Enprotec | Hibbs & Todd

September 17, 2024

CITY OF TOLAR, TEXAS
WASTEWATER TREATMENT PLANT IMPROVEMENTS

Addendum No. 1

Attention is called to the following modifications to the referenced Plans, Specification and Contract Documents for the above referenced project. The City of Tolar (City) will receive sealed Bids for the Wastewater Treatment Plant Improvements Project at **Tolar City Hall** located at **8712 W. Highway 377, Tolar, Texas 76476**, until **Tuesday, October 15, 2024**, at **2:00 p.m.** local time. We hereby modify the documents as follows:

BID DOCUMENTS:

1. Bids are due by **2:00 pm** on Tuesday, October 15th, not 5:00 pm as shown in the original Advertisement for Bids. **REPLACE** Advertisement for Bids in its entirety with the attached.

SPECIFICATIONS:

1. **REPLACE** Section 11241 - Surface Mixer in its entirety with the attached.
2. **REPLACE** Section 13440 - Instrumentation - Basic Requirements in its entirety with the attached.
3. **REPLACE** Section 15103 - Butterfly Valves in its entirety with the attached.
4. **REPLACE** Section 15104 - Ball Valves in its entirety with the attached.
5. **REPLACE** Section 15106 - Check Valves in its entirety with the attached.
6. **REPLACE** Section 15109 - Air Valves in its entirety with the attached.

APPENDIX:

1. **ADD** the attached Geotechnical Report as an Appendix to the Project Manual.

This addendum consists of sixty seven (67) pages and becomes a part of the referenced plans, specifications and contract documents and shall be acknowledged by the proposer and attached to the sealed proposal submitted.

Brittany D. White

By Brittany White, P.E.
Project Engineer

STATE OF TEXAS
BRITTANY D. WHITE
128714
LICENSED
PROFESSIONAL ENGINEER
9/17/2024

PE Firm Registration No. 1151
PG Firm Registration No. 50103
RPLS Firm Registration No. 10011900

ADVERTISEMENT FOR BIDS

CITY OF TOLAR, TEXAS
WASTEWATER TREATMENT PLANT IMPROVEMENTS

General Notice

City of Tolar (Owner) is requesting Bids for the construction of the following Project:

Wastewater Treatment Plant Improvements

Bids for the construction of the Project will be received at the **Tolar City Hall** located at **8712 W. Highway 377, Tolar, Texas 76476**, until **Tuesday, October 15, 2024,** at **2:00 p.m.** local time. At that time the Bids received will be **publicly** opened and read.

The Project includes the following Work:

> Improvements to the City of Tolar's Wastewater Treatment plant, including a new influent lift station, mechanical bar screening, sequencing batch reactor (SBR), disinfection system, solids handling, electrical, SCADA, and supporting systems.

Bids are requested for the following Contract: **Wastewater Treatment Plant Improvements**

Obtaining the Bidding Documents

Information and Bidding Documents for the Project can be found at the following designated website:

www.civcastusa.com

Bidding Documents may be downloaded from the designated website. Prospective Bidders are urged to register with the designated website as a plan holder, even if Bidding Documents are obtained from a plan room or source other than the designated website in either electronic or paper format. The designated website will be updated periodically with addenda, lists of registered plan holders, reports, and other information relevant to submitting a Bid for the Project. All official notifications, addenda, and other Bidding Documents will be offered only through the designated website. Neither Owner nor Engineer will be responsible for Bidding Documents, including addenda, if any, obtained from sources other than the designated website.

Pre-bid Conference

A pre-bid conference for the Project will be held at **Tolar City Hall,** located at **8712 W. Highway 377, Tolar, Texas 76476** on **Tuesday, October 8, 2024** at **2:00 pm.**

Request for Information (RFI)

The deadline for submitting RFIs is **Thursday, October 10, 2024 at 5:00 pm.**

Instructions to Bidders.

For all further requirements regarding bid submittal, qualifications, procedures, and contract award, refer to the Instructions to Bidders that are included in the Bidding Documents.

This Advertisement is issued by:

Owner: **City of Tolar**
By: **Matt Hutsell**
Title: **Mayor**
Date: **September 7, 2024**

SECTION 11241

SURFACE MIXER

PART 1 GENERAL

1.1 SECTION INCLUDES:

A. Furnish one surface mixer or aerator for sludge storage tank. Unit shall be designed to mix the sewage sludge in the tank and keep solids in suspension; aeration of the sludge is acceptable but not required. Unit shall include a motor, a direct drive impeller driven at a constant speed, an integral flotation unit, mooring cables, and appurtenances.

1.2 RELATED SECTIONS:

A. Section 11005 "Equipment Basic Requirements" (including motor specifications)

1.3 SUBMITTALS:

A. Product Data:

1. Submit product data for approval in accordance with Section 01300. As a minimum, include the following:

a. Manufacturer's standard descriptive bulletins.

b. Written calculations showing assumptions made in the design of the system.

c. Calculations indicating that mixer will provide complete solids suspension at low and high water levels.

d. Motor data.

B. Handling and Installation Manual:

1. The mixer manufacturer shall provide two (2) copies of a detailed manual that shall include specific instructions for receiving and handling, assembly, mooring, wiring, installation, repair and service, storage, troubleshooting, detailed exploded drawings of the unit, and a full parts list.

2. The manual shall contain complete detailed instructions on the balancing procedure to be used for rebalancing to the propeller after it has been in service for an extended period of time (if applicable). These instructions shall include, a general procedural description, a detailed explanation of preparing the unit for balancing and the balancing procedure for propellers.

C. Operation and Maintenance Information:

1. Submit instructions for installation, start-up, operation, procedures for routine maintenance, parts lists with illustrations, recommended spare parts list, and lubrication identification, and recommendations.

1.4 MANUFACTURER REQUIREMENTS:

A. The aeration/mixing equipment specified herein shall be the design and fabrication of a single manufacturer which shall have sole source responsibility for said equipment.

B. Manufacturers shall have a minimum of five installations of the same equipment model and design in a similar application for a period of twenty-five years. A reference list shall be provided with names, telephone numbers, and addresses of the qualified installations.

1.5 DELIVERY, STORAGE AND HANDLING:

A. Mixer shall arrive at the installation site fully assembled and ready for attachment to the flotation or support equipment.

B. Mixer with couplings that can become misaligned during shipment are not acceptable.

1.6 WARRANTY

A. The manufacturer shall provide a warranty on equipment against manufacturer's defects for twelve (12) months, commencing on the date of Owner-accepted substantial completion of the project. If the equipment should fail during the warranty period due to a defective part, it shall be replaced and the unit restored at no cost to the owner, including both service and parts.

PART 2 PRODUCTS

2.1 MANUFACTURERS:

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. Aqua-Jet Endura series as manufactured by Aqua-Aerobic Systems.
2. A15-SFG EcoJet DDM as manufactured by Aerator Solutions.
3. DDM-312-SS Aqua-Lator DDM Mixer from Evoqua Water Technologies.
4. Or Engineer-approved equal.

2.2 GENERAL:

A. The mixer shall be suitable for effective mixing of municipal wastewater waste activated sludge (WAS) of approximately 1 to 1.5% solids content, in a 29 ft x 29 ft sludge storage tank with operating side water depths ranging from 9 to 10.5 feet.

B. The mixer shall incorporate design enhancements that provide operation for three years without routine maintenance (greasing).

C. Materials:

1. All system components shall be suitable for municipal wastewater service and outdoor installation.

2. All wetted metallic components shall be stainless steel unless otherwise noted.

3. All fasteners shall be Type 316 stainless steel.

2.3 MIXER DRIVE MOTOR:

A. Motor power: 3 to 15 hp.

B. Motor speed: 1800 rpm maximum.

C. Power supply: 480 volt, 60 Hz, 3 phase service.

D. Enclosure: TEFC.

E. Service factor: 1.15.

F. Insulation: NEMA Class F.

G. The motor windings shall be non-hygroscopic.

H. A condensate drain shall be located at the lowest point in the lower end-bell housing.

I. All motor frame parting surfaces shall be deep registered and Permatex (or equal) sealed.

J. All through bolts, nuts, and screws shall be of type 18-8 stainless steel.

K. Each motor will have a raincap constructed of cast iron or non-corrosive 304 stainless steel. Painted or plated carbon steel rain caps will not be acceptable.

L. A stainless steel nameplate shall be provided with each motor and shall be securely fastened thereto. The voltage, speed, insulation class, amperage, service factor, wiring diagram, motor serial number, and the manufacturer's name and address shall be steel stamped or otherwise permanently marked.

2.4 MOTOR SHAFT:

Unit shall have a one-piece motor shaft continuous from the top motor bearing, through the lower bearing and down to and through the propeller. This shaft shall have a minimum diameter of 1.75" and be manufactured from 17-4 PH stainless steel, or comparable stainless steel having a minimum yield strength of 100,000 psi.

2.5 MOTOR BEARING:

A. Motor bearings shall be regreasable. Sealed bearings are not acceptable. Top bearing shall be shielded on the bottom side only. Bottom bearing shall be open.

B. The top and bottom motor bearings shall be of the combined radial and axial thrust type and shall be packed at the factory with a "high performance" grease.

C. The lower motor bearing inner race shall be locked to the motor shaft via a special washer and locking nut arrangement. The shaft shall be threaded just below the lower bearing and shall have a keyway cut into the motor shaft. This key shall accept a tab from the I.D. of the locking washer, and the locking nut shall have recesses to accept a tab from the O.D. of the locking washer to prevent the nut from backing off. Snap ring type bearing retainers will not be acceptable.

2.6 DIFFUSION HEAD (IF USED):

A. The design of the diffusion head shall be such that the liquid spray will discharge at angle of 90° to the motor shaft, and over a 360° pattern in the horizontal plane, and shall be a stainless steel monolithic casting.

B. The diffusion head casting shall act as a base for the mixer motor, and alignment of the motor to this base shall be controlled by machined index fittings that engage the P-base of the motor. Diffusion head/motor arrangements that are dependent upon boltholes only for alignment will not be acceptable. All diffusion head hardware will be 304 stainless steel and safety wired.

C. The diffusion head casting shall act as a thrust block to deflect the high velocity, pumped volume of the mixer from the vertical to the horizontal direction. In order to minimize vibration, and to provide adequate strength, the diffusion head casting shall weigh no less than 85 lbs. The bottom side of this casting shall have a 90°- radiused transition to effect the hydraulic change in direction with a minimum of head loss.

D. The diffusion head shall absorb all normal and shock loads encountered by the propeller and transmitted to the diffusion head via the motor shaft and lower motor end-bell. The diffusion head shall distribute these forces into the float via webs that terminate in a flange or ring that is an integral part of the diffusion head. This flange shall mate with a similar flange that is an integral part of the float/volute to spread the stresses generated by the propeller uniformly around the float so that no point loading of the float is allowed. These flanges shall be machined flat to provide proper bearing surfaces. The alignment of the diffusion head flange to the float/volute shall be by use of a 360° index pilot.

E. Specifically, diffusion head designs that employ studs and spacers, shoulder bolts or fiberglass are not allowed. Load bearing, machined flat, flange-to-flange connections will be mandatory.

F. The diffusion head shall contain an anti-deflection journal insert to limit the radial deflection of the motor shaft.

G. This anti-deflection journal insert shall be located in the lower extremity of the diffusion head, approximately one-half the distance between the motor base and the lower end of the shaft.

H. The journal insert shall be machined from Delrin or molded from moly-filled urethane and shall be a minimum of 0.060" diameter or larger through the bore than the diameter of the motor shaft.

I. Units featuring a one-piece unsupported shaft will not be acceptable.

J. There shall be a fluid deflector located on the motor shaft immediately below the anti-deflection journal, which shall cover completely the anti-deflection journal insert and the lower portion of the diffusion head.

K. This fluid deflector shall be molded from black neoprene and shall be press fit onto the motor shaft.

L. Each unit shall be furnished with a low trajectory diffuser of high density polyethylene. This assembly shall be attached to the top of the diffusion head and shall be used to lower mixer spray pattern and reduce windblown spray.

2.7 FLOTATION:

A. Each mixer shall have a minimum of 900 lbs. reserve buoyancy to ensure stability and to provide support flotation required during mixer servicing. Floats shall be one piece, i.e.; segmented floats are not acceptable.

B. Flotation stability will be mandatory. Under no circumstances will unstable floatation designs requiring counter balancing, ballast of liquid, solid mass or submerged major fabricated assemblies to stabilize the operation of the mixer be allowed. Only mixers demonstrating stable operational characteristics, without rocking or oscillating will be acceptable.

C. The float shall be a minimum of 71" in diameter and 12" thick, and shall be fabricated of approved fiberglass construction as later described herein.

D. All floats shall be constructed so that the internal void can be filled full of closed cell polyurethane foam having a minimum 2.0 lbs/ft^3 density and shall be completely sealed water tight.

E. All floats shall have six mooring points, spaced for 3 or 4-point mooring around the outer circumference. No mooring connections will be allowed to be attached to the upper or lower float covers. Only tension type connections perpendicular to the outer sidewall will be approved. All mooring connections shall be stainless steel.

F. Floats shall be constructed of polyester fiberglass resins and shall have a resin/glass content of 70% resin and 30% glass. A minimum 0.014" thick gel coat shall cover the entire outer float shell.

G. A moisture inhibitor, such a N.P.G. (neopenthal glycol) or equal, and an ultraviolet inhibitor, such a UV9 or equal, shall be used to protect the float from moisture and sunlight damage.

H. The construction of the float shall be such that no under-water joints shall be used. Joints used to connect the top coverlid shall be overlapped a minimum of 1-1/2", both parts of all joints shall be ground to glass fiber and a resin/glass adhesive shall be applied to complete a 100% monolithic glass-to-glass bond.

I. The float construction shall be such that the volute will distribute the load of the entire motor, drive, diffusion head and volute static load plus, the entire dynamic load from the propeller thrust and radial forces by spreading these forces uniformly around the full 360° circumference of the float's central core. Point connected joints or point stressed connections will not be accepted.

J. The minimum flexural strength of the fiberglass construction materials shall be 26,000 psi and the minimum tensile strength shall be 10,000 psi.

2.8 PROPELLER:

A. The propeller shall be a two-blade, left-handed, marine type precision casting of 316 stainless steel, and shall be specifically designed for the application intended. It shall be a self-cleaning type that will not accumulate fibers, rags, stringy materials, etc. The propeller will have a diameter not allowing a greater clearance with the volute of 1/4".

B. Each propeller blade shall be pitched so that the pitch angle and rake angle are within ± 2 percent of the other blade(s).

C. The propeller shall be pitched so that the drive motor is loaded between 88% and 95% of full load nameplate horsepower.

D. Units using inclined screw impellers will not be acceptable.

2.9 VOLUTE:

A. The propeller shall operate in a volute made of 304 stainless steel and shall be a minimum of 12" in diameter. It shall be round and true so that propeller blade tip clearance is uniform within the volute as it rotates. The volute shall have a minimum of 3/16" wall thickness, and a minimum of four full-length stainless steel gussets shall be welded on a 90° spacing around the circumference of the volute between the top and bottom flanges.

B. The volute shall have a large machined flange at its top extremity that completely encircles the volute, and this flange shall match a similar flange on the bottom of the diffusion head to provide for a bolted, machined flange-to-flange fit to provide uniform distribution of the dynamic loads generated by the propeller and the static weight of the motor and drive. A 360° machined index in the upper flange shall provide concentric alignment of the propeller in the volute by engaging the inside diameter of the mating flange on the diffusion head. Bolt holes alone will not be acceptable to locate the important alignment of the propeller.

C. Fiberglass volutes, or carbon steel volutes that are fiberglass, steel or stainless steel lined are not acceptable.

2.10 INTAKE CONE (IF USED):

A. The intake cone shall be fabricated from .105" 304 stainless steel and shall be gradually expanding, opening outward to the intake end. The length and inlet diameter shall be sufficient to provide uniform inlet hydraulics so that no increase in vibration is caused due to its shape or size. The minimum acceptable length is 8" and minimum inlet diameter is 21-7/16".

B. The material used to fabricate the intake cone shall be structurally sufficient to support the weight of the entire mixer assembly when the mixer is freestanding on dry ground.

C. For maximum in-depth mixing efficiency, the intake cone shall be designed so that the suction lift from the mixer propeller is vertical from the liquid depth below the mixer. Unless specifically required for anti-erosion requirements, side or angle entry suction inlets will not be approved. Fiberglass intake cones are not allowed. All mixers 20 HP and larger must provide anti-vortex crosses welded inside the cones. Anti-erosion devices, if required, must be welded to the crosses.

2.11 BALANCING:

A. The entire rotating assembly including the motor rotor, shaft, shaft accessories, and impeller shall be dynamically balanced to within 2.0 mils peak-to-peak horizontal displacement measured at the upper and lower motor bearing. Measurements shall be taken at a frequency equivalent to the motor RPM.

B. Measurements shall be taken with the motor in a vertical, shaft down position and with the entire power section mounted on resilient pads.

2.12 MOORING:

A. A pivotal mooring system shall be supplied consisting of a stainless steel mooring arm which extends from the basin sidewall to the unit. In addition, two mooring cables complete with clips, thimbles, and quick disconnects shall be supplied as shown on the drawings to assure a consistent location within the basin.

B. A 304 Stainless Steel wall bracket shall be provided to mount the pivot mooring arm to the tank wall.

2.13 ELECTRICAL SERVICE CABLE:

A. Electrical service cable shall be provided and shall be a continuous length (non-spliced). Length shall be at least 30 feet. The cable shall have three power conductors and a ground conductor.

B. Conductors shall be flexible type annealed copper stranded. Each conductor, including the ground conductor, shall be insulated. Cables containing an uninsulated ground conductor will not be acceptable.

C. The insulated conductors shall be assembled together with a non-hygroscopic filler material.

D. Outer jacket shall be high quality CPE, PVC, TPE or equal, and shall be rated at a conductor operating temperature of not less than 90°C.

E. The cable shall be rated for hard usage outdoor service and shall be resistant to oil, sunlight, ozone, grease, acids, water, abrasion and impact.

PART 3 EXECUTION

3.1 INSTALLATION:

A. Install the equipment in accordance with the Manufacturer's recommendations.

3.2 FACTORY TESTING:

A. The mixer manufacturer shall perform the following inspections and tests on each mixer before shipment from the factory:

1. Propeller, motor rating, and electrical connections shall first be checked for compliance to the customer's purchase order.

2. A motor and cable insulation test for moisture content or insulation defects shall be made.

B. A written report stating the foregoing steps have been done shall be supplied with each mixer at the time of shipment.

3.3 FIELD TESTING:

A. Demonstrate proper operation of mixer.

B. Provide the services of a factory-trained representative for one (1) 8-hour day for start-up demonstration, adjustments and operator training. Train Owner's personnel using O&M material provided for the mixer.

END OF SECTION

SECTION 13440

INSTRUMENTATION FOR PROCESS CONTROL: BASIC REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Basic requirements for complete instrumentation and process control system.

2. The following SCADA system integrators (SSI, or instrumentation and controls subcontractor) are acceptable as SSIs, subject to compliance with the Contract Documents (in alphabetical order):

a. Kimark Control Solutions.
b. Prime Controls.
c. TraC-n-trol.
d. Walker Industrial.
e. Wallace Controls & Electric, Inc.

1.2 QUALITY ASSURANCE:

A. Referenced Standards:

1. The Instrumentation, Systems, and Automation Society (ISA):

a. 5.1 – Instrumentation Symbols and Identification.

b. 5.2 – Binary Logic Diagrams for Process Operations.

c. 5.3 – Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic, and Computer Systems.

d. 5.4 – Standard Instrument Loop Diagrams.

e. 20 – Specification Forms for Process Measurement and Control Instruments, Primary Elements, and Control Valves.

2. National Electrical Manufacturers Association (NEMA):

a. 250 – Enclosures for Electrical Equipment (1000 Volts Maximum).

3. National Fire Protection Association (NFPA):

a. 70 – National Electrical Code (NEC).

4. National Institute of Standards and Technology (NIST).

5. Underwriters Laboratories, Inc. (UL):

a. 913 – Standard for Safety, Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1, Hazardous (Classified) Locations.

B. SCADA System Integrator (SSI):

1. Qualifications of SSI:

a. Experience:

i. Have satisfactorily provided a control system for a minimum of five (5) projects of similar magnitude and function.

ii. Have satisfactorily provided a control system for at least one advanced wastewater treatment plant project (requires experience in working with automated system PLCs, such as for an MBR or SBR plant secondary process).

2. A single SSI shall furnish and coordinate instrumentation and control systems.

a. The SSI shall be responsible for functional operations of all systems, performance of control system engineering, supervision of installation, final connections, calibrations, preparation of Drawings and Operation and Maintenance Manuals, start-up, training, demonstration of substantial completion and all other aspects of the control system.

3. Ensure coordination of instrumentation with other work to ensure that necessary wiring, conduits, contacts, relays, converters, and incidentals are provided in order to transmit, receive, and control necessary signals to other control elements, to control panels, and to receiving stations.

4. Prior to Shop Drawing preparation, the SSI shall inspect the Owner's existing equipment and as-constructed electrical documentation to be able to fully coordinate the interface of new and existing instrumentation and controls.

a. All costs associated with this Work shall be incorporated into the original bid.

b. Although such Work is not specifically indicated, furnishand install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure, complete and compatible installation.

1.3 DEFINITIONS:

A. Architecturally finished area: Offices, laboratories, conference rooms, restrooms, corridors, and other similar occupied spaces.

B. Non-architecturally Finished Area: Pump, chemical, mechanical, electrical rooms, and other similar process type rooms.

C. Hazardous Areas: Class I, II or III areas as defined in NFPA 70.

D. Highly Corrosive and Corrosive Areas: Rooms or areas identified on the Drawings where there is a varying degree of spillage or splashing of corrosive materials such as water, wastewater or chemical solutions; or chronic exposure to corrosive, caustic or acidic agents, chemicals, chemical fumes or chemical mixtures.

E. Outdoor Area: Exterior locations where the equipment is normally exposed to the weather and including below grade structures, such as vaults, manholes, handholes and in-ground pump stations.

F. Instrument Air Header: The segment of air supply piping and tubing which transports air from the compressed instrument air source through the branch isolation valve of any takeoff (branch) line.

G. Branch Line: The segment of air supply piping and tubing which transports air from the outlet of the air header branch isolation valve through an air user's isolation valve.

H. Intrinsically Safe Circuit: A circuit in which any spark or thermal effect is incapable of causing ignition of a mixture of flammable or combustible material in air under test conditions as prescribed in UL 913.

I. Calibrate: To standardize a device so that it provides a specified response to known inputs.

1.4 SYSTEM DESCRIPTION:

A. Control System Requirements:

1. This Specification Section provides the general requirements for the instrument and control system.

2. The instrument and control system consists of all primary elements, transmitters, switches, controllers, computers, recorders, indicators, panels, signal converters, signal boosters, amplifiers, special power supplies, special or shielded cable, special grounding or isolation, auxiliaries, software, wiring, and other devices required to provide complete control of the plant as specified in the Contract Documents.

B. Unless otherwise required for instrument compatibility, electric control signals shall be 4-20 mA, 24V DC and pneumatic signals shall be 5 to 15 psi.

C. All signals shall be directly linearly proportional to measured variable unless specifically noted otherwise.

D. Comply with electrical classifications and NEMA enclosure types shown on Drawings.

1.5 SUBMITTALS:

A. Shop Drawings:

1. See Specification Section 01300 – Submittals for requirements for the mechanics and administration of the submittal process.

2. Limit the scope of each submittal to one (1) Specification Section.

   a. Each submittal must be submitted under the Specification Section containing requirements of submittal contents.

   b. Do not provide any submittals for Specification Section 13440.

3. Product technical data including:

   a. Acknowledgement that products submitted meet requirements of standards referenced.
   b. Equipment catalog cut sheets.
   c. Instrument data sheets:

      i. ISA S20 or approved equal.
      ii. Separate data sheet for each instrument.

   d. Materials of construction.
   e. Minimum and maximum flow ranges.
   f. Pressure loss curves.
   g. Physical limits of components including temperature and pressure limits.
   h. Size and weight.
   i. Electrical power requirements and wiring diagrams.
   j. NEMA rating of housings.
   k. Submittals shall be marked with arrows to show exact features to be provided.

4. PLC panel drawings including loop diagrams of each instrument to be wired to the PLC.

5. Comprehensive set of point-to-point wiring diagrams showing all interconnections between packaged systems or equipment control panels, motor control centers, instrumentation and all other electrical equipment as required to depict a complete and functional plant-wide electrical control system as specified in Specification Section 13448 – Control Panels and Enclosures and below:

   a. Instrumentation wiring already shown on loop diagrams need not be included on point-to-point wiring diagrams.

   b. Diagrams shall provide the following minimum information:

      i. Terminal block identification (includes terminals on remote equipment furnished by Others).
      ii. Wire size.

iii. Wire type.
iv. Wire color.
v. Wire shielding and insulation type.
vi. Conductor quantities and associated conduit size.
vii. Ground points.
viii. Interconnection requirements to existing systems or equipment furnished by Others.

c. Diagrams shall be provided on Drawings of sufficient size to minimize the number of drawings.

i. Maximum drawing size: 24 x 36 IN.
ii. Minimum drawing size: 11 x 17 IN.

6. Panel fabrication drawings as specified in Specification Section 13448 – Control Panels and Enclosures.

7. PLC/DCS equipment drawings.

8. HMI graphics.

9. Nameplate layout drawings.

10. Drawings, systems, and other elements are represented schematically in accordance with ISA S5.1 and ISA S5.3.

a. The nomenclature, tag numbers, equipment numbers, panel numbers, and related series identification contained in the Contract Documents shall be employed exclusively throughout submittals.

11. All Shop Drawings shall be modified with as-built information/corrections.

12. Provide a parameter setting summary sheet for each field configurable device.

13. Certifications:

a. Documentation verifying that calibration equipment is certified with NIST traceability.

b. Approvals from independent testing laboratories or approval agencies, such as UL, FM or CSA.

i. Certification documentation is required for all equipment for which the specifications require independent agency approval.

14. Testing reports: Source quality control reports.

B. Operation and Maintenance Manuals:

1. See Specification Section 01300 for requirements for:

a. The mechanics and administration of the submittal process.
b. The content of Operation and Maintenance Manuals.

2. Warranties: Provide copies of warranties and list of factory authorized service agents.

1.6 WARRANTY:

A. The SSI shall furnish a “no exception - no exclusion,” two-year warranty for all parts and labor on all new equipment provided by the SSI.

B. Warranty shall begin when all equipment and systems are installed, functionally checked, and accepted by the Owner.

C. The warranty period is beyond any “limited” warranty extended by manufacturers or suppliers on their packages or products.

1.7 DELIVERY, STORAGE, AND HANDLING:

A. Do not remove shipping blocks, plugs, caps, and desiccant dryers installed to protect the instrumentation during shipment until the instruments are installed and permanent connections are made.

1.8 SITE CONDITIONS:

A. Unless designated otherwise on the Drawings, area designations are as follows:

1. Outdoor area:

a. Wet.

b. Corrosive and/or hazardous when specifically designated on the Drawings or in the Specifications.

c. Below grade vaults and manholes:

i. Subject to temporary submergence when specifically designated on the Drawings or Specifications.

2. Architecturally finished area:

a. Dry.

b. Noncorrosive unless designated otherwise on the Drawings or in the Specifications.

c. Nonhazardous unless designated otherwise on the Drawings or in the Specifications.

3. Non-architecturally finished area: As designated elsewhere on the Drawings or in the Specifications.

PART 2 PRODUCTS

2.1 NEMA TYPE REQUIREMENTS:

A. Provide enclosures/housing for control system components in accordance with the following:

1. Areas designated as wet: NEMA Type 4.

2. Areas designated as wet and/or corrosive: NEMA Type 4X.

a. Unless otherwise shown, enclosures located in process/equipment areas shall be NEMA Type 4X, 316SS.

b. Unless otherwise shown, enclosures located outdoors shall be NEMA Type 4X, 316SS.

3. Areas designated as Class I hazardous, Groups A, B, C, or D as defined in NFPA 70:

a. NEMA Type 7 unless all electrical components within enclosure utilize intrinsically safe circuitry.

i. Utilize intrinsically safe circuits to the maximum extent practical and as depicted in the Contract Documents.

4. Areas designated as Class II hazardous, Groups E, F, or G as defined in NFPA 70:

a. NEMA Type 9 unless all electrical components within enclosure utilize intrinsically safe circuitry.

i. Utilize intrinsically safe circuits to the maximum extent practical and as depicted in the Contract Documents.

5. Either architecturally or non-architecturally finished areas designated as dry, noncorrosive, and nonhazardous (such as Electrical rooms): NEMA Type 12.

6. Areas designated to be subject to temporary submersion: NEMA 6P.

2.2 PERFORMANCE AND DESIGN REQUIREMENTS:

A. System Operating Criteria:

1. Stability: After controls have taken corrective action, as result of a change in the controlled variable or a change in setpoint, oscillation of final control element shall not exceed two (2) cycles per minute or a magnitude of movement of 0.5 percent full travel.

2. Response: Any change in setpoint or change in controlled variable shall produce a corresponding corrective change in position of final control element and become stabilized within 30 seconds.

3. Agreement: Setpoint indication of controlled variable and measured indication of controlled variable shall agree within 3 percent of full scale over a 6:1 operating range.

4. Repeatability: For any repeated magnitude of control signal, from either an increasing or decreasing direction, the final control element shall take a repeated position within 0.5 percent of full travel regardless of force required to position final element.

5. Sensitivity: Controls shall respond to setpoint deviations and measured variable deviations within 1.0 percent of full scale.

6. Performance: All instruments and control devices shall perform in accordance with manufacturer's specifications.

2.3 ACCESSORIES:

A. Provide identification devices for instrumentation system components including:

1. Manufacturer’s model number.
2. Manufacturer’s serial number.
3. Range:

    a. Utilize the same units of measurement as are utilized in the Contract Documents.

4. Power supply requirement.

B. Provide corrosion resistant spacers to maintain 1/4 IN separation between equipment and mounting surface in wet areas, on below grade walls and on walls of liquid containment or processing areas such as Clarifiers, Digesters, Reservoirs, etc.

PART 3 EXECUTION

3.1 INSTALLATION:

A. Wherever feasible, use bottom entry for all conduit entry to instruments and junction boxes.

B. Install electrical components per Division 16.

C. Panel-Mounted Instruments:

1. Mount and wire so removal or replacement may be accomplished without interruption of service to adjacent devices.

2. Locate all devices mounted inside enclosures so terminals and adjustment devices are readily accessible without use of special tools and with terminal markings clearly visible.

3.2 FIELD QUALITY CONTROL:

A. See Specification Section 01600 – Material and Equipment.

B. The SSI shall maintain accurate daily log of all instrumentation and control startup activities, calibration functions, and final setpoint adjustments.

1. Documentation requirements include the utilization of the forms located at the end of this Specification Section.

a. Loop Check-out Sheet.
b. Instrument Certification Sheet.
c. Final Control Element Certification Sheet.

C. In the event that instrument air is not available during calibration and testing, supply either filtered, dry, instrument quality air from a portable compressor or bottled, dry, instrument quality air.

1. Do not, under any circumstances, apply hydrostatic test to any part of the air supply system or pneumatic control system.

D. Pneumatic Signal Tubing Testing:

1. Before the leak test is begun, blow clean with dry air.

2. Test signal tubing per ISA 7.0.01, except for tubing runs of less than 10 feet where simple soap bubble testing will suffice.

3. If a leak is detected, repair the leak and repeat the leak test.

4. After completion of the leak test, check each signal line for obstructions.

a. If any are indicated, remove and retest.

E. Instrumentation Calibration by SSI:

1. Verify that all instruments and control devices are calibrated to provide the performance required by the Contract Documents.

2. Calibrate all field-mounted instruments, other than local pressure and temperature gauges, after the device is mounted in place to assure proper installed operation.

3. Calibrate in accordance with the manufacturer's specifications.

4. Bench calibrate pressure and temperature gauges.

a. Field mount gauge within seven (7) days of calibration.

5. Check the calibration of each transmitter and gauge across its specified range at 0, 25, 50, 75, and 100 percent.

   a. Check for both increasing and decreasing input signals to detect hysteresis.

6. Replace any instrument which cannot be properly adjusted.

7. Stroke control valves with clean dry air to verify control action, positioner settings, and solenoid functions.

8. Mark range, date, setpoint and calibrator's initials on each instrument by means of blue or black ink on a waterproof tag affixed to the instrument.

9. Calibration equipment shall be certified by an independent agency with traceability to NIST.

   a. Certification shall be up-to-date.
   b. Use of equipment with expired certifications shall not be permitted.

10. Calibration equipment shall be at least three (3) times more accurate as the device being calibrated.

F. Loop check-out requirements (by SSI) are as follows:

1. Check control signal generation, transmission, reception and response for all control loops under simulated operating conditions by imposing a signal on the loop at the instrument connections.

   a. Use actual signals where available.

   b. Closely observe controllers, indicators, transmitters, HMI displays, recorders, alarm and trip units, remote setpoints, ratio systems, and other control components.

      i. Verify that readings at all loop components are in agreement.
      ii. Make corrections as required.

         - Following any corrections, retest the loop as before.

2. Stroke all control valves, cylinders, drives and connecting linkages from the local control station and from the control room operator interface.

3. Check all interlocks to the maximum extent possible.

4. In addition to any other as-recorded documents, record all setpoint and calibration changes on all affected Contract Documents and turn over to the Owner.

G. Provide verification of system assembly, power, ground, and I/O tests.

H. Verify existence and measure adequacy of all grounds required for instrumentation and controls.

I. Manufacturers of equipment provided by SSI shall provide Manufacturer's Field Services as defined in Section 01600 to provide the following services:

1. Assistance during installation to include observation, guidance, instruction of General Contractor's assembly, erection, installation or application procedures.

2. Inspection, checking, and adjustment as required for equipment to function as warranted by manufacturer and necessary to provide written approval of installation.

3. Revisiting the site as required to correct problems and until installation and operation are acceptable to OWNER.

4. Resolution of assembly or installation problems attributable to, or associated with, respective manufacturer's products and systems.

5. Assistance during Demonstration Period functional and performance testing, and until product acceptance by the OWNER.

6. Training of OWNER'S personnel in the operation and maintenance of respective product as required herein.

   a. 16 hours of Pre-Demonstration training.
   b. 40 hours of Post-Demonstration training.
   c. Training may be specified as either during the Pre-Demonstration Period or Post Demonstration.

7. Completion of Manufacturer's Certificate of Proper Installation as included in Section 01600 with applicable certificates for proper installation and initial, interim, and final test service.

8. Complete Certificate of Successful Start-up as defined in Section 01600.

END OF SECTION

SECTION 15103

BUTTERFLY VALVES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Butterfly valves.

1.2 QUALITY ASSURANCE

A. Referenced Standards:

1. American Society of Mechanical Engineers (ASME):

a. B16.5, Pipe Flanges and Flanged Fittings - NPS 1/2 through NPS 24.

2. ASTM International (ASTM):

a. A48, Standard Specification for Gray Iron Castings.

b. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

c. A276, Standard Specification for Stainless Steel Bars and Shapes.

d. A395, Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.

e. A436, Standard Specification for Austenitic Gray Iron Castings.

f. A536, Standard Specification for Ductile Iron Castings.

g. B148, Standard Specification for Aluminum-Bronze Sand Castings.

3. American Water Works Association (AWWA):

a. C504, Standard for Rubber-Seated Butterfly Valves.

4. Manufacturers Standardization Society of the Valve and Fittings Industry Inc. (MSS):

a. SP-67, Butterfly Valves.

1.3 SUBMITTALS

A. Shop Drawings:

1. See Division 01 for requirements for the mechanics and administration of the submittal process.

2. See Specification Section 15100 – *Valves – Basic Requirements*.

3. For valves 8 IN and larger, furnish "Affidavit of Compliance" with Owner in accordance with AWWA C504.

B. Operation and Maintenance Manuals:

1. See Division 01 for requirements for:

a. The mechanics and administration of the submittal process.
b. The content of Operation and Maintenance Manuals.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. DeZurik.
2. Clow.
3. Mueller.
4. Pratt.
5. Crispin Valves.
6. Val Matic
7. GA
8. Engineer approved equal.

B. Submit request for substitution in accordance with Division 01.

2.2 BUTTERFLY VALVES (AWWA C504)

A. Comply with AWWA C504.

B. Materials:

1. Valve bodies:

a. ASTM A126, Class B or ASTM A536 Grade 65-45-12 ductile iron.

b. Wafer valves may be constructed of ASTM A48, Class 40 cast iron.

2. Valve shafts:

a. Stainless steel, 18-8, Type 316.

3. Valve discs:

   a. Potable and nonpotable water:

      i. ASTM A48, Class 40 cast iron.
      ii. ASTM A536, Grade 65-45-12 ductile iron.
      iii. ASTM A436, Type 1 alloy cast iron.
      iv. Bronze in accordance with AWWA C504.

   b. Wastewater and similar applications:

      i. ASTM A536, Grade 65-45-12 ductile iron.
      ii. ASTM A436, Type 1 alloy cast iron.
      iii. Bronze in accordance with AWWA C504.

   c. Air and similar applications: ASTM A48, Class 40 cast iron.

4. Valve seats:

   a. Potable and nonpotable water below 150 Deg F:

      i. Natural rubber.

   b. Potable and nonpotable water and wastewater and air below 180 Deg F:

      i. Buna-N.

   c. Heating water and air 180 to 250 Deg F.

      i. EPDM.

5. Mating surfaces:

   a. Valves less than 30 IN: ASTM A276, 18-8, stainless steel.
   b. Valves 30 IN and larger: ASTM A276, 18-8, stainless steel.

C. Design Requirements:

1. Seat type:

   a. Resilient.
   b. Comply with AWWA C504.

2. Exposed and submerged valves 3 through 20 IN.

   a. Body type: Wafer or short body flange (laying length may vary from AWWA C504).

   b. Equip wafer type with fully tapped anchor lugs drilled per ASME B16.5, Class 150.

3. Exposed and submerged valves 24 IN and larger:

   a. Body type: Short body flange.
   b. Working pressure: Rated for 150 psi (Class 150B per AWWA C504).

4. Direct buried valves:

   a. All valves: Working pressure rated for 150 psi (Class 150B per AWWA C504).

2.3 BUTTERFLY VALVES (MSS SP-67)

A. Comply with MSS SP-67.

B. Materials:

1. Valve bodies:

   a. Wafer body: Cast iron ASTM A126, Class B.
   b. Lug body: Ductile iron, ASTM A395.

2. Valve shaft or stem:

   a. Stainless steel, ASTM A276, Type 316.

3. Valve disc:

   a. Ductile iron, ASTM A395, nickel plated.

4. Valve seat:

   a. Water and air below 180 Deg F:

      i. Buna-N.

   b. Water and air 180 to 250 Deg F:

      i. EPDM.

   c. Valve seat shall be a full body seat isolating stem and body from flow.

C. Design Requirements:

1. Exposed and submerged valves 3 IN through 20 IN.

   a. Body type: Wafer.
   b. Working pressure: Rated for 150 psi.
   c. Equip with fully tapped anchor lugs drilled per ASME B16.5, Class 150.

2. Exposed and submerged valves 24 IN and larger:

   a. Body type: Short body flange.
   b. Working pressure: Rated for 150 psi.

2.4 ACCESSORIES

A. Refer to Drawings and/or valve schedule for type of actuators.

   1. Furnish actuator integral with valve.

B. Refer to Section 15100 for actuator requirements.

PART 3 EXECUTION

3.1 INSTALLATION

A. See Section 15100.

END OF SECTION

SECTION 15104

BALL VALVES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Ball valves.

1.2 QUALITY ASSURANCE

A. Referenced Standards:

1. ASTM International (ASTM):

a. A48, Standard Specification for Gray Iron Castings.

b. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

c. D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.

2. American Water Works Association (AWWA):

a. C507, Standard for Ball Valves, 6 IN through 48 IN.

3. Manufacturers Standardization Society of the Valve and Fittings Industry Inc. (MSS):

a. SP-72, Ball Valves with Flanged or Butt-Welding Ends for General Service.

b. SP-110, Ball Valves; Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

1.3 DEFINITIONS

A. PVDF: Polyvinylidene fluoride.

1.4 SUBMITTALS

A. Shop Drawings:

1. See Division 01 for requirements for the mechanics and administration of the submittal process.

2. See Specification Section 15100 – *Valves – Basic Requirements*.

3. Test results for AWWA valves.

B. Operation and Maintenance Manuals:

1. See Division 01 for requirements for:

a. The mechanics and administration of the submittal process.
b. The content of Operation and Maintenance Manuals.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the manufacturers listed in the applicable Articles below are acceptable.

B. Submit request for substitution in accordance with Division 01.

2.2 METALLIC BALL VALVES 1/4 TO 3 IN DIA

A. Acceptable Manufacturers:

1. Apollo.
2. Jamesbury.
3. Watts.
4. Stockham.
5. Nibco.
6. Val Matic.
7. Engineering Approved Equal.

B. Materials:

1. Body: Stainless Steel.
2. Stem, stem gland nut: Stainless Steel.
3. Ball: Brass, chrome plated.
4. Seats, stuffing box ring, and thrust washer: Reinforced Teflon.
5. Handle: Vinyl coated or zinc- or cadmium-plated steel.

C. Design Requirements:

1. Rated for 400 psi and 250 Deg F, WOG for threaded end applications and 285 psi WOG and 150 psi saturated steam service for flanged end applications.

2. Handles showing direction of opening.

3. Stuffing boxes capable of being repacked under pressure and adjustable for wear.

4. Stem with reinforced Teflon stuffing box ring and blowout-proof design.

5. Renewable reinforced Teflon seats.

6. Ball design which does not allow media contact with stem.

7. Balancing stop for all applications.

8. Bodies with mounting pad for applications requiring actuators.

2.3 PLASTIC BALL VALVES: 1/2 IN TO 4 IN DIA

A. Acceptable Manufacturers:

1. Chemtrol.
2. Spears.
3. ASAHI/America.

B. Materials:

1. Body, stem, ball, handle, end connectors:

a. PVC ASTM D1784-12454B
b. CPVC ASTM D1784-23477-B

2. Ball Seat: Teflon.

3. O-rings:

a. General: Viton or PTFE encapsulated fluorocarbon.
b. NaOH or LAS Service: EPDM.

C. Design Requirements:

1. Rated at 150 psi at 75 Deg F.

2. Double or "true union" design.

3. Blocks both directions, upstream and downstream.

4. Union nut capable of compensating for seat wear.

5. Body with mounting pad for actuators where required.

6. Capable of being disconnected at downstream end under full line pressure.

2.4 AWWA C507 BALL VALVES: 6 IN TO 48 IN DIA {PRATT (P), WILLAMETTE (W)}

A. Comply with AWWA C507.

B. Acceptable Manufacturers:

1. Willamette.
2. Pratt.

C. Materials:

1. Body:

   a. Cast iron ASTM A126, Class B (P).
   b. Cast iron ASTM A48, Class 35 (W).

2. Ball:

   a. Cast iron ASTM A48, Class 40 (P).
   b. Cast iron ASTM A48, Class 35 (W).

3. Shaft:

   a. Stainless steel 18-8 Type 304 (P)
   b. Forged steel, chrome plated at seal tensile yield 82,000 psi (W).

4. Bearings, sleeve type, non-metallic:

   a. Teflon lined (P).
   b. Sleeve type (W).

5. Ball seat: Stainless steel Type 304 (P and W).

6. Body seat:

   a. Buna-N (P).
   b. Monel (W).

D. Design Requirements:

1. Design pressure: 150 psi.
2. Flanges: Class 125.
3. Ball shall provide one (1) direction seal or closure.
4. Provide pipe tap for body drain and air vent and legs or base for support.
5. Ball and body seats: Field adjustable and replaceable.

2.5 ACCESSORIES

A. Refer to Drawings and valve schedule for type of actuators.

1. Furnish actuator integral with valve.

B. Refer to Section 15100 for actuator requirements.

2.6 SOURCE QUALITY CONTROL

A. Shop test AWWA C507 ball valves in accordance with AWWA C507.

B. Furnish record of test.

PART 3 EXECUTION

3.1 INSTALLATION

A. See Section 15100.

3.2 FIELD QUALITY CONTROL

A. For AWWA C507 ball valves, and in accordance with Division 01 employ and pay for services of equipment manufacturer's field service representative(s) to:

1. Inspect equipment covered by these Specifications.

2. Supervise adjustments and installation checks.

3. Provide test equipment, tools, and instruments necessary to accomplish equipment testing.

4. Conduct startup of equipment and perform operational checks.

5. Provide Owner with a written statement that manufacturer's equipment has been installed properly, has been started up, and is ready for operation by Owner's personnel.

END OF SECTION

SECTION 15106

CHECK VALVES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Check valves.

1.2 QUALITY ASSURANCE

A. Referenced Standards:

1. American Water Works Association (AWWA):

a. C508, Standard for Swing-Check Valves for Waterworks Service, 2 IN through 24 IN NPS.

2. Manufacturers Standardization Society of the Valve and Fittings Industry Inc. (MSS):

a. SP-71, Cast Iron Swing Check Valves, Flanged and Threaded Ends.
b. SP-80, Bronze Gate, Globe, Angle and Check Valves.

1.3 DEFINITIONS

A. PVDF: Polyvinylidene fluoride.

1.4 SUBMITTALS

A. Shop Drawings:

1. See Division 01 for requirements for the mechanics and administration of the submittal process.
2. See Specification Section 15100 – *Valves Basic Requirements.*

B. Operation and Maintenance Manuals:

1. See Division 01 for requirements for:

a. The mechanics and administration of the submittal process.
b. The content of Operation and Maintenance Manuals.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, manufacturers listed under the valve with types are acceptable.

B. Submit request for substitution in accordance with Division 01.

2.2 CHECK VALVES: 2.5 IN AND SMALLER

A. Class 125 Swing Check Valves:

1. Comply with MSS SP-80.

2. Acceptable manufacturers:

a. Nibco T413-Y.
b. Stockham B-319Y.

3. Materials:

a. Body, bonnet, disc: Cast Iron.

4. Design requirements:

a. 125 psi steam to 406 DegF, 200 psi WOG.
b. Horizontal swing, renewable disc.

2.3 SWING CHECK VALVES: 3 IN TO 30 IN

A. Swing Check Valves:

1. Comply with AWWA C508.

2. Acceptable manufacturers:

a. Clow.
b. American Darling.
c. Golden Anderson.
d. Val Matic.
e. Engineer approved equal.

3. Materials:

a. Body and cover: Cast iron.
b. Seat ring, hinge: Cast Iron.
c. Disc:

i. 3 to 30 IN: Cast iron with rubber face.

d. Hinge shaft: Stainless steel.
e. Bearings, connecting hardware: Stainless Steel.

4. Design requirements:

a. 175 psi working pressure (3 to 12 IN).
b. 150 psi working pressure (14 to 30 IN).
c. Furnish with outside weight and lever or lever and spring.

PART 3 EXECUTION

3.1 INSTALLATION

A. See Specification Section 15100.

B. Install in accordance with manufacturer's instructions.

END OF SECTION

SECTION 15109

AIR VALVES

PART 1 GENERAL

1.1 SUMMARY

A. The contractor shall furnish and install air release, air/vacuum, and combination air valves made of composite materials, complete as shown on the plans and specified herein.

1.2 QUALITY ASSURANCE

A. Referenced Standards:

1. American Water Works Association (AWWA):

a. C512, Standard for Air-Release, Air-Vacuum, and Combination Air Valves for Waterworks Service.

b. American National Standard Institute

1.3 SUBMITTALS

A. Submit under provisions of Division 01.

B. The following submittals are required, at a minimum:

1. Shop Drawings: See Specification Section 15100 – *Valves – Basic Requirements*.

2. Operation and Maintenance Manuals:

a. See Division 01 for requirements for the contents of Operation and Maintenance Manuals.

C. Include any other information necessary for the ENGINEER to determine compliance with the specifications.

D. All deviations from Contract Documents shall be clearly identified and approved in writing by the ENGINEER.

E. Partial or incomplete submittals will not be reviewed by ENGINEER.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the manufacturers listed in the applicable articles below are acceptable.

B. Acceptable:

1. APCO
2. Cla-Val
3. A.R.I.
4. Crispin Valves
5. Val Matic
6. GA
7. Engineer approved equal.

2.2 GENERAL

A. Obtain all valves from a single manufacturer.

B. End connections to be compatible with those specified in the contract documents and shown on the Drawings. End connections shall be threaded male connection (National Pipe Thread).

C. All components shall be compatible with the process fluid as specified herein.

D. All valves specified under this section shall be furnished with 316 stainless steel ball valves equal to the size of the size of the connection in accordance with Section 15.

E. All valves shall be rated for a maximum working pressure of 250 psi.

F. Valves designated for service in solids-bearing liquids such as raw water or sludge shall incorporate appropriate provisions to prevent clogging of the valve mechanism.

2.3 VALVE TYPES

A. Air/Vacuum Valves

1. The valve shall automatically discharge and/or admit large volumes of air during the filling or draining of a pipeline.

B. Combination Air Valves

1. The combination air valve shall include (A) air and vacuum component and (B) air release component.

a. The air and vacuum component shall automatically discharge and/or admit large volumes of air during the filling or draining of a pipeline.

b. The air release component shall automatically release small volumes of air while the pipeline is full and operating under pressure.

C. Vacuum Breaker

1. The valve shall protect the pipeline from a vacuum by allowing large volumes of air into the pipeline.

2. The valve shall not allow any volume (small or large) to vent out of the pipeline.

D. Vacuum Guard

1. The valve shall allow air to be vented out of the pipeline.
2. The valve shall not allow any relief of a vacuum.

E. Surge Arrester (Non-Slam)

1. The valve shall protect the pipeline from water hammer effects.

2.4 MATERIALS OF CONSTRUCTION

A. Body: Reinforced Nylon (NSF 61 Certified)

B. Discharge Outlet: Polypropylene (NSF 61 Certified)

C. Rolling Seal: EPDM (NSF 61 Certified)

D. Rolling Seal Assembly (2" Valve)

1. Screws: Stainless Steel (Type 316)
2. Plug Cover: Reinforced Nylon (NSF 61 Certified)
3. Rolling Seal: EPDM (NSF 61 Certified)
4. Plug: Reinforced Nylon (NSF 61 Certified)

E. Clamping Stem: Reinforced Nylon (NSF 61 Certified)

F. Float: Foamed Polypropylene (NSF 61 Certified)

G. Base: Reinforced Nylon (NSF 61 Certified)

H. O-ring: BUNA-N (NSF 61 Certified)

I. Cover (When specified in SCHEDULE): Cast Iron ASTM A48 Class 35B

2.5 ACCESSORIES

A. Furnish any accessories required to provide a completely operable valve.

2.6 SOURCE QUALITY CONTROL

A. Shop hydrostatically test in accordance with AWWA C512.

2.7 MAINTENANCE MATERIALS

A. Provide one (1) set of any special tools or wrenches required for operation or maintenance for each type valve.

PART 3 EXECUTION

3.1 INSTALLATION

A. See Specification Sections 11005 – *Equipment Basic Requirements* and 15100 – *Valves – Basic Requirements*.

3.2 FIELD QUALITY CONTROL

A. Clean, inspect, and operate valve to ensure all parts are operable and valve seats properly.

B. Check and adjust valves and accessories in accordance with manufacturer's instructions and place into operation.

3.3 SCHEDULE

A. Contractor shall provide all valves shown in Drawings. Refer to Drawings for type, end connections, and locations for all valves.

END OF SECTION

Enprotec | Hibbs & Todd

November 6, 2023

Mayor Matt Hutsell
City of Tolar
8712 W. Highway 377
Tolar, Texas 79476

Re: Geotechnical Investigation
WWTP Improvements
501 Tolar Cemetery Road
Tolar, Texas

Dear Mayor Hutsell:

In accordance with your instructions, we have conducted a Geotechnical Investigation for the above referenced project. The conclusions and recommendations of this investigation are to be found in the attached report.

We trust that this will provide the information you have requested. We are also available to provide the final geotechnical investigation and materials testing services recommended in the Report. If there are any further questions, please do not hesitate to call.

Sincerely,

Enprotec / Hibbs & Todd, Inc.

6 Nov 23

STATE OF TEXAS
GARY SCOTT YUNGBLUT
85640
LICENSED
PROFESSIONAL ENGINEER

G. Scott Yungblut, P.E.
Geotechnical Engineer

Enclosure
22-8434

GEOTECHNICAL INVESTIGATION
WWTP IMPROVEMENTS
TOLAR, TEXAS

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GEOTECHNICAL INVESTIGATION
WWTP IMPROVEMENTS
TOLAR, TEXAS

INTRODUCTION

GENERAL: This investigation was authorized in September 2022 by Mr. Terry Johnson representing the City of Tolar, Texas. The purpose of this investigation is to provide foundation, floor slab, and pavement design information along with construction recommendations for the proposed improvements at the Wastewater Treatment Plant (WWTP) in Tolar, Texas.

Based upon the information provided by Ms. Brittany White, P.E., Project Engineer for Enprotec/Hibbs & Todd, Inc. (eHT), the project includes the construction of the following: a solids dewatering system and an SBR blower pad, each planned to bear at grade; a triplex influent lift station bearing at a depth of about 14 feet below existing grade; SBR Basins that will bear at a depth of about 10 feet below existing grade; a Chlorine Contact Basin which will bear approximately 12½ feet below existing grade; and a Solids Handling Basin that will bear about 13 feet below grade. Detailed structural loading was not provided, however for this analysis it has been assumed that maximum column loads will be less than 60 kips per column and maximum wall loads will be less than 2.5 kips per linear foot of wall, based on dead load plus design live load.

SCOPE: The scope of the exploration and analysis to be performed by eHT included a site reconnaissance, the subsurface exploration, field and laboratory testing, and an engineering analysis and evaluation to provide design recommendations for the foundations, floor slabs, and pavements along with construction recommendations for the proposed site improvements. Details and results of the investigation are discussed in the following sections of this report.

LIMITATIONS: The Geotechnical Engineer warrants that the findings, recommendations, specifications, or professional advice contained herein have been made after being prepared in accordance with generally accepted professional engineering practice in the fields of foundation engineering, soil mechanics, and engineering geology. No other warranties are implied or expressed.

SITE DESCRIPTION

Site Location & Topography: The WWTP is located at 501 Tolar Cemetery Road in southern Tolar, Texas. At the time of the subsurface exploration the improvement areas were covered with manicured grasses or crushed limestone base. The majority of the site appeared relatively flat with areas of slightly rolling terrain and sloped slightly from the southwest down to the north with approximately 8 or 9 feet of elevation difference across the area.

DESCRIPTION OF WORK

Field Investigation: Drilling and soil sampling activities were performed at select locations of the site on September 19th and 20th, 2023. Nine test borings were drilled to depths ranging from about 15 to 25 feet below the existing ground surface elevation at the locations shown on Figure 1 in Appendix A. The site plan with the proposed boring locations was provided by Ms. White. Test Boring No.5 was aborted due to the excessive number of underground utilities in the area.

The test borings were drilled utilizing a truck-mounted rotary drilling rig. The test borings were advanced utilizing dry sampling methods and/or rotary air drilling techniques which allow for accurate groundwater observations. Drilling and sampling activities were performed in general accordance with referenced ASTM and/or TxDOT procedures or other accepted methods.

Soil formations were sampled using a 3-inch diameter Shelby-type steel tube sampler (ASTM D 1587) and/or a 2-inch split barrel sampler (ASTM D 1586). Undisturbed soil samples were subjected to calibrated pocket penetrometer tests (Qp) to assist in evaluating the shear strength of the cohesive soils. Quantitative estimates of the foundation strata bearing capacity were also obtained from interpretation of the Standard Penetration Test (SPT), the Texas Highway Department (TCP) method results, and widely published empirical correlations. The reports of the field tests are reported on the Logs of Borings in Appendix C.

The borings were visually logged in the field, and all recovered samples were placed in core boxes for delivery to the laboratory. The Shelby tube samples, split barrel samples, and grab samples were placed in polyethylene plastic bags to minimize moisture changes. Samples will be retained for 90 days from the date of this report. The samples will then be discarded unless notified in writing by the client requesting the samples be retained.

The borings were observed for groundwater at each test location, during and following the completion of the boring. These observations are shown on the Logs of Borings and discussed in a later section of this report. The borings were backfilled with on-site materials upon completion of the fieldwork. Logs of Borings were subsequently prepared, along with a legend titled EXPLANATION OF SYMBOLS AND TERMS USED ON BORING LOGS and GENERAL NOTES. The legend and general notes show typical soil and rock classifications, drilling symbols, weathering descriptions, and soil structure characteristics.

LABORATORY TESTING: Select materials recovered in the borings were tested in the laboratory and classified based on the laboratory test results. Laboratory testing was conducted in general accordance with ASTM procedures and standards. Atterberg Limits (ASTM D 4318) and Minus 200-Mesh Sieve Tests (ASTM D 1140) were performed on selected soil samples in order to classify and establish index properties and grain size characteristics of the soils. Appendix B summarizes the results of these classification tests. The soil classifications are based on the Unified Soil Classification System (USCS).

ENGINEERING ANALYSIS: An engineering analysis was conducted on the information obtained from the field and laboratory investigations. If deviations from the subsurface conditions presented in this report are encountered during construction, we should be notified to determine if changes in our recommendations are required.

SUBSURFACE MATERIALS AND CONDITIONS

SITE GEOLOGY: As shown on the Dallas Sheet of the *Geologic Atlas of Texas* the site is located in an area where Cretaceous Age Deposits of the Glen Rose Formation are present at or near the surface. The Glen Rose Formation in the project area generally consists of limestone alternating with units of clay, marl, and sand.

SITE STRATIGRAPHY: A detailed description of the site stratigraphy is provided on the Logs of Borings. Generally, the subsurface conditions at the site may be characterized as follows:

Very stiff to hard comparative consistency sandy clays, some with trace gravel, were present from the surface to depths ranging from about 4 to 4½ feet at Test Boring Nos. 4 and 6 to a depth of about 8 to 10 feet at the other test borings. The clays were underlain by weathered shale with interbedded limestone seams, which extended to at least a depth of 25 feet, the termination depth of the deeper test borings. A 5 foot layer of firm relative density clayey silt was encountered at a depth of about 8 feet at Test Boring No. 1.

GROUNDWATER: Groundwater was not encountered within the test borings during or at completion of drilling activities. An accurate depiction of the groundwater depth would require leaving the test borings open for an extended period of time due to the moderately impermeable soils. Based upon the soil moisture contents the groundwater table was considered to exist at depths greater than 25 feet below current grades at the time of the subsurface exploration, although shallower perched water may exist. The water table may fluctuate seasonally and during periods of heavy rainfall. Groundwater is not expected to affect shallow foundation construction at this site. Filtered sump pumps placed in the bottom of excavations are expected to be suitable for removal of the perched water.

FOUNDATION DESIGN RECOMMENDATIONS

GENERAL: The proposed site is underlain by moderate strength, low to highly expansive sandy and silty clays. The Potential Vertical Rise (PVR) has been estimated using the *State of Texas Highway Department Materials and Testing Division Test Method TEX-124-E 'Methods of Determining the Potential Rise'* for the existing soils. For this site, the PVR estimation was based on a plasticity index (PI) ranging from 8 to 35. The estimation assumed average seasonal minimum moistures corresponding to the 'dry line' of the test method. The PVR for the site was estimated to be about one-half of an inch. A differential movement of half of the PVR can be assumed. However, differential movement can be equal to or even double the PVR in extreme conditions such as soils exposed to moisture and swelling in one area and drying and shrinkage in another. Based upon the boring log information this site falls in Seismic Site Class C according to the International Building Code and a Seismic Design Category B based on the OSHPD Seismic Design Maps.

SHALLOW FOUNDATIONS: Following proper site preparation, the solids dewatering system and the SBR Blower pads may be supported by a shallow foundation system. Continuous wall footings for load bearing walls and spread footings for building columns may be designed for maximum net allowable bearing pressures of 2.5 and 3.0 kips per square foot (ksf), respectively, based upon dead load plus design live load considerations. A subgrade modulus of 120 psi/in may be used for foundation design within the properly compacted existing soils or newly placed select fill. The bottoms of the exterior footings should bear a minimum 24 inches below adjacent surface grades along the perimeter to reduce seasonal effects on the supporting soils and should also be in accordance with local building code requirements. The continuous footings should have a minimum width of 14 inches and the pads should have a minimum width of 24 inches even if the actual bearing pressure is less than the design value. Any shallow or near ground supported foundation should be designed by a structural engineer experienced in the design of shallow foundations.

FLOOR SLAB: A soil supported floor slab may be used in conjunction with the shallow foundations. The slab-on-grade should be supported on properly compacted existing soils or select fill used to level or raise the area which should provide a design PVR of about one-half of an inch. Based upon the assumed floor slab live loads a minimum 5-inch thick concrete slab reinforced with at least #5 rebar 18 inches on center, each way, placed mid-height within the floor slab is recommended due to the underlying expansive soils. The actual floor slab design, however, should be provided by the structural engineer.

MAT FOUNDATIONS: Following proper site preparation, the deeper structures may be supported by a mat type foundation. As previously discussed, the finished floor elevations for the new process structures are anticipated to extend to depths ranging from 10½ to 14 feet below existing grade. Mat foundations founded in the weathered shales with interbedded limestone seams may be designed as follows:

Structures	Anticipated Depth Below Existing Grade (ft)	Required Depth of Select Fill (inches)	Net Allowable Bearing Pressure at Depth (ksf)
SBR Basins	10½	6	4.0
Chlorine Contact Basin	12½		
Solids Handling Basin	13		
Influent Lift Station	14		

The allowable capacities are based on published correlations for STP field test data, the Texas Highway Department (TCP) method test data, and widely published empirical correlations. The value includes a safety factor of at least 3 against shear failure in the supporting soils.

A detailed settlement analysis has not been performed, although total settlement of the fill could be on the order of 1 to 2 percent of the fill thickness. Differential settlement is estimated as ½ to ⅔ of total settlement and differential settlement can be reduced by compacting fill properly and uniformly.

PERIMETER MOISTURE CONTROL: Proper design of foundations in expansive soils must include perimeter surface moisture control. Basically, soils experience volume changes when allowed to dry or when allowed access to moisture. Thus, if the soil moisture content remains constant, soil volume changes will be minimal. In reality, it is difficult to prevent seasonal soil-moisture fluctuations, but these moisture changes can be limited.

Proper grading and drainage around the foundation to prevent ponding of water is essential from construction through the life of the improvements. It is recommended that outlets for gutter systems empty either into storm drains or onto paved surfaces to allow for quick discharge of water away from the building areas – failure to do so may result in excessive moisture beneath the foundation and floor slab and cause excessive movement. It is recommended that sidewalks and pavements extend to the building lines to serve as a barrier to soil moisture evaporation and infiltration.

BELOW-GRADE WALL DESIGN PARAMETERS: The following listing presents the recommended soil related design parameters for the below-grade structures.

Braced Excavation or Rigid Wall			
Condition	**Existing Soils (0-8' below grade)**	**Existing Soils (8-20' below grade)**	**Select Fill**
Shear Angle, Φ (deg)	28°	32°	32°
Soil Density, γ (pcf)	125	125	125
Active Earth Pressure Coefficient, K_a	0.36	0.31	0.31
Passive Earth Pressure Coefficient, K_p	2.77	3.20	3.20
At-Rest Earth Pressure Coefficient, K_o	0.63	0.47	0.47

*Notes:

1. See page 364, Terzaghi & Peck, *Soil Mechanics in Engineering Practice*, Second Edition, 1967 or page 330, Terzaghi, Peck & Mesri, *Soil Mechanics in Engineering Practice*, Third Edition, 1996.
2. Based on minimum $N_{SPT} \geq 15$, cohesive fine-grained materials of very stiff to hard consistency
3. See page 412, Terzaghi & Peck, *Soil Mechanics in Engineering Practice*, Second Edition, 1967 or page 357, Terzaghi, Peck & Mesri, *Soil Mechanics in Engineering Practice*, Third Edition, 1996.

The parameters presented for the soils above should be utilized in the design of the walls. The lateral pressure design parameters presented are based upon drained conditions within the backfill material behind the below-grade walls. Hydrostatic loading is additional and should be considered in the design of the walls regardless of backfill type and/or pressure relief designs. The pressures listed are based on level backfill and do not include a surcharge. If surcharge loads are expected, an appropriate additional pressure should be utilized.

BELOW-GRADE WALL BACKFILL: Backfill materials should be compacted under engineering controlled conditions in the necessary layer thickness so that it is placed at above optimum moisture content with a density between 90 and 95 percent of its maximum laboratory dry density as determined by the Standard Proctor Test (ASTM D698). Care should be taken to avoid over compaction of the soils behind the walls, especially with the use of heavy compaction equipment. Temporary bracing of the walls is recommended during backfilling and compaction activities.

FOUNDATION CONSTRUCTION RECOMMENDATIONS

SITE CLEARING/STRIPPING: Initial site preparation will require the removal of the moderately organic topsoil and/or pavement materials present across the proposed improvement areas. Site clearing may also require the removal of a few of the structures that are planned to be abandoned. Removal depths should be verified in the field by a representative of the geotechnical engineer at the time of site grading based upon the subgrade soils and the subgrade stability.

PROOFROLLING/SUBGRADE PREPARATION: Following site clearing and site cutting, where possible the subgrade for the foundations should be proofrolled with a loaded tandem axle truck in the presence of and approved by a qualified geotechnical engineer to locate any soft or unstable areas. If present, these soft or loose soils should be removed to a stable subgrade and replaced with select fill material. Following proofrolling, the subgrade should be scarified to a depth of 6 to 8 inches; moisture conditioned to not less than 2 percent below optimum moisture content; and recompacted to a minimum 95 percent dry density of Standard Proctor (ASTM D 698). There may be areas where proofrolling is not feasible. The subgrade in these areas should be scarified, moisture conditioned, and compacted as described above.

SELECT FILL: Select fill should be used as backfill in areas where fill is required. Select fill should consist of crushed limestone base material with sufficient plastic fines to minimize water transmission. The base should be free of organics and other deleterious materials and should have a maximum liquid limit of 30, a plasticity index between 5 and 12, and have a maximum particle size of 2 inches. The select fill should also meet the USCS classification of SC, GC or CL. The structural fill should be compacted to a minimum 95 percent Standard Proctor (ASTM D 698) at ±2 percent of optimum moisture content. Compacted lift thicknesses should not exceed 6 inches.

FOUNDATION EXCAVATION: Excavations should be observed by the geotechnical consultant to make sure that the proper bearing material has been reached in accordance with the recommendations given herein. It is recommended that a mud mat be placed as soon as possible following foundation excavation of the deeper structures. The excavations should be checked for size and observed to make sure that all loose material has been removed prior to concrete placement. The mud mat should be placed to prevent deterioration of the bearing surface. The mud mat will protect the bearing surface, maintain more uniform moisture in the subgrade, facilitate dewatering of excavations if required, and provide a working surface for placement of formwork and reinforcing steel. Prompt placement of the concrete following foundation preparation is strongly recommended.

UTILITIES: Evidence of underground utilities was present across the site. Prior to construction all underground utilities should be located and, if present in the construction area, permanently capped and removed at the property line or rerouted around the proposed building areas to preserve their function. Special attention should be performed in evaluating the backfill of utilities that will remain which may not be suitable for support of the proposed structures. The soils should be removed and recompacted as described herein if found unsuitable. A representative of the geotechnical engineer should make this determination during construction.

FOUNDATION CONSTRUCTION CONSIDERATIONS

EXCAVATION SAFETY: All excavations should be in accordance with local and federal (OSHA) regulations and the trench safety plan. If instability problems occur, stability within the excavations should be maintained by flattening or widening slope sidewalls. In addition, the on-site soils are susceptible to erosion and disturbance by flowing water and construction traffic. If these soils are disturbed by construction traffic and excessive moisture they may become unstable. The site should therefore be graded to prevent water from ponding near the new foundation and running into excavations.

EXCAVATION DIFFICULTIES: Weathered shales with limestone seams were observed at or near the surface. It is anticipated that some excavation in the area may require specialized excavation equipment for limestone removal. Pre-bid test pits are recommended in the area. Furthermore, excavation bank stability problems may also be encountered. In this event, shallow excavations may be sloped or widened in anticipation of bank stability problems, with deeper excavations possibly requiring more elaborate external support means for stability. All excavations should be performed in accordance with OSHA requirements, which will be the responsibility of the project contractor.

GENERAL: Many problems can be avoided or solved in the field if proper inspection and testing services are provided. eHT should be retained to perform testing and construction observation services sufficient to verify compliance with our recommendations. It is recommended that site preparation, foundation, and floor slab construction be monitored by the geotechnical engineer or his representative. The following are recommended minimum sampling and testing frequencies.

EARTHWORK: During the earthwork phase of the project at least one Proctor test, Atterberg limits test, and minus 200 sieve test should be performed per soil type for subgrade, backfill, and fill materials. At least 1 density and moisture content test per 2,500 square feet should be performed on the subgrade soils, and at least 1 density and moisture content test per 2,500 square feet of select fill material should be performed per structure. A minimum of 2 density and moisture content tests should be performed on the subgrade soils, and at least 2 density and moisture content tests should be performed for each compacted 6-inch thickness of fill in each of the smaller improvement areas. In pavement areas, at least 1 density and moisture content test per 5,000 square feet should be performed on the subgrade soils, and at least 1 density and moisture content test per 5,000 square feet of fill and base material should be performed. Testing of backfilled trenches should be at least 1 density and moisture content test per 100 linear feet of trench per 6 inch compacted lift thickness.

CONCRETE: At least 1 slump, air content (if required) and temperature test, and at least 1 set of 3 concrete cylinders should be molded for each type of concrete per 100 cubic yards or fraction thereof placed in a day. Each set of cylinders should be tested for compressive strength with 1 of the cylinders tested at 7 days and 2 of the cylinders tested at 28 days.

PAVEMENT DESIGN RECOMMENDATIONS

GENERAL: The pavement thickness required is a function of the subgrade soil support characteristics, traffic volume and type, and quality of available construction materials. All pavement designs for long life include routine maintenance for both flexible and rigid pavements. All pavements should be observed for repair or maintenance needs at least one time per calendar year.

SUBGRADE CHARACTERISTICS: The test borings indicate that the upper portion of the soils exhibit low to moderate expansive characteristics. The soils are sandy clays with low to moderate plasticity and liquid limits. Depending on the site grading, the primary subgrade in the pavement areas will be low expansive material.

<u>Flexible Pavement Design</u>: The following table shows flexible pavement thickness alternatives, which may be considered for the support of the anticipated traffic at this site.

Traffic Type	HMAC*	Flexible Base Course	Total Thickness
Heavy (Trucks)	3.0"	12.0"	15.0"
Light (Auto)	2.0"	6.0"	8.0"
* HMAC - Hot-mix asphaltic concrete ** The subgrade should be compacted to a minimum 98 percent of maximum Standard proctor density at above optimum moisture.			

<u>Rigid Pavement Design</u>: The following table shows thickness alternatives for concrete pavements. These values reflect a design life of 20 years with routine maintenance.

Traffic Type	PCC*	Flexible Base Course	Total Thickness
Heavy (Trucks)	7.0"	0.0"	7.0"
Light (Auto)	5.0"	0.0"	5.0"
Dumpster and Roll-off Pads	8.0"	10.0"	18.0"
* PCC - Portland cement concrete ** The subgrade should be compacted to a minimum 98 percent of maximum Standard proctor density at above optimum moisture.			

<u>Portland Cement Concrete is recommended in the truck routes of the site, especially where tight turning may be required.</u>

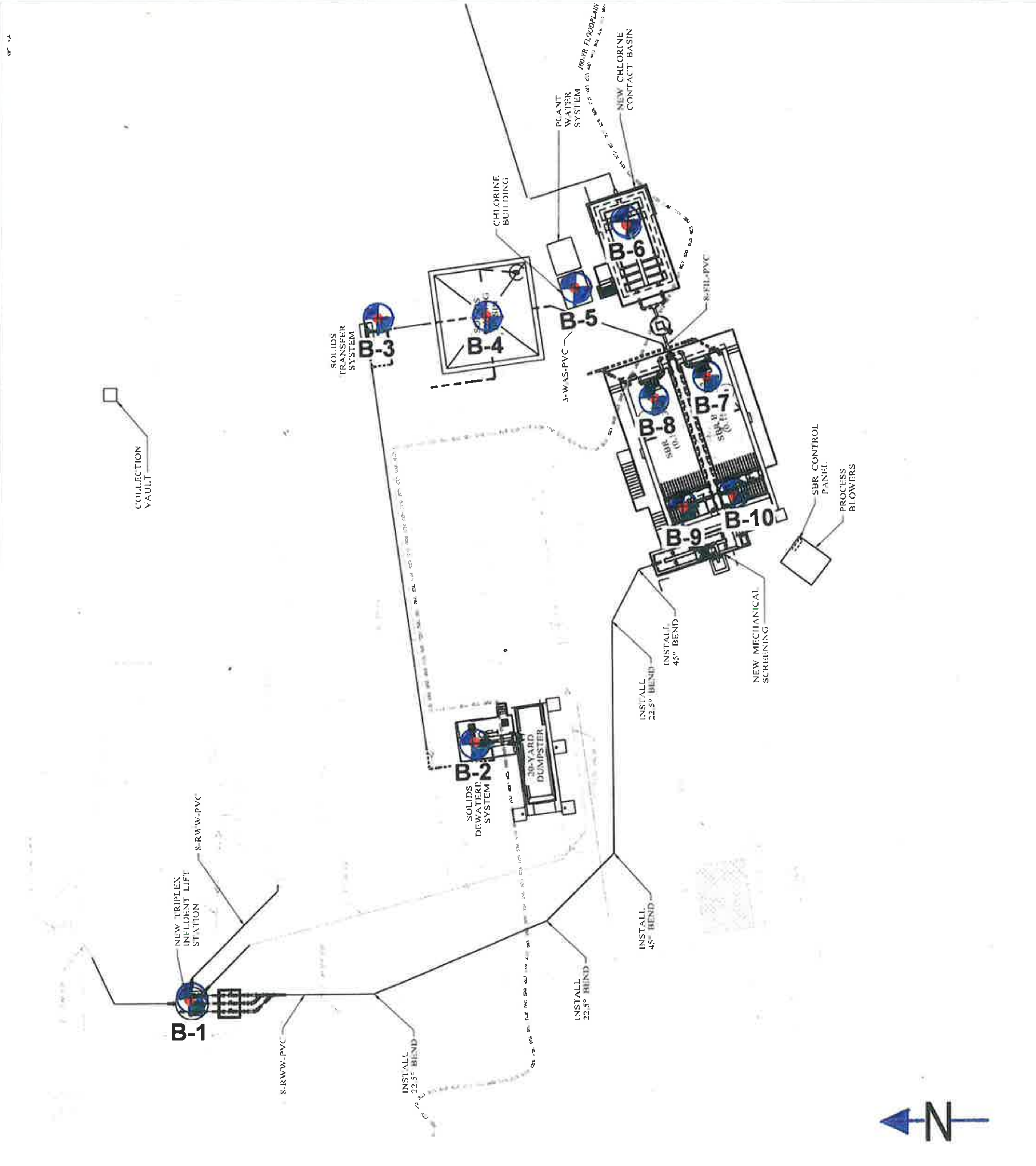
<u>Material Specifications</u>: The pavements should be specified, constructed, and tested to meet the following minimum standards:

1. Hot-Mix Asphaltic Concrete - Texas Department of Transportation (TxDOT) Item 340, Type 'D'. Construction methods and testing should be consistent with those required in this specification.

2. Portland Cement Concrete - TxDOT Item 360. Specify a minimum concrete compressive strength of 3,500 psi at 28 days. Reinforcement for temperature and crack control should not be less than #4 bars on 18-inch spacing for light (auto) traffic areas and #4 bars on 12-inch spacing for heavy (truck) traffic areas. For load transfer at construction and expansion joints, smooth dowel bars should be specified to be at least 14 inches in length and ⅝ inch diameter for the light duty pavement section and 14 inches in length and ⅞ inch diameter for the heavy duty pavement section. These bars should be spaced at 12 inches for light traffic joints and heavy traffic joints. Joint types, joint spacing, and other details for the pavement should be consistent with those such as the American Concrete Institute. Detailing of the concrete pavement may have an impact on the above mentioned reinforcement recommendations. Please contact our office if additional information is required. Construction materials and procedures should be consistent with the above-mentioned specification.

3. Flexible Base Course - TxDOT Item 247, Type A, Grade 2 or better. The base layer should be constructed to a minimum of 98 percent of maximum dry density at ±2 percent of optimum moisture content as determined by ASTM D 1557. Construction procedures should be consistent with this specification.

APPENDIX A



NOT TO SCALE

Enprotec / Hibbs & Todd

BORING LOCATION PLAN

FIGURE 1

WWTP IMPROVEMENTS
501 TOLAR CEMETERY ROAD
TOLAR, TEXAS

Project No.: 23-8434 Date: September 2023

APPENDIX B

WWTP IMPROVEMENTS
SUMMARY OF CLASSIFICATION TESTS

Boring No.	Depth (ft)	Liquid Limit %	Plasticity Index	% Passing #200 Mesh Sieve	Water Content %	USCS	Description
B-1	3½-5'	33	14	---	4.1	CL	Brown Sandy Clay with trace gravel
B-1	8½-10'	60	26	68	22.1	SM	Tan and Gray Clayey Silt
B-2	1½-3½'	30	14	---	4.8	CL	Brown Sandy Clay with trace gravel (possible fill)
B-2	5-8½'	37	20	46	7.7	CL	Tan Sandy Clay with trace gravel
B-3	0-2'	30	14	---	9.4	CL	Brown Sandy Clay
B-3	5-8½'	31	14	63	12.1	CL	Tan Sandy Clay with trace interbedded limestone seams
B-4	5-8½'	29	12	47	7.0	---	Tan Weathered Shale with interbedded limestone seams
B-6	1-3½'	26	11	45	5.3	CL	Tan Sandy Clay with trace gravel
B-6	13½-15'	53	24	86	16.3	---	Tan Weathered Shale with intermittent limestone seams
B-7	5-8½'	26	12	---	2.7	CL	Tan Sandy Clay with trace gravel
B-8	13½-15'	47	22	98	19.5	---	Gray Weathered Shale with intermittent limestone seams
B-9	8½-10'	32	15	60	16.0	CL	Tan Weathered Shale with interbedded limestone seams
B-10	2-3½'	49	28	59	11.6	CL	Brown Sandy Clay
B-10	5-7'	38	22	51	7.3	CL	Brown Sandy Clay with trace gravel

APPENDIX C

ENPROTEC/HIBBS & TODD, INC.
ENVIRONMENTAL AND CIVIL ENGINEERING
402 Cedar Street (325) 698-5560 Abilene, Texas 79601 Firm Registration No. 1151

LOG OF BORING

Project: **WWTP IMPROVEMENTS** Date: 19 SEPTEMBER 2023

Location: **TOLAR, TEXAS** Type: AIR ROTARY Boring No.: **B-1**

DEPTH IN FEET	SAMPLE	MATERIAL DESCRIPTION	N-BLOWS PER FOOT	TEXAS CONE PENETROMETER 1st 6"	TEXAS CONE PENETROMETER 2nd 6"	Qp (tsf)
0–1.5	ST	BROWN AND TAN SANDY CLAY (POSSIBLE FILL)				4.5+
1.5–3.5	AU	BROWN SANDY CLAY				
3.5–5	SS	TAN SANDY CLAY WITH TRACE GRAVEL	38			
5–8	AU					
8–10	SS	TAN AND GRAY CLAYEY SILT	13			
10–13						
13–15	SS	GRAY WEATHERED SHALE WITH INTERMITTENT LIMESTONE SEAMS	50/5"*			
15–18.5						
18.5–20	SS		69			
20–23.5						
23.5–25	SS		50/6"			

TOTAL DEPTH OF BORING 25 FEET

NOTE

NO GROUNDWATER WAS PRESENT DURING OR AT COMPLETION OF DRILLING ACTIVITIES.

* WITH 6" SEAT

8434

ENPROTEC/HIBBS & TODD, INC.
ENVIRONMENTAL AND CIVIL ENGINEERING
402 Cedar Street Abilene, Texas 79601
(325) 698-5560 Firm Registration No. 1151

LOG OF BORING

Project: **WWTP IMPROVEMENTS** Date: 19 SEPTEMBER 2023

Location: **TOLAR, TEXAS** Type: AIR ROTARY Boring No.: **B-2**

DEPTH IN FEET	SYMBOL	SAMPLE	MATERIAL DESCRIPTION	N-BLOWS PER FOOT	TEXAS CONE PENETROMETER 1st 6"	TEXAS CONE PENETROMETER 2nd 6"	Qp (tsf)	DEPTH SCALE
		ST	BROWN SANDY CLAY WITH GRAVEL (FILL)				4.5+	
		AU	BROWN SANDY CLAY WITH TRACE GRAVEL (POSSIBLE FILL)					
		SS	TAN SANDY CLAY WITH TRACE GRAVEL	29				
5		AU						
		SS	- VERY MOIST AT 9'	55/8"				
10			GRAY WEATHERED SHALE WITH INTERMITTENT LIMESTONE SEAMS					
		SS		43				
15								

TOTAL DEPTH OF BORING 15 FEET

NOTE

NO GROUNDWATER WAS PRESENT DURING OR AT COMPLETION OF DRILLING ACTIVITIES.

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402 Cedar Street Abilene, Texas 79601
(325) 698-5560 Firm Registration No. 1151

LOG OF BORING

Project: **WWTP IMPROVEMENTS** Date: 19 SEPTEMBER 2023

Location: **TOLAR, TEXAS** Type: AIR ROTARY Boring No.: **B-3**

SAMPLE	MATERIAL DESCRIPTION	N-BLOWS PER FOOT	TEXAS CONE PENETROMETER 1st 6"	TEXAS CONE PENETROMETER 2nd 6"	Qp (tsf)
ST	BROWN SANDY CLAY				4.5+
ST					4.5+
SS	TAN SANDY CLAY	38			
AU	TAN SANDY CLAY WITH TRACE INTERBEDDED LIMESTONE SEAMS				
SS		34			
	TAN AND GRAY CLAYEY SILT				
SS	GRAY WEATHERED SHALE WITH INTERMITTENT LIMESTONE SEAMS	50/1"*			
TCP			50=0"	50=0"	
SS		59			

Depth scale: 5, 10, 15, 20, 25 feet

TOTAL DEPTH OF BORING 25 FEET

NOTE
NO GROUNDWATER WAS PRESENT DURING OR AT COMPLETION OF DRILLING ACTIVITIES.
* WITH 6" SEAT

8434

ENPROTEC/HIBBS & TODD, INC.
ENVIRONMENTAL AND CIVIL ENGINEERING
402 Cedar Street
(325) 698-5560
Abilene, Texas 79601
Firm Registration No. 1151

LOG OF BORING

Project: **WWTP IMPROVEMENTS** Date: 19 SEPTEMBER 2023

Location: **TOLAR, TEXAS** Type: AIR ROTARY Boring No.: **B-4**

DEPTH IN FEET	SAMPLE	MATERIAL DESCRIPTION	N-BLOWS PER FOOT	TEXAS CONE PENETROMETER 1st 6"	TEXAS CONE PENETROMETER 2nd 6"	Qp (tsf)
	ST	BROWN SANDY CLAY WITH TRACE GRAVEL				3.5
		TAN SANDY CLAY WITH TRACE GRAVEL				
5	SS	TAN WEATHERED SHALE WITH INTERBEDDED LIMESTONE SEAMS	81			
10	SS	- TRACE MOISTURE @ $9\frac{1}{2}$'	53/3"*			
15	SS	GRAY WEATHERED SHALE WITH INTERMITTENT LIMESTONE SEAMS	50/1"*			
20	TCP			50=$\frac{1}{2}$"	50=0"	
25	SS		76			

TOTAL DEPTH OF BORING 25 FEET

NOTE

NO GROUNDWATER WAS PRESENT DURING OR AT COMPLETION OF DRILLING ACTIVITIES.

* WITH 6" SEAT

8434

ENPROTEC/HIBBS & TODD, INC.
ENVIRONMENTAL AND CIVIL ENGINEERING
402 Cedar Street
(325) 698-5560
Abilene, Texas 79601
Firm Registration No. 1151

LOG OF BORING

Project: **WWTP IMPROVEMENTS** Date: 19 SEPTEMBER 2023

Location: **TOLAR, TEXAS** Type: AIR ROTARY Boring No.: **B-6**

DEPTH IN FEET	SAMPLE	MATERIAL DESCRIPTION	N-BLOWS PER FOOT	TEXAS CONE PENETROMETER 1st 6"	TEXAS CONE PENETROMETER 2nd 6"	Qp (tsf)
0–1.5	ST	BROWN SANDY CLAY				4.5+
1.5–4	AU	TAN SANDY CLAY WITH TRACE GRAVEL				
4–5	SS		62			
5–9	AU	TAN WEATHERED SHALE WITH INTERBEDDED LIMESTONE SEAMS				
9–10	TCP			50=0"	50=0"	
12.5–14		GRAY WEATHERED SHALE WITH INTERMITTENT LIMESTONE SEAMS				
14–15	SS		54			
19–20	TCP			50=0"	50=0"	
24–25	SS		50/6"			

TOTAL DEPTH OF BORING 25 FEET

NOTE

NO GROUNDWATER WAS PRESENT DURING OR AT COMPLETION OF DRILLING ACTIVITIES.

8434

ENPROTEC/HIBBS & TODD, INC.
ENVIRONMENTAL AND CIVIL ENGINEERING
402 Cedar Street
(325) 698-5560
Abilene, Texas 79601
Firm Registration No. 1151

LOG OF BORING

Project: **WWTP IMPROVEMENTS** Date: 20 SEPTEMBER 2023

Location: **TOLAR, TEXAS** Type: AIR ROTARY Boring No.: **B-7**

DEPTH IN FEET	SYMBOL	SAMPLE	MATERIAL DESCRIPTION	N-BLOWS PER FOOT	TEXAS CONE PENETROMETER 1st 6"	TEXAS CONE PENETROMETER 2nd 6"	Qp (tsf)	DEPTH SCALE
0-1		ST	BROWN SANDY CLAY				4.5+	
1-3.5		AU	BROWN SANDY CLAY					
3.5-5		SS	BROWN SANDY CLAY	58				
5-6		AU	BROWN SANDY CLAY					
6-8		AU	TAN SANDY CLAY WITH TRACE GRAVEL					
8-8.5		AU	TAN WEATHERED SHALE WITH INTERBEDDED LIMESTONE SEAMS					
8.5-10		SS	TAN WEATHERED SHALE WITH INTERBEDDED LIMESTONE SEAMS	30				
10-13.5			TAN WEATHERED SHALE WITH INTERBEDDED LIMESTONE SEAMS					
13.5-15		SS	GRAY WEATHERED SHALE WITH INTERMITTENT LIMESTONE SEAMS	50/6"				
15-19			GRAY WEATHERED SHALE WITH INTERMITTENT LIMESTONE SEAMS					
19-20		TCP	GRAY WEATHERED SHALE WITH INTERMITTENT LIMESTONE SEAMS		50=1"	50=0"		
20-23.5			GRAY WEATHERED SHALE WITH INTERMITTENT LIMESTONE SEAMS					
23.5-25		SS	GRAY WEATHERED SHALE WITH INTERMITTENT LIMESTONE SEAMS	50/6"				

TOTAL DEPTH OF BORING 25 FEET

NOTE

NO GROUNDWATER WAS PRESENT DURING OR AT COMPLETION OF DRILLING ACTIVITIES.

8434

ENPROTEC/HIBBS & TODD, INC.
ENVIRONMENTAL AND CIVIL ENGINEERING
402 Cedar Street Abilene, Texas 79601
(325) 698-5560 Firm Registration No. 1151

LOG OF BORING

Project: **WWTP IMPROVEMENTS** Date: 19 SEPTEMBER 2023

Location: **TOLAR, TEXAS** Type: AIR ROTARY Boring No.: **B-8**

DEPTH IN FEET	SYMBOL	SAMPLE	MATERIAL DESCRIPTION	N-BLOWS PER FOOT	TEXAS CONE PENETROMETER 1st 6"	TEXAS CONE PENETROMETER 2nd 6"	Qp (tsf)	DEPTH SCALE
0–1.5		ST	BROWN SANDY CLAY				4.5+	
1.5–3		AU	BROWN SANDY CLAY WITH TRACE GRAVEL					
3–4.5		SS	TAN SANDY CLAY WITH TRACE GRAVEL	65				
5		AU						
8–10		SS	TAN WEATHERED SHALE WITH INTERBEDDED LIMESTONE SEAMS	50/4"				
13–15		SS	GRAY WEATHERED SHALE WITH INTERMITTENT LIMESTONE SEAMS	46				
18–20		SS		50/3"*				
23–25		SS		50/6"*				

TOTAL DEPTH OF BORING 25 FEET

NOTE

NO GROUNDWATER WAS PRESENT DURING OR AT COMPLETION OF DRILLING ACTIVITIES.

* WITH 6" SEAT

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LOG OF BORING

Project: **WWTP IMPROVEMENTS** Date: 19 SEPTEMBER 2023

Location: **TOLAR, TEXAS** Type: AIR ROTARY Boring No.: **B-9**

DEPTH IN FEET	SYMBOL	SAMPLE	MATERIAL DESCRIPTION	N-BLOWS PER FOOT	TEXAS CONE PENETROMETER 1st 6"	TEXAS CONE PENETROMETER 2nd 6"	Qp (tsf)	DEPTH SCALE
		ST	BROWN SANDY CLAY				1.5	
		AU	TAN SANDY CLAY WITH TRACE GRAVEL					
5		SS		19				
		AU						
10		SS	TAN WEATHERED SHALE WITH INTERBEDDED LIMESTONE SEAMS	61/11"				
15		SS	GRAY WEATHERED SHALE WITH INTERMITTENT LIMESTONE SEAMS	46				
20		TCP			50=0"	50=$\frac{1}{4}$"		
25		SS		77/11"				

TOTAL DEPTH OF BORING 25 FEET

NOTE

NO GROUNDWATER WAS PRESENT DURING OR AT COMPLETION OF DRILLING ACTIVITIES.

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LOG OF BORING

Project: **WWTP IMPROVEMENTS** Date: 20 SEPTEMBER 2023

Location: **TOLAR, TEXAS** Type: AIR ROTARY Boring No.: **B-10**

Sample	Material Description	N-Blows per Foot	Texas Cone Penetrometer 1st 6"	Texas Cone Penetrometer 2nd 6"	Qp (tsf)
ST	BROWN SANDY CLAY				4.5+
ST					4.5+
SS		19			
ST					4.5+
AU	TAN SANDY CLAY WITH TRACE GRAVEL				
SS		53			
	TAN WEATHERED SHALE WITH INTERBEDDED LIMESTONE SEAMS				
TCP	GRAY WEATHERED SHALE WITH INTERMITTENT LIMESTONE SEAMS		50=½"	50=0"	
SS		78/11"			
SS		50/5"			

Depth in feet: 5, 10, 15, 20, 25

TOTAL DEPTH OF BORING 25 FEET

NOTE
NO GROUNDWATER WAS PRESENT DURING OR AT COMPLETION OF DRILLING ACTIVITIES.

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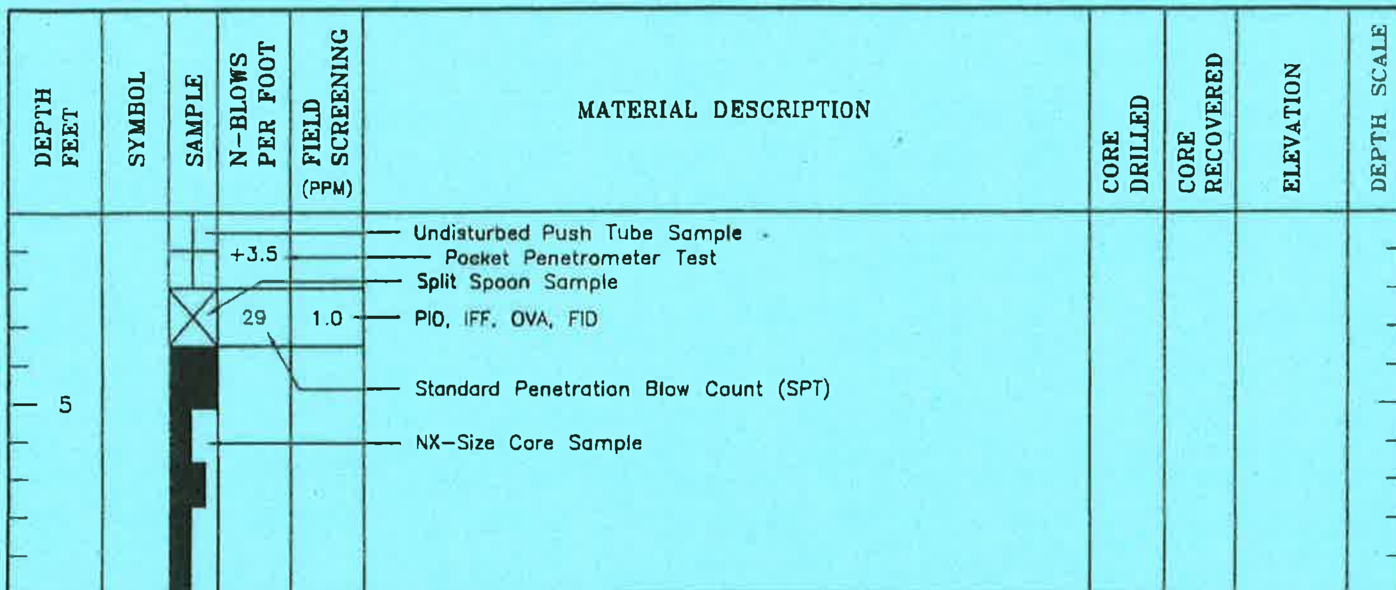
EXPLANATION OF SYMBOLS AND TERMS USED ON BORING LOGS



Water Encountered — Water Level Encountered During Drilling

Static Level (date) — Stabilized Water Level

UNIFIED SOIL CLASSIFICATION DESCRIPTION OF SYMBOLS AND DIVISIONS

Well-Graded Gravels, Gravel Sand Mixtures (GW)

Poorly-Graded Gravels, Gravel Sand Mixtures (GP)

Silty Gravel, Gravel Sand-Silt Mixtures (GM)

Clayey Gravels, Gravel-Sand-Clay Mixtures (GC)

Well-Graded Sands, Gravelly Sands (SW)

Poorly-Graded Sands, Gravelly Sands (SP)

Silty Sands, Poorly-Graded, Sand-Silt Mixtures (SM)

Clayey Sands, Poorly-Graded, Sand-Clay Mixtures (SC)

Inorganic Silts and Very Fine Sands, Silty or Clayey Fine Sands (ML)

Inorganic Clays of Low to Medium Plasticity Gravelly, Sandy or Silty Clays, Lean Clays (CL)

Organic Silts and Organic Silty Clays of Low Plasticity (OL)

Inorganic Silts, Micaceous or Diatomaceous Fine Sandy or Silty Soils (MH)

Inorganic Clays of High Plasticity, Fat Clays (CH)

Organic Clays of Medium to High Plasticity, Organic Silts (OH)

Caliche and Other Impervious Layer (HP)

BEDROCK SYMBOLS

Conglomerate (CGL)

Sandstone (SS)

Limestone (LS)

Shale (Sh)

Weathered Shale (WS)

Sandy Shale (SSh)

Shaley Limestone (Sh LS)

Dolomite (DOL)

MISCELLANEOUS SYMBOLS

Asphaltic Concrete (HMAC)

Cement Grout (CMT)

Bentonite (BENT)

The LOG of BORING is a representation of the subsurface material at specific boring location and within the depth explored. The transition between strata may be gradual and variations in material types and depths between borings can be expected. Water level observations represent those conditions at the time of exploration and may vary with time and location of site.

SOIL COLOR CLASSIFICATION
Determined by
MUNSELL SOIL COLOR CHARTS
1990 EDITION REVISED

GENERAL NOTES

SAMPLE IDENTIFICATION

Soil Samples are visually classified in general accordance with the Unified Soil Classification System (ASTM D2487 or D 2488)

DRILLING AND SAMPLING SYMBOLS

ST:	Shelby Tube - 3" O.D., except where noted
SS:	Split-Spoon
THD:	THD Cone Penetrometer
AU:	Auger Sample
DB:	Diamond Bit
CB:	Carbide Bit
WS:	Wash Sample

SOIL PROPERTY SYMBOLS

N:	Standard "N" penetration: Blows per foot, or fraction thereof, of a 140 pound hammer 30 inches on a split-spoon
Qp:	Calibrated Penetrometer Resistence, TSF
Qu:	Unconfined Compression Strength, TSF
LL:	Liquid Limit, %
PI:	Plasticity Index

SOIL STRENGTH CHARACTERISTICS

NON-COHESIVE (GRANULAR) SOILS

RELATIVE DENSITY	BLOWS PER FOOT(N)
Very Loose	0-4
Loose	5-10
Firm	11-30
Dense	31-50
Very Dense	51+

COHESIVE (CLAYEY) SOILS

COMPARATIVE CONSISTENCY	BLOWS PER FOOT(N)	UNCONFINED COMPRESSIVE STRENGTH (Qu)
Very Soft	0-2	0 - 0.25
Soft	3-4	0.25 - 0.50
Medium Stiff	5-8	0.50 - 1.00
Stiff	9-15	1.00 - 2.00
Very Stiff	16-30	2.00 - 4.00
Hard	31+	4.00+

SOIL CHARACTERISTICS

PARTICLE SIZE

Boulders	8 in.+	Coarse Sand	5mm-0.6 mm	Silt	0.074mm-.005mm
Cobbles	8 in.-3 in.	Medium Sand	0.6mm-0.2mm	Clay	-0.005mm
Gravel	3 in.-5mm	Fine Sand	0.2mm-0.074 mm		

DEGREE OF EXPANSIVE POTENTIAL	PI
Low	0-15
Moderate	15-25
High	25+

DEGREE OF PLASTICITY	PI
None to Slight	0-4
Slight	5-10
Moderate	11-30
High	31+