method of Making and Curing Test Specimens in the Laboratory
ASTM C231	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C309	Standard Specifications for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C494	Standard Specification for Chemical Admixtures for Concrete
ASTM A615	Standard Specification for Deformed and Plain Carbon-Steel Bar for Concrete Reinforcement
ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcine Natural Pozzolan for Use in Concrete
ASTM D1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort
ACI 211.1	Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 306	Cold Weather Concreting
ACI 318	Building Code Requirements Structural Concrete and Commentary (includes Errata)
PCI MNL 116	Quality Control for Plants and Production of Precast Prestressed Concrete Products

3.0 MANUFACTURER CRITERIA

The manufacturer supplying the requested precast concrete flush facility must meet the following:

- A. Manufacturer must be ISO 9001 certified at the time of bid.
- B. Manufacturing plant must be PCI certified at the time of bid.
- C. Manufacturer must not have defaulted on any contract within the last five (5) years.
- D. Manufacturer must provide stamped, engineered drawings prior to acceptance.
- E. Manufacturer must be pre-approved prior to bidding.
- F. Manufacturer must show four (4) examples of precast concrete flush facilities produced, installed and in use as an example of their ability to perform this contract.

- G. Manufacturer (CXT) shall provide a one (1) year warranty on all concrete components. The warranty is valid only when concrete is used within the specified loadings. Furthermore, said warranty includes only the related material necessary for the construction and fabrication of said concrete components.
- H. UL 752 Bullet Resistance on 4" thick concrete samples.

Manufacturer meeting these criteria is:

CXT Incorporated
6701 E. Flamingo Avenue, Building 300
Nampa, ID 83687
Phone 800-696-5766

4.0 DESIGN CRITERIA

The flush building has been designed to individually meet the following criteria. Calculations and engineer's stamped drawings are available, for standard buildings, upon request by the customer and are for their sole and specific use only. The design criteria are to ensure that the flush building not only will withstand the forces of nature listed below, but to provide protection from vandalism and other unforeseen hazards. Building's structural and foundation design will be relevant to the region and properties associated with its final placement. Design will also meet all applicable accessibility and building code requirements. Buildings will also meet various structural loads such as below, but not limited to/or restricted by them.

- A. Roof Snow Load
 - 1. The flush building is designed to withstand a 250 PSF snow load.
- B. Floor Load
 - 1. The flush building is designed to withstand 400 PSF floor load.
- C. Wind Load
 - 1. The flush building will withstand the effects of 150 miles per hour (3-second gust) wind exposure C.
- D. Earthquake
 - 1. The flush building will withstand the effects of a seismic group 1 design category E earthquake.
- E. Additional Design Standards
 - 1. The flush building is designed to meet the accessibility requirements put forth by federal, state, and local statutes.
 - 2. The flush building is an all concrete design with a minimum 3/12 roof pitch. The flush building shall have a minimum 4" wall, 4½" roof, and 5" floor thickness.
 - 3. All wall to floor interior surface seams shall have a minimum 1" radius coving made of high strength grout.
 - + Recycled Material
 - + LED Lighting

5.0 MATERIALS

A. Concrete – General

1. The concrete mix design is designed to ACI 211.1 to produce concrete of good workability.
2. Concrete will contain a minimum of 675 pounds of cementitious material per yard. Cement is a low alkali type I/II or III conforming to ASTM C-150.
3. Coarse aggregates used in the concrete mix design will conform to ASTM C33 with the designated size of coarse aggregate #67.
4. Maximum water/cement ratio will not exceed .45.
5. Air-entraining admixtures will conform to ASTM C260. Water reducing admixtures will conform to ASTM C494, Type A.
6. If Self Compacting Concrete (SCC) is used, it must conform to ASTM C1611.

B. Concrete Reinforcement

1. All reinforcing steel will conform to ASTM A615. All welded wire fabric will conform to ASTM A185.
2. All reinforcement is new, free of dirt, oil, paint, grease, loose mill scale and loose or thick rust when placed.
3. Details not shown on drawings or specified are to ACI318.
4. Steel reinforcement is centered in the cross-sectional area of the walls and will have at least 1¼" of cover on the under surface of the floor.
5. The maximum allowable variation for center-center spacing of reinforcing steel is ½".
6. Full lengths of reinforcing steel are used when possible. When splices are necessary on long runs, splices are alternated from opposite sides of the components for adjacent steel bars.
 - a. Lap bars under #4 a minimum of 12" bar diameters.
 - b. Lap bars larger than #4 a minimum of 24" bar diameters.
7. Reinforcing bars are bent cold. No bars partially embedded in concrete are field bent unless approved by the customer.

C. Caulking, Grout, Adhesive and Sealer

1. Caulking service temperatures from -40°F to +194°F.
2. Interior and exterior joints are caulked with a paintable polyurethane sealant.
3. Grout is a non-shrink type and are painted to match the color of surrounding concrete as nearly as possible.
4. Cement base coating is formulated with a very fine aggregate system and is a built-in bonding agent.

D. Paint

1. All paints and materials will conform to all federal specifications or be similar "top-of-the-line-components."
2. Type of paints for toilets.
 - a. Inside concrete surfaces.
 - i. Interior floors will be a chemical resistant urethane. The color will be gray.

- ii. Interior walls and ceilings will be a modified acrylic, water repellent penetrating stain. The color will be white followed by a clear acrylic anti-graffiti sealer.
 - b. Metal surfaces both inside and out.
 - i. DTM ALKYD.
 - c. Exterior concrete surfaces.
 - i. Exterior slab will be clear sealer
 - ii. Exterior walls and roof will be a water repellent penetrating stain in the same color as the walls or roof followed by a clear acrylic anti-graffiti sealer.
- E. Grab Bars
 - 1. Grab bars will be 18-gauge, type 304 stainless steel with 1½" clearance. Grab bars will each be able to withstand 300-pound top loading.
- F. Toilet Paper Dispenser
 - 1. Dispenser will be constructed of ¼" thick, type 304 stainless steel. Dispenser will be capable of holding three (3) standard rolls of toilet paper. Toilet paper holder fastening system will be able to withstand 300-pound top loading.
- G. Steel Doors
 - 1. Doors will be flush panel type 1¾" thick, minimum 16-gauge galvanized steel, top painted with DTM ALKYD.
 - 2. Door frames will be knockdown or welded type, single rabbet, minimum 16-gauge prime coated steel top painted with DTM ALKYD, width to suit wall thickness. Three (3) rubber door silencers will be provided on latch side of frame.
- H. Door Hinges
 - 1. Door hinges will be three (3) per door with dull chrome plating 4½" x 4½", adjustable tension, and automatic closing for each door.
- I. Commercial Mortise Lockset
 - 1. ANSI/BHMA certified Grade 1 mortise lockset for exterior door.
 - 2. UL & ULC three-hour fire rating.
 - 3. ANSI A-156 13-2005 certified.
 - 4. ADA barrier free accessibility.
 - 5. Deadbolt function included.
- J. Doorstop
 - 1. Doorstop will be a dome style stop meeting ANSI 156.16.
- K. Double Coat Hook
 - 1. Coat hook will be 304 stainless steel 16-gauge (1.5mm), formed construction with a satin finish and have ¾" x 7/8" nail in anchor. Upper hook will extend at least 2½" from the wall. Lower hook will extend at least 1¼" from the wall.
- L. Door Sweep
 - 1. Door sweep will be provided at the bottom of door and will be an adjustable brush type.

M. Wall Vent

1. Wall vent will be crank operated allowing the unit to be opened or closed. Crank will be removable. Vent cover will be 14-gauge 304 stainless steel and anchored into the concrete wall with high strength anti-rust tap con fasteners. Vent to come with insect screen. Cover to be recessed a minimum $\frac{3}{4}$ " on exterior walls with a 45-degree bevel. Interior to be flush mounted. Wall vent will not protrude from the wall.

N. Signs

1. Signs to have raised pictograms, letters, and braille to meet ADA.

O. Windows

1. Window frames will be constructed from steel.
2. Window glazing will be $\frac{3}{16}$ " thick translucent pebble finished mar-resistant Lexan.
3. Windows to have $\frac{3}{4}$ " recess with 45-degree bevel.
4. Window frames to have vandal resistant fasteners.

P. Mirrors

1. Mirror to be 18" x 36" frameless 430 18-gauge stainless steel with #8 bright polish.

Q. Stalls and Stall Doors

1. Stall doors to be solid HDPE in matching white color.
2. Stalls to be made of concrete in matching texture to walls.

R. Plumbing Flush Section/Room

1. All fixtures to meet ANSI A112.19.2
2. Plumbing will be concealed in the service area.
3. *Flush valve* – Concealed closet flush-o-meter constructed of rough brass. Furnish valve with integral vacuum breaker and wall mounted push button. Valve will be of a water saver type. Water closet flow of 1.6 gallons per flush. Urinal .5 gallons per flush.
4. *Hammer arrester* – Installed on water line.
5. *Hose bib* – Available in the chase area.
6. *Lavatory* – Vitreous china with back splashguard, front overflow opening, equipped with brass trap and drainpipe without stopper. Sink will be 20" wide x 18" front to back x $5\frac{3}{4}$ " deep with ADA trap cover. Optional stainless steel fixtures available.
7. Main shut-off valve and drain.
8. *Toilet* – Constructed of vitreous china, wall hung, with siphon jet action. Toilet will have a back spud for a concealed flush valve connection and will be mounted with the top of the seat 18" above the finished floor. Seat will be heavy duty solid plastic with an open front. Optional stainless steel fixtures available.
9. *Urinal* – Urinals will be constructed of vitreous china, wall hung with siphon jet action. Urinal will have a back spud for a concealed flush valve connection and will be mounted at proper height per code. Optional Stainless steel fixtures available.
10. Trap primer distribution unit.
11. *Waste and vent material* – ABS or PVC plastic and will be plumbed to meet Uniform Building Codes.

12. *Water material* – Copper tubing Type L, hard drawn. A gate valve will be provided at the inlet end of the water line. All water lines will be of a size to provide proper flushing action based on a nominal water pressure of 40 psi.
13. *Water valve* – Self-closing water set with indexed push button.
14. *Water heater* – High efficiency commercial grade water heater(s) provided per code.

S. Electrical

1. All components are UL listed.
2. *Breaker panel* – Sized to meet load requirements and mounted to meet electrical code.
3. *Interior lighting* – Vandal resistant fixtures with built-in occupancy sensor, energy efficient LED lights, and lifetime warranty.
4. *Exterior lighting* – Vandal resistant fixtures with built-in photoelectric switch, energy efficient LED lights.
5. *Exhaust fans* – All wet location motion activated with speed control in chase area to control CFM.
6. *Wiring* – Conduit, surface mounted in the service area and concealed in the user compartments. All wire will be copper.
7. GFI outlets provided per code requirements.
8. Optional warm air, ADA compliant, vandal resistant hand dryers available.

6.0 MANUFACTURE

A. Finishing Concrete

1. All exterior building walls and exterior screen walls will be any one of the available textures.
2. All exterior surfaces of the roof panels will be cast to simulate any one of the available textures. The underside of the overhang will have a smooth finish.

B. Cracks and Patching

1. Cracks in concrete components which are judged to affect the structural integrity of the building will be rejected.
2. Small holes, depressions, and air voids will be patched with a suitable material. The patch will match the finish and texture of the surrounding surface.
3. Patching will not be allowed on defective areas if the structural integrity of the building is affected.

7.0 FINISHING AND FABRICATION

A. Structural Joints

1. Wall components will be joined together with two (2) welded plate pairs at each joint. Each weld plate will be 6" long and located one (1) pair in the top quarter and one (1) pair in the bottom quarter of the seam. Weld plates will be anchored into the concrete panel and welded together with a continuous weld.
2. The inside seams will be a paintable caulk. The outside seams will use a caulk in a coordinating building color or clear.

3. Walls and roof will be joined with weld plates, 3" x 6" at each building corner.
 4. The joint between the floor slab and walls will be joined with a grout mixture on the inside, a matching colored caulk on the outside and two (2) weld plates 6" long per wall.
- B. Painting/Staining
1. An appropriate curing time will be allowed before paint is applied to concrete.
 2. Schedule of finishes.
 - a. Inside concrete surfaces.
 - i. Inside floors will be one (1) coat of 1-part water based chemical resistant urethane.
 - ii. Interior walls and ceilings will be two (2) coats of a modified acrylic, water repellent penetrating stain, followed by one (1) coat of clear sealer.
 - b. Metal surfaces both inside and out.
 - i. Two (2) coats of DTM ALKYD.
 - c. Exterior concrete surfaces.
 - i. Exterior walls will be two (2) coats of water repellent penetrating stain in the same color as the walls or roof followed by one (1) coat of clear acrylic anti-graffiti sealer.

8.0 TESTING

The following tests will be performed on concrete used in the manufacture of toilets. All testing will be performed in the CXT (PCI certified) laboratories. Testing will only be performed by qualified individuals who have been certified ACI Technician Grade 1. Sampling will be in accordance with ASTM C172.

- A. The air content of the concrete will be checked per ASTM C231 on the first batch of concrete. The air content will be in the range of 5.0% +/- 2.0%.
- B. The compressive strength of the cylinders will be tested to ASTM C39. We will make one (1) cylinder for release, one (1) for seven (7) days and one (1) for 28 days. The release must be a minimum strength of 2500 psi, the 7-day must be a minimum of 4500 psi and the 28-day must be a minimum of 5000 psi.
- C. A copy of all test reports will be available to the customer as soon as 28-day test results are available.

9.0 INSTALLATION

- A. Scope of Work
 1. Work specified under this section relates to the placement of the unit by CXT on customer prepared foundations. *See Installation Specifications or by others.*
- B. Location
 1. It is the responsibility of the customer to:
 - a. Provide exact location by stakes or other approved method.
 - b. Provide clear and level site free of overhead and/or underground obstructions. *See Installation Questionnaire for details.*
 - c. Provide access to the site for truck delivery and sufficient area for the crane to install and the equipment to perform the contract requirements. *See Installation Questionnaire for details.*
 - d. Water, electrical, and sewage site connections to be placed per CXT drawings. Must be placed to easily connect to the building. *See Installation Questionnaire for details.*

C. Compacting

1. The bottom of the area must be compacted after it has been dug out. After the base has been placed, it must be compacted as well. The bearing of the soil and base should be a minimum of 1,500 pounds per square foot.

D. Base

1. After compacting the bottom of the area, a minimum of 6" thick and consist of ¾" minus crushed rock (i.e. road base material) compacted to 95% of optimal density in accordance with ASTM D1557. Finished surface of sub-base shall be flat and level, with a maximum deviation of -½", +0" from a true horizontal plane.
2. The base should be placed for support, leveling and drainage purposes and also to limit frost action. The base must be confined so as to prevent washout, erosion, or any other undermining.

E. Access to Site

1. Delivery to site made on normal highway trucks and trailers. If at the time of delivery conditions of access are hazardous or unsuitable for truck and equipment due to weather, physical constraints, roadway width or grade, CXT may require an alternate site with better access provided to ensure a safe and quality installation. In any such case, additional costs for cranes, trucking, etc. will be charged to the account of the customer. *See Installation Questionnaire for details.*

10.0 WARRANTY—PRECAST DIVISION

CXT provides a one (1) year warranty. CXT warrants that all goods sold pursuant hereto will, when delivered, conform to specifications set forth above. Goods shall be deemed accepted and meeting specifications unless notice identifying the nature of any non-conformity is provided to CXT in writing within the specified warranty. CXT, at its option, will repair or replace the goods or issue credit for the customer provided CXT is first given the opportunity to inspect such goods. It is specifically understood that CXT's obligation hereunder is for credit, repair, or replacement only, F.O.B. CXT's manufacturing plants, and does not include shipping, handling, installation or other incidental or consequential costs unless otherwise agreed to in writing by CXT.

This warranty shall not apply to:

1. Any goods which have been repaired or altered without CXT's express written consent, in such a way as in the reasonable judgment of CXT, to adversely affect the stability or reliability thereof;
2. To any goods which have been subject to misuse, negligence, acts of God or accidents; or
3. To any goods which have not been installed to manufacturer's specifications and guidelines, improperly maintained, or used outside of the specifications for which such goods were designed.

11.0 DISCLAIMER OF OTHER WARRANTIES

The warranty set forth above is in lieu of all other warranties, express or implied. All other warranties are hereby disclaimed. CXT makes no other warranty, express or implied, including, without limitation, no warranty of merchantability of fitness for a particular purpose or use.

12.0 LIMITATION OF REMEDIES

In the event of any breach of any obligation hereunder, breach of any warranty regarding the goods or any negligent act or omission or any party, the parties shall otherwise have all rights and remedies available at law; however, IN NO EVENT SHALL CXT BE SUBJECT TO OR LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES.