

SECTION 01 11 13
WORK COVERED BY CONTRACT DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes

1. Definitions.
2. Work Covered by Contract Documents.
3. Cash Allowances.
4. Owner-Furnished Products.
5. Document Management Software
6. Work Sequence.
7. Work Guidelines.
8. Coordination of Work.
9. Contractors Use of Premises.
10. Contract Clarification.
11. Alternate Construction Methods.
12. Utility Lines.
13. Warranty.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 00 – Bidding Requirements, Contract Forms, and Conditions of the Contract.
2. Division 01 – General Requirements.

1.2 MEASUREMENT AND PAYMENT (NOT USED)

1.3 SUBMITTALS (NOT USED)

1.4 DEFINITIONS

- A. Small Diameter Lines: Water lines 20-inch in diameter and smaller. Unless otherwise noted in the Contract Documents, requirements pertaining to large diameter water lines do not apply to pipe, valves, and appurtenances 20-inches in diameter and smaller.
- B. For the purposes of this contract, the terms “Water Main”, “Water Line”, “water line”, “Waterline”, and “waterline” all refer to the same item as the primary component of this work product.

1.5 WORK COVERED BY CONTRACT DOCUMENTS

- A. Installation of 12-inch water main (line) by means of trenchless installation to replace a damaged water line of the same diameter crossing Panther Branch (creek) between the two dead-ends of Grogan's Point Road.
1. Install approximately 1,000 linear feet of 12-inch fused HDPE or PVC pipe to cross Panther Branch. Provide a drill so that the resultant depth of cover under the center flow line of the creek is a minimum of 20-feet. The installation of the drill will start approximately 250 linear feet west of the west high bank of the creek and extend to approximately 500 linear feet east of the east bank of the creek (see drawings). Adjust as necessary to allow for tie-in on west side to existing buried PVC 12-inch water line.
 2. Remove approximately 20 linear feet (two locations) of existing 12-inch water line to allow for tie-in of proposed 12-inch fused water line.
 3. Install 2-12-inch gate valves with boxes, with one at either end of the proposed water line where the tie-in is made to the existing water line.
 4. Provide all necessary equipment and materials to provide access as necessary to the site to perform the previously noted work. This includes all bridging/bridge materials to traverse ditches and wash-outs on the west side and to traverse the deep/steep drainage channel on the east side. Any bridging structures must allow for drainage through/beneath the structure, and temporary structure must be removed in the event of a tropical cyclone potentially hitting The Woodlands, Texas area (no additional cost). Access will only be allowed along the existing water line/access easement owned by SJRA. If other means of access are desired, Contractor must make all necessary arrangements with related property owner to acquire ingress/egress and provide a written form of agreement to the Owner to allow for verification that the agreement has been made and formalized. All work to access the job site to perform the water line work is to be performed

at no additional cost to the Owner. Include all costs for this effort in associated proposal items as noted on Exhibit 4 – Pricing Sheet.

- B. Provide all other work as required to complete the work and by these contract documents, including all work to test, disinfect and flush the proposed line.

1.6 CASH ALLOWANCES (NOT USED)

1.7 OWNER-FURNISHED PRODUCTS

- A. Items furnished by the Owner for installation and final connection by Contractor:

1. Water for pressure testing and flushing – The Owner will provide water for these activities via fire hydrant. Please note that the location of the nearest working hydrant may be at a substantial distance from the work site which the Contractor must allow for. Contractor to provide certified and calibrated meter and backflow preventer, and record water used to provide to Owner for water loss data.

- B. Contractor's Responsibilities:

1. Arrange and pay for product delivery to site.
2. Receive and unload products at site; jointly with Owner's Representative, inspect for completeness or damage.
3. Handle, store, install, and finish products.
4. Repair or replace damaged items.

1.8 DOCUMENT MANAGEMENT SOFTWARE

- A. Contractor and the Owner's Representative shall be given the applicable number of Document Management System user names and passwords.
- B. Contractor shall use the Owner's internet based document management system to transmit its documents to the Owner's Representative, including but not limited to Requests for Information (RFIs), shop drawing submittals, applications for payment, and letters of correspondence. Refer to Specification Section 01 33 00 – Submittals. The document management software should be able to automatically notify all team members of a submittal upload regardless of the originator, i.e. contractor, Principal Architect/Engineer, Owner's Representative, or Owner. Notification of new uploads should go to all team members regardless if they are the Principal Architect/Engineer or not, i.e. sub-consultants for construction management & inspection, but are not tasked as the Principal Architect/Engineer.
- C. A minimum of one (1) and a maximum of three (3) accounts on the document management system will be provided by the Owner. Additional accounts may be requested by the Contractor.

- D. Each account will allow one (1) user to access the document management system. Training on the document management system will be provided by the Owner as requested by the Contractor at a mutually agreed upon date and location.

1.9 WORK SEQUENCE

- A. Construct Work in phases during the construction period. Coordinate construction schedule and operations with the Owner's Representative. Subcontractors shall coordinate its activities and operations with the Contractor.
- B. Construction of this project may require using multiple crews working concurrently in order to complete the project within the specified Contract Time. At no time will multiple crews be allowed to work in consecutive traffic control phases during construction.
- C. Due to overall project complexity and numerous active utility interface requirements, submit a sequence of construction of water lines for review by the Owner's Representative. Proposed sequence of construction shall address proposed method and timing of all major construction activities to be undertaken.
- D. Data for all facilities and utilities shown were taken from available plans, record drawings, and/or utility maps made available from several sources. Actual field locations of facilities and utilities may vary from that shown on the Drawings. Contractor shall make a complete and independent verification of utility locations prior to submittal of subsequent shop drawings. Unless otherwise approved by the Owner's Representative, work shall not continue at locations where there is a conflict with existing utilities.
- E. Construction disturbing traffic shall be conducted during off-peak hours, 9:00 a.m. to 4:00 p.m. weekdays and/or weekends 7:00 p.m. Friday to 4:00 a.m. Monday, dependent upon provisions of Texas Department of Transportation. Weekend work must be approved by the Owner. Exception to these times, if necessary, shall be sought during the permit application process. Continue work in areas using same construction schedule during following, consecutive days and/or weekends until work is completed.

1.10 WORK GUIDELINES

- A. Maintain local driveway access to public schools, residential and commercial properties adjacent to work areas at all times. Provide temporary driveway access in accordance with Specification Sections 01 55 26 – Traffic Control and 01 14 19 – Use of Premises. Coordinate work and schedule with impacted business owners, schools, and residents in conjunction with the Owner, well in advance of commencing the Work in the area(s) of the impacted entities.
- B. Contractor shall adhere to each privately owned and operated utility company's construction guidelines when constructing the proposed Work adjacent-to or across each such entities wet or dry utility.

- C. Contractor shall coordinate its Work with the respective pipeline companies' at all proposed utility crossings. See appropriate Contract Drawings for additional and /or related information.
- D. Obtain right-of-entry agreement(s), insurance, crossing permit(s), and other documentation as required or deemed necessary by each utility or pipeline company or other such entity at no additional cost to the Owner.
- E. Contractor shall coordinate its Work schedule with those utility companies who require a representative of their company to be present (onsite) during the construction adjacent-to or across their wet or dry utility.
- F. Site restoration at all crossings shall be performed immediately upon completion of the Work. Restoration shall be performed in accordance with all applicable Specification Sections and utility company requirements.
- G. Hand dig within one (1) foot of underground service lines (public or private).
- H. Contractor shall bear the sole responsibility for damage to existing traffic cables resulting from its construction activities. The Contractor shall be responsible for the repair of damaged traffic cables including the re-cabling of the entire intersection if required, at no additional cost to the Owner.
- I. Work associated with hydrostatic testing, disinfection, flushing, or cleaning of the new facility shall not begin without prior approval from the Owner's Representative.

1.11 COORDINATION OF WORK

- A. Coordinate activity schedule and extend full cooperation to other Contractors who have responsibilities either concurrent with, proceeding, or following this project's duration along the work site. Ensure availability of access to selected portions of this project area to others and provide appropriate information for planning purposes to other Contractors. No compensation or time extension will be allowed as a result of conflicting construction activities.
- B. Comply with coordination requirements outlined in Specification Section 01 14 19 – Use of Premises.
- C. Coordinate work with the following construction activities by others:
- D. Dial 811 to contact either Texas 811 or Lone Star 811 One-Call all three (3) One-Call centers in the state of Texas a minimum of seventy-two (72) hours prior to construction within twenty-five (25) feet of a private pipeline.
- E. Contact SJRA Woodlands Division at 281-367-9511 a minimum of seventy-two (72) hours prior to construction to have utilities marked.
- F. Contact SJRA GRP Division at 936-588-1662 minimum of seventy-two (72) hours prior to construction to have utilities marked.
- G. Contact the Woodlands Joint Powers Agency at 855-426-7283 a minimum of seventy-two (72) hours prior to construction to have utilities marked.

Contact numbers for such centers are as follows:

1. TESS (Texas) One Call (800) 344-8377
 2. Texas One-Call (800) 245-4545
 3. Texas (Lone Star) One Call (800) 669-8344
- H. Approvals from the following pipeline entities are needed for this project. Approvals are obtained during design and are the responsibility of the Principal Architect/Engineer:
- I. Existing structures adjacent to the proposed alignment shall be closely monitored prior to and during construction in all areas. Several conditions including, but not limited to, soil type, construction methods, weather conditions, surrounding construction, personnel experience, and supervision may impact the amount of ground movement within and surrounding the alignment. Contractor shall survey and adequately document the condition and elevation of existing structures adjacent to the proposed alignment.
- J. All work shall be performed to the lines, grades, elevations, and locations shown on the Drawings.
- K. Prevent overstress or damage of any structure and any part or member of it during construction. This applies to new and existing facilities, utilities, and structures affected by construction operations. Contractor shall monitor and record the effect of its construction operations on new and existing facilities, utilities and structures and provide engineered temporary supports and connections as required to assure the safety and stability of the same to prevent overstress of any part
- L. Prior to commencing any Work involving state or local agencies, agency stipulated notifications shall be made by the Contractor.
- M. Work shall include the restoration of existing drainage swale systems within TXDOT rights-of-way. Contractor shall restore ground cover to areas damaged during construction. Within residential areas, provide block sod. Perform block sodding or hydro-mulch per Specification Sections.
- N. Contractor Work performed within all rights-of-way shall be performed in accordance with the respective entities' standards.

1.12 CONTRACTOR USE OF PREMISES

- A. Comply with all requirements outlined in Specification Section 01 14 19 – Use of Premises.

1.13 CONTRACT CLARIFICATION

- A. Should clarification of the Contract Documents be requested, request clarification before proceeding with Work by submitting a Request for Information (RFI). Such requests shall be preceded by a diligent investigation of the Contract Documents. Include evidence of such investigation(s) in all requests for clarification.

1.14 ALTERNATE CONSTRUCTION METHODS

- A. Alternate construction means and methods will be permitted in accordance with applicable Contract Document details and specification at no additional cost to the Owner. Alternate construction means and methods shall provide a substantial benefit to the project and/or the Owner. Contractor accepts full responsibility for all additional costs of geotechnical investigations and other incidental items, including any re-design that may be necessary to permit the alternate construction means and methods.
- B. Contractor shall submit the below listed modifications for alternate construction methods to the Owner's Representative for Principal Architect/Engineer and Owner's consideration. Submittal shall be made prior to commencement of any construction activity utilizing an alternate construction method. Contractor execution of alternate construction methods prior to its receiving Principal Architect/Engineer and Owner's approval shall be at the sole risk of the Contractor for removal and replacement at no additional cost to the Owner. The following modifications must also be signed and sealed by a Licensed Professional Engineer registered in the State of Texas prior to submittal to Owner's Representative.
1. Revisions to horizontal or vertical alignment;
 2. Revisions to air release/vacuum relief valve vault details, if applicable;
 3. Proposed construction method and detailed plan of approach;
 4. Location of access shafts, if applicable;
 5. Proposed traffic control plan;
 6. Proposed storm water pollution prevention plan;
 7. Revisions to material specifications, and;
- C. If alignment revisions are requested, Contractor shall immediately inform the Owner Representative of any proposed changes and any potential impacts the revised alignment may have on that portion of the transmission line segment and all adjacent line segments, existing or proposed.

1.15 UTILITY LINES

- A. All utilities represented on the Drawings are shown as an approximate location and are based on the best information available during project design. Contractor shall field-verify the exact location of all utilities prior to commencing construction. The Contractor shall be responsible for any and all damage to these utilities, caused or resulting from their failure to locate, protect and/or maintain these utilities during construction.

1.16 WARRANTY

- A. Comply with the warranty requirements stipulated in Contract Document General Conditions and the warranty requirements of the various specification sections of this project manual.

PART 2 - PRODUCTS

2.1 TYPES OF PIPE FOR SMALL DIAMETER WATERLINES

- A. Refer to drawings and specifications for size, material and installation method for water lines in this project.

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 14 19

USE OF PREMISES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Administrative and procedural requirements for:
 - a. Contractor Responsibilities
 - b. Temporary Utilities
 - c. Limits of Construction
 - d. Storage Sheds and Buildings
 - e. Working Times
 - f. Site Access Times
 - g. Notification to Adjacent Occupants
 - h. Safety Requirements
 - i. First Aid Equipment
 - j. Fire Protection
 - k. Security Measures
 - l. Protection of Utilities, Pipelines, and Property
 - m. Surface Restoration
 - n. Traffic Control and Use of Public Rights of Way
 - o. Contractor's Roads and Parking
 - p. Coordination with Facility Owner's Operations
 - q. Contractor's Field Office
 - r. Principal Architect/Engineer's Field Office
 - s. Project Photographs
 - t. Special Considerations Related to Adjacent Properties and Facilities
 - u. Historical and Archaeological Sites

B. Related Specification Sections include but are not necessarily limited to:

1. Division 00 – Proposing Requirements, Contract Forms, and General Conditions of the Contract.

2. Division 01 – General Requirements.
3. Specification Section 31 21 33 – Trenching, Backfilling, and Compacting for Utilities.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Price. No separate payment will be made for this item. Include the cost in associated items for this project.

1.3 SUBMITTALS

- A. See Specification Section 01 33 00 – Submittals for the requirements for the mechanics and administration of the submittal process.
- B. Contractors Safety Program.
- C. All proposed notifications to adjacent occupants.
- D. Planning requests for temporary Owner's facility shutdowns.

1.4 CONTRACTOR RESPONSIBILITIES

- A. Comply with applicable requirements specified in other sections of Project Specifications.
- B. Comply with procedures for access to the site and Contractor's use of rights-of-way.
- C. Maintain and operate temporary construction facilities and temporary systems to assure continuous service of Owner's and other adjacent existing facilities.
- D. Modify and extend temporary systems as Work progress requires.
- E. Completely remove materials and equipment when no longer required.
- F. Restore existing facilities used for temporary services to original or better condition, or as specified.
- G. Prior to installation of material, equipment and/or other work, verify with subcontractors, material or equipment manufacturers, and installers that the substrate or surface to which those materials will attach is acceptable for installation of those materials or equipment. (Substrate is defined as any building or construction surfaces to which materials or equipment are attached to, or required prior to installation i.e., floors, walls, ceilings, soils, utilities, site grading, and backfill etc.).
- H. Correct unacceptable substrate until acceptable for installation of equipment or materials.

1.5 TEMPORARY UTILITIES

- A. Obtaining Temporary Service:
 1. Make arrangements with utility service companies for temporary services,

unless provided by Owner.

2. Abide by rules and regulations of utility service companies and/or authorities/agencies/entities having jurisdiction.
3. Be responsible for utility service costs and permits until Work is substantially complete. Included services are fuel, power, light, heat, and any other utility services necessary for execution, completion, testing, and initial operation of Work.
4. Be responsible for providing approved metering devices, as necessary, for any temporary utilities.

B. Water:

1. Contractor to provide water required for performance of Work, specified tests of piping, equipment, devices, or other equipment, and for other uses as necessary.
2. Provide and maintain adequate supply of potable water for consumption by Contractor personnel and Owner's Representatives.
3. Provide necessary approved metering devices and backflow preventers.

C. Electricity and Lighting:

1. Provide electrical service required for Work, including testing of Work. Provide power for lighting, operation of equipment, and other use as necessary.
2. For projects on existing sites, electric power service to be provided includes temporary power service or generator(s) to maintain Owner's operations during scheduled shutdown(s). Coordinate all temporary shutdowns with Owner and Owner's Representative(s).
3. Minimum lighting level shall be ten (10) foot-candles for open areas; twenty (20) foot-candles for stairs and shops. Provide minimum of one (1) 300 watt lamp for each 200 square feet of work area.

D. Heat and Ventilation:

1. Provide temporary heat as necessary for protection or completion of Work.
2. Provide temporary heat and ventilation to assure safe working conditions. Maintain enclosed areas at minimum of 50°F.

E. Telephone:

1. Provide emergency telephone service (including call waiting and call forwarding) at Project Site for use by Contractor personnel, Owner, Owner's Representative, and others performing work or furnishing services at the site.

F. Sanitary Facilities:

1. Provide and maintain sanitary facilities for persons on job site. Comply with regulations of State and local departments of health.
2. Enforce use of sanitary facilities by construction personnel at job site. Enclose sanitary facilities. Pit-type toilets will not be permitted. No discharge will be allowed from these facilities. Collect and store sewage and waste so as not to cause nuisance or health problem. Haul sewage and waste off-site and properly dispose of in accordance with all applicable regulations.
3. Locate toilets near Work site, within 500 feet of working activities for line work projects and secluded from view as best as possible. Keep toilets clean and supplied throughout course of Work. Locate toilets a minimum of 100 feet from all water wells.

1.6 LIMITS OF CONSTRUCTION

- A. Construction operations and storage areas are limited to Owner's property, permanent easements, temporary construction easements (TCE), and/or the Limits of Construction or Construction Limits as indicated on the Contract Drawings.
- B. Unauthorized use of areas, or trespassing on land outside of defined limits, is not permitted.
- C. Make arrangements, at no cost to the Owner, for Contractor's temporary use of any private properties which may be needed by Contractor for performance of Work. Contractor and Contractor's surety shall indemnify and hold harmless the Owner and Owner's Representatives against claims or demands arising from use of properties outside the Limits of Construction. Submit notarized copy of any separately negotiated agreement(s) between private property owner(s) and Contractor prior to use of area.
- D. Where Limits of Construction are shown on Contract Drawings to extend to a property or Right-of-Way line, keep equipment, materials, and stockpiles a minimum of 5 feet from boundary, or existing fence lines.
- E. Where utility alignment is within an esplanade and Limits of Construction are shown to extend to edge of the esplanade, keep equipment, materials, and stockpiles a minimum of 5 feet from back of curb.
- F. There are unique terms and conditions associated with the various public and private easements, rights-of-entry, encroachment and crossing documents (collectively, the easement documents) which may be site specific. Contractor shall familiarize itself with all easement Documents. Easement documents are available from the Owner on a case by case basis upon request.
- G. The Contractor, at its sole expense, shall be responsible for complying with all

terms and conditions of all easement documents and the easement rights described therein for this project.

- H. Contractor shall safely, properly, and adequately assume and perform all of the duties, indemnities, responsibilities, and liabilities of the Owner under the easement documents.
- I. Contractor, at its cost, shall provide all insurance required by the easement documents. All land included within the tracts covered by the easement documents and easements described herein shall be restored to its original condition prior to Substantial Completion of the construction (including, without limitation, repair or replacement of pavement, concrete, signs, fencing, trees, sidewalks, landscaping, shrubbery, and grass) unless otherwise specified in the Contract Documents.

1.7 STORAGE SHEDS AND BUILDINGS

- A. Provide adequately ventilated, watertight storage facilities with floor above ground level for protection of materials and equipment susceptible to weather damage.
- B. Store materials in neat and orderly manner. Store materials and equipment to permit easy access for identification, inspection, and inventory.
- C. Storage of materials not susceptible to weather damage may be on blocks off ground.
- D. Storage of all fuels and chemicals shall be in designated areas by Contractor.
- E. Refer to Specification Section 01 65 50 – Product Delivery, Storage, and Handling for additional requirements.
- F. Fill and grade site for temporary structures to provide positive drainage away from Work area, but not to impact adjacent property owners.
- G. Restrict total length of distributed materials along route of construction up to 1,000 linear feet as approved in writing by Owner's Representative.
- H. Avoid obstructing drainage ditches or inlets. When obstruction is unavoidable due to requirements of Work, provide grading and temporary drainage structures to maintain unimpeded drainage flow. Failure of the Contractor to maintain proper site drainage shall prohibit it from making a claim against the Owner for monetary or time damages due to drainage impacts.

1.8 WORKING TIMES

- A. Construction shall be conducted during working hours as indicated in Specification Section 00 72 00 – General Conditions of the Contract, unless otherwise amended by a supplemental specification or agreement to the General Conditions of the Contract, and approved by Owner.

1.9 SITE ACCESS TIMES

- A. Contractor to coordinate all site access, including deliveries, outside of working hours with Owner's Representative. Neither Owner nor Owner's Representatives shall sign for any Contractor deliveries. Refer to Specification Section 01 65 50 – Product Delivery, Storage, and Handling.
- B. Contractor shall coordinate with Owner to not interfere with Owner's facility operations.

1.10 NOTIFICATION OF ADJACENT OCCUPANTS

- A. Notify individual occupants in areas to be affected by Work of proposed construction activities and schedule using a standardized notification form letter and/or door hanger. Notification shall be made not less than 72 hours or more than 2 weeks prior to performance of work within 200 feet of homes or businesses. Coordinate all notifications with Owner's Representative.
- B. Include in notification the names and telephone numbers of two Contractor representatives for resident contact available on 24-hour call. Describe precautions that Contractor will take to protect private property and identify potential inconveniences and disruptions to resident's access and utilities.
- C. For Contractor's convenience, Owner's Representative will provide an example notice at the pre-construction meeting. In addition to other requirements of this specification regarding notification to adjacent occupants, Contractor's notice is generally to follow the form and content of the example notice.
- D. Submit proposed notification(s) to Owner for approval prior to distribution. Provide notice(s) in languages as appropriate (i.e., double sided notice. Notice on one side shall be written in English and flip side shall be written in Spanish).

1.11 SAFETY REQUIREMENTS

- A. Beware of overhead power lines existing in area and in close proximity to project. When 10 feet of clearance between energized overhead power line and construction-related activity cannot be maintained, submit a request to the appropriate utility provider to de-energize or move conflicting overhead power line(s).
- B. Submit Contractor's Safety Program in accordance with Specification Section 01 33 00 – Submittals. Include Site Safety and Site Security in accordance with Specification Section 00 72 00 – General Conditions of the Contract. Include documented response to trench safety requirements as specified in Specification Section 00 31 32.10 – Trench Safety Geotechnical Information.
- C. Conduct operations in strict accordance with the Contractor's Safety Program, in accordance with applicable Federal, State, and local safety codes and statutes, and with good construction practice. Establish and maintain procedures for safety of all work, personnel, and equipment involved in Project.

- D. Observe and comply with Texas Occupational Safety Act (Art. 5182a, V.C.S.) and with all safety and health standards promulgated by Secretary of Labor under Section 107 of Contract Work Hours and Standards Act, published in 29 CFR Part 1926 and adopted by Secretary of Labor as occupational safety and health standards under Williams-Steiger Occupational Safety and Health Act of 1970, and to other legislation enacted for safety and health of Contractor employees. Safety and health standards apply to subcontractors and their employees as well as to Contractor and its employees.
- E. Observance of and compliance with regulations is solely and without qualification responsibility of Contractor without reliance or superintendence of or direction by the Owner or Owner's Representative. Immediately advise Owner's Representative of investigation or inspection by Federal Safety and Health Inspectors of Contractor or subcontractor's work or place of work on job site under this Contract, and after investigation or inspection, advise Owner's Representative of results. Submit one copy of accident reports to Owner's Representative within 10 days of occurrence.
- F. Protect areas occupied by workmen using best available devices for detection of lethal and combustible gases. Test devices frequently to assure functional capability. Constantly observe infiltration of liquids into Work area for visual or odor evidences of contamination, and immediately take appropriate steps to seal off entry of contaminated liquids into Work area.
- G. Implement safety measures, including but not limited to safety personnel, first-aid equipment, ventilating equipment, and other safety equipment, as specified or detailed on the Contract Drawings.
- H. Maintain required coordination with Police and Fire Departments during entire period covered by Contract.
- I. In safety plan, include project safety analysis. Itemize major tasks and potential safety hazards. Plan to eliminate hazards or protect workers and public from each hazard.

1.12 FIRST AID EQUIPMENT

- A. Provide first aid kit throughout construction period. List telephone numbers for hospitals, and ambulance services in each first aid kit.
- B. Have at least one person thoroughly trained in first aid and cardiopulmonary resuscitation (CPR) procedures present on site whenever Work is in progress. Contractor to conform to protocols and requirements for training and protection against "blood borne pathogens."

1.13 FIRE PROTECTION

- A. Conform to specified fire protection and prevention requirements established by Federal, State, or local governmental agencies and as provided in

Contractor's Safety Program.

1.14 SECURITY MEASURES

- A. Protect all Work materials, equipment, and property from loss, theft, damage, and vandalism. Perform duty to protect property of the Owner used in connection with performance of Work.
- B. If existing fencing or barriers are breached or removed for purposes of construction, provide and maintain temporary security fencing equal to existing.

1.15 PROTECTION OF UTILITIES, PIPELINES, AND PROPERTY

- A. Utilize Utility Coordinating Committee One Call System (telephone number, (713) 223-4567), which must be called 48 hours in advance to locate utilities. Toll free telephone number is 1-800-669-8344, Texas (Lone Star) One Call System.
- B. Notify SJRA Woodlands Division a minimum of 72 hours in advance of any field activities to mark existing SJRA Woodlands utilities. Telephone number is 281-367-9511. Contact Steve McKeon (primary) or Jason Williams (secondary).
- C. Notify SJRA GRP Division a minimum of 72 hours in advance of any field activities along FM 2978 to mark existing GRP utilities. Telephone number is 936-588-1662.
- D. Notify Woodlands Joint Powers Association (WJPA) a minimum of 72 hours in advance of any field activities to have WJPA utilities marked. Telephone number 281-367-1271.
- E. Prevent damage to existing utilities during construction. Utilities shown on Drawings are at approximate locations. Pre-locate, by whatever means may be required (metal detection equipment, probes, excavation, survey), underground utilities before excavating in accordance with the Critical Locations investigation described in Specification Section 31 21 33 – Trenching, Backfilling and Compacting for Utilities. Perform investigative work and repairs required after investigation. Contractor is responsible for damages caused by failure to locate and preserve these underground utilities. Give owners of utilities a minimum of five (5) days' notice before commencing Work in area, for locating utilities during construction and for making adjustments or relocation of utilities when they conflict with proposed Work. Include cost for temporary relocation of utilities necessary to accommodate construction in unit costs for utility construction unless otherwise noted on Drawings. Bypassing of sanitary waste to storm drainage facilities is not allowed. Utility service laterals are not shown on Drawings. Contractor shall anticipate that service lines exist and repair them when damaged due to construction activity. No separate payment will be made for repair work. Include payment in unit prices for work in

appropriate sections.

- F. Contractor shall adhere to each privately owned and operated utility company's construction guidelines when working adjacent-to or across each such entities wet or dry utility.
- G. Prior to abandonment of any utility indicated on the Drawings, make arrangements with Owner's Representative and utility owner to terminate service, remove meters, valves, appurtenances, transformers, and/or poles, as required.
- H. Utility Outages and Shutdowns: Provide a notification to the Owner's Representative and private utility companies (when applicable) a minimum of 48 hours, excluding weekends and holidays, in advance of required utility shutdown. Shutdown planning and coordination activities shall commence a minimum of 2-weeks prior to scheduled shutdown. Coordinate all work as required.
- I. Protect and prevent damage to existing crossing, parallel, and adjacent pipelines during construction in accordance with Specification Section 01 11 13 – Work Covered by Contract Documents.
- J. When excavating near product pipelines and prior to start of excavation, request that representative of pipeline company come to the construction site(s) to meet representatives of Contractor and Owner's Representative to discuss actual procedures that will be used. Request that pipeline company's representative probe and locate pipelines in at least three locations: one at each side of proposed excavation and one at centerline of proposed Work. Representative of the pipeline company and Owner's Representative must be present to observe activities of Contractor at all times when excavation is being conducted within 15 feet of existing pipelines.
- K. Protection of the Work, and Public and Private Property
 - 1. Take precautions, provide programs, and take actions necessary to protect the Work, and public and private property from damage.
 - 2. Do not alter condition of properties adjacent to and along Limits of Construction.
 - 3. Do not use ways, means, methods, techniques, sequences, or procedures that result in damage to adjacent properties or improvements.
 - 4. Restore properties damaged by Contractor outside of designated Limits of Construction at no cost to Owner.
 - 5. Take action to prevent damage, injury, or loss, including, but not limited to, the following:
 - a. Store materials, supplies, and equipment in orderly, safe manner that will

not interfere with progress of Work or work of others.

- b. Provide suitable storage for materials subject to damage by exposure to weather, theft, breakage, or otherwise.
 - c. Place upon Work or any part thereof only safe loads.
 - d. Frequently clean up refuse, rubbish, scrap materials, and debris created by construction operations, keeping Project site safe and orderly.
 - e. Provide safe barricades and guard rails to protect pedestrian and vehicular traffic around openings, scaffolding, temporary stairs and ramps, excavations, elevated walkways, and other hazardous areas.
6. Assume full responsibility for preservation of public and private property on or adjacent to the Limits of Construction. When direct or indirect damage is done by or on account of any act, omission, neglect, or misconduct in execution of Work by Contractor, restore to condition equal to or better than that existing before damage was done.
 7. Perform daily clean up in affected construction areas in order to restore site to existing or better conditions. Areas should be free of debris, scrap material, dirt, mud, and other items identified by Owner's Representative. Do not leave buildings, roads, streets, or other construction areas unclean. If deemed necessary by the Owner's Representative, Contractor shall employ street sweeping/cleaning equipment to maintain area streets.

L. Barricades and Warning Signals:

1. Where Work is performed on or adjacent to any roadway, right-of-way, or public place, furnish and erect barricades, fences, lights, warning signs, and danger signals, and take other precautionary measures, for protection of persons or property and of the Work.
2. Paint barricades to be visible at night. From sunset to sunrise, furnish and maintain at least one light at each barricade.
3. Erect sufficient barricades to keep vehicles and pedestrians from entering the area under construction.
4. Maintain barricades, signs, lights and provide watchmen until Project is accepted by the Owner or the site has been completely restored to its preconstruction condition.
5. Whenever Work creates encroachment on public roadways, station flagmen to manage traffic flow in accordance with approved traffic control plan. Refer to Specification Section 01 55 26 – Traffic Control.

M. Protection of Existing Structures:

1. Underground Structures:

- a. Underground structures are defined to include, but not be limited to, sewer, water, gas, and other piping, manholes, boxes, chambers, electrical signal and communication conduits, tunnels, and other existing subsurface installations located within or adjacent to limits of Work.
 - b. Known underground structures including water, sewer, electric, and telecommunication services are shown on Contract Drawings. This information is not guaranteed to be correct or complete.
 - c. Explore ahead of trenching and excavation work and sufficiently uncover obstructing underground structures to determine their location, to prevent damage to them, and to prevent interruption of utility services. Restore underground structures to original conditions at no additional cost if damaged during construction.
 - d. Locate and protect private lawn sprinkler systems which may exist within site. Repair or replace damaged systems to condition existing at start of Work, or better.
 - e. Necessary changes in location of Work may be made by the Owner to avoid unanticipated underground structures.
 - f. If permanent relocation of underground structures or other subsurface installations is required and not otherwise provided in Contract, the Owner will direct Contractor in writing to perform Work, which is paid for under provisions for changes as described in Specification Section 00 72 00 - General Conditions of the Contract.
2. Surface Structures: Surface structures are defined as existing buildings, structures and other constructed installations above ground surface. Included with structures are their foundations and any extensions below the surface. Surface structures include, but are not limited to buildings, tanks, walls, bridges, roads, dams, channels, open drainage, piping, poles, wires, posts, signs, markers, curbs, walks, guard cables, fencing, and other facilities visible above ground surface.
 3. Existing Condition Survey: Contractor shall survey and adequately document the condition and elevation of existing structures adjacent to the proposed alignment.
 4. Protection of Underground and Surface Structures:
 - a. Support in place and protect from direct or indirect damage underground and surface structures located within or adjacent to limits of Work.
 - b. Prevent overstress or damage to any structure and any part or member of structures during construction. This applies to new and existing facilities, utilities, and structures affected by construction operations. Contractor shall monitor and record the effect of its construction

operations on new and existing facilities, utilities, and structures, and shall provide engineered temporary supports and connections as required to assure the safety and stability of the structures and prevent overstress of any part. Employ a registered Professional Engineer licensed in the State of Texas to design temporary supports to assure safety and integrity of structures and facilities.

- c. Install temporary supports carefully and as required by party owning or controlling structure. Before installing structure supports, satisfy Owner's Representative that methods and procedures have been approved by owner of structure.
- d. Avoid moving or changing property of public utilities or private corporations without prior written consent of responsible official of that service or public utility. Representatives of these utilities reserve the right to enter within limits of this Project for purpose of maintaining their properties, or of making changes or repairs to their property that may be considered necessary by performance of this Contract.
- e. Notify owners and/or operators of utilities and pipelines adjacent to the Work of the nature of construction operations and dates when operations will be performed. When construction operations are required in immediate vicinity of existing structures, pipelines, or utilities, give minimum of 5 working days advance notice. Probe and flag location of underground utilities prior to commencement of excavation. Keep flags in place until construction operation reaches and uncovers utility.
- f. Assume risks attending presence or proximity of underground and surface structures within or adjacent to Work including but not limited to damage and expense for direct or indirect damage caused by Contractor's Work to structure. Immediately repair damage.

N. Protection of Installed Products:

- 1. Provide protection of installed products to prevent damage from subsequent operations. Remove protection facilities when no longer needed, prior to final completion of Work.
- 2. Control traffic to prevent damage to equipment, materials, and surfaces.
- 3. Provide coverings to protect equipment and materials from damage. Cover projections, wall corners, jambs, sills, and exposed sides of openings in areas used for traffic and passage of materials in subsequent work.

1.16 SURFACE RESTORATION

- A. Restore site to the condition which existed before construction in accordance with Specification Section 01 74 23 – Restoration of Site, unless otherwise noted in Contract Documents.

- B. For projects not having well defined phases, the total linear footage of project rights-of-way and/or easements that may be disturbed at any given time, shall be limited to no more than fifty (50) percent of the total project linear footage or 1,000 linear feet, whichever is less. Accordingly, disturbed areas shall be restored in accordance with Specification Section 01 74 23 – Restoration of Site prior to proceeding with Work that would exceed the fifty (50) percent total project disturbed length or 1,000 linear feet, whichever is less.

1.17 TRAFFIC CONTROL AND USE OF PUBLIC RIGHTS OF WAY

- A. Comply with traffic regulation in accordance with Specification Section 01 55 26 - Traffic Control, and approved traffic control plan(s).
- B. Provide barricades and signs in accordance with Section VI of the State of Texas Manual on Uniform Traffic Control Devices.
- C. Obtain necessary permits and Owner's approval when the nature of Work requires closing an entire street. Obtaining permits required for street closure are the Contractor's responsibility. Avoid unnecessary inconvenience to abutting property owners. Avoid closing more than two (2) consecutive intersections at one time, except by permission of Owner.
- D. Notify Owner's Representative at least 48 hours prior to closing a street or street crossing. It is the Contractor's responsibility to obtain all required permits for street closures in advance.
- E. Maintain 10-foot-wide minimum access lane for emergency vehicles, including access to fire hydrants, at all times.
- F. Remove surplus materials and debris and open each 500 lineal foot length of roadway for public use when work within that length is complete.
- G. Contractor shall provide and install signs indicating entrances to businesses whose normal entry is impaired or detoured as a result of construction. Proposed signs shall be submitted to the Owner's Representative for approval prior to manufacture and installation.
- H. Final acceptance of any portion of Work is not based on return of roadway to public use.
- I. Avoid obstructing driveways or entrances to private property.
- J. Provide temporary access or complete excavation and backfill in one continuous operation to minimize duration of obstruction when excavation is required across drives or entrances.
- K. Contractor shall bear the sole responsibility for damage to existing traffic cables resulting from its construction activities. The Contractor shall be responsible for the repair of damaged traffic cables including the re-cabling of the entire intersection if required, at no additional cost to the Owner.

- L. Construct and maintain temporary detours, ramps, and/or roads to provide for normal public traffic flow when use of public roads or streets is closed by necessities of Work. Contractor shall obtain all required roadway closure or detour permits in advance of commencing the proposed temporary detour, ramps, and/or roadway Work.
- M. Provide mats or other means to prevent overloading or damage to existing roadways from tracked equipment, large tandem axle trucks or equipment that will damage existing roadway surface. Contractor shall repair or replace damaged roadway not scheduled for removal and/or replacement at no additional cost to the Owner. Repairs or replacement shall be in conformance with the roadway owner's requirements.
- N. Provide daily sweeping of hard-surface roadways to remove soils tracked onto public roadways.

1.18 CONTRACTORS ROADS AND PARKING

- A. Prevent interference with traffic on existing roads.
- B. Construct and maintain temporary access roads and parking areas.
- C. Designate temporary parking areas to accommodate Contractor's and Owner's Representative personnel. When site space is not adequate, provide additional off-site parking. Locate as approved by Owner's Representative.
- D. Minimize use by construction traffic of existing streets and driveways.
- E. Do not allow heavy vehicles or construction equipment in existing parking areas.
- F. Do not inhibit the ability of the Owner's personnel to access, operate, and maintain existing facilities during construction.

1.19 COORDINATION WITH FACILITY OWNER'S OPERATIONS

- A. Definition: A "shutdown" is when a portion of the normal operation of Owner's facility, whether equipment, systems, piping, or conduit, has to be temporarily suspended or taken out of service to perform the Work.
- B. Work that may interrupt normal operations shall be accomplished at times convenient to, and approved by Owner.
- C. Except for necessary shutdowns, perform the Work such that Owner's facilities remain in continuous satisfactory operation during the Project. Schedule and conduct the Work such that the Work does not:
 - 1. Impede Owner's production or processes,
 - 2. Create potential hazards to public health or wellbeing,
 - 3. Create potential hazards to operating equipment and personnel,
 - 4. Reduce the quality of Owner's facilities' product(s) or effluent, or

5. Cause odors or other nuisances.
- D. Coordinate shutdowns with Owner. When possible, combine activities into a single shutdown to minimize impacts on Owner's operations and processes.
- E. Submit a shutdown plan to the Owner and Principal Architect/Engineer a minimum of 30 days prior to a planned shutdown. Shutdown plan shall consist of the following:
 1. For each shutdown, submit an inventory of labor and materials required to perform the shutdown and activities, an estimate of time required to accomplish the complete shutdown including time for Owner to take down and start up existing equipment, systems, or conduits, and written description of steps required to complete the Work associated with the shutdown.
- F. After acceptance of shutdown planning submittal and prior to starting the shutdown, provide written notification to Owner of date and time each shutdown is to start. Provide written notification submitted to the Owner's Representative at least 72 hours in advance of each shutdown.
- G. Furnish at the Site, in close proximity to the shutdown and tie-in work areas, tools, equipment, spare parts and materials, both temporary and permanent, necessary to successfully complete the shutdown. Complete to the extent possible, prefabrication of piping and other assemblies prior to the associated shutdown. Demonstrate to Owner's satisfaction that Contractor has complied with these requirements before commencing the shutdown.
- H. If Contractor's operations cause an unscheduled interruption of Owner's operations, immediately re-establish satisfactory operation for Owner.
- I. Unscheduled shutdowns or interruptions of continued safe and satisfactory operation of Owner's facilities that result in fines or penalties by authorities having jurisdiction shall be paid solely by Contractor.
- J. Shutdowns of Electrical Systems: Comply with Laws and Regulations, including the National Electric Code. Contractor shall lock out and tag circuit breakers and switches operated by Owner and shall verify that affected cables and wires are de-energized to ground potential before shutdown Work is started. Upon completion of shutdown Work, remove the locks and tags and notify Owner that facilities are available for use.

1.20 CONTRACTOR'S FIELD OFFICE (NOT USED)

1.21 PRINCIPAL ARCHITECT/ENGINEER'S FIELD OFFICE (NOT USED)

1.22 PROJECT PHOTOGRAPHS

- A. Refer to Specification Section 01 32 36.01 – Project Photographs

1.23 SPECIAL CONSIDERATIONS RELATED TO ADJACENT PROPERTIES AND FACILITIES

- A. Contractor shall be responsible for negotiations of any waivers or alternate arrangements required to enable transportation of materials to the site.
- B. Maintain conditions of access road to site such that access is not hindered as the result of construction related deterioration.
 - 1. Provide daily sweeping of hard-surface roadways to remove soils tracked onto roadway.

1.24 HISTORICAL AND ARCHAEOLOGICAL SITES

- A. If, during the course of construction, evidence of deposits of historical or archeological interest are found, the Contractor shall cease operations affecting the find and shall notify Owner.
 - 1. No further disturbance of the deposits shall ensue until the Contractor has been notified by Owner that Contractor may proceed.
 - 2. Owner will issue a notice to proceed after appropriate authorities have surveyed the find and made a determination to Owner.
 - 3. Compensation to the Contractor, if any, for lost time or changes in construction resulting from the find shall be determined in accordance with changed or extra work provisions of the Contract Documents.
- B. Refer to Specification Section 00 72 00 – General Conditions of the Contract including paragraph 4.2.4.

1.25 WARRANTY (NOT USED)

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 MAINTENANCE

- A. Maintain temporary facilities in a clean, neat, and orderly manner including maintenance of all-weather surface driveway and parking areas, buildings and furnishings, and equipment or materials furnished and supplied as part of any temporary field office or storage yard for duration of Contract.
- B. Provide regular janitorial services for any temporary field office for duration of Contract. Janitorial services consist of twice weekly sweeping and mopping of floors and trash removal, weekly cleaning of restrooms, and weekly dusting of furniture and equipment.
- C. Provide soap and water, paper towels, toilet paper, cleansers, and other

necessary consumables to properly maintain any temporary field office and all temporary toilet facilities.

- D. At this office, maintain complete field file of Shop Drawings, posted Drawings and Specifications, and other files of field operations including provisions for maintaining "As Built Drawings."
- E. Immediately repair damage, leaks, or defective service.
- F. Remove any field office provided under this contract from site upon acceptance of the entire work by the Owner.

3.2 OWNER TRAINING (NOT USED)

END OF SECTION

SECTION 01 22 00

UNIT PRICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Authority
 - 2. Unit Quantities Specified
 - 3. Measurement
 - 4. Payment Plus Conditions
 - 5. Nonconformance Assessment
 - 6. Nonpayment for Rejected Products
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 – Bidding Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Division 01 – General Requirements.

1.2 MEASUREMENT AND PAYMENT

- A. Measurement:
 - 1. Measurement by Weight: Reinforcing steel, rolled or formed steel or other metal shapes are measured by CRSI or AISC Manual of Steel Construction weights. Welded assemblies are measured by CRSI or AISC Manual of Steel Construction or scale weights.
 - 2. Measurement by Volume:
 - a. Stockpiles: Measured by cubic dimension using mean length, width, and height or thickness.
 - b. Excavation and Embankment Materials: Measured by cubic dimension using average end area method.
 - 3. Measurement by Area: Measured by square dimension using mean length and width or radius.
 - 4. Linear Measurement: Measured by linear dimension, at item centerline or mean chord.
 - 5. Stipulated Price Measurement: By unit designated in Agreement.
 - 6. Other: Items measured by weight, volume, area, or linear means or combination, as appropriate, as completed item or unit of Work.
 - 7. Measurement by Each: Measured by each instance or item provided.

8. Measurement by Lump Sum: Measure includes all associated work.

B. Payment:

1. Payment Includes: Full compensation for required supervision, labor, products, tools, equipment, plant, transportation, services, and incidentals; and erection, application or installation of an item of Work; and Contractor's overhead and profit.
2. Total compensation for required Unit Price Work shall be included in Unit Price provided in Proposal. Claims for payment as Unit Price Work, but not specifically covered in list of unit prices contained in Proposal, will not be accepted.
3. Interim payments for stored materials will be made only for materials to be incorporated under items covered in unit prices, unless disallowed in Supplementary Conditions.
4. Progress payments will be based on Owner's Representative's observations and evaluations of quantities incorporated in Work multiplied by unit price.
5. Final payment for Work governed by unit prices will be made on basis of actual measurements and quantities determined by Owner's Representative multiplied by unit price for Work which is incorporated in or made necessary by the Work.

1.3 SUBMITTALS (NOT USED)

1.4 AUTHORITY

- A. Measurement methods delineated in Specification sections are intended to complement criteria of this section. In event of conflict, the order of governance is: General Conditions, Individual Specifications, 01 22 00 – Unit Prices.
- B. Owner's Representative will take measurements and compute quantities accordingly.
- C. Assist by providing necessary equipment, workers, and survey personnel.

1.5 UNIT QUANTITIES SPECIFIED

- A. Quantity and measurement estimates stated in Agreement are for contract purposes only. Quantities and measurements supplied or placed in Work and verified by Owner's Representative (GCs 11.6.2) shall determine payment as stated in Specifications Section 00 72 00 - General Conditions of the Contract.
- B. When actual Work requires greater or lesser quantities than those quantities indicated in Proposal, provide required quantities at unit prices contracted as stated in Specifications Section 00 72 00 – General Conditions of the Contract.

1.6 NONCONFORMANCE ASSESSMENT

- A. Remove and replace Work, or portions of Work, not conforming to Contract Documents.

- B. When not practical to remove and replace Work, Owner's Representative will direct one of the following remedies:
 - 1. Nonconforming Work will remain as is, but Unit Price will be adjusted lower at discretion of Owner's Representative.
 - 2. Nonconforming Work will be modified as authorized by Owner's Representative, and Unit Price will be adjusted lower at discretion of Owner's Representative, when modified Work is deemed less suitable than specified.
- C. Specification sections may modify above remedies or may identify a specific formula or percentage price reduction.
- D. Authority of Owner's Representative to assess nonconforming work and identify payment adjustment is final.

1.7 NONPAYMENT FOR REJECTED PRODUCTS

- A. Payment will not be made for the following:
 - 1. Products wasted or disposed of in unacceptable manner.
 - 2. Products determined as nonconforming before or after placement.
 - 3. Products not completely unloaded from transporting vehicle.
 - 4. Products placed beyond lines and levels of required Work.
 - 5. Products remaining on hand after completion of Work, unless specified otherwise.
 - 6. Loading, hauling, and disposing of rejected products.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 25 13

PRODUCT SUBSTITUTIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. The procedure for requesting the approval of substitution of a product that is not equivalent to a product which is specified by descriptive or performance criteria or defined by reference to one or more of the following:
 - a. Name of manufacturer.
 - b. Name of vendor.
 - c. Trade name.
 - d. Catalog number.
2. Substitutions are not "or-equals".
3. This Specification Section does not address substitutions for major equipment.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 00 – Bidding Requirements, Contract Forms, and Conditions of the Contract.
2. Division 01 – General Requirements.

C. Request for Substitution – General:

1. Base all bids on materials, equipment, and procedures specified.
2. Certain types of equipment and kinds of material are described in specifications by means of references to names of manufacturers and vendors, trade names, or catalog numbers.
 - a. When this method of specifying is used, it is not intended to exclude from consideration other products bearing other manufacturer's or vendor's names, trade names, or catalog

numbers, provided said products are "or-equals," as determined by Owner's Representative.

3. Other types of equipment and kinds of material may be acceptable substitutions under the following conditions:
 - a. Or-equals are unavailable due to strike, discontinued production of products meeting specified requirements, or other factors beyond control of Contractor; or,
 - b. Contractor proposes a cost and/or time reduction incentive to the Owner.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Price. No separate payment will be made for this item. Include the cost in associated items for this project.

1.3 SUBMITTALS (NOT USED)

1.4 QUALITY ASSURANCE

- A. In making request for substitution or in using an approved product, Contractor represents Contractor:
 1. Has investigated proposed product, and has determined that it is adequate or superior in all respects to that specified, and that it will perform function for which it is intended.
 2. Will provide same guarantee for substitute item as for product specified.
 3. Will coordinate installation of accepted substitution into Work, to include building modifications if necessary, making such changes as may be required for Work to be complete in all respects.
 4. Waives all claims for additional costs related to substitution which subsequently arise.

1.5 DEFINITIONS

- A. Product: Manufactured material or equipment.

1.6 PROCEDURE FOR REQUESTING SUBSTITUTION

- A. Substitution shall be considered only:
 1. After award of Contract.
 2. Under the conditions stated herein.
- B. Written request through Contractor only.
- C. Transmittal Mechanics:
 1. Follow the transmittal mechanics prescribed for Shop Drawings in Specification Section 01 33 00 – Submittals.

- a. Product substitution will be treated in a manner similar to "deviations," as described in Specification Section 01 33 00 – Submittals.
- b. List the letter describing the deviation and justifications on the transmittal form in the space provided under the column with the heading DESCRIPTION.
 - 1) Include in the transmittal letter, either directly or as a clearly marked attachment, the items listed in the following paragraph below.

D. Transmittal Contents:

1. Product identification:
 - a. Manufacturer's name.
 - b. Telephone number and representative contact name.
 - c. Specification Section or Drawing reference of originally specified product, including discrete name or tag number assigned to original product in the Contract Documents.
2. Manufacturer's literature clearly marked to show compliance of proposed product with Contract Documents.
3. Itemized comparison of original and proposed product addressing product characteristics including but not necessarily limited to:
 - a. Size.
 - b. Composition or materials of construction.
 - c. Weight.
 - d. Electrical or mechanical requirements.
4. Product experience:
 - a. Location of past projects utilizing product.
 - b. Name and telephone number of persons associated with referenced projects knowledgeable concerning proposed product.
 - c. Available field data and reports associated with proposed product.
5. Data relating to changes in construction schedule.
6. Data relating to changes in cost.
7. Samples:
 - a. At request of Owner's Representative.
 - b. Full size if requested by Owner's Representative.
 - c. Held until substantial completion.

- d. Owner's Representative not responsible for loss or damage to samples.

1.7 APPROVAL OR REJECTION

- A. Written approval or rejection of substitution given by the Owner's Representative, Principal Architect/Engineer, and the Owner.
- B. Owner's Representative reserves the right to require proposed product to comply with color and pattern of specified product if necessary to secure design intent.
- C. In the event the substitution is approved, the resulting cost and/or time reduction will be documented by Change Order in accordance with the General Conditions.
- D. Substitution will be rejected if:
 - 1. Submittal is not through the Contractor with his stamp of approval.
 - 2. Request is not made in accordance with this Specification Section.
 - 3. In Owner's Representative opinion, acceptance will require substantial revision of the original design.
 - 4. In the Owner's Representative opinion, substitution will not perform adequately the function consistent with the design intent.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 26 63

CHANGE ORDERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

Procedures for processing Change Orders, including:

1. Quality Assurance.
2. Responsible Individual.
3. Documentation of Change in Contract Price and Contract Time.
4. Change Procedures.
5. Proposals and Contract Modifications.
6. Work Change Directive.
7. Change Order.
8. Execution of Change Documentation.
9. Correlation of Contractor Submittals.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 00 – Introductory Information, Proposing Requirements, Contract Forms, and Conditions of the Contract.
2. Division 01 – General Requirements.

1.2 MEASUREMENT AND PAYMENT (NOT USED)

1.3 SUBMITTALS (NOT USED)

1.4 QUALITY ASSURANCE

A. Reference Standards:

1. Equipment Rental Rates: equipmentwatch.com. Rental Rate is defined as full unadjusted base rental rate for appropriate item of construction equipment.

1.5 RESPONSIBLE INDIVIDUAL

- A. Provide letter to the Owner's Representative indicating name, title, address and contact information of individual authorized to execute change documents and who is responsible for informing others in Contractor's employ and Subcontractors of changes to the Work. Information should be provided at the

Preconstruction Conference but, no later than 10 calendar days following the Preconstruction Conference.

1.6 DOCUMENTATION OF CHANGE IN CONTRACT PRICE AND CONTRACT TIME

- A. Maintain detailed records of changes in Work. Provide full information required for identification and evaluation of proposed changes, and substantiate costs of changes in Work.
- B. Document each proposal for change in cost or time with sufficient data to allow evaluation of proposal. Provide additional information upon request of the Owner or the Owner's Representative.
- C. Proposals shall include the following minimum information:
 - 1. Quantities of items in original Proposal with additions, reductions, deletions, and substitutions.
 - 2. Quantities and cost of items in original schedule of values with additions, reductions, deletions, and substitutions.
 - 3. Provide unit prices for items not included in original Proposal with supporting information when absent from original Proposal Work.
 - 4. Justification for changes in Contract Time.
 - 5. Additional data upon request.
- D. For changes in Work performed on a time-and-materials basis, provide the following additional information:
 - 1. Quantities and description of products and equipment.
 - 2. Taxes, insurance and bonds.
 - 3. Overhead and profit as noted in Document 00 72 00 - General Conditions, Article 11.5.
 - 4. Dates, times, and by whom work was performed.
 - 5. Time records and certified copies of applicable payrolls.
 - 6. Invoices, receipts for products, rented equipment, and subcontracts, similarly documented.
- E. For changes in Work performed on a time-and-materials basis, payment for rental equipment will be as follows:
 - 1. Actual invoice cost for duration required to complete extra work without markup for overhead and profit. When extra work comprises only a portion of rental invoice where equipment would otherwise be on site, compute

- hourly equipment rate by dividing the actual monthly invoice by 176. (One day equals 8 hours and 1 week equals 40 hours.)
2. Do not exceed estimated operating costs given on equipmentwatch.com website for items of equipment. Overhead and profit will be allowed on operating cost.
- F. For changes in Work performed on a time-and-materials basis using Contractor-owned equipment, use equipmentwatch.com rates as follows:
1. Contractor-owned equipment will be paid at Rental Rate for duration of time required to complete extra work without markup for overhead and profit. Utilize lowest cost combination of hourly, daily, weekly, or monthly rates. Use 150 percent of Rental Rate for double shifts (one extra shift per day) and 200 percent of Rental Rate for more than two shifts per day. Standby rates shall be 50 percent of appropriate Rental Rate shown on equipmentwatch.com website. No other rate adjustments apply.
 2. Do not exceed estimated operating costs given on equipmentwatch.com. Overhead and profit will be allowed on operating cost. Operating costs will not be allowed for equipment on standby.

1.7 CHANGE PROCEDURES

- A. Changes to Contract Price or Contract Time can only be made by issuance of Change Order. Issuance of Work Change Directive will be formalized into a Change Order. Changes will be in accordance with requirements of the General Conditions.
- B. The Owner's Representative will advise of minor changes in Work not involving an adjustment to Contract Price or Contract Time as authorized by the General Conditions by issuing supplemental instructions.
- C. Request clarification of Drawings, Specifications, Contract Documents, or other information by using Request for Information. Response by the Owner's Representative to Requests for Information does not authorize Contractor to perform tasks outside scope of Work. Changes must be authorized as described in this section.

1.8 PROPOSALS AND CONTRACT MODIFICATIONS

- A. The Owner or the Owner's Representative may issue a Request for Proposal (RFP), which includes detailed description of proposed change with supplementary or revised Drawings and Specifications. The Owner or the Owner's Representative may also request a proposal in response to a Request for Information. Prepare and submit proposal within 7 days or as specified in the request.
- B. Submit request for Contractor changes to Owner's Representative describing proposed change and its full effect on Work, with a statement describing reason

for change and effect on Contract Price and Contract Time including full documentation.

C. The Owner may use the Principal Architect/Engineer to review Change Orders.

1.9 WORK CHANGE DIRECTIVE

- A. The Owner may issue a signed Work Change Directive instructing Contractor to proceed with a change in Work. Work Change Directive will subsequently be incorporated in Change Order.
- B. Document will describe changes in Work and designate method of determining change in Contract Price or Contract Time.
- C. Proceed promptly to execute changes in Work in accordance with Work Change Directive.

1.10 CHANGE ORDER

- A. Stipulated Price Change Order
 - 1. Stipulated Price Change Order will be based on accepted proposal.
- B. Unit Price Change Order
 - 1. Where Unit Prices for affected items of Work are included in Proposal, unit price Change Order will be based on unit prices, subject to the General Conditions.
 - 2. Where unit prices of Work are not pre-determined in Proposal, Work Change Directive or accepted proposal will specify unit prices to be used.
- C. Time-and-Material Change Order
 - 1. Provide itemized account and supporting data after completion of change, within time limits indicated for claims in the General Conditions.
 - 2. The Owner will determine change allowable in Contract Price and Contract Time as provided in the General Conditions.
 - 3. Maintain detailed records of work done on time-and-material basis as specified in paragraph 1.4, Documentation of Change in Contract Price and Contract Time.
 - 4. Provide full information required for evaluation of changes and substantiate costs for changes in Work.

1.11 EXECUTION OF CHANGE DOCUMENTATION

- A. The Owner or the Owner's Representative will issue Change Orders, Work Change Directives, or accepted proposal for signatures of parties as described in the General Conditions.

1.12 CORRELATION OF CONTRACTOR SUBMITTALS

- A. For Stipulated Price Contracts, promptly revise Schedule of Values and Application for Payment forms to record authorized Change Orders as separate line item.

- B. For Unit Price Contracts, next monthly estimate of Work after acceptance of a Change Order will be revised to include new items not previously included and appropriate unit rates.
- C. Promptly revise progress schedules to reflect change in Contract Time, and to adjust time for other items of work affected by change, and resubmit for review.
- D. Promptly enter changes to on-site and record copies of Drawings, Specifications, or Contract Documents.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 29 73
SCHEDULE OF VALUES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Measurement and Payment
 - 2. Definition
 - 3. Preparation
 - 4. Submittal
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 – Introductory Information, Proposing Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Division 01 – General Requirements.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Price. No separate payment will be made for this item. Include the cost in associated items for this project.

1.3 SUBMITTALS

- A. Submit Schedule of Values in accordance with requirements of Section 01 33 00 – Submittals. Submit at least 10 days prior to submitting first application for progress payment. Submit via SharePoint.
- B. Revise Schedule of Values and resubmit for items affected by contract modifications, Change Orders, and Work Change Directives. After changes are reviewed without exception by Authority's Principal Architect/Engineer, make submittal at least 10 days prior to submitting next application for progress payment.

1.4 DEFINITIONS

- A. Schedule of Values: Is a schedule, prepared and maintained by the Contractor, allocating portions of the Contract Amount to various portions of the Work, including a tabulation of all of the costs of the various Subcontracts and materials which in the aggregate make up the Cost of the Work. The Schedule of Values shall be subject to Owner's approval and, after such approval, be used as the basis for reviewing the Contractor's Application For Payment.
- B. Break down costs to list major products or operations for each line item which has an installed value of more than \$5000.

1.5 PREPARATION

- A. For stipulated price contracts, subdivide Schedule of Values into logical portions of Work, such as major work items or work in contiguous geographic areas.
- B. Schedule and Schedule of Values shall be developed together. At a minimum, the Schedule of Values shall be broken out by trade and split between materials and labor as approved by the Owner. Such Prices will include overhead and profit applicable to each item of work.
- C. For lump sum equipment items where submittal of operation/maintenance data and testing are required, include separate item for equipment operation and maintenance data submittal valued at 5 percent of lump sum amount for each equipment item and separate item for testing and adjusting valued at 5 percent of lump sum amount for each equipment item.
- D. Round off figures for each listed item to nearest \$100 except for value of one item, when necessary, to make total of items in Schedule of Values equal Contract Price for stipulated price contracts or lump sum amount in Schedule of Unit Price Work.
- E. Submit Schedule of Values in approved electronic spreadsheet, formatted to print on 11" x 17" paper, to the Owner's Document Management System.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 32 16

CONSTRUCTION PROGRESS SCHEDULE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Specific requirements for the preparation, submittal, updating, status reporting and management of the construction Progress Schedule.
- B. Provide Construction Schedules for Work included in Contract in accordance with requirements in this Section. Create Construction Schedule using Critical Path Method (CPM) computer software capable of mathematical analysis of Precedence Diagramming Method (PDM) plans. Provide printed activity listings and bar charts in formats described in this Section.
- C. Related Specification Sections include, but are not necessarily limited to:
 1. Division 00 - Bidding Requirements, Contract Forms and Conditions of the Contract.
 2. Division 01 - General Requirements.

1.2 MEASUREMENT AND PAYMENT

- A. No separate payment will be made for this item. Include the cost of construction scheduling in overhead cost for this project.

1.3 SCHEDULING STAFF

- A. Employ or retain services of individual experienced in critical path scheduling for duration of Contract. Individual shall cooperate with Owner's Representative and shall update schedule (Progress Schedule) monthly as required by the Contract's General Conditions, to indicate current status of Work.

1.4 QUALITY ASSURANCE

- A. The person preparing and revising the construction Progress Schedule shall be experienced in the preparation of schedules of similar complexity.
- B. Within five (5) days from award of the Contract, Contractor shall submit to Owner's Representative the name of the person responsible for the preparation, maintenance, updating and revision of all schedules.
1. Qualifications necessary:
 - a. Proficient in the use of Microsoft® Project® 2007 or newer.

1.5 DEFINITIONS

- A. The following definitions shall apply to this Specification Section:
1. **BASELINE SCHEDULE:** The initial as-bid, detailed, cost and resource loaded Progress Schedule prepared by the Contractor to define its plan for

constructing the Project as required by the Contract Documents, and accepted by the Owner or Owner's Representative as meeting the requirements of the Contract Documents for specified constraints, sequences, milestones and completion dates.

2. **PROGRESS SCHEDULE:** The initially accepted Baseline Schedule, or subsequently approved Revised Baseline Schedules, updated each month to reflect actual start and finish dates of schedule activities and all time impact events whether caused by Contractor or Owner or factors beyond the control of either party.
3. **REVISED BASELINE SCHEDULE:** The initially accepted Baseline Schedule revised to reflect only approved changes.
4. **WORKING SCHEDULE:** A schedule developed from the Progress Schedule, utilizing scheduling software features not allowed for Baseline and Progress Schedules at the Contractor's sole discretion, to indicate the Contractor's plan for executing the Work, and providing for schedule recovery when approved time extensions are not sufficient to provide for

timely completion due to Contractor inefficiencies beyond the control of the Owner or outside the risks accepted by the Owner.

1.6 SUBMITTALS

A. Shop Drawings:

1. See Specification Section 01 33 00 – Submittals for requirements for the mechanics and administration of the submittal process.
2. Scheduler qualifications.
3. Baseline Schedule: Submitted within 14 days after Effective Date of Agreement.
4. Monthly Progress Schedules.
5. Revised Baseline Schedules.

1.7 GENERAL REQUIREMENTS

A. Contractor shall prepare and submit Baseline and Progress Schedules and updates and revisions to them as specified herein.

1. All scheduling to be performed in Microsoft® Project® 2007.
2. The Baseline and Progress Schedules shall be a calendar day-based and cost-loaded Critical Path Method (CPM) network diagram with supporting data.

B. Disallowed Scheduling Software Features:

1. The following specific features are not allowed to be applied in the Baseline and Progress Schedules:
 - a. Resource leveling.
 - b. Activity or event constraints, other than those specified by the Contract Documents.
 - c. Leads and lags:
 - 1) Create specific activities with specific durations in-lieu-of leads and lags.
 - 2) Durations shall have positive values.
 - d. Default progress data:
 - 1) Start and finish dates shall not be automatically updated.
 - 2) Update with actual start and finish dates documented from field reports.
 - 3) Work activities shall be updated by actual Work progression, not cash flow driven.
 - 4) Updating of activity percent complete and remaining duration shall be independent functions, not one parameter calculated from the other.

- 5) Out-of-sequence progress shall be accounted for through retained logic, not a default option of progress override.
- e. Multiple calendars.
2. Any float suppression techniques or other software features that corrupts the pure mathematical model calculating the critical path.
 - a. The following CPM schedule outputs will be rejected without further review:
 - 1) Schedules indicating the start of the critical path at a date point or activity beyond the date of Notice to Proceed, or schedules indicating a discontinuous critical path from Notice to Proceed to Contract completion.
 - 2) Schedules defining critical activities as those on a path or paths having some minimum value of float.
 - 3) Schedules with multiple critical paths.
 - 4) Schedules indicating a completion date beyond the contractual completion date.
3. Contractor, at Contractor's sole discretion, may employ the disallowed scheduling software features for Contractor's exclusive use in preparing a Working Schedule.
- C. Float Time:
 1. Neither the Owner nor the Contractor owns the float; the project owns the float.
 2. As such, liability for delay of the project completion date rests with the party actually causing delay to the project completion date.
- D. By preparing and submitting the Baseline Schedule, the Contractor represents that it can and intends to execute the Work and portions thereof within the specified times and constraints and that its bid covers the costs associated with the execution of the Work in accordance with the Construction Schedule.
- E. Contractor shall provide an electronic copy for the Baseline Schedule and Progress Schedule and all monthly updates of both to accompany hard copies

of the schedules and tabular reports. Submit these via the Owner's Sharepoint® site.

1. Electronic submittal shall be in a format compatible with Microsoft® Project® 2007.
2. Contractor shall provide with the schedules, a procedural outline of the system shut-downs and proposed tie-ins, and the Owner's O&M staff, which shall be subject to approval of the Owner.

1.8 SUBMITTAL PACKAGES

A. Baseline Schedule:

1. CPM time-scaled network diagram:
 - a. Provide electronic format.
2. Supporting data:
 - 1) Holidays that will be observed during construction.
 - 2) Number of planned working days and shifts per week.

B. Monthly updates that include the following:

1. Revised Baseline Schedule as appropriate.
 - a. Update to reflect approved Change Orders occurring since the prior update.
2. Updated Progress Schedule.
3. Explanation of changes in logic, duration of activities.
4. Upload electronic version (pdf) to SharePoint.

1.9 START-UP, DEMONSTRATION, TRAINING, AND FINAL COMPLETION (NOT USED)

1.10 SCHEDULING CONFERENCE (NOT USED)

1.11 BASELINE SCHEDULE

- A. Schedule shall include, but not be limited to, activities that show the following that are applicable to the project:
1. Project characteristics, salient features, or interfaces, including those with outside entities that could affect time of completion.
 2. Project start date, scheduled completion date and other milestones.
 3. Work performed by Contractor, subcontractors and suppliers.
 4. Submittal development, delivery, review and approval, including those from Contractor, subcontractors and suppliers.
 5. Procurement, delivery, installation and testing of materials, plants and equipment.
 6. Testing and settlement periods.

7. Utility notification and relocation.
 8. Erection and removal of falsework and shoring.
 9. Finish work and final cleanup.
 10. Project float as the predecessor activity to the scheduled completion date.
- B. Schedule shall have not less than 10 activities, unless otherwise authorized by the Owner's Representative.
1. The number of activities shall be sufficient to assure adequate planning of the project, to permit monitoring and evaluation of progress, and to do an analysis of time impacts.
 2. Schedule activities shall include the following:
 - a. A clear and legible description.
 - b. Start and finish dates.
 - c. A duration of not less than one (1) working day, except for event activities, and not more than 20 working days, unless otherwise authorized by the Owner's Representative.
 - d. At least one (1) predecessor and one (1) successor activity, except for project start and finish milestones.
 - e. Required constraints: Only contractually required constraints may be inserted into the Baseline Schedule.
 - f. Codes for responsibility, stage, work shifts, location and contract pay item numbers.
- C. Working durations shall be planned to incorporate the effects of normal weather impacts. See General Conditions Article 12.2 for the "Baseline Rain Day Determination".

1.12 PROGRESS SCHEDULE

- A. Develop Progress Schedule based on approved Baseline and Revised Baseline Schedules.
1. All restrictions on use of constraints, leads and lags, resource leveling, etc., shall also apply to Progress Schedules.
- B. The Progress Schedule will be updated once per month for monitoring progress.
1. Contractor may submit one (1) additional update per month for its own convenience.
- C. Indicate progress by making entries on the most recently accepted version of the network diagram and supporting data to show:
1. Activities completed.
 2. Activities started.

3. Remaining duration for each activity started but not yet completed.
 4. Percent complete based on value of work in place and value of equipment or material delivered and properly stored.
 5. Status of activity due to be completed by the next scheduled progress meeting.
- D. Computerized Progress Schedule and percent completion of Work shall be used to verify Contractor's payment requests.
1. Progress payments will not be processed by the Owner's Representative unless the updated Progress Schedule has been submitted concurrently with a pay request and found acceptable by the Owner's Representative.

1.13 REVISIONS TO PROGRESS SCHEDULE

- A. Contractor shall submit data for a revised Progress Schedule within five (5) days of the occurrence of any of the following:
1. When contractor-caused delay in completion of any activity or group of activities indicates an overrun of the Contract Time or Control Dates by 30 working days or 10 percent of the remaining duration, whichever is less.
 2. When delays in submittals, deliveries, or work stoppages are encountered making necessary the replanning or rescheduling of the Work.
 3. When the schedule does not represent the actual progress of the Work.
 4. When a change order significantly affects the contract completion date.
- B. The revised Progress Schedule shall be the basis of a Working Schedule showing:
1. How Contractor intends to return to schedule.
 2. How Contractor intends to avoid falling behind schedule on future activities.
- C. Show changes on the network diagram and supporting data including:
1. New activities and their duration.
 2. Modifications to existing activities.
- D. Except as provided in the following subparagraphs 1 and 2, the cost of revisions to the Progress Schedule resulting from changes in the Work shall be included in the cost for the change in the Work, and shall be based on the complexity of

the revision or Change Order, man-hours expended in analyzing the change, and the total cost of the change.

1. The cost of revision to the Construction Schedule not resulting from authorized changes in the Work shall be the responsibility of the Contractor.
 2. The cost of revision to the Construction Schedule for the Contractor's convenience shall be the responsibility of the Contractor.
- E. The revised network diagram and supporting data for the Progress Schedule shall be submitted to the Owner's Representative upon completion of the revisions, but not later than the next progress meeting.
- F. Revisions to the Progress Schedule for the Contractor's convenience:
1. Must be approved by the Owner's Representative before Contractor changes the sequence of Work.

1.14 TIME IMPACT ANALYSIS (TIA)

- A. The accepted initial Baseline Schedule or subsequently accepted Revised Baseline Schedule shall be used for TIA.
- B. Contractor shall submit a written TIA to the Owner's Representative with each request for adjustment of Contract Time, or when Contractor or Owner's Representative consider that an approved or anticipated change may impact the critical path or contract progress.
1. The TIA must be attached to any change order prior to approval of any change to time or cost.
- C. The TIA shall illustrate the impacts of each change or delay on the current scheduled completion date or internal milestone, as appropriate.
1. The analysis shall use the Baseline or Revised Baseline Schedule (accepted Baseline Schedule) that has a data date closest to and prior to the event.
 2. If the Owner's Representative determines that the accepted Baseline Schedule used does not appropriately represent the conditions prior to the event, the accepted Baseline Schedule shall be updated to the day before the event being analyzed.
 3. The TIA shall include an impact schedule developed from incorporating the event into the accepted Baseline Schedule by adding or deleting activities, or by changing durations or logic of existing activities as appropriate to the nature of the change event.
 4. If the impact schedule shows that incorporating the event modifies the critical path and scheduled completion date of the accepted Baseline

Schedule, the difference between scheduled completion dates of the two (2) schedules shall be equal to the adjustment of Contract Time.

D. Contractor shall submit a TIA in duplicate within 15 working days of receiving a written request for a TIA from the Owner's Representative.

1. Contractor shall allow the Owner's Representative two (2) weeks after receipt to approve or reject the submitted TIA.
2. All approved TIA schedule changes shall be shown on the next update schedule.

E. In the event of a TIA rejection:

1. If a TIA submitted by the Contractor is rejected by the Owner's Representative, the Contractor shall meet with the Owner's Representative to discuss and resolve issues related to the TIA.
2. If agreement is not reached, the Contractor will be allowed 15 days from the meeting with the Owner's Representative to give notice.
3. Contractor shall only show actual as-built work, not unapproved changes related to the TIA, in subsequent update schedules.
4. If agreement is reached at a later date, approved TIA schedule changes shall be shown on the next update schedule.
5. Owner's Representative will withhold remaining payment on the schedule contract item if a TIA is requested by Owner's Representative and not submitted by Contractor within 15 working days.
6. The schedule item payment will resume on the next estimate after the requested TIA is submitted.

a. No other contract payment will be retained regarding TIA submittals.

1.15 NARRATIVE SCHEDULE REPORT (NOT USED)

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 32 36.01

PROJECT PHOTOGRAPHS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Technical and submittal requirements for project photographs, including:
 - a. Measurement and Payment
 - b. Project photographs for facility and pipeline projects. Facility projects may have one or more distinct sites. Pipeline projects may have more than one segment but are usually linear in nature, such as waterline or wastewater line projects.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
2. Division 01 - General Requirements.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Price. No separate payment will be made for this item. Include the cost in associated items for this project.

1.3 DEFINITIONS:

1. Pre-construction Photographs: Photographs taken, in sufficient numbers and detail, prior to beginning field activities, to show original construction site conditions.

1.4 SUBMITTALS:

1. Refer to Section 01 33 00 – Submittals.
2. Format and Media. Digital photography shall be used for Preconstruction Photographs.
 - a. Prints.
 - 1) Submit Preconstruction Photograph via the Owner's Sharepoint site. Preconstruction photographs must be taken prior the first construction activities in the field and submitted prior to the first Pay Application being made by the Contractor.
 - b. Media
 - 1) Digital Photography. Use at least 6.0 megapixel density for photographs.
3. Submittal Quantities and Frequencies
 - a. Preconstruction photographs:

- 1) For Pipeline Projects, Contractor shall provide photos to document the existing conditions of the site. For water line and wastewater line projects, Contractor shall take photos at approximately 200 foot intervals (plus or minus 25 feet) along the center line of the project. One photo shall be taken looking in the direction of increasing stationing, one photo looking to the right (90°R) from the first photo, one photo looking to the left (90°L), one photo looking in the direction of decreasing stationing (180° from the increasing stationing direction). Where the project is to be constructed in or near active traffic lanes offset the location of the photos such that the photographs are taken from the sidewalk or shoulder or median and not from the active traffic pavement. In addition to the centerline photographs, Contractor shall document with photographs all features such as mailboxes, signs, traffic and light poles, driveways, culverts, inlets, and landscaping along the pipeline route which could be damaged by the Contractor's operations. Preconstruction Photo prints submittals shall progress from the lowest station to the highest station along the centerline. Progress Photographs

4. Labeling:

- a. Digital Images: Place a label on the CD, Labels shall contain the following information:

- 1) Name of Project and Project Number
- 2) Name of Contractor.
- 3) For each digital image create a file name which has as part of the name the date the photograph was taken and the location of the photograph by station, coordinates or other unique identifier

B. Quality Assurance:

1. Contractor shall be responsible for the quality of and timely execution and submittal of photographs.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 33 00

SUBMITTALS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Mechanics and administration of the submittal process for:
 - a. Shop Drawings.
 - b. Samples.
 - c. Miscellaneous submittals.
 - d. Operation and Maintenance Manuals.
2. General content requirements for Shop Drawings.
3. Content requirements for Operation and Maintenance Manuals.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
2. Division 01 - General Requirements.
3. Sections in Divisions 02 through 48 identifying required submittals.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Price. No separate payment will be made for this item. Include the cost in associated items for this project.

1.3 SUBMITTALS (NOT USED)

1.4 DEFINITIONS

A. Shop Drawings:

1. See General Conditions.
2. Product data and samples are Shop Drawing information.

B. Operation and Maintenance (O&M) Manuals:

1. Contain the information required for proper installation and maintenance of building materials and finishes.
2. Contain the technical information required for proper installation, operation and maintenance of process, electrical and mechanical equipment and systems.

C. Miscellaneous Submittals:

1. Submittals other than Shop Drawings and O&M Manuals.

2. Representative types of miscellaneous submittal items include but are not limited to:
 - a. Construction schedule.
 - b. Facility Shutdown Plan(s)
 - c. HVAC test and balance reports.
 - d. Installed equipment and systems performance test reports.
 - e. Manufacturer's installation certification letters.
 - f. Instrumentation and control commissioning reports.
 - g. Warranties.
 - h. Service agreements.
 - i. Construction photographs.
 - j. Record Documents.
 - k. Cost breakdown (Schedule of Values).
 - l. Safety Plan(s).

1.5 SUBMITTAL SCHEDULE (NOT USED)

1.6 PREPARATION OF SUBMITTALS

A. General:

1. All submittals and all pages of all copies of a submittal shall be completely legible.
2. Submittals which, in the Owner's Representative's or Principal Engineer's sole opinion, are illegible will be returned without review.

B. Shop Drawings:

1. Scope of any submittal and shop drawing transmittal:
 - a. Submit shop drawings utilizing Owner's standard Submittal Transmittal Form.
 - b. Limited to one (1) Specification Section.
 - c. Do not submit under any Specification Section entitled (in part) "Basic Requirements" unless the product or material submitted is specified, in total, in a "Basic Requirements" Section.
2. Numbering letter of transmittal:
 - a. Include a series number, "xx", beginning with "01" and increasing sequentially with each additional transmittal.
 - b. Assign consecutive series numbers to subsequent transmittals.
3. Describing transmittal contents:

- a. Provide listing of each component or item in submittal capable of receiving an independent review action.
 - b. Identify for each item:
 - 1) Manufacturer and Manufacturer's Drawing or data number.
 - 2) Contract Document tag number(s).
 - 3) Unique page numbers for each page of each separate item.
 - 4) Use divider sheets with labeled tabs to separate independent items within a single submittal.
 - c. When submitting "or-equal" items that are not the products of named manufacturers, include the words "or-equal" in the item description.
4. Contractor stamping:
- a. General:
 - 1) Contractor's review and approval stamp shall be applied either to the letter of transmittal or a separate sheet preceding each independent item in the submittal.
 - a) Contractor's signature and date shall be wet ink signature. Is an electronic signature acceptable as most submittals are uploaded to SharePoint as a .PDF electronic document?
 - b) Shop Drawing submittal stamp shall read "(Contractor's Name) has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review and approval as stipulated under General Conditions Paragraph 6.20.4."
 - 2) Submittals containing multiple independent items shall be prepared with an index sheet for each item listing the discrete page numbers for

each page of that item, which shall be stamped with the Contractor's review and approval stamp.

- a) Individual pages or sheets of independent items shall be numbered in a manner that permits Contractor's review and approval stamp to be associated with the entire contents of a particular item.
- b) Use divider sheets with labeled tabs to separate independent items within a single submittal.

b. Electronic stamps:

- 1) Contractor may electronically embed Contractor's review and approval stamp to either the Submittal Transmittal Form or a separate index sheet preceding each independent item in the submittal.
- 2) Contractor's signature and date on electronically applied stamps shall be wet ink signature. Is an electronic signature acceptable as most submittals are uploaded to SharePoint as a PDF electronic document?

5. Resubmittals:

- a. Number with original root number and a suffix letter starting with "A" on a new Submittal Transmittal Form.
- b. Do not increase the scope of any prior transmittal.
- c. Account for all components of prior transmittal.
 - 1) If items in prior transmittal received "A" or "B" Action code, list them and indicate "A" or "B" as appropriate (See also 1.6, this Section).
 - a) Do not include submittal information for items listed with prior "A" or "B" in resubmittal.
 - 2) Indicate items to be resubmitted "at a later date" for any prior "C" or "D" Action item not included in resubmittal.
 - a) Obtain Principal Architect/Engineer's approval to exclude items.

- 6. For 8-1/2 x 11 In, 8-1/2 x 14 In, and 11 x 17 In hard copy size sheets, provide three (3) copies of each page for Principal Architect/Engineer's plus

the number required by the Contractor. In today's electronic environment, is subsection No. 6 necessary to be included in the contract documents?

- a. The number of copies required by the Contractor will be defined at the Preconstruction Conference, but shall not exceed four (4) hard copies.
7. Electronic submittals utilizing web based document management system (SharePoint®):
 - a. Shop drawing submittals shall be produced (scanned) in Adobe Acrobat's Portable Document Format (PDF) Version 5.0 or higher.
 - b. Do not password protect and/or lock the PDF document.
 - c. Create one (1) PDF document (PDF file) for each submittal.
 - d. Drawings or other graphics must be converted to PDF format and made part of the single (one [1]) PDF document.
 - 1) Scanning to be used only where actual file conversion is not possible.
 - e. Limit PDF document size to 5MB.
 - f. Rotate pages that must be viewed in landscape to the appropriate position for easy reading.
 - g. Images only shall be scanned at a resolution of 300 dpi or greater.
 - 1) Perform Optical Character Recognition (OCR) capture on all images.
 - 2) Achieve OCR with the "original image with hidden text" option.
 - 3) Word searches of the PDF document must operate successfully to demonstrate OCR compliance.
 - h. Create bookmarks in the navigation frame, for each entry in the Table of Contents/Index.
 - 1) Normally three (3) levels deep (i.e., "Chapter," "Section," "Sub-section").
 - i. Set the opening view for PDF files as follows:
 - 1) Initial view: Bookmarks and Page.
 - 2) Magnification: Fit in Window.
 - 3) Page layout: Single page.
 - 4) Set the file to open to the cover page of the submittal with bookmarks to the left, and the first bookmark linked to the cover page.
 - j. All PDF documents shall be set with the option "Fast Web View" to open the first pages of the document for the viewer while the rest of the document continues to load.
 - k. File naming conventions:

- 1) File names shall use a "nine dot three" convention (XXXXXX-YY-Z.PDF) where XXXXXX is the Specification Section number, YY is the Shop Drawing Root series number and Z is an ID number used to designate the associated volume.
 - a) Example 1:
 - (1) Two (2) pumps submitted as separate Shop Drawings under the same Specification Section:
 - (a) Pump 1 = 43 21 21-01-1.pdf.
 - (b) Pump 2 = 43 21 21-02-1.pdf.
 - b) Example 2:
 - (1) Control system submitted as one (1) Shop Drawing but separated into two (2) shop drawing submittals:
 - (a) Volume 1 = 40 90 00-01-1.pdf.
 - (b) Volume 2 = 40 90 00-01-2.pdf.
8. Provide clear space (3 In Sq) for Principal Architect/Engineer stamping of each component defined in the PREPARATION OF SUBMITTALS Article – Contractor Stamping.
9. Contractor shall not use red color for marks on transmittals.
 - a. Duplicate all marks on all copies transmitted, and ensure marks are photocopy reproducible.
 - b. Outline Contractor marks on reproducible transparencies with a rectangular box.
10. Transmittal contents:
 - a. Coordinate and identify Shop Drawing contents so that all items can be easily verified by the Owner's Representative and the Principal Architect/Engineer.
 - b. Identify equipment or material use, tag number, Drawing detail reference, weight, and other Project specific information.
 - c. Provide sufficient information together with technical cuts and technical data to allow an evaluation to be made to determine that the item submitted is in compliance with the Contract Documents.
 - d. Submit items such as equipment brochures, cuts of fixtures, product data sheets or catalog sheets on 8-1/2 x 11 In pages.
 - 1) Clearly mark (indicate) exact item or model and all options proposed.
 - e. When a Shop Drawing submittal is called for in any Specification Section, include as appropriate, scaled details, sizes, dimensions, performance characteristics, capacities, test data, anchoring details, installation instructions, storage and handling instructions, color charts, layout

Drawings, rough-in diagrams, wiring diagrams, controls, weights and other pertinent data in addition to information specifically stipulated in the Specification Section.

1) Arrange data and performance information in format similar to that provided in Contract Documents.

2) Provide, at minimum, the detail specified in the Contract Documents.

f. Provide warranty information.

g. If proposed equipment or materials deviate from the Contract Drawings or Specifications in any way, clearly note the deviation and justify the said deviation in detail in a separate letter immediately following transmittal sheet.

11. Samples:

a. Identification:

1) Identify sample as to transmittal number, manufacturer, item, use, type, project designation, tag number, standard Specification Section

or Drawing detail reference, color, range, texture, finish and other pertinent data.

- 2) If identifying information cannot be marked directly on sample without defacing or adversely altering samples, provide a durable tag with identifying information securely attached to the sample.

- b. Include application specific brochures, and installation instructions.
- c. Provide Contractor's stamp of approval on samples or transmittal form as indication of Contractor's checking and verification of dimensions and coordination with interrelated work.
- d. Resubmit samples of rejected items.

C. Miscellaneous Submittals:

1. Prepare in the format and detail specified in Specification requiring the miscellaneous submittal.

D. Operation and Maintenance Manuals:

1. Owner's use of manufacturer's Operation and Maintenance materials:
 - a. Materials are provided for Owner's use, reproduction and distribution as training and reference materials within Owner's organization.
 - 1) Applicable to hard copy or electronic media.
 - 2) Applicable to materials containing copyright notice as well as those with no copyright notice.
 - b. Notify manufacturer of this intended use of materials provided under the Contract.
2. Number each Operation and Maintenance Manual transmittal with the original root number of the associated Shop Drawing.
 - a. Identify resubmittals with the original number plus a suffix letter starting with "A."
3. Submittal format:
 - a. Interim submittals: Submit two (2) paper copies until manual is approved.
 - b. Final submittals:
 - 1) Within 30 days of receipt of approval, submit one (1) additional paper copy and two (2) electronic copies to the Owner's Document

Management System (SharePoint) in Portable Document Format (PDF).

- a) Compact discs to be secured in jewel cases.
- 2) Electronic copies will be reviewed for conformance with the approved paper copy and the electronic copy (PDF) requirements of this Specification.
- 3) Non-conforming CDs will be returned with comments.
 - a) Provide final CDs within 30 days of receipt of comments.
- 4. Paper copy submittals:
 - a. Submit Operation and Maintenance Manuals printed on 8-1/2 x 11 In size heavy first quality paper with standard three-hole punching and bound in

appropriately sized three-ring (or post) vinyl view binders with clear overlays front, spine and back.

- 1) Provide binders with titles inserted under clear overlay on front and on spine of each binder.
 - a) As space allows, binder titles shall include, but not necessarily be limited to, Project Name, related Specification Number, Equipment Name(s) and Project Equipment Tag Numbers.
- 2) Provide a Cover Page for each manual with the following information:
 - a) Manufacturer(s).
 - b) Date.
 - c) Project Owner and Project Name.
 - d) Specification Section.
 - e) Project Equipment Tag Numbers.
 - f) Model Numbers.
 - g) Principal Architect/Engineer.
 - h) Contractor.
- 3) Provide a Table of Contents or Index for each manual.
- 4) Use plastic-coated dividers to tab each section of each manual per the manual's Table of Contents/Index for easy reference.
- 5) Provide plastic sheet lifters prior to first page and following last page.
- b. Reduce Drawings or diagrams bound in manuals to an 8-1/2 x 11 In or 11 x 17 In size.
 - 1) Where reduction is not practical to ensure readability, fold larger Drawings separately and place in vinyl envelopes which are bound into the binder.
 - 2) Identify vinyl envelopes with Drawing numbers.
- c. Mark each sheet to clearly identify specific products and component parts and data applicable to the installation for the Project.
 - 1) Delete or cross out information that does not specifically apply to the Project.
5. Electronic copy submittals:
 - a. Electronic copies of the approved paper copy Operation and Maintenance Manuals are to be produced in Adobe Acrobat's Portable Document Format (PDF) Version 5.0 or higher.
 - b. Do not password protect and/or lock the PDF document.

- c. Create one (1) PDF document (PDF file) for each equipment O&M Manual.
- d. Drawings or other graphics must be converted to PDF format and made part of the one (1) PDF document.
 - 1) Scanning to be used only where actual file conversion is not possible.
- e. Rotate pages that must be viewed in landscape to the appropriate position for easy reading.
- f. Images only shall be scanned at a resolution of 300 dpi or greater.
 - 1) Perform Optical Character Recognition (OCR) capture on all images.
 - 2) Achieve OCR with the "original image with hidden text" option.
 - 3) Word searches of the PDF document must operate successfully to demonstrate OCR compliance.
- g. Create bookmarks in the navigation frame, for each entry in the Table of Contents/Index.
 - 1) Normally three (3) levels deep (i.e., "Chapter," "Section," "Sub-section").
- h. Thumbnails must be generated for each PDF file.
- i. Set the opening view for PDF files as follows:
 - 1) Initial view: Bookmarks and Page.
 - 2) Magnification: Fit in Window.
 - 3) Page layout: Single page.
 - 4) Set the file to open to the cover page of the manual with bookmarks to the left, and the first bookmark linked to the cover page.
- j. All PDF documents shall be set with the option "Fast Web View" to open the first pages of the document for the viewer while the rest of the document continues to load.
- k. File naming conventions:
 - 1) File names shall use a "ten dot three" convention (XXXXXX-YY-Z.PDF) where XXXXXX is the Specification Section number, YY is the

Shop Drawing Root number and Z is an ID number used to designate the associated volume.

a) Example 1:

(1) Two (2) pumps submitted as separate Shop Drawings under the same Specification Section:

(a) Pump 1 = 43 21 21-01-1.pdf.

(b) Pump 2 = 43 21 21-02-1.pdf.

b) Example 2:

(1) Control system submitted as one (1) Shop Drawing but separated into two (2) O&M volumes:

(a) Volume 1 = 40 90 00-01-1.pdf.

(b) Volume 2 = 40 90 00-01-2.pdf.

I. Labeling:

1) As a minimum, include the following labeling on all CD-ROM discs and jewel cases:

a) Project Name.

b) Equipment Name and Project Tag Number.

c) Project Specification Section.

d) Manufacturer Name.

e) Vendor Name.

m. Binding:

1) Include labeled CD(s) in labeled jewel case(s).

a) Bind jewel cases in standard three-ring binder Jewel Case Page(s), inserted at the front of the Final paper copy submittal.

b) Jewel Case Page(s) to have means for securing Jewel Case(s) to prevent loss (e.g., flap and strap).

6. Operation and Maintenance Manuals for Materials and Finishes:

a. Building Products, Applied Materials and Finishes:

1) Include product data, with catalog number, size, composition and color and texture designations.

2) Provide information for re-ordering custom manufactured products.

b. Instructions for Care and Maintenance:

1) Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods and recommended schedule for cleaning and maintenance.

- c. Moisture Protection and Weather Exposed Products:
 - 1) Include product data listing, applicable reference standards, chemical composition, and details of installation.
 - 2) Provide recommendations for inspections, maintenance and repair.
 - d. Additional requirements as specified in individual product specifications.
7. Operation and Maintenance Manuals for Equipment and Systems:
- a. Submission of Operation and Maintenance Manuals for equipment and systems is applicable but not necessarily limited to:
 - 1) Major equipment.
 - 2) Equipment powered by electrical, pneumatic or hydraulic systems.
 - 3) Specialized equipment and systems including instrumentation and control systems and system components for HVAC process system control.
 - 4) Valves and water control gates.
 - b. Equipment and Systems Operation and Maintenance Manuals shall include, but not necessarily be limited to, the following completed forms and detailed information, as applicable:
 - 1) Fully completed type-written copies of the associated Equipment Record(s), Exhibits A1, A2 and A3, shall be included under the first

tab following the Table of Contents of each Operation and Maintenance Manual.

- a) Each section of the Equipment Record must be completed in detail.
 - (1) Simply referencing the related manual for nameplate, maintenance, spare parts or lubricant information is not acceptable.
 - b) For equipment items involving components or subunits, a fully completed Equipment Record Form is required for each operating component or subunit.
 - c) Submittals that do not include the associated Equipment Record(s) will be rejected without further content review.
 - d) Electronic copies of the Exhibits may be obtained by contacting the Project Manager.
- 2) Equipment function, normal operating characteristics, limiting operations.
 - 3) Assembly, disassembly, installation, alignment, adjustment, and checking instructions.
 - 4) Operating instructions for start-up, normal operation, control, shutdown, and emergency conditions.
 - 5) Lubrication and maintenance instructions.
 - 6) Troubleshooting guide.
 - 7) Parts lists:
 - a) Comprehensive parts and parts price lists.
 - b) A list of recommended spare parts.
 - c) List of spare parts provided as specified in the associated Specification Section.
 - 8) Outline, cross-section, and assembly Drawings; engineering data; and electrical diagrams, including elementary diagrams, wiring diagrams,

connection diagrams, word description of wiring diagrams and interconnection diagrams.

9) Test data and performance curves.

10) As-constructed fabrication or layout Drawings and wiring diagrams.

11) Instrumentation or tag numbers assigned to the equipment by the Contract Documents are to be used to identify equipment and system components.

12) Additional information as specified in the associated equipment or system Specification Section.

1.7 TRANSMITTAL OF SUBMITTALS

A. Shop Drawings, Samples and Operation and Maintenance Manuals:

1. Transmit all submittals via Owner's Document Management System (SharePoint).
2. Transmit all paper submittals to the address provided below.

San Jacinto River Authority

2436 Sawdust Road

The Woodlands, Texas 77380

Attn: Donald Morrison – Construction Manager

3. Utilize SJRA Standard Submittal Transmittal Form (to be provided by Owner) to transmit all Shop Drawings, Samples and Operation and Maintenance Manuals.
4. All submittals must be from Contractor.
 - a. Submittals will not be received from or returned to subcontractors.
 - b. Operation and Maintenance Manual submittal stamp may be Contractor's standard approval stamp.
5. Provide submittal information defining specific equipment or materials utilized on the Project.
 - a. Generalized product information, not clearly defining specific equipment or materials to be provided, will be rejected.

B. Miscellaneous Submittals:

1. Transmit under Contractor's standard Submittal Transmittal Form or letterhead.
2. Submit in triplicate or as specified in individual Specification Section.
3. Transmit to the address provided below.

San Jacinto River Authority
2436 Sawdust Road
The Woodlands, Texas 77380
Attn: Donald Morrison – Construction Manager

4. Provide copy of Submittal Transmittal without attachments to Owner's Representative.
- C. Expedited Return Delivery:
 1. Include prepaid express envelope or airbill in submittal transmittal package for any submittals Contractor expects or requires express return mail.
 2. Inclusion of prepaid express envelope or airbill does not obligate Owner's Representative or Principal Architect/Engineer to conduct expedited review of submittal.
- D. Fax Transmittals:
 1. Permitted on a case-by-case basis to expedite review when approved by Principal Architect/Engineer.
 2. Requires hard copy transmittal to immediately follow.
 - a. Principal Architect/Engineer will proceed with review of fax transmittal.
 - b. Principal Architect/Engineer 's approval or rejection comments will be recorded and returned on hard copy transmittal.
 3. Provisions apply to both:
 - a. Initial transmittal contents.
 - b. Supplemental information required to make initial transmittal contents complete.

1.8 PRINCIPAL ARCHITECT/ENGINEER 'S REVIEW ACTION

- A. Shop Drawings and Samples:
 1. Items within transmittals will be reviewed for overall design intent and will receive one of the following actions:
 - a. NO EXCEPTION.
 - b. EXCEPTIONS AS NOTED.
 - c. REVISE & RESUBMIT
 - d. REJECTED - RESUBMIT.
 - e. ACKNOWLEDGE RECEIPT.
 - f. FOR INFORMATION PURPOSES ONLY.

- g. SUPPLEMENTARY INFORMATION.
- 2. Submittals received will be initially reviewed to ascertain inclusion of Contractor's approval stamp.
 - a. Submittals not stamped by the Contractor or stamped with a stamp containing language other than that specified herein will not be reviewed for technical content and will be returned without any action.
- 3. In relying on the representation on the Contractor's review and approval stamp, Owner and Principal Architect/Engineer reserve the right to review and process poorly organized and poorly described submittals as follows:
 - a. Submittals transmitted with a description identifying a single item and found to contain multiple independent items:
 - 1) Review and approval will be limited to the single item described on the transmittal letter.
 - 2) Other items identified in the submittal will:
 - a) Not be logged as received by the Principal Architect/Engineer.
 - b) Be removed from the submittal package and returned without review and comment to the Contractor for coordination, description and stamping.
 - c) Be submitted by the Contractor as a new series number, not as a re-submittal number.
 - b. Principal Architect/Engineer, at Principal Architect/Engineer's discretion, may revise the transmittal letter item list and descriptions, and conduct review.
 - 1) Unless Contractor notifies Principal Architect/Engineer in writing that the Principal Architect/Engineer's revision of the Submittal Transmittal Form item list and descriptions was in error, Contractor's review and

approval stamp will be deemed to have applied to the entire contents of the submittal package.

4. Submittals returned with Action "A" or "B" are considered ready for fabrication and installation.
 - a. If for any reason a submittal that has an "A" or "B" Action is resubmitted, it must be accompanied by a letter defining the changes that have been made and the reason for the resubmittal.
 - b. Destroy or conspicuously mark "SUPERSEDED" all documents having previously received "A" or "B" Action that are superseded by a resubmittal.
5. Submittals with Action "A" or "B" combined with Action "C" (Revise and Resubmit) or "D" (Rejected) will be individually analyzed giving consideration as follows:
 - a. The portion of the submittal given "C" or "D" will not be distributed (unless previously agreed to otherwise at the Preconstruction Conference).
 - 1) One (1) copy or the one (1) transparency of the "C" or "D" Drawings will be marked up and returned to the Contractor.
 - a) Correct and resubmit items so marked.
 - b. Items marked "A" or "B" will be fully distributed.
 - c. If a portion of the items or system proposed are acceptable, however, the major part of the individual Drawings or documents are incomplete or require revision, the entire submittal may be given "C" or "D" Action.
 - 1) This is at the sole discretion of the Principal Architect/Engineer.
 - 2) In this case, some Drawings may contain relatively few or no comments or the statement, "Resubmit to maintain a complete package."
 - 3) Distribution to the Owner and field will not be made (unless previously agreed to otherwise).
6. Failure to include any specific information specified under the submittal paragraphs of the Specifications will result in the submittal being returned to the Contractor with "C" or "D" Action.
7. Calculations: Requirements for the submittal of calculations in the individual Specification Sections shall be satisfied through the submittal of a certification sealed by the Principal Architect/Engineer that the calculations have been performed. Certification will be received for information purposes only and will be returned stamped "D. ACKNOWLEDGE RECEIPT".
8. Transmittals of submittals which the Principal Architect/Engineer considers as "Not Required" submittal information, which is supplemental to but not essential to prior submitted information, or items of information in a transmittal which have been reviewed and received "A" or "B" Action in a

prior submittal, will be returned with Action "E. Acknowledge Receipt"
(Principal Architect/Engineer 's Review Not Required).

9. Samples may be retained for comparison purposes.
 - a. Remove samples when directed.
 - b. Include in bid all costs of furnishing and removing samples.
10. Approved samples submitted or constructed, constitute criteria for judging completed work.
 - a. Finished work or items not equal to samples will be rejected.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

Equipment Data and Spare Parts Summary

Standard Specification
Contract No. 19-0017

Recommended Maintenance Summary

Standard Specification
Contract No. 19-0017

EXHIBIT A3 Equipment Record

Lubrication Summary

Equipment Description	Project Equip. Tag No(s).
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Lubricant Point						
Lubricant Type	Manufacturer		Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

Lubricant Point						
Lubricant Type	Manufacturer		Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

Lubricant Point						
Lubricant Type	Manufacturer		Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

Lubricant Point						
Lubricant Type	Manufacturer		Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

Lubricant Point						
Lubricant Type	Manufacturer		Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

Lubricant Point						
Lubricant Type	Manufacturer		Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

END OF SECTION

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SECTION 01 35 05

ENVIRONMENTAL PROTECTION AND SPECIAL CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Addresses:

1. Minimizing the pollution of air, water, or land; control of noise, the disposal of solid waste materials, and protection of deposits of historical or archaeological interest.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 00 – Bidding Requirements, Contract Forms, and Conditions of the Contract.
2. Division 01 – General Requirements.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Prices. No separate payment will be made for this item. Include the cost of same in associated items for this project.

1.3 SUBMITTALS

A. Shop Drawings:

1. See Specification Section 01 33 00 – Submittals for requirements for the mechanics and administration of the submittal process.
2. Prior to the start of any construction activities submit:
 - a. A detailed proposal of all methods of control and preventive measures to be utilized for environmental protection.
 - b. A drawing of the work area, haul routes, storage areas, access routes and current land conditions including trees and vegetation.
 - c. Submit manufacturer's catalog sheets and other product data on dispensing equipment, pump, and aboveground fuel storage tanks, indicating capacity and dimensions of tank.
 - d. Submit drawings to show location of tank protection area and driveway. Indicate nearest inlet or channelized flow area. Clearly dimension distances and measurements.
 - e. Submit list of spill containment equipment, and quantities thereof, located at fueling area.

1.4 ENVIRONMENTAL CONTROLS

- A. Provide and maintain methods, equipment, and temporary construction as necessary for controls over environmental conditions at construction site and adjacent areas.
- B. Work to minimize impact to surrounding environment. Adopt construction procedures that do not cause unnecessary excavation and filling of terrain, indiscriminate destruction of vegetation, air or stream pollution, nor harassment or destruction of wildlife.
- C. Recognize and adhere to environmental requirements of Project. Limit disturbed areas to boundaries established by Contract. Avoid pollution of "on-site" streams, sewers, wells, or other water sources.
- D. Burning of rubbish, debris, or waste materials is not permitted.

1.5 POLLUTION CONTROL

- A. Provide methods, means, and facilities required to prevent contamination of soil, water, or atmosphere by discharge of noxious substances from construction operations.
- B. Provide equipment and personnel to perform required emergency measures to contain spillage, and to remove contaminated soils or liquids. Excavate and dispose of contaminated earth off-site, and replace with suitable compacted fill and topsoil.
- C. Provide systems for control of atmospheric pollutants.
 - 1. Prevent toxic concentrations of chemicals.
 - 2. Prevent harmful dispersal of pollutants into atmosphere.
- D. Use equipment that conforms to current Federal, State, and local laws and regulations.
- E. Install or otherwise implement positive controls to prevent hazardous materials migrating from Work area.

1.6 PEST AND RODENT CONTROL

- A. Provide rodent and pest control as necessary to prevent infestation of construction or storage areas.
- B. Employ methods and use materials which will not adversely affect conditions at site or on adjoining properties.

1.7 NOISE CONTROL

- M. Provide vehicles, equipment, and construction activities that minimize noise to greatest degree practicable. Conform noise levels to latest OSHA standards.

Do not permit noise levels to interfere with Work or create nuisance in surrounding areas.

- N. Conduct construction operations during daylight hours except as approved by Owner's Representative.
- O. Select construction equipment to operate with minimum noise and vibration. When in opinion of Owner's Representative, objectionable noise or vibration is produced by equipment, rectify conditions without additional cost to Owner. Sound Power Level (PWL) of equipment shall not exceed 85 dbA (re: 10-12

watts) measured 5 feet from piece of equipment. Explicit equipment noise requirements are specified with equipment specifications.

1.8 DUST CONTROL

- A. Control objectionable dust caused by operation of vehicles and equipment. Apply water or use other methods, subject to approval of Owner's Representative, to control amount of dust generated.

1.9 WATER RUNOFF AND EROSION CONTROL

- A. Comply with Texas Pollutant Discharge Elimination System (TPDES) permit when required.
- B. In addition to TPDES requirements:
 - 1. Provide methods to control surface water, runoff, subsurface water, and water from excavations and structures to prevent damage to Work, site, or adjoining properties.
 - 2. Control fill, grading and ditching to direct water away from excavations, pits, tunnels, and other construction areas; and to direct drainage to proper runoff courses so as to prevent erosion, sedimentation or damage.
 - 3. Provide, operate, and maintain equipment and facilities of adequate size to control surface water.
 - 4. Dispose of drainage water in manner to prevent flooding, erosion, or other damage to portion of site or to adjoining areas and in conformance with environmental requirements.
 - 5. Retain existing drainage patterns external to construction site by constructing temporary earth berms, sedimentation basins, retaining areas, and temporary ground cover as needed to control conditions.
 - 6. Plan and execute construction and earth work by methods to control surface drainage from cuts and fills, and from borrow and waste disposal areas, to prevent erosion and sedimentation.
 - a. Minimize area of bare soil exposed at one time.
 - b. Provide temporary control measures, as berms, dikes, and drains.
 - 7. Construct fills and waste areas by selective placement to eliminate erosion of surface silts or clays.
 - 8. Inspect earthwork periodically to detect evidence of start of erosion. Apply corrective measures as required to control erosion.

1.10 QUALITY ASSURANCE

- A. Person conducting visual examination for pollutant shall be fully knowledgeable about the TPDES Construction General Permit, detecting sources of storm water contaminants, inspection of aboveground storage tank and appurtenances for

leakage, and the day-to-day operations that may cause unexpected pollutant releases.

PART 2 - PRODUCTS

2.1 ABOVEGROUND FUEL STORAGE TANK

- A. Tank Assembly: Must be listed with UL 1709 and UL 2085.
- B. Inner Steel Storage Tank: Follow UL 142, with minimum thickness of 1/8-inch welded construction.
- C. Tank Encasement: Either concrete or steel to provide minimum of 110 percent containment of inner tank capacity. Provide 5-gallon overspill containment pan for tank refueling.
- D. Dispenser Pump: For submersible pump, UL listed emergency shut-off valve to be installed at each dispenser. For suction pump, UL listed vacuum-activated shut-off valve, with shear section, is to be installed at each dispenser. Fuel may not be dispensed from tank by gravity flow or by pressurization of tank. Means must be provided to prevent release of fuel by siphon flow.
- E. Representative Manufacturers: Convault, Fireguard, Ecovault, SuperVault, or equal.

2.2 CONCRETE

- A. Provide concrete with minimum strength of 4,000 psi at 28 days.

2.3 AGGREGATES

- A. Coarse aggregate shall consist of crushed stone, gravel, crushed blast furnace slag, or combination of these materials. Aggregate shall be composed of clean,

hard, durable materials, free from adherent coatings, salt, alkali, dirt, clay, loam, shale, soft or flaky materials, or organic and injurious matter.

B. Coarse aggregates shall conform to following gradation requirements.

Sieve Size	Percent Retained
<u>(Square Mesh)</u>	<u>(By Weight)</u>
2-1/2"	0
2"	0 - 20
1-1/2"	15 - 50
3/4"	60 - 80
No. 4	95 - 100

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Employ and utilize environmental protection methods, obtain all necessary permits, and fully observe all local, state, and federal regulations.
- B. No clearing and grubbing or rough cutting permitted until erosion and sediment control systems are in place, other than site Work specifically directed by Owner's Representative to allow soil testing and surveying.
- C. Prohibit equipment and vehicles from maneuvering on areas outside of dedicated rights-of-way and easements for construction. Immediately repair damage caused by construction traffic to erosion and sediment control systems.
- D. Maintain existing erosion and sediment control systems located within project site until acceptance of Project or until directed by Owner's Representative to remove and discard existing system.
- E. Regularly inspect and repair or replace damaged components of erosion and sediment control systems as specified in this Section. Unless otherwise directed, maintain erosion and sediment control systems until project area stabilization is accepted by the Owner. Remove erosion and sediment control systems promptly when directed by Owner's Representative. Discard removed materials off site.
- F. Remove and dispose sediment deposits at designated spoil site for Project. If a project spoil site is not designated on Drawings, dispose of sediment off site at location not in or adjacent to stream or flood plain. Assume responsibility for off-site disposal. Spread sediment evenly throughout site, compacted and stabilized. Prevent sediment from flushing into a stream or drainage way. If

sediment has been contaminated, dispose of in accordance with existing federal, state, and local rules and regulations.

- G. Assume responsibility for collecting, storing, hauling, and disposing of spoil, silt, and waste materials as specified in this or other Specifications and in compliance with applicable federal, state, and local rules and regulations.
- H. Employ protective measures to avoid damage to existing trees to be retained on project site. Conduct construction operations under this Contract in conformance with erosion control practices described in Drawings and this or other Specifications.
- I. Prepare spill response and containment procedures to be implemented in event of significant materials spill. Significant materials include but are not limited to: raw materials; fuels; materials such as solvent, detergents, and plastic pellets; finished materials such as metallic products; raw materials used in food processing or production; hazardous substances designated under Section 101(14) of CERCLA; chemical required to be reported pursuant to Section 313 of Title III of SARA; fertilizers; pesticides, and waste products such as slag, ashes and sludge that have potential to be released with storm water discharges. Spill containment procedures shall be kept on-site or in construction field office.
- J. Spill containment equipment appropriate to size of operation is to be located in close proximity of fueling area. Such equipment includes, but not limited to,

suitable waste containers for significant materials, drip pans, booms, inlet covers, or absorbent.

- K. Properly label significant materials or waste containers used for construction activities and stored on-site overnight.
- L. Install, maintain, and inspect erosion, sediment control measures and practices as specified in Drawings and in this or other Specifications
- M. Land Protection:
 - 1. Except for any work or storage area and access routes specifically assigned for the use of the Contractor, the land areas outside the limits of construction shall be preserved in their present condition.
 - a. Contractor shall confine his construction activities to areas defined for work within the Contract Documents.
 - 2. Manage and control all borrow areas, work or storage areas, access routes and embankments to prevent sediment from entering nearby water or land adjacent to the work site.
 - 3. Restore all disturbed areas including borrow and haul areas and establish permanent type of locally adaptable vegetative cover.
 - 4. Unless earthwork is immediately paved or surfaced, protect all side slopes and backslopes immediately upon completion of final grading.
 - 5. Plan and execute earthwork in a manner to minimize duration of exposure of unprotected soils.
 - 6. Except for areas designated by the Contract Documents to be cleared and grubbed, the Contractor shall not deface, injure or destroy trees and

vegetation, nor remove, cut, or disturb them without approval of the Owner's Representative.

- a. Any damage caused by the Contractor's equipment or operations shall be restored as nearly as possible to its original condition at the Contractor's expense.
7. Utilize, as necessary, erosion control methods to protect side and backslopes, minimize and the discharge of sediment to the surface water leaving the construction site as soon as rough grading is complete.
- a. These controls shall be maintained until the site is ready for final grading and landscaping or until they are no longer warranted and concurrence is received from the Owner's Representative.
 - b. Physically retard the rate and volume of run-on and runoff by:
 - 1) Implementing structural practices such as diversion swales, terraces, straw bales, silt fences, berms, storm drain inlet protection, rocked outlet protection, sediment traps and temporary basins.
 - 2) Implementing vegetative practices such as temporary seeding, permanent seeding, mulching, sod stabilization, vegetative buffers,

hydroseeding, anchored erosion control blankets, sodding, vegetated swales or a combination of these methods.

- 3) Providing Construction sites with graveled or rocked access entrance and exit drives and parking areas to reduce the tracking of sediment onto public or private roads.
8. Discharges from the construction site shall not contain pollutants at concentrations that produce objectionable films, colors, turbidity, deposits or noxious odors in the receiving stream or waterway.

N. Solid Waste Disposal:

1. Collect solid waste on a daily basis.
2. Provide disposal of degradable solid waste to an approved solid waste disposal site.
3. Provide disposal of nondegradable solid waste to an approved solid waste disposal site or in an alternate manner approved by Owner's Representative and regulatory agencies.
4. No building materials wastes or unused building materials shall be buried, dumped, or disposed of on the site.

O. Fuel and Chemical Handling:

1. Store and dispose of chemical wastes in a manner approved by regulatory agencies.
2. Take special measures to prevent chemicals, fuels, oils, greases, herbicides, and insecticides from entering drainage ways.
3. Do not allow water used in onsite material processing, concrete curing, cleanup, and other waste waters to enter a drainage way(s) or stream.
4. The Contractor shall provide containment around fueling and chemical storage areas to ensure that spills in these areas do not reach waters of the state.

P. Control of Dust:

1. The control of dust shall mean that no construction activity shall take place without applying all such reasonable measures as may be required to

prevent particulate matter from becoming airborne so that it remains visible beyond the limits of construction.

- a. Reasonable measures may include paving, frequent road cleaning, planting vegetative groundcover, application of water or application of chemical dust suppressants.
 - b. The use of chemical agents such as calcium chloride must be approved by the State of Texas DOT.
2. Utilize methods and practices of construction to eliminate dust in full observance of agency regulations.
 3. The Owner's Representative will determine the effectiveness of the dust control program and may request the Contractor to provide additional measures, at no additional cost to Owner.

Q. Burning:

1. Do not burn material on the site.
2. If the Contractor elects to dispose of waste materials by burning, make arrangements for an off-site burning area and conform to all agency regulations.

R. Control of Noise:

1. Control noise by fitting equipment with appropriate mufflers.

S. Completion of Work:

1. Upon completion of work, leave area in a clean, natural looking condition.
2. Ensure all signs of temporary construction and activities incidental to construction of required permanent work are removed.

T. Historical Protection:

1. If during the course of construction, evidence of deposits of historical or archaeological interests is found, cease work affecting find and notify Owner's Representative.
 - a. Do not disturb deposits until written notice from Owner's Representative is given to proceed.
2. The Contractor will be compensated for lost time or changes in construction to avoid the find based upon normal change order procedures.

3.2 TOPSOIL PLACEMENT FOR EROSION AND SEDIMENT CONTROL SYSTEMS

- A. When topsoil is specified as a component of another Specification, conduct erosion control practices described in this Specification during topsoil placement operations.

- B. When placing topsoil, maintain erosion and sediment control systems consisting of swales, grade stabilization structures, berms, dikes, waterways, and sediment basins.
- C. Maintain grades which have been previously established on areas to receive topsoil.
- D. After areas to receive topsoil have been brought to grade, and immediately prior to dumping and spreading topsoil, loosen subgrade by discing or by scarifying to a depth of at least 2 inches to permit bonding of topsoil to subsoil. Compact by passing bulldozer up and down slope, tracking over entire surface area of slope to create horizontal erosion control slots.
- E. No sod or seed shall be placed on soil which has been treated with soil sterilants until sufficient time has elapsed to permit dissipation of toxic materials.

3.3 DUST CONTROL

- A. Implement dust control methods to control dust creation and movement on construction sites and roads and to prevent airborne sediment from reaching receiving streams or storm water conveyance systems, to reduce on-site and off-site damage, to prevent health hazards, and to improve traffic safety.
- B. Control blowing dust by using one or more of following methods:
 - 1. Mulches bound with chemical binders such as Carasol, Terratack, or equal.
 - 2. Temporary vegetative cover.
 - 3. Spray-on adhesives on mineral soils when not used by traffic.
 - 4. Tillage to roughen surface and bring clods to surface.
 - 5. Irrigation by water sprinkling.
 - 6. Barriers using solid board fences, snow fences, burlap fences, crate walls, bales of hay, or similar materials.
- C. Implement dust control methods immediately whenever dust can be observed blowing on project site.

3.4 KEEPING STREETS CLEAN

- A. Keep streets clean of construction debris and mud carried by construction vehicles and equipment. If necessary, install stabilized construction exits at construction, staging, storage, and disposal areas. Vehicle/equipment wash area (stabilized with coarse aggregate) may be installed adjacent to stabilized construction exit, as needed. Release wash water into a drainage swale or inlet

protected by erosion and sediment control measures. Construction exit specified in Section 01 57 13.02 - Stabilized Construction Access.

- B. In addition to stabilized construction exits, shovel or sweep pavement to extent necessary to keep street clean. Water hosing or sweeping of debris and mud off of street into adjacent areas is not allowed.

3.5 EQUIPMENT MAINTENANCE AND REPAIR

- A. Confine maintenance and repair of construction machinery and equipment to areas specifically designated for that purpose. Locate areas so that oils, gasoline, grease, solvents, and other potential pollutants cannot be washed directly into receiving streams or storm water conveyance systems. Provide these areas with adequate waste disposal receptacles for liquid as well as solid waste. Clean and inspect maintenance areas daily.
- B. On construction site where designated equipment maintenance areas are not feasible, take precautions during each individual repair or maintenance operation to prevent potential pollutants from washing into streams or conveyance systems. Provide temporary waste disposal receptacles.

3.6 WASTE COLLECTION AND DISPOSAL

- A. Formulate and implement a plan for collection and disposal of waste materials on construction site. In plan, designate locations for trash and waste receptacles and establish a collection schedule. Specify and carry out methods for ultimate disposal of waste in accordance with applicable local, state, and federal health and safety regulations. Make special provisions for collection and disposal of liquid wastes and toxic or hazardous materials.
- B. Keep receptacles and waste collection areas neat and orderly to extent possible. Waste shall not be allowed to overflow its container or accumulate from day-to-day. Locate trash collection points where they shall least likely be affected by concentrated storm water runoff.

3.7 WASHING AREAS

- A. Avoid washing concrete delivery trucks or dump trucks and other construction equipment at locations where runoff shall flow directly into a watercourse or storm water conveyance system. Designate special areas for washing vehicles. Locate these areas where wash water shall spread out and evaporate or infiltrate directly into ground, or where runoff can be collected in temporary holding or seepage basin. Beneath wash areas construct a gravel or rock base to minimize mud production.

3.8 STORAGE OF CONSTRUCTION MATERIALS AND CHEMICALS

- A. Isolate sites where chemicals, cements, solvents, paints, or other potential water pollutants are stored in areas where they shall not cause runoff pollution.
- B. Store toxic chemicals, materials, pesticides, paints, and acids in accordance with manufacturers' guidelines. Protect groundwater resources from leaching

by placing a plastic mat, packed clay, tar paper, or other impervious materials on areas where toxic liquids are to be opened and stored.

3.9 DEMOLITION AREAS

- A. Demolition activities which create large amounts of dust with significant concentrations of heavy metals or other toxic pollutants shall use dust control techniques to limit transport of airborne pollutants. However, retain water or slurry used to control dust contaminated with heavy metals or toxic pollutants on site, and prevent runoff directly into watercourses or storm water conveyance systems. Carry out methods of ultimate disposal of these materials in accordance with applicable local, state, and federal health and safety regulations.

3.10 SANITARY FACILITIES

- A. Provide construction sites with adequate portable toilets for workers in accordance with applicable health regulations.

3.11 PESTICIDES

- A. Use and store pesticides during construction in accordance with manufacturers' guidelines and with local, state, and federal regulations. Avoid overuse of pesticides which could produce contaminated runoff. Take great care to prevent accidental spillage. Never wash pesticide containers in or near flowing streams or storm water conveyance systems.

3.12 CONSTRUCTION METHODS

- A. Provide fuel tank protection area and driveway as shown on Drawings.
- B. Do not locate fueling area in or near channelized flow area or close to storm sewer conveyance system. Provide sufficient space to allow installation of other erosion and sediment controls to protect those areas.
- C. Clear and grub fueling area to remove unsuitable materials. Place geotextile fabric as permeable separator to prevent mixing of coarse aggregate with underlying soil. Overlap fabric minimum of 6 inches. Place coarse aggregate on top of geotextile fabric to minimum depth of 8 inches.
- D. Grade protection area and driveway to provide sufficient drainage away from stabilized areas. Use sandbags, gravel, boards, or similar methods to prevent sediment from entering public right-of-way, receiving stream or storm water conveyance system. Provide driveway to fuel tank area with minimum width of 15 feet for one-way traffic and 30 feet for two-way traffic.
- E. Place aboveground storage tank on top of cast-in-place or pre-cast foundation. Base size and thickness of foundation on size and weight of tank to be used, with minimum thickness of 6 inches. Enclose concrete foundation by 5-inch by

5-inch concrete curb and extend minimum of 1 foot beyond tank and dispenser assemblies, so that leak and drip can be contained within concrete foundation.

- F. Slope concrete foundation minimum of 1 percent toward 6-inch wide by 12-inch long by 4-inch deep sump pit. Install minimum of 2-inch pipe inside sump pit with valve on outside of curb to allow draining of concrete foundation.
- G. Install portable concrete Jersey Barrier around concrete foundation. Provide minimum clearance of 2 feet from edge of foundation. In lieu of Jersey barrier, install 4-inch diameter steel pipe bollards around foundation. Bury bollards minimum of 3 feet deep, 3 feet above ground, and 4 feet on center, encased in 12-inch wide concrete foundation.

3.13 MAINTENANCE

- A. Inspections shall be conducted by designated health and safety officer qualified to conduct health and safety inspections.
- B. Inspect stabilized areas after every storm event and at least once a week. Provide periodic top dressing with additional coarse aggregate to maintain required depth. Repair and clean out damaged control measures used to trap sediment.
- C. Inspect fuel tank foundation's bermed area after every storm event and at least once a week. Visually examine storm water contained in tank's bermed foundation area for oil sheen or other obvious indicators of storm water pollution. Properly dispose of storm water when pollutant is present. Record visual examination of storm water discharge in Report noting date and time of examination, name of examiner, observations of water quality, and volume of storm water discharged from bermed area. Keep Report with other storm water pollution control inspection reports on site, in readily accessible location.

3.14 TEMPORARY FUELING AREA CLOSURE

- A. Dispose of temporary vehicle and equipment fueling area by removal of sediment and erosion controls properly off site. Owner's Representative will inspect top soils in fueling area and immediate vicinity for evidence of fuel leaks. If Owner's Representative determines that sufficient pollutants have been released, remove soil and properly dispose off site. Other remediation methods may be required.

END OF SECTION

SECTION 01 45 16.32
CONTRACTOR'S QUALITY CONTROL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Measurement and Payment
 - 2. Quality Assurance/Control of Installation
 - 3. References
 - 4. Manufacturer's Field Services and Reports
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 – Bidding Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Division 01 – General Requirements.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Price. No separate payment will be made for this item. Include the cost in associated items for this project.

1.3 SUBMITTALS (NOT USED)

1.4 QUALITY ASSURANCE/CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality at no additional cost to the Owner.
- B. Comply fully with manufacturers' installation instructions, including each step in sequence.
- C. Request clarification Owner's Representative before proceeding when manufacturers' instructions conflict with Contract.
- D. Comply with specified standards as minimum requirements for Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Perform Work by persons qualified to produce specified level of workmanship.

1.5 REFERENCES

- A. Obtain copies of standards and maintain at job site when required by individual Specification sections.

1.6 MANUFACTURERS' FIELD SERVICES AND REPORTS

- A. When specified in individual Specification sections or as required by Owner's Representative, provide material or product suppliers' or manufacturers' technical representative to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, operator training, test, adjust and balance of equipment as applicable and to initiate operation, as required. Conform to minimum time requirements for start-up operations and operator training when defined in Specification sections.
- B. At Owner's Representative's request, submit qualifications of manufacturers' representative to Owner's Representative 15 days in advance of required representatives' services. Representative is subject to approval by Owner's Representative.
- C. A manufacturers' representative is to report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to a manufacturer's written instructions. Submit report within 14 days of observation to Owner's Representative for review.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 45 29
TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Testing laboratory services
2. Requirements of this section apply to testing laboratories employed by the Contractor for approval of manufactured products, materials, including mix designs and quality control of materials
3. Requirements of this section also apply to testing laboratories employed by the Owner for approval of materials and the constructed Work on site.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 00 – Proposal Requirements, Contract Forms, and Conditions of the Contract.
2. Division 01 – General Requirements.

1.2 MEASUREMENT AND PAYMENT

A. Unit Price. No separate payment will be made for this item. Include the cost in associated items for this project

1.3 QUALITY ASSURANCE

A. Reference Standards

1. ASTM C 1077 – Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.
2. ASTM D 3666 – Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Bituminous Paving Materials.
3. ASTM D 3740 – Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
4. ASTM E 329 – Standard Specification for Minimum Requirements for Agencies Engaged the Testing and/or Inspection of Materials Used in Construction.
5. ISO/IEC 17025 – General Requirements for the Competence of Calibration and Testing Laboratories.

1.4 RELATED REQUIREMENTS

A. To test products and materials and provide certifications as identified in Part 2

Products, in the individual Specification sections, the Contractor shall either

1. Select, employ and pay for services of an independent testing laboratory or laboratories, or
 2. Cause its suppliers to perform required inspection and testing using an independent testing laboratory or a qualified in-house laboratory.
- B. Owner's Representative may, at its option, observe or witness any and all testing of materials and products which are to be utilized in the construction of the Work as they are being tested by the Contractor's laboratories.
- C. Owner will select, employ, and pay for services of an independent testing laboratory to perform inspection and testing identified in Part 3 of individual Specification sections.
- D. Employ and pay for services of independent testing laboratory or laboratories to perform inspection and testing identified in Part 2 of individual Specification sections.
- E. Employment of testing laboratory by Owner does not relieve the Contractor of obligation to perform the Work in accordance with requirements of Contract Documents.
- F. Owner's Representative schedules and monitors Owner's testing laboratory. Provide minimum 24 hours notice of testing to Owner's Representative to avoid delay of the Work.

1.5 QUALIFICATION OF LABORATORY

- A. Meet laboratory qualification requirements of ASTM E 329 and applicable requirements of ASTM C 1077, ASTM D 3666, and ASTM D 3740.
- B. Meet ISO/IEC 17025 conditions for accreditation by the American Association for Laboratory Accreditation (A2LA) in specific fields of testing required in individual Specification sections.
- C. If laboratory subcontracts are part of testing services, such work will be placed with laboratory complying with requirements of this Section.

1.6 LABORATORY

- A. Owner's testing laboratory will provide and distribute copies of laboratory reports to the distribution list provided by Owner's Representative at the preconstruction conference. Distribution will include download to the Owner's electronic document management system (SharePoint) for the Project.
- B. Keep one copy of each laboratory report at site field office for duration of project.
- C. Contractor's testing laboratory will provide and distribute copies of laboratory test reports for materials to be incorporated into this Work to the distribution list provided by Owner's Representative at the preconstruction conference.

Distribution will include download to the Owners electronic document management system (Sharepoint) for the Project

- D. Laboratories will email material supplier, Contractor, and Owner's Representative no later than close of business on working day following test completion and review, reports which indicate failing test results.

1.7 LIMITS ON TESTING LABORATORY AUTHORITY

- A. Laboratory may not release, revoke, alter, or enlarge requirements of Contract.
- B. Laboratory may not approve or accept any portion of the Work.
- C. Laboratory may not assume duties of Contractor or the Owner
- D. Laboratory has no authority to stop the Work.

1.8 SUBMITTALS (NOT USED)

1.9 CONTRACTOR RESPONSIBILITIES

- A. Provide safe access to the Work and to manufacturer's facilities for Owner's Representative, and for testing laboratory personnel.
- B. Provide testing laboratory with copy of construction schedule and copy of each update to construction schedule.
- C. Notify Owner's Representative and testing laboratory during normal working hours of the day previous to expected time for operations requiring inspection and testing services. When Contractor fails to make timely prior notification, then do not proceed with operations requiring inspection and testing services.
- D. Notify Owner's Representative 24 hours in advance when Specification requires presence of Owner's Representative for sampling or testing.
- E. Request and monitor testing as required to provide timely results and avoid delay to the Work. Where specified, provide samples to laboratory in sufficient time to allow required test to be performed in accordance with specified test methods before intended use of material.
- F. Cooperate with laboratory personnel in collecting samples on site. Provide incidental labor and facilities for safe access to the Work to be tested; to obtain and handle samples at site or at source of products to be tested; and to facilitate tests and inspections including storage and curing of test samples.
- G. Arrange with laboratory through Owner's Representative. Payment for additional testing will be made in accordance with Specification Section 00 72 00 - General Conditions of the Contract:
 - 1. Retesting required for failed tests
 - 2. Retesting for nonconforming Work
 - 3. Additional sampling and tests requested beyond specified requirements
 - 4. Insufficient notification of cancellation of tests for Work scheduled but not

performed.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CONDUCTING TESTING

- A. Conform laboratory sampling and testing specified in individual Specification sections to latest issues of ASTM standards, TxDOT methods, or other recognized test standards as approved by Owner's Representative.
- B. Requirements of this section also apply to those tests for approval of materials, for mix designs and for quality control of materials as performed by employed testing laboratories.

END OF SECTION

SECTION 01 51 36.01

PROCEDURE FOR WATER VALVE ASSISTANCE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

Operation of valves. Owner employees will operate existing valves. Contractor's employees may operate new valves included in the Project prior to acceptance by the Owner.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 00 – Bidding Requirements, Contract Forms, and Conditions of the Contract.
2. Division 01 – General Requirements

1.2 MEASUREMENT AND PAYMENT

A. No separate payment will be made for this item. Include the cost of valve operation and valve assistance in Unit Price bid for valves and water mains.

1.3 PROCEDURE

A. Contractor to coordinate with Owner's Representative for valve assistance.

1.4 SUBMITTALS

A. Submit request for work order planning meetings in accordance with Section 01 33 00 – Submittals.

1.5 CANCELLATION

A. The Owner may cancel a scheduled valve assistance appointment at no extra cost to either party. Cancellation may be caused by bad weather, preparation work taking longer than anticipated or unforeseen delays by one or more of the three parties.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 55 26
TRAFFIC CONTROL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes traffic control requirements for signs, signals, control devices, flares, lights, as well as construction parking control, English-speaking flagpersons, peace officers, designated haul routes and bridging of trenches and excavations.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 – Proposal Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Division 01 – General Requirements.

1.2 MEASUREMENT AND PAYMENT

- A. Traffic Control and Regulation. No separate payment. Include in price for associated items for water line replacement.
- B. Flagmen. No separate payment. Include in price for associated items for water line replacement.

1.3 SUBMITTALS

- A. Conform to requirements of Specification Section 01 33 00 – Submittals.
- B. Traffic control plan responsive to the current Texas Manual on Uniform Traffic Control Devices (TMUTCD) sealed by Registered Professional Engineer is incorporated into Drawings. If Contractor proposes to implement traffic control without modification to plan provided, submit a letter confirming decision. If Contractor proposes to implement traffic control different than plan provided, submit a traffic control plan in conformance with TMUTCD sealed by Registered Professional Engineer.
- C. Submit copies of approved lane closure permits.
- D. For both traffic control plan and flagperson use, submit Schedules of values within 30 days following notice to proceed. Refer to Specification Section 01 29 73 – Schedule of Values.
- E. Provide information and records regarding use of qualified flagmen to verify use of “peace officers” as flagmen in compliance with Contract and Texas law, including but not limited to, Article 4413 (29bb), commonly referred to as Private Investigators and Private Security Agencies Act, and Article 2.12, Texas Code of Criminal Procedure.
- F. Provide information and records regarding use of qualified flagmen to verify Contractor’s use of “certified flagmen” as flagmen is in compliance with Contract.

1.4 FLAGMEN

- A. Use flagmen, qualified as described under Paragraph 1.4.B, Uniformed Peace Officers, and Paragraph 1.4.C, Certified Flagmen, to control, regulate, and direct even flow and movement of vehicular and pedestrian traffic when construction operations encroach on public traffic lanes.
- B. Uniformed Peace Officer: Individual who has full-time employment as peace officer and receives compensation as flagman for private employment as individual employee or independent contractor. Private employment may be either employee-employer relationship or on an individual basis. Flagman may not be in employ of another peace officer and may not be a reserve peace officer.
 - 1. Peace officer is defined as:
 - a. Sheriffs and their deputies
 - b. Constables and deputy constables
 - c. Marshals or police officers of an incorporated city, town, or village
 - d. As otherwise provided by Article 2.12, Texas Code of Criminal Procedure, as amended
 - 2. Individual who has full-time employment as a peace officer is one who is actively employed in a full-time capacity as a peace officer working, on average, a minimum of 32 paid hours per week, being paid a rate of pay not less than prevailing minimum hourly wage rate set by federal Wage and Hour Act and entitled to full benefits of participation in retirement plan, vacation, holidays, and insurance benefits. A reserve peace officer does not qualify, under this definition, as a peace officer.
- C. Certified Flagman: Individual who receives compensation as flagman and meets the following qualifications and requirements:
 - 1. Formally trained and certified in traffic control procedures.
 - 2. Required to wear distinctive uniform, bright-colored vest, and be equipped with appropriate flagging and communication devices
 - 3. English speaking, with Spanish as advantageous, but not required, primary, or secondary language.
 - 4. Paid as Certified Flagman, equivalent to hourly wage rate set for Rough Carpenter under Specification Section 00 73 43 – Wage Scale for Construction.
 - 5. Required to carry proof of training/certification and photographic identification card issued by training institute to allow Owner's Representative to easily determine necessary full-time traffic control is actually provided when and where construction work encroaches upon traffic lanes.

PART 2 - PRODUCTS

2.1 SIGNS, SIGNALS, AND DEVICES

- A. Comply with Texas State Manual on Uniform Traffic Control Devices.
- B. Traffic Barriers, Cones and Drums, Flares and Lights: As approved by local jurisdictions.

PART 3 - EXECUTION

3.1 PUBLIC ROADS

- A. Abide by laws and regulations of governing authorities when using public roads. If Work requires public roads be temporarily impeded or closed, obtain approvals from governing authorities and pay permits before starting any Work. Coordinate activities with Owner's Representative.
- B. Maintain 10-foot-wide, all-weather lane adjacent to Work areas for use of emergency vehicles. Keep all-weather lane free of construction equipment and debris.
- C. Cover or remove the permanent signs and construction signs that are incorrect or that do not apply to the current situation for a particular phase. Do not mount signs on drums or barricades, except those listed in the latest Barricades and Construction standard sheets.
- D. Place positive barriers to protect drop-off conditions greater than 1 FT within the clear zones that remain overnight.
- E. Construction activities not to obstruct normal flow of traffic from 7:00 a.m. to 9:00 a.m. and 4:00 p.m. to 6:00 p.m. on designated major arterials or as directed by the Owner.
- F. Maintain local driveway access to residential and commercial properties adjacent to Work areas at all times. Use all-weather materials as approved by Owner's Representative when maintaining temporary driveway access to commercial and residential driveways.
- G. Cleanliness of Surrounding Streets: Keep streets used for entering and leaving job area free of excavated material, debris, and foreign material resulting from construction operations.
- H. Provide Owner's Representative 1-week notice prior to implementing each approved traffic control phase.
- I. Notify local schools, churches, bus lines, police department, commercial businesses, and fire department in writing of construction a minimum of 5 working days prior to beginning Work.
- J. Remove existing signing and striping that are in conflict with construction activities or may cause driver confusion.
- K. Provide safe access for pedestrians along major cross streets.

- L. Alternate closures of cross streets so that two adjacent cross streets are not closed simultaneously.
- M. Do not close more than two consecutive esplanade openings at a time without prior approval by Owner's Representative.

3.2 CONSTRUCTION PARKING CONTROL AND ACCESS

- A. Control vehicular parking to prevent interference with public traffic and parking, and access by emergency vehicles.
- B. Monitor parking of construction personnel's vehicles in existing facilities. Maintain vehicular access to and through parking areas.
- C. Prevent parking on or adjacent to access roads or in non-designated areas.
- D. Contractor and all personnel shall not utilize adjacent private driveways for access to project site unless Contractor receives written approval from landowner(s).

3.3 FLARES AND LIGHTS

- A. Provide flares and lights during hours of low visibility to delineate traffic lanes and to guide traffic.

3.4 HAUL ROUTES

- A. Utilize haul routes designated by authorities or shown on Drawings for construction traffic.
- B. Confine construction traffic to designated haul routes.
- C. Provide traffic control at critical areas of haul routes to regulate traffic and minimize interference with public traffic.

3.5 TRAFFIC SIGNS AND SIGNALS

- A. Construct necessary traffic control devices for temporary signals including but not limited to loop detectors, traffic signal conduits, traffic signal wiring, and crosswalk signals required to complete Work. Notify, a minimum of 60 days in advance, the agency concerning control boxes and switchgear. The agency will perform service, programming, or adjustments, to signal boxes and switchgear should this work be required during construction.
- B. Install and operate traffic control signals to direct and maintain orderly flow of traffic in areas under Contractor's control and areas affected by Contractor's operations. Establish notices, signs, and traffic controls before moving into next phase of traffic control.
- C. Relocate traffic signs and signals as Work progresses to maintain effective traffic control.
- D. Unless otherwise approved by Owner's Representative, provide driveway signs with name of business that can be accessed from particular cross-over. Use two signs for each cross-over.
- E. Replace existing traffic control devices in project area.

- F. Owner's Representative may direct Contractor to make minor traffic control sign adjustments to eliminate driver confusion and maintain traffic safety during construction at no additional payment.

3.6 BRIDGING TRENCHES AND EXCAVATIONS

- A. Whenever necessary, bridge trenches and excavation to permit an unobstructed flow of traffic. Provide steel plates that can be laid across construction areas and major drives of commercial businesses.
- B. Secure bridging against displacement by using adjustable cleats, angles, bolts, or other devices whenever bridge is installed:
 - 1. On existing bus route.
 - 2. When more than 5 percent of daily traffic is comprised of commercial or truck traffic.
 - 3. When more than two separate plates are used for bridge.
 - 4. When bridge is to be used for more than 5 consecutive days.
- C. Install bridging to operate with minimum noise.
- D. Adequately shore trench or excavation to support bridge and traffic.
- E. Extend steel plates used for bridging a minimum of 1 foot beyond edges of trench or excavation. Use temporary paving materials (premix) to feather edges of plates to minimize wheel impact on secured bridging.
- F. Use steel plates of sufficient thickness to support H-20 loading, truck or lane, that produces maximum stress.

3.7 REMOVAL

- A. Remove equipment and devices when no longer required.
- B. Repair damage caused by installation.
- C. Remove post settings to a depth of 2 feet.

3.8 TRAFFIC CONTROL, REGULATION, AND DIRECTION

- A. Use flagmen to control, regulate, and direct even flow and movement of vehicular and pedestrian traffic including but not limited to the following conditions:
 - 1. Where multi-lane vehicular traffic must be diverted into single lane vehicular traffic
 - 2. Where vehicular traffic must change lanes abruptly
 - 3. Where construction equipment must enter or cross vehicular traffic lanes and walks
 - 4. Where construction equipment may intermittently encroach on vehicular traffic lanes and unprotected walks and crosswalks

5. Where traffic regulation is needed due to rerouting of vehicular traffic around Work site.
 6. Other areas of Work where construction activities might affect public safety and convenience.
- B. Use and maintain flagmen at points for periods of time as may be required to provide for public safety and convenience of travel.
- C. Use of flagmen is for purpose of assisting in regulation of traffic flow and movement and does not relieve Contractor of full responsibility for taking other steps and providing other flaggers or personnel as Contractor may deem necessary to protect Work and public.

3.9 INSTALLATION STANDARDS

- A. Work in other phases shall be permitted, provided 1) phases are not continuous to one work is being done in presently, 2) installation of utility occurs in only one phase. Keep work and operation in second phase to an absolute minimum. Perform work in no more than two phases at a time. Authorization to perform work in second phase shall not relieve any responsibility of completing backfilling and paving operations in accordance with Contract.
- B. Place temporary pavement with a single lane closure, in accordance with TMUTCD.
- C. Reinstall temporary and permanent pavement markings as directed by Owner's Representative. Alternative markings shall be considered when marking manufacturer's weather conditions cannot be met. These alternatives are to be submitted and approved by Owner's Representative prior to installation. No extra payment will be made for use of alternative markings.

3.10 MAINTENANCE OF EQUIPMENT AND MATERIAL

- A. Designate individual to be responsible for maintenance of traffic handling around construction area. Individual must be accessible at all times to immediately correct any deficiencies in equipment and materials used to handle traffic including missing, damaged, or obscured signs, drums, barricades, or pavement markings. Give name, address, and telephone number of designated individual to Owner's Representative.
- B. Make daily inspections of signs, barricades, drums, lamps, and temporary pavement markings to verify that these are visible, in good working order, and conform with traffic handling plans and directions of Owner's Representative. When not in compliance, immediately bring equipment and materials into compliance by replacement, repair, cleaning, relocation, and realignment.
- C. Keep equipment and materials, especially signs and pavement markings, clean and free of dust, dirt, grime, oil, mud, or debris.
- D. Owner's Representative shall decide if damaged or vandalized signs, drums, and barricades can be reused.

END OF SECTION

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SECTION 01 56 39

TEMPORARY TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for tree and plant protection.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 – Bidding Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Division 01 – General Requirements.

1.2 MEASUREMENT AND PAYMENT

- A. Unless a separate bid item has been established, no separate payment will be made for tree and plant protection specified herein. Include cost in price bid for related work items.

1.3 SUBMITTALS

- A. Conform to requirements of Section 01 33 00 – Submittals.
- B. Submit name and experience of qualified Arborist to Owner's Representative.

1.4 PROJECT CONDITIONS WHEN TREES AND PLANTS ARE IDENTIFIED TO REMAIN

- A. Preserve and protect existing trees and plants from foliage, branch, trunk, or root damage that could result from construction operations when trees and plants are identified to remain.
- B. Do not allow any vehicular traffic, construction equipment, parking of vehicles or stockpiling of excavated material or construction materials within protected tree

root zone areas. Refer to Section 1.6 DEFINITIONS, for Dripline/Root Zone Area definition.

C. Prevent the following types of damage:

1. Compaction of root zone area by equipment, vehicles, foot traffic or materials storage.
2. Suffocating roots by placing soil in excess of three inches (3") within root zone areas, including placement of any select fill or soil with high clay content.
3. Trunk and limb damage resulting from contact with equipment and vehicles.
4. Poisoning by pouring solvents, fuel, and other injurious materials on or near root zone areas or in areas where such materials will leak or wash into root zone areas.
5. Changing soil pH within root zones by depositing concrete, powdered lime or other materials used to stabilize or dehydrate soils.
6. Cutting roots measuring one inch (1") in diameter and larger within protected areas unless required for root pruning.
7. Scorching of foliage, twigs and limbs caused by direct contact with expulsion of hot exhaust from equipment or vehicles.
8. Branch damage due to improper pruning or trimming.
9. Damage from permanently altering drainage patterns near root zones.
10. Trunk and branch damage resulting from nailing or bolting.

1.5 DAMAGE ASSESSMENT

- A. When trees other than those designated for removal are destroyed or badly damaged as result of construction operations, remove and replace with same size, species, and variety up to and including 8 inches in trunk diameter. Any tree larger than 8 inches in diameter shall be replaced with 8-inch diameter tree of same species and variety and total contract amount shall be reduced by amount determined from following International Shade Tree Conference formula: $0.7854 \times D^2 \times \38.00 where D is diameter in inches of tree or shrub trunk measured 12 inches above grade.

1.6 DEFINITIONS

- A. Dripline/Root Zone Area - The ground area delineated by the branch spread of a single plant or group of plants. This area is considered the most critical area

of roots and should be protected, excluding the area within the street located between curbs.

- B. Zero Curb Cut - The process in which required street work is conducted without cutting or otherwise disturbing soil located immediately behind the existing curb.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Protection Fencing - Orange, plastic mesh fencing, four feet (4') in height with six feet (6') high steel T-bar posts. Set posts eighteen inches (18") into ground. Stretch fencing material taut prior to securing.
- B. Fertilizer - A low salt, slow release fertilizer containing twenty-seven percent (27%) nitrogen, nine percent (9%) phosphorus and nine percent (9%) potassium (potash) or similar.
- C. Plastic Vapor Barrier - Polyethylene sheeting at least 6-mil thickness and three feet width to prevent leaching of stabilized material into native soil.
- D. Tree Replacements - Shall be as approved by Owner's Representative as necessary.

PART 3 - EXECUTION

3.1 PROTECTION AND MAINTENANCE OF EXISTING TREES AND SHRUBS

- A. Except for trees shown on Drawings or determined by Owner's Representative to be removed or relocated, trees within Project area are to remain in place, protected from damage and maintained by Contractor.
- B. If required by the Project specifications, employ a qualified Arborist. The Arborist must be approved by Owner's Representative and shall have a minimum of 5 (five) years of experience in the field of tree protection.
- C. Perform the following services as required by construction activities for trees that remain:
 - 1. Trimming
 - a. Trees shall be pruned in accordance ANSI A300 (Part 1) - 2001 Pruning Revision of ANSI A300-1995 Tree, Shrub and Other Woody Plant Maintenance - Standard Practices. Pruning shall be done by a

professional arborist who has received training in proper pruning techniques.

- b. Pruning shall not alter the natural shape or character of the tree or leave holes in the canopy. Trees and shrubs should be pruned for balance as well as to maintain proper form and branching habit.
- c. Cut limbs at branch collar. No stubs should remain on trees. Branch cuts should not gouge outer layer of tree structure or trunk.

2. Root Pruning

- a. When excavating with equipment within the root zone area is unavoidable and roots cannot be preserved, root prune prior to excavation to minimize damage to the portion of the root system that will remain.
- b. Prune roots using a conventional trenching machine. Trench along the proposed edge of excavation limits to a depth of three feet (3'). Do not allow ripping of roots with a backhoe or other equipment.
- c. Following trenching with the machine, re-cut roots measuring one inch (1") in diameter and larger using appropriate sharpened, pruning shears or pruning saws to make a clean, smooth-cut surface. Cut roots flush with edge of soil to limit root exposure.
- d. Backfill trench in a manner that will not allow settling using clean, native soil.

3. Fertilizing and Watering

- a. Trees should be fertilized in accordance with the American National Standard for tree fertilization ANSI A300 (Part 2) - 1998 Tree, Shrub and Other Woody Plant Maintenance - Standard Practices (Fertilization).
- b. Deep root fertilize all trees that have received disturbance or damage to their root zone area.
- c. Fertilize entire root zone area within the dripline of the tree and continue ten feet (10') beyond the dripline.
- d. Mixture shall be injected into the top ten inches (10") of soil, under pressure of one hundred and fifty pounds per square inch (150 psi) to two

- hundred pounds per square inch (200 psi). Mix and apply per product label instructions.
- e. Inject one-half gallon (1/2) of solution at a depth of ten inches (10") on spacing of three feet (3') between injection points.
 - f. Fertilizer shall be mixed in a tank with mechanical agitation.
 - g. Fertilizer to be added to tank and mixed on site.
 - h. During periods of inadequate rainfall, water trees once weekly to saturate soil to a depth of six inches (6") to eight inches (8") within root zones. Allow soils to dry between watering. Do not allow soils to remain wet.
- 4. Water areas currently being served by private sprinkler systems to maintain health of existing landscapes if the affected systems are temporarily taken out of service due to construction activities.
 - 5. Contractor's option with Owner's Representative's permission, shrubs to remain may be temporarily transplanted and returned to original positions under supervision of professional horticulturist.

3.2 PROTECTION

A. Construction Methods

1. General

- a. Contractor shall attend a pre-construction meeting conducted by the Owner's Representative to review tree preservation requirements and sequence of services for the construction process.
- b. Protect tree limbs, trunks and foliage from direct exposure to hot exhaust from equipment and vehicles by providing adequate exhaust pipe deflectors.
- c. Cover exposed roots within 24 hours to reduce damage caused by desiccation. Roots may be covered with soil or mulch to help protect them from drying.
- d. Protect root zone areas from damage that may result from soil compaction or from noxious materials in solution caused by run-off or

spillage during mixing and placement of construction materials, or drainage from stored materials.

- e. Minimize cut to two inches (2") below grade when installing silt fence within tree root zones or anchor base of fabric on grade using gravel or staples. Do not cut roots 1" in diameter or larger.
- f. Site preparation work and/or construction work shall not begin in any area where tree preservation measures have not been completed and approved by the Owner's Representative.

2. Preparation

- a. Contractor shall not allow any vehicular traffic, parking of vehicles or stockpiling of excavated material or construction material within the root zone area of trees to be preserved.
- b. When access within protected root zone areas by equipment traffic or frequent foot traffic cannot be avoided, contact Owner's Representative for review prior to entrance. Place a three-quarter inch (3/4") thick layer of plywood on natural grade within root zones to minimize soil compaction. Overlap edges of plywood by six inches (6") to twelve inches (12") to ensure adequate coverage. This is not acceptable bridging for driving over exposed tree roots. Exposed roots should not be driven over.
- c. Contractor shall notify Owner's Representative if existing tree locations differ from locations represented on construction drawings. The tree location and dripline/root zone area as observed in the field shall supersede that outlined on construction plans.

3. Tree Protection Fencing

- a. Each tree located adjacent to proposed soil excavation shall be protected with a tree protection fence or as designated on the plans. Fence locations shall be approved by Owner's Representative.
- b. Contractor shall not remove or relocate tree protection fencing and shall not operate within the limits shown without approval of the Owner's Representative.
- c. Fences shall be placed in continuous alignment to protect a tree or group of trees.
- d. Posts shall be installed on eight-foot (8') centers at eighteen inches (18") below grade. The fencing shall be continuous between posts, shall be

pulled taut prior to securing to posts, and shall be firmly attached to the posts with a minimum of three (3) wire ties.

- e. Place fencing in a manner that will not obstruct traffic sight lines at curbs, intersections or driveways.
- f. Fencing shall be removed only after all work within the immediate area is complete.
- g. Contractor shall immediately repair fences if damage occurs at no additional charge to client.

4. Excavation within Root Zone Areas

- a. For excavation within root zone areas, where required for personal safety, provide excavation protection by using vertical-wall-shoring techniques at excavations to minimize excavation width. Do not bench cut or step cut edge where such techniques will encroach on root zone areas.
- b. If roots are encountered and must be severed, roots measuring one inch (1") in diameter and larger shall be cut using a sharpened pruning instrument to leave a smooth, clean-cut surface.

5. Zero Curb Cut and Vapor Barrier Installation

- a. Where existing curb is to be removed within tree root zone areas, do not disturb soil immediately back of curb. Do not allow forms and stakes to disturb roots.
- b. A vapor barrier shall be installed to provide a non-leaching barrier between any stabilized material and/or concrete and tree roots and soils.
- c. Vapor barrier shall be installed vertically to a depth of five inches (5") below limits of stabilized material. Vapor barrier to be extended ten inches (10") above natural grade and ten feet (10') beyond the dripline limits of the tree. Trim vertical vapor barrier to approximately one inch (1") above grade after installation of final grade.

6. Boring/Tunneling

- a. In areas indicated, bore under root systems of trees at a minimum depth of four feet (4') from the top of pipe to the soil surface at natural grade.
- b. Bore pits and receiving pits shall be located outside of protected root zone areas.
- c. Equipment and material shall be positioned outside of protected root zone areas. When access within protected root zone area by equipment traffic or frequent foot traffic cannot be avoided, place a three-quarter inch (3/4")

thick layer of plywood on natural grade within root zones to minimize soil compaction, refer to Section 3. 2, A, 2.

7. Trunk Barricading

- a. Install trunk barricading to protect trees in close proximity of moving or mechanical equipment and construction work when work is required within the tree protection fencing as shown on the plans.
- b. Place trunk barricading around entire tree trunks to protect tree trunks located within five feet (5') of construction activities.
- c. Install 2x4's or 2x6's (5-foot to 6-foot lengths) spaced 3 inches (3") apart around the circumference of the tree trunk.
- d. Tie in place with 9 to 12 gauge steel wire.

B. Sequence of Tree Protection and Services

1. Fertilize trees affected by construction between the months of October and May.
2. Prune/trim trees for clearance and safety.
3. Root Prune trees.
4. Place tree protection fence and trunk barricades to protect trees. Place fencing prior to any construction activities.
5. Remove tree protection upon completion of project.

C. Existing Stressed and Declining Trees

1. Prior to beginning the construction phase, trees located within the right-of-way should be reviewed and trees that appear to be stressed or declining in health should be documented. Immediately notify the Owner's Representative of any dead and dying trees.

D. Accidental Spills of Toxic Materials

1. Concrete, lime or other chemicals placed or accidentally spilled within root zone protection areas shall be completely removed. Contaminated soil shall be completely removed at the time of the spill and removed by hand shovel. Fresh soil shall be added as necessary to bring the soil level to that of natural grade.

3.3 MAINTENANCE OF NEWLY PLANTED TREES AND REPLANTED TREES

- A. Show proof of capacity to water during dry periods.
- B. Guarantee trees planted for this Project shall remain alive and healthy at least until end of 1-year warranty period.
 1. Within 4 weeks notice from Owner's Representative, replace dead trees or trees that in opinion of Owner's Representative have become unhealthy,

unsightly or have lost their natural shape as result of additional growth, improper pruning, maintenance or weather conditions.

2. When tree must be replaced, guarantee period begins on date of tree replacement, subject to Owner's Representative's inspection, for no less than 1 year.
3. Straighten leaning trees and bear entire cost.
4. Dispose of trees rejected by Owner's Representative and bear entire cost.

END OF SECTION

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SECTION 01 57 13.02
STABILIZED CONSTRUCTION ACCESS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Stabilized construction roads, parking areas, exits and truck washing area requirements.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 00 – Proposing Requirements, Contract Forms, and Conditions of the Contract.
2. Division 01 – General Requirements.

1.2 MEASUREMENT AND PAYMENT

- A. Measure and pay for stabilized construction roads, parking areas, exits and truck washing area shall be incidental to the work to replace the water line. No

separate payment shall be made for Street Cleaning as Required by Section 10 57 13.01 – TPDES Requirements.

1.3 SUBMITTALS

- A. Conform to requirements of Specification Section 01 33 00 – Submittals.
- B. Submit manufacturer's catalog sheets and other product data on geotextile fabric.
- C. Submit sieve analysis of aggregates conforming to requirements of this Specification.

1.4 REFERENCES

- A. ASTM D4632 – Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.

PART 2 - PRODUCTS

2.1 GEOTEXTILE FABRIC

- A. Provide woven or non-woven geotextile fabric made of polypropylene, polyethylene, ethylene, or polyamide material.
- B. Geotextile fabric shall have minimum grab strength of 270 psi in any principal direction (ASTM D4632) and equivalent opening size between 50 and 140.
- C. Geotextile and threads shall be resistant to chemical attack, mildew, and rot and shall contain ultraviolet ray inhibitors and stabilizers to provide minimum of 6 months of expected usable life at temperature range of 0°F to 120°F.
- D. Representative Manufacturers: Mirafi, Inc. or equal.

2.2 COARSE AGGREGATES

- A. Coarse aggregate shall consist of crushed stone, gravel, crushed blast furnace slag, or combination of these materials. Aggregate shall be composed of clean, hard, durable materials free from adherent coatings, salt, alkali, dirt, clay, loam, shale, soft or flaky materials, or organic and injurious matter.
- B. Coarse aggregates shall be 3 inch to 5 inch granular material.

PART 3 - EXECUTION

3.1 PREPARATION AND INSTALLATION

- A. If necessary to keep street clean of mud carried by construction vehicles and equipment, provide stabilized construction roads and exits at construction, staging, parking, storage, and disposal areas. Construct erosion and sediment

controls in accordance with requirements shown on Drawings and specified in this Section.

- B. No clearing, grubbing or rough cutting permitted until erosion and sediment control systems are in place, other than as specifically directed by the Owner's Representative to allow soil testing and surveying.
- C. Maintain existing erosion and sediment control systems located within Project site until acceptance of Project or until directed by Owner's Representative to remove and discard existing system.
- D. Regularly inspect, repair, or replace components of stabilized construction exits. Unless otherwise directed, maintain stabilized construction roads and exits until project is accepted by the Owner. Remove stabilized construction roads and exits promptly when directed by Owner's Representative. Discard removed materials off site.
- E. Remove and dispose of sediment deposits at designated spoil site for Project. If project spoil site is not designated on Drawings, dispose of sediment off site at location not in or adjacent to stream or flood plain. Assume responsibility for off site disposal. Spread sediment evenly throughout site, compacted and stabilized. Do not allow sediment to flush into stream or drainage way. If sediment has been contaminated, dispose in accordance with existing federal, state, and local rules and regulations.
- F. Prohibit equipment and vehicles from maneuvering on areas outside of dedicated rights-of-way and easements for construction. Immediately repair damage caused by construction traffic to erosion and sediment control systems.
- G. Conduct construction operation under this Contract in conformance with erosion control practices described in this and other Specifications.

3.2 CONSTRUCTION METHODS

- A. Provide stabilized access roads, subdivision roads, parking areas, and other on-site vehicle transportation routes where shown on Drawings.
- B. Provide stabilized construction exits and truck washing areas when approved by Owner's Representative, of sizes and locations where shown on Drawings or as specified in this Section.
- C. Vehicles leaving construction areas shall have their tires cleaned to remove sediment prior to entrance onto public right-of-way. When washing is needed to remove sediment, construct truck washing area. Truck washing shall be done on stabilized areas which drain into drainage system protected by erosion and sediment control measures.
- D. Details for stabilized construction exit are shown on Drawings. Construct other stabilized areas to same requirements. Maintain roadway width at least 14 feet for one-way traffic and 20 feet for two-way traffic and sufficiently for ingress and egress. Furnish and place geotextile fabric as permeable separator to prevent mixing of coarse aggregate with underlying soil. Maximum exposure of

geotextile fabric to elements between laydown and cover of 14 days to minimize damage potential.

- E. Grade roads and parking areas to provide sufficient drainage away from stabilized areas. Use sandbags, gravel, boards, or similar methods to prevent sediment from entering public right-of-way, receiving stream or storm water conveyance system.
- F. Inspect and maintain stabilized areas daily. Provide periodic top dressing with additional coarse aggregates to maintain required depth. Repair and clean out damaged control measures used to trap sediment. Immediately remove sediment spilled, dropped, washed, or tracked onto public right-of-way.
- G. Maintain length of stabilized area as shown on Drawings, but not less than 50 feet. Maintain thickness less than 8 inches. Maintain width less than full width of all points of ingress or egress.
- H. Stabilization for other areas shall have same coarse aggregate, thickness, and width requirements as stabilized construction exit, except where shown otherwise on Drawings.
- I. Stabilized area may be widened or lengthened to accommodate truck washing area when authorized by Owner's Representative.
- J. Alternative methods of construction may be utilized when shown on Drawings, or when approved by Owner's Representative. These methods include following:
 - 1. Cement-Stabilized Soil - Compacted cement-stabilized soil or other fill material in application thickness of at least 8 inches.
 - 2. Wood Mats/Mud Mats - Oak or other hardwood timbers placed edge-to-edge and across support wooden beams which are placed on top of existing soil in application thickness of at least 6 inches.
 - 3. Steel Mats - Perforated mats placed across perpendicular support members.
- K. Provide street cleaning, such as sweeping or vacuuming, at locations around project site where construction traffic has caused tracking of sediments onto roadways. Do not wash or flush sediments into adjacent drainage systems.
- L. Mechanical sweepers shall be vacuum-type or regenerative sweepers. Sweeping speed not to exceed 6 mph. Make two passes.
- M. Clean street daily before end of workday. When excess sediments have tracked onto streets, Owner's Representative may direct contractor to clean street as often as necessary. Remove and dispose of sediments properly.
- N. Use other erosion and sediment control measures to prevent sediment runoff during period of rains and non-working hours and when storm discharges are expected.

END OF SECTION

SECTION 01 57 23

TEMPORARY STORM WATER POLLUTION AND EROSION CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Construction and maintenance of temporary storm water protection and erosion control devices.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 00 – Bidding Requirements, Contract Forms, and Conditions of the Contract.
2. Division 01 – General Requirements.
3. Section 03 09 00 – Concrete.
4. Section 31 10 00 – Clearing and Grubbing.
5. Section 31 21 33 – Trenching, Backfilling, and Compacting for Utilities.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Price. No separate payment will be made for this item. Include the cost in associated items for this project.

1.3 QUALITY ASSURANCE

A. Reference Standards:

1. ASTM International (ASTM):
 - a. A36 – Standard Specification for Carbon Structural Steel.
 - b. D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
 - c. D3786 – Standard Test Method for Hydraulic Bursting Strength for Knitted Goods and Nonwoven Fabrics.
 - d. D4355 – Standard Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus).
 - e. D4491 – Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
 - f. D4632 – Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
 - g. D4833 – Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.

- h. D6382 – Standard Practice for Dynamic Mechanical Analysis and Thermogravimetry of Roofing and Waterproofing Membrane Material.

1.4 DEFINITIONS

- A. Filter Fabric Fence and Reinforced Filter Fabric Fence: Installed to allow surface or channel runoff percolation through fabric in sheet-flow manner and to retain and accumulate sediment.
- B. Straw Bale Fence: Installed to allow surface runoff percolation through straw in sheet-flow manner and to retain and accumulate sediment.
- C. Interceptor Dikes and Swales: Constructed to direct surface or channel runoff around the project area or runoff from project area into sediment traps.
- D. Drop Inlet Baskets: Installed to allow runoff percolation through the basket and to retain and accumulate sediment.
- E. Sediment Traps: Constructed to pool surface runoff from construction area to allow sediment to settle onto the bottom of trap.

1.5 SUBMITTALS

- A. Conform to requirements of Specification Section 01 33 00 – Submittals.
- B. Submit manufacturer's literature for product specifications and installation instructions.
- C. Submit manufacturers catalog sheets and other product data on geotextile or filter fabrics, outlet pipe, perforated riser, and connectors.
- D. Submit proposed methods, equipment, materials, and sequence of operations for storm water pollution prevention structures.
- E. Submit shop drawings for Drop Inlet Baskets.

PART 2 - PRODUCTS

2.1 CONCRETE

- A. Concrete: In accordance with Specification Section 03 09 00 – Concrete.

2.2 AGGREGATE MATERIALS

- A. Stone: Use open graded aggregates with minimum diameter of 3 inches, and maximum 5 inches in diameter and less than ½ cubic foot in volume unless otherwise specified. Use clean, hard crushed concrete or stone free from

adherent coatings, salt, alkali, dirt, clay, loam, shale, soft or flaky materials, or organic and injurious matter.

- B. Provide gravel lining in accordance with Specification Section 31 21 33 – Trenching, Backfilling, and Compacting for Utilities, or as shown on the Drawings.
- C. Provide clean cobbles and gravel consisting of crushed concrete or stone. Use clean, hard crushed concrete or stone free from adherent coatings, salt, alkali, dirt, clay, loam, shale, soft or flaky materials, or organic matter.
- D. Sediment Pump Pit Aggregate: Use nominal 2-inch diameter river gravel.

2.3 GEOTEXTILE FILTER FABRIC

- A. Woven or nonwoven geotextile filter fabric made of either polypropylene, polyethylene, ethylene, or polyamide material, in continuous rolls of longest practical length.
- B. Grab Strength: 100 psi in any principal direction (ASTM D4632), Mullen burst strength greater than 200 psi (ASTM D3786), and equivalent opening size between 50 and 140 for soils with more than 15 percent by weight passing No. 200 sieve and between 20 and 50 for soils with less than 15 percent by weight passing No. 200 sieve; and maximum water flow rate of 40 gallons per minute per square foot (ASTM D4491).
- C. Filter fabric material shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six months of expected usable construction life at a temperature range of 0°F to 120°F. Ultraviolet stability exceed shall exceed 70% after 500 hours of exposure (ASTM D4355).
- D. Acceptable Manufacturers: Mirafi, Inc., Synthetic Industries, or approved equal.

2.4 FENCING

- A. Wire Fencing: Woven galvanized steel wire, 12½ gauge by 2 inch by 4 inch mesh spacing, minimum 24-inch roll or sheet width of longest practical length.
- B. Fence Stakes: Nominal 2 by 2 inch moisture-resistant treated wood or steel posts (min. of 1.25 lbs. per linear foot and Brinell Hardness greater than 140)

with safety caps on top; length as required for minimum 8 inch bury and full height of filter fabric.

2.5 SANDBAGS

- A. Provide woven material made of polypropylene, polyethylene, or polyamide material.
- B. Minimum unit weight of 4 ounces per square yard.
- C. Minimum grab strength of 100 psi in any principal direction (ASTM D4632)
- D. Mullen burst strength exceeding 300 psi (ASTM D3786).
- E. Ultraviolet stability exceeding 70 percent (ASTM D4355).
- F. Size: Length: 18 to 24 inches. Width: 12 to 18 inches. Thickness: 6 to 8 inches. Weight: 50 to 125 pounds.

2.6 DROP INLET BASKET

- A. Provide steel frame members in accordance with ASTM A36.
- B. Construct top frame of basket with two short sides of 2-inch by 2-inch and single long side of 1-inch by 1-inch, 1/8 inch angle iron. Construct basket hangers of 2 inch by 1/4 inch iron bars. Construct bottom frame of 1-inch by 1/4 inch iron bar or 1/4 inch plate with center 3 inches removed. Use minimum 1/4 inch diameter iron rods or equivalent for sides of inlet basket. Weld minimum of 14 rods in place between top frame/basket hanger and bottom frame. Exact

dimensions for top frame and insert basket will be determined based on dimensions of type of inlet being protected.

2.7 STRAW BALE

- A. Straw: Standard-baled agricultural hay bound by wire, nylon, or polypropylene rope. Do not use jute or cotton binding.
- B. Straw Bale Stakes (applicable where bales are on soil): No. 3 (3/8 diameter) reinforcing bars, deformed or smooth at Contractor's option, length as required for minimum 18-inch bury and full height bales.

PART 3 - EXECUTION

3.1 PREPARATION, INSTALLATION AND MAINTENANCE

- A. Provide erosion and sedimentation control systems at the locations shown on Drawings. Construct in accordance with the requirements shown on the Drawings and as specified in this Section.
- B. Control fill, grading and ditching to direct water away from excavations, pits, tunnels, and other construction areas, and to direct drainage to proper runoff courses to prevent erosion, sedimentation or damage.
- C. Do not clear, grub or rough cut until erosion and sediment control systems are in place unless approved by Owner's Representative to allow installation of erosion and sediment control systems, soil testing, and surveying.
- D. Maintain erosion and sediment control systems located within project site until acceptance of project or until directed by Owner's Representative to remove and discard existing system.
- E. Regularly inspect and repair or replace damaged components of erosion and sediment control structures. Unless otherwise directed, maintain erosion and sediment control structure until project area stabilization is accepted. Redress and replace granular fill at outlets as needed to replenish depleted granular fill. Remove erosion and sediment control structures promptly when directed by Owner's Representative. Dispose of materials in accordance with Specification Section 01 74 19 – Construction Waste Management and Disposal.
- F. Remove and dispose sediment deposits at the designated spoil site for the Project. If a project spoil site is not designated on Drawings, dispose of sediment off site at approved location in accordance with Specification Section 01 74 19 – Construction Waste Management and Disposal. Off-site disposal shall be the responsibility of the Contractor. Sediment to be placed at the project site should be spread, compacted and stabilized in accordance with the Owner's Representative directions. Sediment shall not be allowed to flush into

streams or drainage ways. If sediment has been contaminated, it needs to be disposed of in accordance with existing federal, state and local regulations.

- G. Unless otherwise shown on the Drawings, compact embankments, excavations, and trenches in accordance with Specification Section 31 23 16.01 – Roadway Excavation or Specification Section 31 21 33 – Trenching, Backfilling, and Compacting for Utilities.
- H. Conduct all construction operations under this Contract in conformance with erosion control practices described in Specification Section 01 35 05 – Environmental Protection and Special Controls.
- I. Prohibit equipment and vehicles from maneuvering on areas outside of dedicated right of way and easements for construction. Immediately repair damage caused by construction traffic to erosion and sediment control structures.
- J. Protect existing trees and plants in accordance with Specification Section 01 56 39 – Temporary Tree and Plant Protection.
- K. Conduct all construction operations under this Contract in conformance with the erosion control practices required by State and local law.

3.2 CONSTRUCTION METHODS

A. Filter Fabric Fence (Type 1):

- 1. Provide filter fabric fence systems at locations specified on the Drawings in accordance with the Drawing detail. Filter fabric fence systems shall be installed in such a manner that surface runoff will percolate through the system in sheet flow fashion and allow sediment to be retained and accumulated.
- 2. Attach the filter fabric to 2-inch by 2-inch wooden stakes or equivalent steel posts spaced a maximum of 6 feet apart and embedded a minimum of 1 foot. If filter fabric is factory pre-assembled with support netting, then maximum spacing allowable is 8 feet. The wooden stakes shall be installed at a slight angle toward the source of anticipated runoff.
- 3. Trench in the toe of the filter fabric fence with a spade or mechanical trencher so that the downward face of the trench is flat and perpendicular to the direction of flow or for V-trench configuration as shown on Drawings. Lay filter fabric along the edges of the trench. Backfill and compact trench.
- 4. Securely fasten filter fabric to stakes using staples or wire ties at 3 inches on center maximum. Filter fabric fence shall have a minimum height of 18 inches and a maximum height of 36 inches above natural ground.
- 5. The filter fabric should be provided in continuous rolls and cut to the length of the required to minimize the use of joints. When joints are necessary, the

fabric should be spliced together only at a support post with a minimum 6-inch overlap, and sealed securely.

6. Inspect sediment filter barrier systems after each rainfall, daily during periods of prolonged rainfall, and at a minimum once a week. Repair or replace damaged section immediately to restore the requirements of this Item. Remove sediment deposits when silt reaches a depth one-third of the height of the fence or 6 inches, whichever is less.

B. Reinforced Filter Fabric Fence (Type 2):

1. Attach the filter fabric to 2-inch by 2-inch wooden stakes or equivalent steel posts spaced a maximum of 6 feet apart and embedded a minimum of 1 foot. If filter fabric is factory pre-assembled with support netting, then maximum spacing allowable is 8 feet. The wooden stakes shall be installed at a slight angle toward the source of anticipated runoff.
2. Trench in the toe of the filter fabric fence with a spade or mechanical trencher so that the downward face of the trench is flat and perpendicular to the direction of flow or for V-trench configuration as shown on Drawings. Lay filter fabric along the edges of the trench. Backfill and compact trench.
3. Use galvanized 2-inch by 4-inch welded fabric for woven wire securely fasten filter fabric material to woven wire fence with tie wires.
4. Securely fasten filter fabric to stakes using staples or wire ties at 3 inches on center maximum. Filter fabric fence shall have a minimum height of 18 inches and a maximum height of 36 inches above natural ground.
5. The filter fabric should be provided in continuous rolls and cut to the length of the required to minimize the use of joints. When joints are necessary, the fabric should be spliced together only at a support post with a minimum 6-inch overlap, and sealed securely.
6. Inspect sediment filter barrier systems after each rainfall, daily during periods of prolonged rainfall, and at a minimum once a week. Repair or replace damaged section immediately to restore the requirements of this Item. Remove sediment deposits when silt reaches a depth one-third of the height of the fence or 6-inches, whichever is less.
7. When used in swales, ditches or diversions, elevation of barrier at top of filter fabric at flow line location in channel shall be lower than bottom

elevation of filter fabric at ends of barrier or top of bank, whichever is less, in order to keep storm water discharge in channel from overtopping bank.

C. Triangular Filter Fabric Fence:

1. Attach filter fabric to wire fencing, minimum 18 inches on each side. Provide a fabric cover and skirt with continuous wrapping of fabric. Skirt should form continuous extension of fabric on upstream side of fence.
2. Secure triangular fabric filter fence in place using one of the following methods:
 - a. Toe-in skirt 6-inches with mechanically compacted material;
 - b. Weight down skirt with continuous layer of 3-inch to 5-inch graded rock; or
 - c. Trench-in entire structure 4-inches.
3. Anchor triangular fabric filter fence structure and skirt securely in place using 6-inch wire staples on 2-foot centers on both edges and on skirt, or staked using 18-inch by 3/8-inch diameter re-bar with tee ends.
4. Lap fabric filter material by 6-inches to cover segment joints. Fasten joints with galvanized shoat rings.

D. Sediment Traps:

1. Use fill material for embankment free of roots, woody vegetation, oversized stones or rocks, or organic or other objectionable matter. Clear, grub, and strip area under embankment of vegetation and root material.
2. Limit of excavation and outlet length and height shall be as specified on Drawings. Use side slopes of 2H:1V or flatter.
3. Maintain minimum of 6-inches between top of core material and top of stone outlet, minimum of 4-inches between bottom of core material and existing ground and minimum of 1-foot between top of stone outlet and top of embankment.
4. Embed rock minimum of 4-inches into existing ground for stone outlet.
5. For stone outlet, core shall be minimum of 1-foot in height and 1-foot in width and wrapped in triple layer of geotextile fabric.
6. Install stone outlet or outlet pipe and riser as shown on Drawings.
7. Repair or replace damaged trap components. Redress and replace stone as needed to replenish depleted stone. Remove sediment deposit and restore

traps to original dimensions when sediment has accumulated to one-half design depth of the trap or 1-foot, whichever is less.

E. Dikes and Swales:

1. Unless otherwise indicated, maintain minimum dike height of 18-inches, measured from cleared ground at up slope toe to top of dike. Maintain side slopes of 2:1 or flatter.
2. Dike and Swale Stabilization: When shown on the Drawings, place gravel lining 3 inches thick and compacted into the soil or 6 inches thick if truck crossing is expected. Extend gravel lining across bottom and up both sides of swale minimum height of 8 inches vertically, above bottom. Gravel lining on dike side shall extend up the up slope side of dike a minimum height of 8 inches, measured vertically from interface of existing or graded ground and up slope toe of dike, as shown on Drawings.
3. Divert flow from dikes and swales to sediment basins, stabilized outlets, or sediment trapping devices of types and at locations shown on Drawings. Grade dikes and swales as shown on Drawings, or, if not specified, provide positive drainage with maximum grade of 1 percent to outlet or basin.
4. Clear in accordance with Specification Section 31 10 00 – Clearing and Grubbing.
5. Carry out excavation for swale construction so that erosion and water pollution is minimal. Minimum depth shall be 1 foot and bottom width shall be 4 feet, with level swale bottom. Excavation slopes shall be 2H:1V or flatter. Clear, grub and strip excavation area of vegetation and root material.

F. Downspout Extenders:

1. Downspout extender shall have slope of approximately 1 percent. Use pipe diameter of 4 inches or as shown on the Drawings. Place pipe in

accordance with Specification Section 31 21 33 – Trenching, Backfilling, and Compacting for Utilities.

G. Paved Flumes:

1. Compact soil around and under the entrance section to top of the embankment in lifts appropriately sized for method of compaction utilized.
2. Construct subgrade to required elevations. Remove and replace soft sections and unsuitable material. Compact subgrade thoroughly and shape to a smooth, uniform surface.
3. Construct permanent paved flumes in accordance with Drawings.
4. Remove sediment from riprap apron when sediment has accumulated to depth of one foot.

H. Level Spreaders:

1. Construct level spreader on undisturbed soil and not on fill. Ensure that spreader lip is level for uniform spreading of storm runoff.
2. Maintain at required depth, grade, and cross section as specified on Drawings. Remove sediment deposits as well as projections or other irregularities that will impede normal flow.

I. Inlet Protection Barriers:

1. Place sandbags and filter fabric fences at locations shown on Drawings.
2. Maintain to allow minimal inlet inflow restrictions/blockages during storm events.

J. Drop Inlet Baskets:

1. Fit inlet insert basket into inlet without gaps around insert at locations shown on Drawings.
2. Support for inlet insert basket shall consist of fabricated metal as shown on Drawings.
3. Construct top frame of basket with two short sides of 2-inch by 2-inch and single long side of 1-inch by 1-inch, 1/8-inch angle iron. Construct basket hangers of 2-inch by 1/4-inch iron bars. Construct bottom frame of 1-inch by 1/4-inch iron bar or 1/4-inch plate with center 3-inches removed. Use minimum 1/4-inch diameter iron rods or equivalent for sides of inlet basket. Weld minimum of 14 rods in place between top frame/basket hanger and bottom frame. Exact dimensions for top frame and insert basket will be determined based on dimensions of type of inlet being protected.
4. Push down and form filter fabric to shape of basket. Use sheet of fabric large enough to be supported by basket frame when holding sediment and

extend at least 6-inches past frame. Place inlet grates over basket/frame to serve as fabric anchor.

5. Remove sediment deposit after each storm event and whenever accumulation exceeds 1-inch depth during weekly inspections.

K. Straw Bale Fences:

1. Place bales in row with ends tightly abutting adjacent bales. Place bales with bindings parallel to ground surface.
2. Embed bale in soil a minimum of 4-inches.
3. Securely anchor bales in place with Straw Bale Stakes driven through bales a minimum of 18-inches into ground. Angle first stake in each bale toward previously laid bale to force bales together.
4. Fill gaps between bales with straw to prevent water from channeling between bales. Wedge carefully in order not to separate bales.
5. Replace with new straw bale fence every two months or as required by Owner's Representative.

L. Brush Berms:

1. Construct brush berm along contour lines by hand placing method. Do not use machine placement of brush berm.
2. Use woody brush and branches having diameter less than 2-inches with 6-inches overlap. Avoid incorporation of annual weeds and soil into brush berm.
3. Use minimum height of 18-inches measured from top of existing ground at upslope toe to top of berm. Top width shall be 24-inches minimum and side slopes shall be 2H:1V or flatter.
4. Embed brush berm into soil a minimum of 4-inches and anchor using wire, nylon or polypropylene rope across berm with a minimum tension of 50 pounds. Tie rope securely to 18-inch x 3/8-inch diameter rebar stakes driven into ground on 4-foot centers on both sides of berm.

3.3 STREET AND SIDEWALK CLEANING

- A. Keep areas clean of construction debris and mud carried by construction vehicles and equipment. If necessary, install stabilized construction exits at construction, staging, storage, and disposal areas, following Specification Section 01 57 13.02 – Stabilized Construction Access.
- B. In lieu of or in addition to stabilized construction exits, shovel or sweep pavements as required to keep areas clean. Do not hose or sweep debris and

mud off street into adjacent areas, except, hose sidewalks during off-peak hours, after sweeping.

3.4 WASTE COLLECTION AREAS

- A. Prevent water runoff from passing through waste collection areas, and prevent water runoff from waste collection areas migrating outside collection areas.

3.5 EQUIPMENT MAINTENANCE AND REPAIR

- A. Confine maintenance and repair of construction machinery and equipment to areas specifically designated for that purpose, so fuels, lubricants, solvents, and other potential pollutants are not washed directly into receiving streams or storm water conveyance systems. Provide these areas with adequate waste disposal receptacles for liquid and solid waste. Clean and inspect maintenance areas daily.
- B. Where designated equipment maintenance areas are not feasible, take precautions during each individual repair or maintenance operation to prevent potential pollutants from washing into streams or conveyance systems. Provide temporary waste disposal receptacles.

3.6 VEHICLE/ EQUIPMENT WASHING AREAS

- A. Install wash area (stabilized with coarse aggregate) adjacent to stabilized construction exit(s), as required to prevent mud and dirt run-off. Release wash water into drainage swales or inlets protected by erosion and sediment controls. Build wash areas following Specification Section 01 57 13.02 – Stabilized Construction Access. Install gravel or rock base beneath wash areas.
- B. Wash vehicles only at designated wash areas. Do not wash vehicles such as concrete delivery trucks or dump trucks and other construction equipment at

locations where runoff flows directly into watercourses or storm water conveyance systems.

- C. Locate wash areas to spread out and evaporate or infiltrate wash water directly into ground, or collect runoff in temporary holding or seepage basins.

3.7 REMOVAL OF CONTROLS

- A. Remove erosion and sediment controls when the site is finally stabilized, as directed by Owner's Representative.
- B. Dispose of sediments and waste products following Specification Section 01 35 05 – Environmental Protection and Special Controls.

3.8 OWNER TRAINING (NOT USED)

END OF SECTION

SECTION 01 57 23.02

CONTROL OF GROUND WATER AND SURFACE WATER

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

Control of ground water and surface water.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 00 – Proposing Requirements, Contract Forms, and Conditions of the Contract.
2. Division 01 – General Requirements.

1.2 MEASUREMENT AND PAYMENT

- A. Stipulated Price (Lump Sum). If Contract is a Stipulated Price Contract, payment for this Work is included in the total Stipulated Price.

1.3 REFERENCES

- A. ASTM D698 – Standard Test Methods for Laboratory Compaction of Soils Using Standard Effort (12,400 ft-lbf/ft³ (600kN-m/m³).
- B. Federal Regulations 29 CFR Part 1926, Standards-Excavation, Occupational Safety and Health Administration (OSHA).

1.4 DEFINITIONS

- A. Ground water control includes both dewatering and depressurization of water-bearing soil layers.
1. Dewatering includes lowering water table and intercepting seepage that would otherwise emerge from slopes or bottoms of excavations, or into tunnels and shafts, and disposing of removed water. Intent of dewatering is to increase stability of tunnel excavations and excavated slopes, prevent dislocation of material from slopes or bottoms of excavations, reduce lateral loads on sheeting and bracing, improve excavating and hauling characteristics of excavated material, prevent failure or heaving of bottom of

excavations, and to provide suitable conditions for placement of backfill materials and construction of structures and other installations.

2. Depressurization includes reduction in piezometric pressure within strata not controlled by dewatering alone, as required to prevent failure or heaving of excavation bottom or instability of tunnel excavations.
- B. Excavation drainage includes keeping excavations free of surface and seepage water.
- C. Surface drainage includes use of temporary drainage ditches and dikes and installation of temporary culverts and sump pumps with discharge lines as required to protect work from any source of surface water.
- D. Equipment and instrumentation for monitoring and control of ground water control system includes piezometers, monitoring wells and flow meters for observing and recording flow rates.
- E. Surface water includes water from rainfall, runoff, the SJRA canal, and all other sources not considered ground water.

1.5 PERFORMANCE REQUIREMENTS

- A. Conduct subsurface investigations to identify groundwater conditions and to provide parameters for design, installation, and operation of groundwater control systems. Submit prepared method and spacing of readings for review prior to obtaining water level readings.
- B. Design ground water control system, compatible with requirements of Federal Regulations 29 CFR Part 1926 and Specification Section 31 41 00 – Trench Safety System to produce following results:
 1. Effectively reduce hydrostatic pressure affecting:
 - a. Excavations
 - b. Tunnel excavation, face stability, or seepage into tunnels
 2. Develop substantially dry and stable subgrade for subsequent construction operations.
 3. Preclude damage to adjacent properties, buildings, structures, utilities, installed facilities, and other work.
 4. Prevent loss of fines, seepage, boils, quick condition, or softening of foundation strata.
 5. Maintain stability of sides and bottom of excavations.
- C. Provide ground water control systems that include single-stage or multiple-stage well point systems, eductor and ejector-type systems, deep wells, or combinations of these equipment types, as appropriate.
- D. Provide drainage of seepage water and surface water, as well as water from any other source entering excavation. Excavation drainage may include

placement of drainage materials, crushed stone and filter fabric, together with ditches and sump pumping.

- E. Provide ditches, berms, pumps, and other methods necessary to divert and drain surface water from excavation and other work areas.
- F. Locate ground water control and drainage systems so as not to interfere with utilities, construction operations, adjacent properties, or adjacent water wells.
- G. Assume sole responsibility for ground water control systems and for any loss or damage resulting from partial or complete failure of protective measures and any settlement or resultant damage caused by ground water control operations. Modify ground water control systems or operations if they cause or threaten to cause damage to new construction, existing site improvements, adjacent property, or adjacent water wells, or affect potentially contaminated areas. Repair damage caused by ground water control systems or resulting from failure of system to protect property as required.
- H. Provide adequate number of piezometers installed at proper locations and depths as required to provide meaningful observations of conditions affecting excavation, adjacent structures and water wells.
- I. Provide environmental monitoring wells installed at proper locations and depths as required to provide adequate observations of hydrostatic conditions and possible contaminant transport from contamination sources into work area or ground water control system.

1.6 SUBMITTALS

- A. Conform to requirements of Specification Section 01 33 00 – Submittals.
- B. Submit Ground Water and Surface Water Control Plan for review by Owner's Representative prior to start of any field work. Plan shall be signed by Professional Engineer registered in State of Texas. Submit plan to include following:
 - 1. Results of subsurface investigation and description of extent and characteristics of water bearing layers subject to ground water control.
 - 2. Names of equipment suppliers and installation subcontractors.
 - 3. Description of proposed surface water control systems for bypass of canal flows including location, arrangement, system components, capacity, installation details, and operation and maintenance procedures.
 - 4. Description of proposed ground water control systems indicating arrangement, location, depth, and capacities of system components, installation details and criteria and operation and maintenance procedures.
 - 5. Description of proposed monitoring and control system indicating depths and locations of piezometers and monitoring wells, monitoring installation

details and criteria, type of equipment and instrumentation with pertinent data and characteristics.

6. Installation of a temporary staff gauge upstream of the siphon to monitor canal water surface elevations throughout construction. Staff gauge should be survey accurate and correlate with the project datum and survey control points.
 7. Description of proposed filters including types, sizes, capacities, and manufacturer's application recommendations.
 8. Certification of design calculations demonstrating adequacy of proposed systems for intended applications. Define potential area of influence of ground water control operation near contaminated areas.
 9. Operating requirements, including piezometric control elevations for dewatering and depressurization.
 10. Excavation drainage methods including typical drainage layers, sump pump application and other necessary means.
 11. Surface water control and drainage installations.
 12. Proposed methods and locations for disposing of removed water.
- C. Submit following records upon completed initial installation:
1. Installation and development reports for well points, eductors, and deep wells.
 2. Installation reports and baseline readings for piezometers and monitoring wells.
 3. Baseline analytical test data of water from monitoring wells.
 4. Initial flow rates.
- D. Submit the following records weekly during operations:
1. Records of flow rates and piezometric elevations obtained during monitoring of dewatering and depressurization. Refer to Paragraph 3.2, Requirements for Eductor, Well Points, or Deep Wells.
 2. Maintenance records for ground water control installations, piezometers and monitoring wells.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Comply with requirements of agencies having jurisdiction.
- B. Comply with Texas Commission on Environmental Quality regulations and Texas Water Well Drillers Association for development, drilling, and abandonment of wells used in dewatering system.
- C. Obtain necessary permits from agencies with control over use of groundwater and matters affecting well installation, water discharge, and use of existing

storm drains and natural water sources. Because review and permitting process may be lengthy, take early action to pursue and submit for required approvals.

- D. Monitor ground water discharge for contamination while performing pumping in vicinity of potentially contaminated sites.
- E. Filter water discharged from dewatering systems prior to entering drainage ways.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS

- A. Use optional equipment and materials as necessary to achieve desired results for dewatering. Selected equipment and materials are subject to review of Owner's Representative through submittals required in Paragraph 1.6, Submittals.
- B. Eductors, well points, or deep wells, where used, must be furnished, installed and operated by experienced contractor regularly engaged in ground water control system design, installation, and operation.
- C. Equipment must be in good repair and operating order.
- D. Keep sufficient standby equipment and materials available to ensure continuous operation, where required.

PART 3 - EXECUTION

3.1 GROUND WATER CONTROL

- A. Perform subsurface investigation by borings as necessary to identify water bearing layers, piezometric pressures, and soil parameters for design and installation of ground water control systems. Perform pump tests, if necessary to determine draw down characteristics of waterbearing layers. Present results in Ground Water and Surface Water Control Plan (See Paragraph 1.6B.1).
- B. Provide labor, material, equipment, techniques and methods to lower, control and handle ground water in manner compatible with construction methods and site conditions. Monitor effectiveness of installed system and its effect on adjacent property.
- C. Install, operate, and maintain ground water control systems in accordance with Ground Water and Surface Water Control Plan. Notify Owner's Representative

- in writing of changes made to accommodate field conditions and changes to Work. Provide revised drawings and calculations with notification.
- D. Provide for continuous system operation, including nights, weekends, and holidays. Arrange for appropriate backup if electrical power is primary energy source for dewatering system.
 - E. Monitor operations to verify system lowers ground water piezometric levels at rate required to maintain dry excavation resulting in stable subgrade for prosecution of subsequent operations.
 - F. Where hydrostatic pressures in confined water bearing layers exist below excavation, depressurize those zones to eliminate risk of uplift or other instability of excavation or installed works. Define allowable piezometric elevations in Ground Water and Surface Water Control Plan.
 - G. Remove ground water control installations.
 - 1. Remove pumping system components and piping when ground water control is no longer required.
 - 2. Remove monitoring wells when directed by Owner's Representative.
 - 3. Grout abandoned well and piezometer holes. Fill piping that is not removed with cement-bentonite non-shrink grout or cement-sand grout along entire shaft length.
 - H. During backfilling, dewatering may be reduced to maintain water level minimum of 5 feet below prevailing level of backfill. However, do not allow that water level to result in uplift pressures in excess of 80 percent of downward pressure produced by weight of structure or backfill in place. Do not allow water levels to rise into cement stabilized sand until at least 48 hours after placement.
 - I. Provide uniform diameter for each pipe drain run constructed for dewatering. Remove pipe drain when it has served its purpose. If removal of pipe is impractical, provide grout connections at 50-foot intervals and fill pipe with cement-bentonite grout or cement-sand grout when pipe is removed from service.
 - J. Extent of construction ground water control for structures with permanent perforated underground drainage system may be reduced, for units designed to withstand hydrostatic uplift pressure. Provide means of draining affected portion of underground system, including standby equipment. Maintain drainage system during operations and remove it when no longer required.
 - K. Remove system upon completion of construction or when dewatering and control of surface or ground water is no longer required.
 - L. Compact backfill to not less than 95 percent of maximum dry density in accordance with ASTM D 698.
 - M. Foundation Beds: Maintain saturation line at least 5 feet below lowest elevations where concrete is to be placed. Drain foundations in areas where

concrete is to be placed before placing reinforcing steel. Keep free from water for 3 days after concrete is placed.

3.2 REQUIREMENTS FOR EDUCTOR, WELL POINTS, OR DEEP WELLS

- A. Design, install, and operate all dewatering wells to prevent the removal of native material except as incidental to well development.
- B. For aboveground piping in ground water control system, include 12-inch minimum length of clear, transparent piping between every eductor well or well point and discharge header to visually monitor discharge from each installation.
- C. Install sufficient piezometers or monitoring wells to show trench or shaft excavations in water bearing materials are predrained prior to excavation. Provide separate piezometers for monitoring of dewatering and for monitoring of depressurization. Install piezometers and monitoring wells for tunneling as appropriate for selected method of Work.
- D. Install piezometers or monitoring wells not less than 1 week in advance of beginning associated excavation.
- E. Dewatering may be omitted for portions of under drains or other excavations, but only where auger borings and piezometers or monitoring wells show that soil is predrained by existing system and that criteria of ground water control plan are satisfied.
- F. Replace installations that produce noticeable amounts of sediments after development.
- G. Provide additional ground water control installations, or change methods, in event that installations according to ground water control plan does not provide satisfactory results based on performance criteria defined by plan and by specification. Submit revised plan according to Paragraph 1.6B.

3.3 EXCAVATION DRAINAGE

- A. May use excavation drainage methods if necessary to achieve well drained conditions. Excavation drainage may consist of layer of crushed stone and filter

fabric, and sump pumping in combination with sufficient wells for ground water control to maintain stable excavation and backfill conditions.

3.4 MAINTENANCE AND OBSERVATION

- A. Conduct daily maintenance and observation of piezometers or monitoring wells while ground water control installations or excavation drainage are operating in area or seepage into tunnel is occurring. Keep system in good condition.
- B. Replace damaged and destroyed piezometers or monitoring wells with new piezometers or wells as necessary to meet observation schedule.
- C. Cut off piezometers or monitoring wells in excavation areas where piping is exposed, only as necessary to perform observation as excavation proceeds. Continue to maintain and make observations, as specified.
- D. Remove and grout piezometers inside or outside excavation area when ground water control operations are complete. Remove and grout monitoring wells when directed by Owner's Representative. Follow applicable regulations for abandoning piezometers and monitoring wells.

3.5 MONITORING AND RECORDING

- A. Monitor and record average flow rate of operation for each deep well, or for each wellpoint or eductor header used in dewatering system. Also monitor and record water level and ground water recovery. Obtain records daily until steady conditions are achieved, and twice weekly thereafter.
- B. Observe and record elevation of water level daily as long as ground water control system is in operation, and weekly thereafter until Work is completed or piezometers or wells are removed, except when Owner's Representative determines more frequent monitoring and recording are required. Comply with Owner's Representative direction for increased monitoring and recording and take measures necessary to ensure effective dewatering for intended purpose.
- C. Observe and record daily water surface elevations upstream of the siphon using the temporarily installed staff gauge.

3.6 SURFACE WATER CONTROL

- A. Intercept surface water and divert it away from excavations through use of dikes, ditches, curb walls, pipes, sumps or other approved means.

Requirement includes temporary works required to protect adjoining properties from surface drainage caused by construction operations.

- B. Divert surface water and seepage water into sumps and pump it into drainage channels or storm drains, when approved by agencies having jurisdiction. Provide settling basins when required by agencies.

END OF SECTION

SECTION 01 65 50

PRODUCT DELIVERY, STORAGE, AND HANDLING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for product delivery, storage and handling.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Proposing Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Division 01 - General Requirements.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Price. No separate payment will be made for this item. Include the cost in associated items for this payment.

1.3 SUBMITTALS

- A. Provide Owner project Log Book.

1.4 TRANSPORTATION

- A. Make arrangements for transportation, delivery, and handling of equipment and materials required for timely completion of Work.
- B. Transport and handle products in accordance with instructions.
- C. Consign and address shipping documents to proper party giving name of Project, street number, and city. Shipments shall be delivered to Contractor.

1.5 DELIVERY

- A. Scheduling: Schedule delivery of products or equipment as required to allow timely inspection and installation, and to avoid prolonged storage, overburdening of limited storage space, conflicts with other contractors on site. Confirm availability of equipment and personnel for handling products prior to delivery.
- B. Packaging: Deliver products or equipment in manufacturer's original unopened and unbroken cartons or other containers designed and constructed to protect the contents from physical or environmental damage.
- C. Identification: Clearly and fully mark and identify as to manufacturer, item, and installation location.
- D. Protection and Handling: Provide manufacturer's instructions for storage and handling.

PART 2 - PRODUCTS

- A. Products: Means material, equipment, or systems forming Work. Does not include machinery and equipment used for preparation, fabrication, conveying, and erection of Work. Products may also include existing materials or components designated for reuse.
- B. For material and equipment specifically indicated or specified to be reused in the work:
 - 1. Use special care in removal, handling, storage and reinstallation, to assure proper function in completed work.
 - 2. Arrange for transportation, storage and handling of products which require offsite storage, restoration or renovation. Pay all costs for such work.
- C. When contract documents require that installation of work comply with manufacturer's printed instructions, obtain and distribute copies of such instructions to parties involved in installation, including two copies to Owner's Representative. Maintain one set of complete instructions at job site during installation until completion.
- D. Provide equipment and components from fewest number of manufacturers as practical, in order to simplify spare parts inventory and allow for maximum interchangeability of components. For multiple components of same size, type, or application, use same make and model of component throughout Project.

PART 3 - EXECUTION

3.1 PROTECTION, STORAGE AND HANDLING

- A. Protection:
 - 1. Protect materials in accordance with manufacturer's recommendations and requirements of these Specifications.
 - a. Store products or equipment in location to avoid loss or physical damage to items while in storage.
 - 2. Protect equipment from exposure to elements and keep thoroughly dry.
 - 3. When space heaters are provided in equipment, connect and operate heaters during storage until equipment is placed in service.
- B. Storage:
 - 1. Store materials in accordance with manufacturer's recommendations and requirements of these Specifications.
 - 2. Make necessary provisions for safe storage of materials and equipment. Place loose soil materials, and materials to be incorporated into Work to prevent damage to any part of Work or existing facilities and to maintain free access at all times to all parts of Work and to utility service company installations in vicinity of Work. Keep materials and equipment neatly and compactly stored in locations that will cause minimum inconvenience to

other contractors, public travel, adjoining owners, tenants, and occupants. Arrange storage to provide easy access for inspection.

3. Restrict storage to areas available on construction site for storage of material and equipment as shown on Drawings or approved by Owner's Representative.
4. Provide off-site storage and protection when on-site storage is not adequate. Provide addresses of and access to off-site storage locations for inspection by Owner's Representative.
5. Do not use lawns, grass plots, or other private property for storage purposes without written permission of owner or other person in possession or control of premises.
6. Store in manufacturers' unopened containers.
7. Neatly, safely, and compactly stack materials delivered and stored along line of Work to avoid inconvenience and damage to property owners and general public, and maintain at least 3 feet from fire hydrant. Keep public, private driveways, and street crossings open.
8. Repair or replace damaged lawns, sidewalks, streets, or other improvements to satisfaction of Owner's Representative. Total length which materials may be distributed along route of construction at one time is 1,000 linear feet, unless otherwise approved in writing by Owner's Representative.

C. Handling:

1. Handle materials in accordance with manufacturer's recommendations and requirements of these Specifications.
2. Coordinate off-loading of materials and equipment delivered to job site. If necessary to move stored materials and equipment during construction, relocate materials and equipment at no additional cost to Owner. Do not allow the off-loading of materials in those parking areas used for crew's personal vehicles.
3. Provide equipment and personnel necessary to handle products by methods to prevent damage to products or packaging.
4. Provide additional protection during handling as necessary to prevent breaking, scraping, marring, or otherwise damaging products or surrounding areas.
5. Handle products by methods to prevent over bending or over stressing.
6. Lift heavy components only at designated lifting points.
7. Do not drop, roll, or skid products off delivery vehicles. Hand carry or use suitable materials handling equipment.

3.2 STORAGE FACILITIES

A. Temporary Storage Building (if required):

1. Provide a weatherproof temporary storage building specifically for the purpose of providing for protection of products and equipment.
 - a. Size building to accommodate anticipated storage items.
2. Equip building with lockable doors and lighting, and provide electrical service for equipment space heaters and heating or ventilation as necessary to provide storage environments acceptable to specified manufacturers.
3. Provide methods of storage of products and equipment off the ground.
4. Provide this structure within 60 days after Notice to Proceed.
 - a. Locate building on-site where shown on the Drawings or in location approved by the Owner's Representative.
 - b. Remove building from site prior to startup and demonstration period.

3.3 FIELD QUALITY CONTROL

A. Inspect Deliveries:

1. Inspect all products or equipment delivered to the site prior to unloading.
 - a. Reject all products or equipment that are damaged, used, or in any other way unsatisfactory for use on Project.

B. Monitor Storage Area: Monitor storage area to ensure suitable temperature and moisture conditions are maintained as required by manufacturer or as appropriate for particular items.

END OF SECTION

SECTION 01 71 13

MOBILIZATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for mobilization.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 – Proposing Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Division 01 – General Requirements.

1.2 MEASUREMENT AND PAYMENT

- A. Measurement for mobilization is on lump sum basis.
- B. Mobilization payments will be included in periodic progress payment upon written application subject to following provisions:
 - 1. Authorization for payment of 50 percent of Contract Price for mobilization will be made upon receipt and approval by Owner's Representative of the following items, as applicable:
 - a. Schedule of Values submittal in accordance with Specification Section 01 29 73 – Schedule of Values.
 - b. Trench safety program.
 - c. Safety Program/Plan submittal in accordance with the Trench Safety Program/Plan in accordance with Specification Section 31 41 00 – Trench Safety System.
 - d. Construction Schedule submittal in accordance with Specification Section 01 32 16 – Construction Progress Schedule.
 - e. Preconstruction photographs in accordance with Specification Section 01 32 36.01 – Project Photographs.
 - f. Critical Location Report in accordance with Specification Section 31 21 33 – Trenching, Backfilling, and Compacting for Utilities.
 - g. Control of groundwater and surface water plan in accordance with Specification Section – 1 57 23.02 – Control of Ground Water and Surface Water, when required.
 - 2. Authorization for payment of remaining 50 percent of Contract Price for mobilization will be made upon completion of Work amounting to 5 percent of Contract Price less mobilization unit price.
- C. Mobilization payments will be subject to retainage amounts stipulated in Specification Section 00 72 00 – General Conditions of the Contract.

- D. A reduction of 10 percent of mobilization amount bid in Schedule for Unit Price Work will be applied to each Payment Application when Field Office is not properly maintained. Proper maintenance consists of operational plumbing and sanitary facilities, adequate potable water supply, operational telephone and facsimile machine and functional temperature control.

1.3 SUBMITTALS (NOT USED)

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 71 32.16
CONSTRUCTION SURVEYING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for construction surveying.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 – Proposing Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Division 01 – General Requirements.

1.2 QUALITY CONTROL

- A. Conform to State of Texas laws for surveys requiring licensed surveyors.
- B. Employ land surveyor acceptable to the Owner, if required.

1.3 MEASUREMENT AND PAYMENT

- A. No Separate payment will be made for field surveying. Include cost in unit price for Work requiring field surveying.

1.4 SUBMITTALS

- A. Conform to requirements of Specification Section 01 33 00 – Submittals.
- B. Submit to Owner's Representative name, address, and telephone number of Surveyor before starting survey work.
- C. Submit documentation verifying accuracy of survey work on request.
- D. Submit certificate signed by surveyor, that elevations and locations of Work are in conformance with Contract.

1.5 PROJECT RECORD DOCUMENTS

- A. Maintain complete and accurate log of control and survey Work as it progresses.
- B. Prepare certified survey setting forth dimensions, locations, angles, and elevations of construction and site Work upon completion of foundation walls and major site improvements.
- C. Submit Record Documents under provisions of Specification Section 01 78 39 – Project Record Documents.

1.6 EXAMINATION

- A. Verify locations of survey control points prior to starting Work.
- B. Notify Owner's Representative immediately of any discrepancies discovered.

1.7 SURVEY REFERENCE POINTS

- A. Control datum for survey established by provided survey as indicated on Contract Drawings. Inform Owner's Representative in advance of time at which horizontal and vertical control points will be established so verification deemed necessary by Owner's Representative may be done with minimum inconvenience to Owner's Representative and minimum delay to Contractor.
- B. Locate and protect survey control points prior to starting site work; preserve permanent reference points during construction.
- C. Notify Owner's Representative 48 hours in advance of need for relocation of reference points due to changes in grades or other reasons.
- D. Report promptly to Owner's Representative loss or destruction of reference point.
- E. Contractor to replace permanent reference points disturbed by operations, at no additional cost to the Owner.

1.8 SURVEY REQUIREMENTS

- A. Utilize recognized engineering survey practices.
- B. Establish minimum of two permanent bench marks on site, referenced to established control points. Record locations with horizontal and vertical data on Project Record Documents.
- C. Establish elevations, lines, and levels to provide quantities required for measurement and payment and to provide appropriate controls for Work. Locate and lay out by instrumentation and similar appropriate means:
 - 1. Site improvements including pavements; stakes for grading; fill and topsoil placement; utility locations, slopes, and invert elevations
 - 2. Grid or axis for structures
 - 3. Building foundation, column locations, ground floor elevations
- D. Periodically verify layouts by same means.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 74 13

CLEANING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes intermediate and final cleaning of Work, not including special cleaning of closed systems specified elsewhere.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 – Bidding Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Division 01 – General Requirements.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Price. No separate payment will be made for this item. Include the cost in associated items for this project.

1.3 SUBMITTALS (NOT USED)

1.4 STORAGE AND HANDLING

- A. Store cleaning products and cleaning wastes in containers specifically designed for those materials.

1.5 SCHEDULING

- A. Schedule cleaning operations so that dust and other contaminants disturbed by cleaning process will not fall on newly painted surfaces.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents:
 - 1. Compatible with surface being cleaned.
 - 2. New and uncontaminated.
 - 3. For Manufactured Surfaces: Material recommended by manufacturer.

PART 3 - EXECUTION

3.1 CLEANING - GENERAL

- A. Prevent accumulation of wastes that create hazardous conditions.
- B. Conduct cleaning and disposal operations to comply with laws and safety orders of governing authorities.

- C. Do not dispose of volatile wastes such as mineral spirits, oil, or paint thinner in storm or sanitary drains or sewers.
- D. Dispose of degradable debris at an approved solid waste disposal site.
- E. Dispose of nondegradable debris at an approved solid waste disposal site or in an alternate manner approved by regulatory agencies.
- F. Handle materials in a controlled manner with as few handlings as possible.
- G. Do not drop or throw materials from heights greater than 4 FT or less than 4 FT if conditions warrant greater care.
- H. On completion of work, leave area in a clean, natural looking condition.
 - 1. Remove all signs of temporary construction and activities incidental to construction of required permanent Work.
- I. Do not burn on-site.

3.2 INTERIOR CLEANING

A. Cleaning During Construction:

- 1. Keep work areas clean so as not to hinder health, safety or convenience of personnel in existing facility operations.
- 2. At maximum weekly intervals, dispose of waste materials, debris, and rubbish.
- 3. Vacuum clean interior areas when ready to receive finish painting.
 - a. Continue vacuum cleaning on an as-needed basis, until Substantial Completion.

B. Final Cleaning:

- 1. Complete immediately prior to Demonstration Period.
- 2. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from sight-exposed surfaces.
- 3. Wipe all lighting fixture reflectors, lenses, lamps and trims clean.
- 4. Wash and shine glazing and mirrors.
- 5. Polish glossy surfaces to a clear shine.
- 6. Ventilating systems:
 - a. Clean permanent filters and replace disposable filters if units were operated during construction.

- b. Clean ducts, blowers and coils if units were operated without filters during construction.
- 7. Replace all burned out lamps.
- 8. Broom clean process area floors.
- 9. Mop office and control room floors.

3.3 EXTERIOR (SITE) CLEANING

A. Cleaning During Construction:

- 1. Construction debris:
 - a. Confine in strategically located container(s):
 - 1) Cover to prevent blowing by wind.
 - 2) Store debris away from construction or operational activities.
 - 3) Haul from site minimum once a week.
 - b. Remove from work area to container daily.
 - c. Site clean-up prior to storm events. Thoroughly clean site of all loose or unsecured items which may become airborne or transported by flowing water during storm events.
- 2. Vegetation: Keep weeds and other vegetation trimmed to 3 IN maximum height.
 - a. The use of chemical weed control substances should be avoided unless prior Owner approval is received.
- 3. Soils, sand, and gravel deposited on paved areas and walks:
 - a. Remove as required to prevent muddy or dusty conditions.
 - b. Do not flush into storm sewer system.

B. Final Cleaning:

- 1. Remove trash and debris containers from site.
 - a. Repair areas disturbed by location of trash and debris containers to Owner's satisfaction including but not limited to re-seeding, sod

placement, pavement repair, asphalt repair, sidewalk repair, and rut removal and/or fill placement.

2. Clean paved roadways.

3.4 FIELD QUALITY CONTROL

- A. Immediately prior to Demonstration Period, conduct an inspection with Owner's Representative to verify condition of all work areas.

END OF SECTION

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SECTION 01 74 19

CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for construction waste management and disposal.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 – Proposing Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Division 01 – General Requirements.

1.2 MEASUREMENT AND PAYMENT

- A. No separate payment will be made for waste material disposal under this Section. Include payment in unit price for related sections.

1.3 SUBMITTALS

- A. Conform to requirements of Specification Section 01 33 00 – Submittals.
- B. Obtain and submit disposal permits for proposed disposal sites if required by local ordinances. Submit a copy of all disposal permits to the Owner's Representative.
- C. Submit copy of written permission from property owner(s) outside limits of Project, with description of property, prior to disposal of excess material. Submit written and signed release from property owner upon completion of

disposal work. Copies of the permission and release documents are to be submitted to the Owner's Representative.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 SALVAGEABLE MATERIAL

- A. Excavated Material: When indicated on Drawings, load, haul, and deposit excavated material at location or locations shown on Drawings outside limits of Project.
- B. Other Salvageable Materials: Conform to requirements of individual Specification Sections.
- C. Coordinate with the Owner's Representative the loading of salvageable material.

3.2 EXCESS MATERIAL

- A. Remove and legally dispose of vegetation, rubble, broken concrete, debris, asphaltic concrete pavement, excess soil, and other materials not designated for salvage from job site.
- B. Excess soil may be deposited on private property outside the Project limits when written permission is obtained from property owner. See Paragraph 1.3C above.
- C. Verify flood plain status of any proposed disposal site. Do not dispose of excavated materials in area designated as within 100-year Flood Hazard Area unless the proper permit has been obtained. Remove excess material placed in "100-year Flood Hazard Area" at no additional cost to the Owner.
- D. Remove waste materials from site daily, in order to maintain site in neat and orderly condition, unless otherwise authorized by the Owner.

END OF SECTION

SECTION 01 74 23
RESTORATION OF SITE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for the restoration of sites affected by Utility Work, Roadway Reconstruction or Widening, or Facilities Work. Section does not apply to roadway extension projects.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 – Proposing Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Division 01 – General Requirements.
 - 3. Section 02 41 13 13 – Removing Existing Pavements and Structures.
 - 4. Section 31 21 33 – Trenching, Backfilling, and Compacting for Utilities.
 - 5. Section 32 13 13 – Concrete Pavement, Curb, Sidewalks, and Steps.
 - 6. Section 32 90 00 – Seeding, Sodding, and Landscaping.
 - 7. Section 32 92 13 – Hydro-Mulching.

1.2 MEASUREMENT AND PAYMENT

- A. Measurement for restoration of project site for utilities disturbed by proposed construction for utilities is by linear foot. Site Restoration for utilities will be measured like particular utility as described in appropriate specification. No separate measurement will be made for restoration of branch pipe, valves and other associated work for utilities. Multiple utilities within same right-of-way will be paid on linear foot basis for only one utility.
- B. Payment will be made at unit price for Site Restoration, regardless of size or type of pipe, method of construction, paved or unpaved areas, or thickness and width of pavement. Payment for site restoration will be made when restoration is complete within right-of-way, including service connections if applicable. No partial payment will be made.

1.3 REFERENCES

- A. ANSI Z60.1 – American Standard for Nursery Stock.

1.4 DEFINITIONS

- A. Site Restoration is replacement or reconstruction of site improvements to rights-of-way, easements, public property, and private property that are affected or altered by construction operations, with improvements to restore to a condition

which is equal to, or better than, that which existed prior to construction operations.

- B. Site Improvement includes but is not limited to pavement, curb and gutter, esplanades, sidewalks, driveways, culverts, headwalls, mail boxes, lighting, signage, fences, lawns, irrigation systems, and landscaping.
- C. Line Segment. Length of water line or, in line junction structure and bends as designated on Drawings, and to end of stubs or termination of pipe.
- D. Minimum Trench Width. Allowable trench width for corresponding pipe outside diameter as defined in Specification Section 31 21 33 – Trenching, Backfilling, and Compacting for Utilities, unless otherwise indicated on the Drawings.

1.5 SUBMITTALS

- A. Conform to requirements of Specification Section 01 33 00 – Submittals.
- B. Submit qualifications of nursery or landscaping firm to be used.

1.6 QUALITY ASSURANCE

- A. Have trees, landscape shrubs, and plantings performed by qualified personnel.

1.7 SCHEDULING

- A. After paving or utility work is completed on line segment and segment is submitted on monthly estimate for payment, complete site restoration for that segment in accordance with 3.1 of this Section, unless extended in writing by Owner's Representative.
- B. For utility work requiring testing or post-installation TV inspection, completion of segment is not considered to include testing or TV inspection. Schedule for completion of site restoration is not determined by completion of testing or TV inspection.

1.8 WARRANTY

- A. Provide 2-week warranty on plants and sod grasses that die due to shock or damage only.
- B. Replace plants that fail during warranty period according to specifications governing original plants.
- C. At the end of the warranty period, provide written notification to homeowner(s) stating the underlying property owner, advising that home owner is subsequently responsible for watering, maintaining replaced plants and grasses. Provide copy of notice to Owner's Representative. Notice to include date and time notice was provided, who provided the notice and how was delivered.

- D. Damage caused by natural hazards including hail, high winds or storm is not covered by warranty.
- E. Existing plant material required to be moved on site are covered under warranty.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Seeding and Sodding.
 - 1. Provide sod and mechanically seed as specified in Specification Section 32 90 00 – Seeding, Sodding, and Landscaping. For areas to be seeded, conform to
 - 2. Provide hydro-mulching/seeding in accordance with Specification Section 32 92 13 – Hydro-Mulching.
- B. Trees, Shrubs, and Plantings.
 - 1. Provide trees, shrubs, and plants of quantity, size, genus, species, and variety of those being replaced and conforming to recommendations and requirements of ANSI Z60.1 and Specification Section 32 90 00 – Seeding, Sodding and Landscaping.
 - 2. Use balled-and-burlapped nursery stock for tree replacement.
 - 3. Within availability of standard nursery stock, replace each removed tree with one of an equivalent species and size, but with not less than 2½-inch diameter trunk, as measured 1½ feet above natural ground.

PART 3 - EXECUTION

3.1 COORDINATION

- A. For water main and sanitary sewer and roadway reconstruction and widening, construction cannot exceed site restoration by more than 50% of total Project length or 1,000 lineal feet, whichever is less, unless otherwise approved by the Owner's Representative. Site restoration must proceed continuously and be sequentially completed in order of work progress. When utility work and reconstruction or widening work occurs within same limits of right-of-way, utility installation cannot exceed pavement improvements by more than 1,000 linear feet, unless otherwise approved by the Owner's Representative. No intermediate areas can be skipped or left to be completed at a future date, unless otherwise approved by the Owner.
- B. For water main and sanitary sewer construction, site restoration associated with wet connections, cut and plugs, salvaging of fire hydrants and sewer reconnections which needs to occur after line is tested, can be restored after 45 days provided site is restored immediately after accomplishing such work.

Payment may be withheld for such wet connections, cut and plugs, salvaging of fire hydrants and sewer reconnection work until site restoration is complete.

- C. Limit utility installation to maximum of two project site locations for projects involving multiple subdivisions or locations, unless otherwise approved by the Owner's Representative.
- D. When roadway reconstruction and widening is being completed in phases, complete restoration of site in previous phase before continuing to next phase, unless otherwise approved by the Owner's Representative.

3.2 EXAMINATION

- A. Construction Site Photographs. Document conditions on and adjacent to construction site with construction photographs as specified in Specification Section 01 32 36.01 – Project Photographs.
- B. Make photographs of all areas where construction operations will be conducted including driveways and sidewalks within or adjacent to Work area.

3.3 PREPARATION

- A. Removing Pavements and Structures.
 - 1. Remove minimum pavement, curb and gutter, and other structures as required to perform Work. Perform removals in accordance with Specification Section 02 41 13 13 – Removing Existing Pavements and Structures.
 - 2. Remove concrete and asphaltic concrete material using sawed joints in accordance with Specification Section 32 13 13 – Concrete Pavement, Curb, Sidewalks, and Steps.
 - 3. Remove curb and gutter a distance of 2 feet outside excavation, unless otherwise approved by the Owner's Representative.
- B. Remove or relocate existing fencing, if required, for construction operations. Maintain integrity of private property owner's fencing if needed for protection of children, pets, or property. Notify Property owner and/or resident at least 72 hours in advance before removing fencing and coordinate security needs in accordance with Specification Section 01 11 20 – Use of Premises.

3.4 INSTALLATION

- A. Pavement, Sidewalk, and Driveway Restoration.
 - 1. Replace pavement, curb and gutter, culverts, headwalls, sidewalks, and driveways removed or damaged as result of construction operations.
 - 2. Where replacement sidewalks terminate at street curb radius, construct wheel chair ramp that meets current Texas Accessibility Standards.
- B. Seeding and Sodding.
 - 1. Clean up construction debris and level area with bank sand so that resulting surface of new grass matches level of existing grass and maintains pre-

construction drainage patterns. Level minor ruts or depressions caused by construction operations where grass is still viable by filling with bank sand.

2. Restore previously existing turfed areas with sod and fertilize in accordance with Specification Section 32 90 00 – Seeding, Sodding, and Landscaping. Sod to match existing turf.
3. Restore unpaved areas not requiring sodding with hydromulch methods conforming to Specification Section 32 92 13 – Hydro-Mulching.

C. Trees, Shrubbery, and Plants.

1. Take extra care in removing and replanting trees, shrubbery, and plants. Remove trees, shrubbery, and plants, leaving soil around roots. Place trees, shrubbery, and plants outside of excavation area.
2. Replace in kind any trees, shrubbery, and plants removed or damaged by construction operations.
3. Have nursery or landscape firm make tree replacements using balled-and-burlapped nursery stock.

D. Fence Removal and Replacement.

1. Replace fencing removed or damaged to equal or better than what existed prior to construction, including concrete footings and mow strips. Provide new wood posts, top and bottom railing and panels. Metal fencing material not damaged by Work may be reused.
2. Remove and dispose of damaged or substandard material.

3.5 CLEANING

- A. Remove debris and trash to maintain clean and orderly site as described in General Conditions and Specification Section 01 74 19 – Construction Waste Management and Disposal.

3.6 MAINTENANCE

- A. Maintain shrubs, plantings, sodded areas and seeded areas through warranty period.
- B. Replace shrubs, plantings, and seeded or sodded areas that fail to become established through warranty period.
- C. Maintain newly planted trees, shrubs, and plantings as follows:
1. Water as often as necessary to keep ground and backfill moist until plantings have become established.
 2. Repair or replace bracing as necessary.
 3. Prune as necessary.
 4. Treat plants in accordance with approved methods of horticultural practices where insects or disease affect plants after planting.

- D. Refer to Specification Section 01 56 39 – Temporary Tree and Plant Protection, Specification Section 32 92 13 – Hydro-Mulching and Specification Section 32 90 00 – Seeding, Sodding, and Landscaping for additional maintenance requirements.

END OF SECTION

SECTION 01 77 19
CLOSEOUT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for closeout of a construction project.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 – Introductory Information, Proposing Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Division 01 – General Requirements.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Price. No separate payment will be made for this item. Include the cost in associated items for this project.

1.3 SUBMITTALS (NOT USED)

1.4 SUBSTANTIAL COMPLETION

- A. Comply with Specification Section 00 72 00 – General Conditions of the Contract regarding Substantial Completion when Contractor considers the

Work, or portion thereof designated by Owner's Representative, to be substantially complete.

- B. Insure the following items have been completed when included in the Work, prior to presenting a list of items to be inspected by Owner's Representative for issuance of a Certificate of Substantial Completion:
 - 1. Cutting, plugging, and abandoning of water, wastewater, and storm sewer lines, as required by specifications for each item;
 - 2. Construction of, and repairs to, pavement, driveways, sidewalks, culverts, headwalls and curbs and gutters;
 - 3. Sodding and hydromulch seeding, unless waived by the Owner in writing;
 - 4. General clean up including signage, lighting, pavement markings, transfer of services, successful testing and landscape;
 - 5. Installation of all bid items included in Specification Section 00 41 00.02 – Proposal Form and approved Contract Document changes.
 - 6. Any additional requirements in Specification Section 01 11 20 – Use of Premises.
- C. Assist Owner's Representative with inspection of Contractor's list of items and complete or correct the items, including items added by Owner's Representative, within a time period of 30 days or as mutually agreed.
- D. Should Owner's Representative's inspection show failure of Contractor to comply with substantial completion requirements, including those items in

Paragraph 1.2B of this specification, Contractor shall complete or correct the items, before requesting another inspection by Owner's Representative.

1.5 CLOSEOUT PROCEDURES

- A. Comply with Specification Section 00 72 00 – General Conditions of the Contract regarding Final Inspection and Final Payment when Work is complete and ready for Owner's Representative's final inspection.
- B. Provide Project Record Documents in accordance with Specification Section 01 78 39 – Project Record Documents.
- C. Complete or correct items on punch list, with no new items added. Address new items during warranty period.
- D. Owner will occupy portions of Work as specified in other Sections.

1.6 FINAL CLEANING

- A. Execute final cleaning prior to Final Inspection.
- B. For facilities, clean interior and exterior glass and surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
- C. Clean equipment and fixtures to sanitary condition.
- D. Clean or replace filters of operating equipment.
- E. Clean debris from roofs, gutters, down spouts, and drainage systems.
- F. Clean site; sweep paved areas, rake landscaped surfaces clean.
- G. Remove waste and surplus materials, rubbish, and temporary construction facilities from site following final test of utilities and completion of Work.

1.7 ADJUSTING

- A. Adjust operating equipment to ensure smooth and unhindered operation in accordance with manufacturer's written instructions. Value of this testing and adjusting is five (5) percent of Lump Sum Amount in Schedule of Values for item being tested.

1.8 OPERATION AND MAINTENANCE DATA

- A. Submit operations and maintenance data as noted in Specification Section 01 33 00 – Submittals.
- B. Five (5) percent of Lump Sum Amount of each piece of equipment as indicated in Schedule of Unit Price Work or Schedule of Values shall be paid after

required O&M data submissions are received and approved by Owner's Representative.

1.9 WARRANTY

- A. Provide one original and two copies of each warranty from subcontractors, suppliers, and manufacturers.
- B. Provide Table of Contents and assemble warranties in three-ring/D binder with durable plastic cover.
- C. Submit warranties prior to final progress payment.
- D. Warranties shall commence in accordance with requirements in Specification Section 00 72 00 – General Conditions of the Contract.

1.10 SPARE PARTS AND MAINTENANCE MATERIALS

- A. Provide products, spare parts, maintenance, and extra materials in quantities specified in individual Specification sections.
- B. Deliver to location as directed by Owner's Representative; obtain receipt prior to final Payment Application.

1.11 TEXAS DEPARTMENT OF LICENSING AND REGULATION (TDLR) INSPECTION

- A. Contact TDLR's Houston Regional Office, 5425 Polk Street, Houston, Texas, 77023, telephone 713-924-6303, fax 713-921-3106, to schedule an inspection for ADA compliance prior to final completion.
- B. Provide results of TDLR's inspection to Owner's Representative prior to final inspection.

1.12 FINAL PHOTOS

- A. Provide per Specification Section 01 32 36.01 – Project Photographs.

1.13 PROJECT RECORD DOCUMENTS

- A. Provide per Specification Section 01 78 39 – Project Record Documents.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 78 23.13

OPERATIONS AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Measurement and Payment
2. Submittals
3. Equipment Operation and Maintenance Data

B. Related Specification Sections include but are not necessarily limited to:

1. Division 00 – Bidding Requirements, Contract Forms, and Conditions of the Contract.
2. Division 01 – General Requirements.

1.2 MEASUREMENT AND PAYMENT

- A. Value of approved equipment operations and maintenance manuals is 5 percent of individual equipment value as indicated in Exhibit 4 – Pricing Sheet.

This amount can be included in next progress payment after approval of submitted manual.

1.3 SUBMITTALS

- A. Conform to requirements of Section 01 33 00 – Submittals. Submit list of operation and maintenance manuals and parts manuals to be provided.
- B. Submit documents, bound in 8½- x 11-inch text pages, three-ring/D binders with durable plastic covers.
- C. Prepare binder covers with printed title “OPERATION AND MAINTENANCE INSTRUCTIONS,” title of project and subject matter of binder when multiple binders are required.
- D. Internally subdivide binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
- E. Contents: Prepare Table of Contents for each volume, with each Product or system description identified.
 - 1. Part 1: Directory, listing names, addresses, and telephone numbers of Owner, Owner’s Representative, Contractor, Subcontractors, and major equipment suppliers.
 - 2. Part 2: Operation and maintenance instructions, arranged by system. For each category, identify names, addresses, and telephone numbers of subcontractors and suppliers. Identify following:
 - a. Significant design criteria
 - b. List of equipment
 - c. Parts list for each component
 - d. Operating instructions
 - e. Maintenance instructions for equipment and systems
 - f. Maintenance instructions for special finishes, including recommended cleaning methods and materials and special precautions identifying detrimental agents
 - 3. Part 3: Project documents and certificates, including following:
 - a. Shop drawings and product data
 - b. Air and water balance reports
 - c. Certificates
 - d. Photocopies of warranties
- F. Within 1 month prior to placing equipment or facility in service, submit one original and two copies of operation and maintenance manual and parts manual for review.

- G. Submit one original and two copies of completed volumes in final form 10 days prior to final inspection. This will be returned after final inspection, with Owner's comments. Revise content of documents as required prior to final submittal.
- H. Revise and resubmit final volumes within 10 days after final inspection.

1.4 EQUIPMENT OPERATION AND MAINTENANCE DATA

- A. Furnish operation and maintenance manuals for equipment. Operation and maintenance manual must contain all information required for the Owner to operate, maintain, and repair equipment. Manual must be prepared by equipment manufacturer, furnished to Owner's Representative and, as minimum, contain following:
 - 1. Equipment functions, normal operating characteristics and limiting conditions
 - 2. Assembly, installation, alignment, adjustment, and checking instructions
 - 3. Operating instructions for start-up, normal operation, regulation and control, normal shutdown and emergency shutdown
 - 4. Lubrication and detailed maintenance instructions. Maintenance instructions are to include detailed drawings giving location of each maintainable part and lubrication point and detailed instructions on disassembly and reassembly of equipment
 - 5. Troubleshooting guide
 - 6. Complete spare parts list with predicted life of parts subject to wear, lists of spare parts recommended on hand for both initial start-up and for normal operating inventory, and local or nearest source of spare parts availability
 - 7. Outline, cross-section, and assembly drawings; engineering data; wiring diagram
 - 8. Test data and performance curves
- B. Furnish parts manuals for equipment. Manual must be prepared by equipment manufacturers, furnished to Owner's Representative and, as minimum, contain following:
 - 1. Detailed drawings giving location of each maintainable part
 - 2. Complete spare parts list with predicted life of parts subject to wear, lists of spare parts recommended on hand for both initial start-up and for normal

operating inventory, and local or nearest source of spare parts availability including local contact information.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 78 39

PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Maintenance and Submittal.
2. Recording.
3. Submittals.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 00 – Proposing Requirements, Contract Forms, and Conditions of the Contract.
2. Division 01 – General Requirements.

1.2 MEASUREMENT AND PAYMENT

No separate payment will be made for this item. Include the cost in associated items for this project.

1.3 MAINTENANCE OF DOCUMENTS AND SAMPLES

- A. Maintain one record copy of documents at site in accordance with Specification Section 00 72 00 – General Conditions of the Contract.
- B. Store Record Documents and samples in field office when field office is required by Contract, or in secure location. Provide files, racks, and secure storage for Record Documents and samples.
- C. Label each document "PROJECT RECORD" in neat, large, printed letters.
- D. Maintain Record Documents in clean dry and legible condition. Do not use Record Documents for construction purposes.
- E. Keep Record Documents and Samples available for inspection by Owner's Representative.
- F. Bring Record Drawings to progress review meetings for viewing by Owner's Representative.

1.4 RECORDING

- A. Record information concurrently with construction progress. Do not conceal Work until required information is recorded.
- B. Contract Drawings: Legibly mark each item to record actual construction, or "as built" conditions, including:
 1. Measured depths of elements of foundation in relation to finish first floor datum.

2. Measured horizontal locations and elevations of underground utilities and appurtenances, referenced to permanent surface improvements.
 3. Elevations of underground utilities referenced to bench mark utilized for Project.
 4. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of construction.
 5. Field changes of dimension and detail.
 6. Modifications made by Change Order.
 7. Details not on original Contract Drawings.
 8. References to related shop drawings and modifications.
- C. Maintain on site at all times an instrument for accurately measuring elevations. Survey every joint of water main at time of construction and record on drawings water main invert elevation, including elevation top of manway and centerline horizontal location relative to baseline.
- D. Record information with red felt-tip marking pen on set of blue line opaque drawings.
- E. Legibly mark Record Drawings to record:
1. Manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually installed.
 2. Changes made by Change Order or Field Order.
 3. Other matters not originally specified.
- F. Legibly annotate shop drawings to record changes made after review.

1.5 SUBMITTALS

- A. At Contract closeout, deliver Project Record Documents to Owner's Representative.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 31 10 00
SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Site clearing, tree protection, stripping topsoil and demolition.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Division 01 - General Requirements.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Price. No separate payment will be made for this item. Include the cost in associated items for this project.
- B. Stipulated Price (Lump Sum). If Contract is a Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect existing trees and other vegetation to remain against damage.
 - 1. Do not smother trees by stockpiling construction materials or excavated materials within drip line.
 - 2. Avoid foot or vehicular traffic or parking of vehicles within drip line.
 - 3. Provide temporary protection as required.
- B. Repair or replace trees and vegetation damaged by construction operations.
 - 1. Repair to be performed by a qualified tree surgeon.
 - 2. Remove trees which cannot be repaired and restored to full-growth status.
 - 3. Replace with new trees of minimum 4 IN caliper.
- C. Owner will obtain authority for removal and alteration work on adjoining property.

3.2 SITE CLEARING

A. Topsoil Removal:

1. Strip topsoil to depths encountered.
 - a. Remove heavy growths of grass before stripping.
 - b. Stop topsoil stripping sufficient distance from such trees to prevent damage to main root system.
 - c. Separate from underlying subsoil or objectionable material.
2. Stockpile topsoil where directed by Owner's representative.
 - a. Construct storage piles to freely drain surface water.
 - b. Seed or cover storage piles to prevent erosion.
3. Do not strip topsoil in wooded areas where no change in grade occurs.
4. Borrow topsoil: Reasonably free of subsoil, objects over 2 IN DIA, weeds and roots.

B. Clearing and Grubbing:

1. Clear from within limits of construction all trees not marked to remain.
 - a. Include shrubs, brush, downed timber, rotten wood, heavy growth of grass and weeds, vines, rubbish, structures and debris.
2. Grub (remove) from within limits of construction all stumps, roots, root mats, logs and debris encountered.
 - a. Totally grub under areas to be paved.
 - b. Grubbing in lawn areas:
 - 1) In cut areas, totally grub.
 - 2) In fill areas, where fill is less than 3 FT totally grub ground.
 - 3) Where fill is 3 FT or more in depth, stumps may be left no higher than 6 IN above existing ground surface.

C. Disposal of Waste Materials:

1. Do not burn combustible materials on site.
2. Remove all waste materials from site.
3. Do not bury organic matter on site.

3.3 ACCEPTANCE

- #### **A.**
- Upon completion of the site clearing, obtain Owner's representative's acceptance of the extent of clearing, depth of stripping and rough grade.

END OF SECTION

SECTION 31 21 33

TRENCHING, BACKFILLING, AND COMPACTING FOR UTILITIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Excavation, trenching, backfilling and compacting for all underground utilities.
 - 2. Specification Section is applicable to 33 05 23.13, 33 11 10, 33 11 12, 33 11 12.01, 33 11 13, and 33 11 15.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 – Bidding Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Division 01 – General Requirements.
 - 3. Section 03 09 00 – Concrete..

1.2 MEASUREMENT AND PAYMENT

- A. Unit Price. No separate payment will be made for this item. Include the cost for installed underground piping, sewer, conduit or ductwork.
- B. When Owner's Representative directs Contractor to overexcavate trench bottom, Contractor will be paid by unit priced bid per linear foot under bid item = 6" Overexcavation of Trench Bottom.
 - 1. No payment will be paid if Owner's Representative does not direct Contractor to overexcavate trench bottom.
 - 2. No overexcavation will be measured or paid when unsuitable conditions result from dewatering system not in conformance with Section 01 57 23.02 – Control of Ground Water and Surface Water.
- C. No additional payment will be made for performing Critical Location exploratory excavation. Include cost in unit price for installed underground piping, sewer, conduit, or duct work.

1.3 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. ASTM International (ASTM):
 - a. C40 – Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
 - b. C94 – Standard Specification for Ready-Mixed Concrete.

- c. C123 – Standard Test Method for Lightweight Particles in Aggregate.
 - d. C131 – Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
 - e. C136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - f. C142 – Standard Test Method for Clay Lumps and Friable Particles in Aggregates.
 - g. D558 – Standard Test Methods for Moisture-Density (Unit Weight) Relations of Soil-Cement Mixtures.
 - h. D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
 - i. D1140 – Standard Test Methods for Amount of Material in Soils Finer than No. 200 Sieve.
 - j. D1557 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 - k. D2487 – Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
 - l. D2922 – Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
 - m. D4253 – Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
 - n. D4254 – Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
 - o. D4318 – Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
2. Texas Department of Transportation (TxDOT):
- a. Tex-101-E – Preparing Soil and Flexible Base Materials for Testing.
 - b. Tex-110-E – Particle Size Analysis of Soils.
 - c. Tex-460-A – Determining Crushed Face Particle Count.
3. Occupational Safety and Health Administration (OSHA):
- a. Federal Regulations – 29 CFR Part 1926,
4. AWWA Standards – Excavation:
- a. AWWA M9 – Concrete Pressure Pipe

b. AWWA M11 – Steel Water Pipe

B. Qualifications:

1. Testing and analysis of backfill materials for soil classification and compaction during construction will be performed by an independent laboratory provided by the Owner.
2. Contractor shall provide licensed professional engineer licensed in Texas for design of trench shoring systems or other trench safety plans.

1.4 DEFINITIONS

- A. Classification of Excavation: Excavation shall be "unclassified" and involves the removing of the necessary materials to provide the trench to the required width and depth. The Contractor, prior to submitting a proposal, must satisfy himself as to the actual subsurface conditions. No extra or separate payments shall be made for rock, dewatering, or any other condition.

1.5 SUBMITTALS

A. Shop Drawings:

1. See Specification Section 01 33 00 – Submittals for requirements for the mechanics and administration of the submittal process.
2. Submit planned typical method of excavation, backfill placement and compaction including:
 - a. Trench widths.
 - b. Procedures for foundation and pipe zone bedding placement, and trench backfill compaction
 - c. Procedures for assuring compaction against undisturbed soil when pre-manufactured trench safety systems are proposed.
3. Submit respective pipe or conduit manufacturer's data regarding bedding methods of installation and general recommendations.
4. Submit backfill material sources and product quality information in accordance with requirements of this section.
5. Submit sieve analysis reports on all granular materials.
6. Certified Test Reports for embedment material, coarse gravel, and flexbase. Certified Test Reports shall be from an independent laboratory. Test reports shall include sieve analysis, Atterburg limits, and results of an Abrasion test.

B. Miscellaneous Submittals:

1. See Specification Section 01 33 00 – Submittals for requirements for the mechanics and administration of the submittal process.

2. Submit record of location of utilities as installed, referenced to survey control points. Include locations of utilities encountered or rerouted. Give stations, horizontal dimensions, elevations, inverts and gradients.
3. Submit 11-inch by 17-inch copy of Drawing with plotted utility or obstruction location titled Critical Location Report to Owner's Representative as described in 1.6.D.1. Drawing shall be signed and sealed by R.P.L.S.
4. Submit trench excavation safety program.
5. Submit trench shield (trench box) certification if employed:
 - a. Specific to Project conditions.
 - b. Re-certified if members become distressed.
 - c. Certification by licensed professional structural engineer, licensed in the State of Texas
 - d. Owner's Representative and Owner are not responsible to, and will not, review and approve.

1.6 SITE CONDITIONS

- A. Avoid overloading or surcharge a sufficient distance back from edge of excavation to prevent slides or caving.
 1. Maintain and trim excavated materials in such manner to be as little inconvenience as possible to public and adjoining property owners.
- B. Provide full access to public and private premises and fire hydrants, at street crossings, sidewalks and other points as designated by Owner's Representative to prevent serious interruption of travel.
- C. Protect and maintain bench marks, monuments or other established points and reference points and if disturbed or destroyed, replace items to full satisfaction of Owner's Representative and controlling agency.
- D. Protection of Existing Structures and Utilities
 1. The Contractor shall advise the Owner's Representative of any existing utilities that are not shown on the Drawings, or are shown incorrectly, that affect the pipe layout. Contractor shall also propose a resolution to the utility conflict for the Owner's Representative's review. The Owner's Representative will determine whether the utility will be relocated or the proposed pipeline location revised. If the pipeline location is revised, an adjustment to the Contract price will be agreed to as described in the General Conditions. If the proposed pipe grade is adjusted by 2 vertical feet or less, no Contract Price adjustment will be made. If the proposed pipe grade is adjusted by more than 2 vertical feet, a Contract Price adjustment will be agreed to as described in the General Conditions.
 2. Utilities that affect the pipe layout will be interpreted by the Owner's Representative as follows:

- a. Utilities that conflict with the grade of the proposed pipe will be interpreted as affecting the pipe layout.
- b. Utilities that conflict with the operations and maintenance of the proposed pipe will be interpreted as affecting the pipe layout.
- E. Where excavation endangers adjacent structures and utilities, the Contractor shall, at his own expense, carefully support and protect such structures and/or utilities so that there shall be no damage. In the case where the structure cannot be protected and must be temporarily or permanently relocated, Contractor will be compensated for actual cost only once approved by the Owner's Representative.
- F. If in the opinion of the Owner's Representative, concrete backfill is necessary for the support of utility lines crossing trenches, the Owner's Representative may direct 2000 psi concrete backfill to be used. Payment shall be made to the Contractor at the unit price bid for the installation of such quantity of the concrete backfill as directed by the Owner's Representative.

1.7 WARRANTY (NOT USED)

PART 2 - PRODUCTS

2.1 MATERIAL CLASSIFICATIONS

- A. Classify materials for backfill for purpose of quality control in accordance with Unified Soil Classification Symbols as defined in ASTM D 2487. Material use and application is defined in utility installation specifications and Drawings either by class, as described in Paragraph 2.01B, or by product descriptions, as given in Paragraph 2.02.
- B. Class Designations Based on Laboratory Testing:
 - 1. Class I: Well-graded gravels and sands, gravel-sand mixtures, crushed well-graded rock, little or no fines (GW, SW):
 - a. Plasticity index: non-plastic.
 - b. Gradation: D_{60}/D_{10} - greater than 4 percent; amount passing No. 200 sieve - less than or equal to 5 percent.
 - 2. Class II: Poorly graded gravels and sands, silty gravels and sands, little to moderate fines (GM, GP, SP, SM):
 - a. Plasticity index: non-plastic to 4.
 - b. Gradations:
 - 1) Gradation (GP, SP): amount passing No. 200 sieve - less than 5 percent.
 - 2) Gradation (GM, SM): amount passing No. 200 sieve - between 12 percent and 50 percent.

- 3) Borderline gradations with dual classifications (e.g., SP-SM): amount passing No. 200 sieve - between 5 percent and 12 percent.
- 3. Class III: Clayey gravels and sands, poorly graded mixtures of gravel, sand, silt, and clay (GC, SC, and dual classifications, e.g., SP-SC):
 - a. Plasticity index: greater than 7.
 - b. Gradation: amount passing No. 200 sieve - between 12 percent and 50 percent.
- 4. Class IVA: Lean clays (CL).
 - a. Plasticity Indexes:
 - 1) Plasticity index: greater than 7, and above A line.
 - 2) Borderline plasticity with dual classifications (CL-ML): PI between 4 and 7.
 - b. Liquid limit: less than 50.
 - c. Gradation: amount passing No. 200 sieve - greater than 50 percent.
 - d. Inorganic.
- 5. Class IVB: Fat clays (CH).
 - a. Plasticity index: above A line.
 - b. Liquid limit: 50 or greater.
 - c. Gradation: amount passing No. 200 sieve - greater than 50 percent.
 - d. Inorganic.
- 6. Use soils with dual class designation according to ASTM D 2487, and which are not defined above, according to more restrictive class.

2.2 MATERIALS

- A. Soils classified as silt (ML), elastic silt (MH), organic clay and organic silt (OL, OH), and organic matter (PT) are not acceptable as backfill materials.
 - 1. These soils may be used for site grading and restoration in unimproved areas as approved by the Owner's representative.
 - 2. Soils in Class IVB, fat clay (CH) may only be used as backfill materials outside of roadways and where otherwise allowed by this Specification Section.
- B. Provide backfill material that is free of stones greater than 2 IN, free of roots, waste, debris, trash, organic material, unstable material, non-soil matter, hydrocarbon or other contamination, conforming to the following limits for deleterious materials:
 - 1. Clay lumps: Less than 0.5 percent for Class I, and less than 2.0 percent for Class II, when tested in accordance with ASTM C142.

2. Lightweight pieces: Less than 5 percent when tested in accordance with ASTM C123.
 3. Organic impurities: No color darker than standard color when tested in accordance with ASTM C40.
 4. Clay Clods: Less than 4 inches in least dimension.
- C. Manufactured materials, such as crushed concrete, may be substituted for natural soil or rock products where indicated in the product specification, and approved by the Owner's representative, provided that the physical property criteria are determined to be satisfactory by testing.
- D. Bank Run Sand: Durable bank run sand classified as SP, or SW by the Unified Soil Classification System (ASTM D2487) meeting the following requirements:
1. Less than 15 percent passing the number 200 sieve when tested in accordance with ASTM D 1140.
 - a. The amount of clay lumps or balls not exceeding 2 percent.
 2. Material passing the number 40 sieve shall meet the following requirements when tested in accordance with ASTM D4318:
 - a. Liquid limit: not exceeding 25 percent.
 - b. Plasticity index: not exceeding 7.

- E. Concrete Sand: Natural sand, manufactured sand, or a combination of natural and manufactured sand conforming to the requirements of ASTM C33 and graded within the following limits when tested in accordance with ASTM C136:

Sieve	Percent Passing
3/8 IN	100
No. 4	95 to 100
No. 8	80 to 100
No. 16	50 to 85
No. 30	25 to 60
No. 50	10 to 30
No. 100	2 to 10

- F. Gem Sand: Sand conforming to the requirements of ASTM C33 for course aggregates specified for number 8 size and graded within the following limits when tested in accordance with ASTM C136:

Sieve	Percent Passing
3/8 IN	95 to 100
No. 4	60 to 80
No. 8	15 to 40

- G. Pea Gravel: Durable particles composed of angular gravels and graded within the following limits when tested in accordance with ASTM C136:

Sieve	Percent Passing
1/2 IN	100
3/8 IN	85 to 100
No. 4	10 to 30
No. 8	0 to 10
No. 16	0 to 5

- H. Crushed Aggregates: Crushed aggregates consist of durable particles obtained from an approved source and meeting the following requirements:

1. Materials of one product delivered for the same construction activity from a single source.
2. Non-plastic fines.
3. Los Angeles abrasion test wear not exceeding 45 percent when tested in accordance with ASTM C131.

4. Crushed aggregate shall have a minimum of 90 percent of the particles retained on the No. 4 sieve with 2 or more crushed faces as determined by Test Method TxDOT Tex-460-A, Part I.
5. Crushed stone:
 - a. Produced from oversize plant processed stone or gravel, sized by crushing to predominantly angular particles from a naturally occurring single source.
 - b. Uncrushed gravel are not acceptable materials for embedment where crushed stone is shown on the applicable utility embedment drawing details.
 - c. Where coarse gravel is required for water drainage, restoration of trench foundation, or other uses, it shall be crushed stone in compliance with ASTM C33 for Coarse Concrete Aggregate. Gradation shall be ASTM C33 No. 57, No. 67, or as follows:

Sieve Size Sq. Openings	Amount Passing Percent by Weight
1"	95-100
3/4"	55-85
1/2"	25-50
No. 4	0-5

6. Crushed Concrete:
 - a. The Owner's Representative will make a determination as to whether crushed concrete can be allowed and what the acceptable gradation is.
 - b. Gradation and quality control test requirements are the same as crushed stone.
 - c. Provide crushed concrete produced from normal weight concrete of uniform quality; containing particles of aggregate and cement material, free from other substances such as asphalt, reinforcing steel fragments, soil, waste gypsum (calcium sulfate), or debris.
7. Gradations, as determined in accordance with TxDOT Tex-110-E.

Sieve	Percent Passing by Weight for Pipe Embedment by Ranges of Nominal Pipes Sizes		
	>15 IN	15 IN - 8 IN	<8 IN
1 IN	95 - 100	100	-
3/4 IN	60 - 90	90 - 100	100
1/2 IN	25 - 60	-	90 - 100
3/8 IN	-	20 - 55	40 - 70
No. 4	0 - 5	0 - 10	0 - 15
No. 8	-	0 - 5	0 - 5

- I. Select Backfill: Class III clayey gravel or sand or Class IV lean clay with a plasticity index between 7 and 20 or clayey soils treated with lime to meet plasticity criteria.
- J. Native Backfill: Any suitable soil or mixture of soils initially excavated during trench excavation, meeting the requirements of section 2.2 B of this Specification, and within Classes I, II, III and IV; or fat clay (CH) where allowed by this Specification Section.
- K. Cement Stabilized Sand:
 1. Sand-cement mixture shall produce a minimum unconfined compressive strength of at least 100 pounds per square inch in 48 hours and contain not less than 2.0 sacks of cement per ton of dry sand.
 - a. Design will be based on strength specimens molded in accordance with ASTM D558 at a moisture content within 2 percent of optimum and within 4 hours of batching.
 - b. Determine minimum cement content from production data and statistical history.
 - c. Granular material to be used as cement stabilized sand should be well graded and have the grain size characteristics as listed below:

Sieve	Percent Passing
No. 4	55 to 100
No. 10	37 to 100
No. 40	24 to 100
No. 200	10 to 20

2. Cement: Type I Portland cement conforming to ASTM C150.
3. Sand: Clean, durable sand meeting grading requirements for fine aggregates of ASTM C33, or requirements for Bank Run Sand of this Specification Section and the following requirements:

- a. Classified as SW, SP, SW-SM, SP-SM, or SM by the United Soil Classification System of ASTM D2487.
- b. Deleterious materials:
 - 1) Clay lumps, ASTM C142; less than 0.5 percent.
 - 2) Lightweight pieces, ASTM C123; less than 5.0 percent.
 - 3) Organic impurities, ASTM C40, color no darker than the standard color.
- c. Plasticity index of 4 or less when tested in accordance with ASTM D4318.
 - 1) Water: Potable water, free of oils, acids, alkalies, organic matter, or other deleterious substances, meeting requirements of ASTM C94.
- L. Concrete Backfill: Conform to Class B concrete as specified in Division 03 – Concrete.
- M. Subgrade Stabilization Materials: Provide subgrade stabilization material per Specification Section 32 11 13.01 – Lime/Fly-Ash Stabilized Subgrade, Specification Section 32 11 13.02 – Portland Cement Stabilized Subgrade, or Specification Section 32 11 13.13 – Lime Treated Subgrade as required.
- N. Granular Embedment Material: Granular embedment material may be pea gravel or bank run sand as defined in sections 2.2 G and 2.2 D, respectively. Additionally, granular embedment material shall be free from large stones, clay, and organic material. Granular embedment material shall be a soil classification of GW, GP, SW, or SP as determined by ASTM D2487. The granular embedment material shall be such that when wet, the fine material shall not form mud or muck. The granular embedment material shall be composed of angular, tough durable particles, free from thin, flat and elongated pieces, of suitable quality to insure permanence in the trench and have a percentage of wear of not more than 40 percent when tested in accordance with ASTM C131 or ASTM C535. The P.I. of the fines shall not exceed 3. Light weight aggregate is not acceptable for granular embedment. Material used for granular embedment shall have a resistivity of not less than 5000 ohms/cm as measured by ASTM G57.
- O. Well-graded Crushed Stone Bedding Material:
 - 1. ASTM C33, gradation 67 (3/4 IN to No. 4 sieve) defined below:

P.

Sieve	Percent
1"	100
3/4"	90 to 100
3/8"	20 to 55
No. 4	0 to 10

Q. Lime Stabilized Clay Backfill.

1. Clayey material hydrated lime or quicklime to achieve a pH of 12.4 and a plasticity index (PI) of less than 20 in accordance with ASTM D 4318.
2. The optimum lime content to be determined by lime optimization curve using specific soil sample and proposed lime additive.

R. Flowable fill: Provide Flowable Fill in accordance with Specification Section 03 31 31 – Concrete Mixing, Placing, Jointing, and Curing as required.

PART 3 - EXECUTION

3.1 GENERAL

- A. Remove and dispose of unsuitable materials as directed by Owner's Representative to site provided by Contractor.
- B. Establish traffic control when working within the public right of way per applicable specifications. Maintain barricades and warning lights for streets and intersections affected by Work, and are considered hazardous to traffic movements.
- C. Perform work to conform to applicable safety standards and regulations. Employ trench safety system as designed by the Contractor's engineer licensed in the State of Texas.
- D. Immediately notify agency or company owning any existing utility line which is damaged, broken or disturbed. Obtain approval from Owner's Representative and agency for any repairs or relocations, either temporary or permanent.
- E. Maintain permanent benchmarks, monumentation and other reference points. Unless otherwise directed in writing, replace those which are damaged or destroyed.
- F. Limit pavement removal to less than five pipe laying days in advance of pipe laying.

3.2 EXCAVATION

- A. Unclassified Excavation: Remove rock excavation, clay, silt, sand, gravel, hard pan, loose shale, and loose stone to required lines and grades, or as directed by Owner's Representative.
- B. Upon discovery of unknown utilities, badly deteriorated utilities not designated for removal, or concealed conditions, discontinue work at that location. Notify Owner's Representative and obtain instructions before proceeding.
- C. Excavation for Appurtenances:
 1. 12 IN (minimum) clear distance between outer surface and embankment.
 2. See Specification Section 31 23 00 – Earthwork for applicable requirements.

3. See Specification Section 33 05 16 – Precast Concrete Manhole Structures for applicable requirements.

D. Groundwater Dewatering:

1. Where groundwater is, or is expected to be, encountered during excavation, install a dewatering system to prevent softening and disturbance of subgrade, to allow pipe, bedding, embedment, and backfill material to be placed in a dry, stable trench.
2. Groundwater shall be drawn down and maintained at least 3 FT below the bottom of any trench or manhole excavation prior to excavation.
3. Review soils investigation before beginning excavation and determine where groundwater is likely to be encountered during excavation.
 - a. Employ dewatering specialist for selecting and operating dewatering system.
4. Keep dewatering system in operation until dead load of pipe, structure and backfill exceeds possible buoyant uplift force on pipe or structure.
5. Dispose of groundwater to an area which will not interfere with construction operations or damage existing construction.
6. Install groundwater monitoring wells as necessary.
7. Shut off dewatering system at such a rate to prevent a quick upsurge of water that might weaken the subgrade.
8. No additional payment for groundwater dewatering.

E. Critical Location Investigation

1. Prior to purchase of pipe, the contractor shall properly locate and identify all existing utilities in proximity to the water line corridor. The contractor shall confirm utilities using vacuum excavation or other suitable excavation method and provide a submittal to the Owner with their findings and proof of completion.
2. Horizontal and vertical location of various underground lines shown on Drawings, including but not limited to water lines, gas lines, storm sewers, sanitary sewers, telecommunication lines, electric lines or power ducts, pipelines, concrete and debris, are based on best information available but are only approximate locations. Unless otherwise approved by Owner's Representative, at Critical Locations shown on Drawings, perform vacuum excavation to field verify horizontal and vertical locations of such lines within zone of 2 feet vertically and 4 feet horizontally of proposed work.
 - a. Verify location of existing utilities prior to purchase of pipe and prior to beginning installation of auger pit or tunnel shaft. Use extreme caution and care when uncovering utilities designated by Critical Locate.

- b. Notify Owner's Representative in writing immediately upon identification of obstruction. In event of failure to identify obstruction in minimum of 7 days, Contractor will not be entitled to extra cost for downtime including, but not limited to, payroll, equipment, overhead, demobilization and remobilization, until 7 days has passed from time Owner's Representative is notified of obstruction.
3. Notify involved utility companies of date and time that investigation excavation will occur and request that their respective utility lines be marked in field. Comply with utility or pipeline company requirements that their representative be present during excavation. Provide Owner's Representative with 48 hours notice prior to field excavation or related work.
4. Survey vertical and horizontal locations of obstructions relative to project baseline and datum and plot on 12 inch by 18 inch copy of Drawings.

F. Protection

1. Protect trees, shrubs, lawns, existing structures, and other permanent objects outside of grading limits and within grading limits as designated on Drawings, and in accordance with requirements of Section 01 56 39 – Temporary Tree and Plant Protection.
2. Protect and support above-grade and below-grade utilities which are to remain.
3. Restore damaged permanent facilities to pre-construction conditions unless replacement or abandonment of facilities is indicated on Drawings.
4. Take measures to minimize erosion of trenches. Do not allow water to pond in trenches. Where slides, washouts, settlements, or areas with loss of density or pavement failures or potholes occur, repair, recompact, and pave those areas at no additional cost to Owner.

G. Trench Excavation:

1. Excavate trenches by open cut method to depth shown on Drawings and necessary to accommodate work.
 - a. Support existing utility lines where proposed work crosses at a lower elevation.
 - 1) Stabilize excavation to prevent undermining of existing utility .
2. Open trench outside buildings, units, and structures:
 - a. No more than the distance between two manholes, structures, units, or 300 LF, whichever is less.
 - b. No more than 100 LF of open trench where located on or parallel and adjacent to the Conroe Dam embankment.
 - c. Field adjust limitations as weather conditions dictate.

3. Trenching within buildings, units, or structures:
 - a. No more than 100 LF at any one time.
4. Any trench or portion of trench, which is opened and remains idle for seven (7) calendar days, or longer, as determined by the Owner's Representative, may be directed to be immediately refilled, without completion of work, at no additional cost to Owner.
 - a. Said trench may not be reopened until Owner's Representative is satisfied that work associated with trench will be prosecuted with dispatch.

H. Pipe Trench:

1. The "pipe zone" shall be defined as the zone from 12 inches below the bottom of the pipe to 12 inches above the top of the pipe, unless otherwise noted on Drawings.
2. The trench walls in the pipe zone shall be vertical. Trench widths shall be as shown on the Drawings.
3. Trench walls above the pipe zone may be laid back or benched where room permits as necessary to meet the requirements of OSHA.
4. For semi-rigid pipe or flexible pipe (including AWWA C200 steel pipe, AWWA C303 bar-wrapped concrete cylinder pipe, PVC, Ductile Iron, and other pipe materials as listed in appropriate specifications), where the character of the trench walls is loose, unstable, saturated soft clays, quicksand or otherwise unable to provide adequate side support to maintain the required pipe deflection, the Contractor shall modify the backfill to keep the pipe within the limits of the specified pipe deflection.
 - a. Contractor shall widen the trench excavation to accommodate modified backfill procedure.
 - b. Contractor shall protect exterior pipe coating, and shall repair any damage caused by backfilling.
 - c. Concrete encasement, soil cement, flowable fill or some other method approved by the Owner's Representative may be used in lieu of this procedure.

I. Pipe Foundation:

1. Excavate the trench to an even grade so that the full length of the pipe barrel is supported and joints make up properly. Excavate the trench to the line and grade indicated and as directed by the Owner's Representative. Grades shall be uniform between high points and low points to eliminate intermediate "highs and lows."

2. The trench shall be "rough cut" a minimum of 12 inches below the bottom of the pipe, unless otherwise noted on drawings. The "rough cut" dimension shall be increased as necessary to provide a minimum clearance of 2 inches from the bottom of the trench to the bottom of the bells, flanges, valves, fittings, etc.
3. The entire foundation area in the bottom of all excavations shall be firm, stable material. Loose material shall be removed, leaving a clean, flat trench bottom, and material shall not be disturbed below required sub grade except as hereinafter described. If the subgrade is soft, spongy, disintegrated, or where the character of the foundation materials is such that a proper foundation cannot be obtained at the elevation specified, then when directed by the Owner's Representative the Contractor shall deepen the excavation to a depth where a satisfactory foundation can be obtained. The subgrade shall then be brought back to the required grade with the well-graded crushed stone bedding materials and construction methods specified in section 3.3 and 3.4 of this specification. Payment for additional excavation and backfill shall be made at the unit price bid in the Proposal.
4. Remove soft, loose or spongy foundation soil caused by Contractor failure to dewater, rainfall, or Contractor operations. Replace with well-graded crushed stone bedding material, as noted above, with no additional compensation.
5. If over excavation does not yield satisfactory foundation conditions, then construct the foundation in accordance with section 3.3 J. of this specification.

J. Correcting Faulty Grade:

1. If the trench is excavated to a faulty grade (at a lower elevation than indicated), correct the faulty grade as specified below:
 - a. In uniform, stable dry soils, correct the faulty grade with embedment material thoroughly compacted, as defined in sections 3.3 and 3.4 of this specification.
 - b. In soft spongy disintegrated soils or where necessary to allow proper drainage, correct the faulty grade using well-graded crushed stone bedding in accordance with section 3.3 J. of this specification.
 - c. Maximum allowable loose lift thickness for embedment or well-graded crushed stone bedding material shall be 8 inches.

K. Pipe Clearance in Rock: Remove ledge rock, rock fragments, or unyielding shale or marl to provide a clearance of at least 12 inches below the parts of the pipe, valves or fittings. Provide adequate clearance for properly jointing pipe laid in rock trenches at bell holes. Refill the excavation to grade with embedment material.

L. Blasting Procedure: Blasting shall not be allowed.

M. Bell Holes Required:

1. Bell holes of ample dimension shall be dug in trenches at each joint of pipe to permit the jointing to be made properly, visually inspected, and so that the pipe will rest on the full length of the barrel.
2. Pipe with field-applied exterior coatings shall have the joints excavated to sufficient depth to allow proper cleaning, application, testing and inspection of the field-applied coating system.

N. Care of Surface Material for Reuse: Surface materials such as topsoil in its natural state, suitable for reuse in restoring the excavated surface, shall be kept separate from the general excavation material. The top 12 inches of the trench backfill shall be considered topsoil. Save the topsoil to be used as backfill of the top 12 inches of the trench after pipe laying.

O. Manner of Piling Excavated Material: Place excavated material so that Work is not endangered or interferes with public traffic, or the stability of excavations and open trenches. Do not place excavated material over buried pipelines or existing utilities unless adequate provisions are made to protect those pipelines and/or utilities. Roads and driveways must be kept open in every case. Keep drainage channels clear of obstructions or make other satisfactory provisions for drainage.

P. Trenching by Machine or by Hand: The use of trench digging machinery is approved except in places where operations of same will cause damage to existing structures above or below ground, in which case employ hand methods.

Q. Trenching for Electrical Installations:

1. Observe the Trench Excavation paragraph above.
2. Modify for electrical installations as follows:
 - a. Open no more than 600 LF of trench in exterior locations for trenches more than 12 IN, but not more than 30 IN wide.
 - b. Any length of trench may be opened in exterior locations for trenches which are 12 IN wide or less.
 - c. No more than 100 LF of open trench where located within the Conroe Dam embankment limited excavation zone. (Only applicable to PCS #1)
 - d. Do not over excavate trench.
 - e. Cut trenches for electrical runs with minimum 30 IN cover, unless otherwise specified or shown on Drawings.
 - f. See Division 26 – Electrical for additional requirements.

3.3 BACKFILLING OF TRENCHES OUTSIDE ROADWAYS

- A. General: This Section is intended to cover the requirements for trench backfill where trench is in open fields, unimproved alleys, fields, and other similar open areas, except public and private roadways.
- B. Time of Backfilling: Backfill operations shall immediately follow pipe jointing, joint coating application, and curing.
- C. Braced and Sheeted Trenches: Remove sheeting and shoring as backfilling operations progress. Incorporate methods so that a good bond is obtained between the backfill material and the undisturbed trench walls.
- D. Protection of Pipe during Backfilling Operations: Take the necessary precautions to protect the pipe during backfilling operations. Take care to prevent damage to the pipe or to the pipe coating, and repair any damaged pipe before being "covered up". Backfill the trench to prevent the deformation or otherwise deflection of the cylindrical shape of the pipe by more than the allowable pipe deflection as specified elsewhere. Use methods such as stulling or ellipsing as necessary.
- E. Site and Preparation: In addition to clearing and grubbing of brush and trees along the right of way for this Project, alteration to the topography shall be done if indicated on the Drawings, at the locations and to the extent shown.
- F. Compaction: All compaction shall be in accordance with specification 3.6 of this specification. See specification section 3.6 for density and testing requirements.
- G. Backfill Procedure for Water Lines:
 - 1. Embedment material for water lines shall granular embedment material as specified in section 2.2 N. Place the first lift of granular embedment material (bedding layer) to a depth slightly above the bottom of pipe grade and compact. Lay pipe on this material to the indicated grade. Provide bell holes to permit the pipe to rest on the full length of the barrel and to permit joint make-up.
 - 2. Place subsequent lifts of granular embedment uniformly on both sides of the pipe to a depth of 12 inches above the pipe. Compact using low ground pressure vibration or mechanical tamping in 6 to 8 inch loose lifts. Contractor shall take precautions to ensure no voids occur under the haunches of the pipe and to prevent disturbance of the pipe alignment. The Contractor shall be responsible for any damage that may occur to the pipe.
 - 3. Backfill above pipe zone:

- a. Under unimproved areas: After placement and compaction of the granular embedment, place native backfill in the trench for the full width of the trench to the top of the trench. Consolidate this material by mechanical compaction in 6 to 8 inch loose lifts. The Contractor shall be responsible for any damage that may occur to the pipe.
- b. Under proposed paving: After placement and compaction of the granular embedment, deposit native backfill in the trench for the full width of the trench to within 3 feet of pavement subgrade then place lime stabilized clay or cement stabilized sand or Owner approved select backfill to immediately below pavement subgrade. Consolidate this material by mechanical compaction in 6 to 8 inch loose lifts. The Contractor shall be responsible for any damage that may occur to the pipe.

H. Backfill Procedure for Storm and Sanitary Lines:

1. Embedment material for storm and sanitary sewer lines shall cement stabilized sand as defined in section 2.2 K. Place the first lift of cement stabilized sand to the bottom of pipe grade and compact. Lay pipe on this material to the indicated grade. Provide bell holes to permit the pipe to rest on the full length of the barrel and to permit joint make-up.
2. Place subsequent lifts of cement stabilized sand uniformly on both sides of the pipe to 12 inches above the top of the pipe. Compact using low ground pressure vibration or mechanical tamping in 6 to 8 inch loose lifts. Contractor shall take precautions to ensure no voids occur under the haunches of the pipe and to prevent disturbance of the pipe alignment.
3. Backfill above pipe zone:
 - a. Under unimproved areas: Place the native material above the pipe zone in lifts not exceeding 8 inches loose depth. Mechanical compaction shall be utilized. The Contractor shall be responsible for any damage that may occur to the pipe.
 - b. Under proposed paving: Continue placement and compaction of the cement stabilized sand in the trench for the full width above. Consolidate this material by mechanical compaction in 6 to 8 inch loose lifts. The Contractor shall be responsible for any damage that may occur to the pipe.

I. Surface Material Replacement:

1. The top 12 inches of the trench backfill shall be composed of the original surface material or topsoil excavated from the trench. Place the topsoil over the consolidated trench backfill material and neatly round over the trench to a sufficient height to allow settlement to grade after consolidation. Grade the surface to allow drainage in the same manner as existed prior to construction.

2. Top soil shall not contain rocks or clods larger than those adjacent to the trench in the undisturbed condition.

J. Backfill in Wet Conditions:

1. If wet conditions are encountered, backfill utilities lines in accordance with details provided in the Drawings for wet trench construction.

K. Flowable Fill:

1. Backfill the pipe trench with flowable fill to 12 inches above the top of the pipe. Pipe shall be blocked up on soil pads to allow a minimum of 6 inches of flowable fill below the pipe.
2. Discharge from a mixer by any means acceptable to the Owner's representative into the area to be filled.
3. Place in 4 FT maximum lifts to the elevations indicated.
 - a. Allow 12 HR set-up time before placing next lift or as approved by the Owner's representative.
 - b. Place flowable fill lifts in such a manner as to prevent flotation of the pipe.
4. Do not place flowable fill on frozen ground.
5. Place flowable fill on subgrade free of disturbed or softened material and water.
6. Conform to appropriate requirements of Specification Section 31 23 00.
7. Start flowable fill batching, mixing, and placing if weather conditions are favorable, and the air temperature is 34 DegF and rising.
8. Temperature of flowable fill at the time of placement: At least 40 DegF.
9. Stop mixing and placing when the air temperature is 38 DegF or less and falling.
10. Each filling stage shall be as continuous an operation as is practicable.
11. Prevent traffic contact with flowable fill for at least 24 HRS after placement or until flowable fill is hard enough to prevent rutting by construction equipment.
12. Do not place flowable fill until water has been controlled or groundwater level has been lowered in conformance with the requirements of the Groundwater Dewatering paragraph in this Specification Section.

L. Backfilling for Electrical Installations:

1. Observe backfilling methods described above or when approved by the Owner's representative.

2. Modify for electrical installation and observe notes and details on electrical drawings for fill in immediate vicinity of direct burial cables.

3.4 BACKFILL PROCEDURE FOR UTILITIES UNDER EXISTING PUBLIC AND PRIVATE ROADS OR UNDER OTHER UTILITIES

- A. Compact backfill material within the pipe zone as described in 3.3.
- B. For trench excavation above the pipe zone, fill the excavation to the pavement subgrade with cement stabilized sand compacted to 95 percent standard density at plus 2 to minus 1 percent optimum moisture in maximum 6 to 8 inch lifts.

3.5 TRENCH SHORING AND BACKFILL

- A. Shoring of Trench Walls.
 1. Install Special Shoring in advance of trench excavation or simultaneously with trench excavation, so that soils within full height of trench excavation walls will remain laterally supported at all times.
 2. For all types of shoring, support trench walls in pipe embedment zone throughout installation. Provide trench wall supports sufficiently tight to prevent washing trench wall soil out from behind trench wall support.
 3. Leave sheeting driven into or below pipe embedment zone in place to preclude loss of support of foundation and embedment materials, unless otherwise directed by Owner's Representative. Leave rangers, walers, and braces in place as long as required to support sheeting, which has been cut off, and trench wall in vicinity of pipe zone.
 4. Employ special methods for maintaining integrity of embedment or foundation material. Before moving supports, place and compact embedment to sufficient depths to provide protection of pipe and stability of trench walls. As supports are moved, finish placing and compacting embedment.
 5. If sheeting or other shoring is used below top of pipe embedment zone, do not disturb pipe foundation and embedment materials by subsequent removal. Maximum thickness of removable sheeting extending into embedment zone shall be equivalent of 1-inch-thick steel plate. As sheeting is removed, fill in voids left with grouting material.
- B. Use of Trench Shields. When trench shield (trench box) is used as worker safety device, the following requirements apply:
 1. Make trench excavations of sufficient width to allow shield to be lifted or pulled freely, without damage to trench sidewalls.
 2. Move trench shields so that pipe, and backfill materials, after placement and compaction, are not damaged nor disturbed, nor degree of compaction reduced. Recompect after shield is moved if soil is disturbed.

3. When required, place, spread, and compact pipe foundation and bedding materials beneath shield. For backfill above bedding, lift shield as each layer of backfill is placed and spread. Place and compact backfill materials against undisturbed trench walls and foundation.
 4. Maintain trench shield in position to allow sampling and testing to be performed in safe manner.
 5. Conform to applicable Government regulations.
- C. Voids under paving area outside shield caused by Contractor's work will require removal of pavement, consolidation and replacement of pavement in accordance with Contract Documents. Repair damage resulting from failure to provide adequate supports.
- D. Place sand or soil behind shoring or trench shield to prevent soil outside shoring from collapsing and causing voids under pavement. Immediately pack suitable material in outside voids following excavation to avoid caving of trench walls.
- E. Coordinate excavation within 15 feet of pipeline with company's representative. Support pipeline with methods agreed to by pipeline company's representative. Use small, rubber-tired excavator, such as backhoe, to do exploratory excavation. Bucket that is used to dig in close proximity to pipelines shall not have teeth or shall have guard installed over teeth to approximate bucket without teeth. Excavate by hand within 1 foot of pipeline company's line. Do not use larger excavation equipment than normally used to dig trench in vicinity of pipeline until pipelines have been uncovered and fully exposed. Do not place large excavation and hauling equipment directly over pipelines unless approved by pipeline company's representative.

3.6 COMPACTION

A. General:

1. Place and assure bedding, backfill, and fill materials achieve an equal or higher degree of compaction than undisturbed materials adjacent to the work.
2. In no case shall degree of compaction below minimum compactions specified be accepted.

B. Compaction Requirements:

1. Unless noted otherwise on Drawings or more stringently by other Specification Sections, comply with following minimum trench compaction criteria.

LOCATION	MATERIAL	COMPACTION DENSITY
All applicable areas	Bank sand	95 percent of standard proctor density, +2 to -1% optimum density, by ASTM D698 and ASTM D2922

Pea gravel	95 percent of maximum relative density by ASTM D4253 and ASTM D4254
Well-graded crushed stone	95 percent of maximum relative density by ASTM D4253 and ASTM D4254
Native backfill	95 percent of standard proctor density, +2 to -1% optimum density, by ASTM D698 and ASTM D2922
Cement stabilized sand	95 percent of standard proctor density, +2 to -1% optimum density, by ASTM D558 and ASTM D2992

3.7 FIELD QUALITY CONTROL

A. Testing:

1. In-place density tests of compacted materials will be performed by Owner's Representative according to the standards provided in section 3.6, and at the following frequencies and conditions.
2. Owner will provide a recognized testing laboratory capable of performing a full range of testing procedures complying with the standards or testing procedures specified. The testing lab shall provide certified technicians that are trained and knowledgeable in, in-trench nuclear density testing, sand cone, concrete sampling and testing, ASTM D698 and D1557 proctors at a minimum.
3. Testing Frequency: Accommodate the Owner's Representative in performing the following:
 - a. Testing: Pothole every 1000 feet and grab Samples at pipe level for materials testing and proctors.
 - b. Owner's Representative shall take a minimum of three in-trench/ pipe zone nuclear density tests every 150 feet of installed pipe.
 - c. Owner's Representative shall take a minimum of three nuclear density tests above the pipe zone for every 150 feet.
 - d. Owner's Representative shall take a minimum of three in-trench/pipe zone nuclear density test and a minimum of three above pipe zone nuclear density test at all open cut road crossings.
 - e. Contractor to update his field "as-built" drawings with density test locations in the profile.
4. When requested by Owner's Representative, Contractor shall excavate test pits after the backfill has been placed and compacted in the pipe zone for the purpose of taking field density tests and inspecting the haunch areas under the pipe for voids.

5. When requested by Owner's Representative, Contractor shall excavate the test pits to a depth and area of sufficient size to allow the inspector to visually inspect the haunch area of the pipe for voids or loose material next to the pipe and to make a field density test. Provide a safety trench shield to protect the inspector while in the pit.
6. After inspection, backfill and compact the test pit area in accordance with the applicable specification herein.
7. Dig one test pit for inspection of each day's work, if deemed necessary, as determined by the Owner's Representative. Repair and replace areas that are found not to be in compliance with the Specification requirements, until satisfactory results are consistently and uniformly attained.
8. Special care should be taken by the Contractor to ensure the backfill material flows under the pipe haunches. The Contractor's method and procedures used to accomplish this will be observed to confirm that adequate results are being achieved. This may require the removal of pipe joints to observe the results and make density tests. Pipe laying shall not begin until satisfactory results are achieved by the Contractor's proposed method. Perform additional tests as directed until compaction meets or exceeds requirements.
 - a. Cost associated with "Failing" tests shall be paid by Contractor.
9. Assure Owner's representative has immediate access for testing of all soils related work.
10. Ensure excavations are safe for testing personnel.

3.8 OWNER TRAINING (NOT USED)

END OF SECTION

12-Inch WL Replacement Across Panther
Branch
SJRA Project No. WDPR0090.1009.2N001

**TRENCHING, BACKFILLING, AND
COMPACTING FOR UTILITIES**

SECTION 31 21 33.01

EXTRA UNIT PRICE WORK FOR EXCAVATION AND BACKFILL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Measurement and payment applicable to extra unit price work items for excavation and backfill made necessary by unusual or unforeseen circumstances encountered during utility installations.
2. Extra unit price work for excavation and backfill is paid only when authorized in advance by Owner or Owner's Representative.

B. Related Specification Sections include, but are not necessarily limited to:

1. Division 00 – Bidding Requirements, Contract Forms, and Conditions of the Contract.
2. Division 01 – General Requirements.

1.2 MEASUREMENT AND PAYMENT

- A. Excavation Around Obstructions: Payment for excavation around obstructions is on cubic yard basis, measured in place, without deduction for volume occupied by portions of pipes, ducts, or other structures left in place across trenches excavated under this item.
- B. Extra Hand Excavation: Payment for extra hand excavation is on cubic yard basis, measured in place.
- C. Extra Machine Excavation: Payment for extra machine excavation is on cubic yard basis, measured in place.
- D. Extra Placement of Backfill Material: Payment for extra placement of backfill material is on cubic yard basis, measured in place, for material installed as part of Work. At discretion of Owner or Owner's Representative, measurement of cubic yards may be calculated from volume of Extra Hand Excavation or Extra Machine Excavation for which replacement is made, minus volume of any Extra Placement of Granular Backfill authorized in conjunction with Work.
- E. Extra Placement of Granular Backfill: Payment for extra placement of granular backfill material is on cubic yard basis, measured in place.
- F. Extra Select Backfill: Payment for extra select backfill is on cubic yard basis, measured in place for a theoretical minimum trench width. The Owner or Owner's Representative may authorize extra select backfill when soil from the excavation work does not include adequate quantities for placement of suitable on-site material (random backfill).
- G. Refer to Section 00 21 00 – Unit Prices for unit price procedures.

1.3 DEFINITIONS

- A. Excavation Around Obstructions: Excavation necessitated by obstruction of pipes (other than service connections 3 inches in diameter or less), ducts, or other structures, not shown on Drawings, and of an unusual or unforeseen nature which interfere with installation of utility piping by normal methods of excavation or auguring.
- B. Extra Hand Excavation: Excavation by manual labor made necessary by unusual or unforeseen circumstances at locations approved in advance by Owner's representative.
- C. Extra Machine Excavation: Excavation by machine at or near project site to perform related work not included in original project scope but added for convenience of Owner, as approved in advance by Owner's representative.
- D. Extra Placement of Backfill Material: Handling, backfill, and compaction of excavated material authorized under extra work bid items for Extra Hand Excavation or Extra Machine Excavation. Placement and compaction shall conform to requirements specified for excavation and backfill in Division 31 – Earthwork.
- E. Extra Placement of Granular Backfill: Hauling, placing, and compacting granular backfill materials as approved by Owner's Representative in conjunction with Extra Placement of Backfill Material. Materials placed under this item shall conform to requirements for Bank Run Sand, Cement Stabilized Sand, Concrete Sand, Gem Sand, Crushed Stone, or Crushed Concrete specified for backfill material in Division 31 - Earthwork.
- F. Extra Select Backfill: Unsuitable material removed from the project and select backfill material hauled to the project, or conditioning unsuitable material on the site to make it select backfill. Provide select backfill material specified in Section 31 21 33 Trenching, Backfilling, and Compacting for Utilities.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 31 32 13.16
CEMENT STABILIZED SAND

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Cement Stabilized Sand
- B. Related Specification Sections include, but are not necessarily limited to:
 - 1. Division 00 – Bidding Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Division 01 – General Requirements.
 - 3. Specification Section is applicable to 03 09 00 and 31 21 33.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Price. No separate payment will be made for this item. Include the cost in associated items for this project.

1.3 REFERENCES

- A. C 33 – Standard Specification for Concrete Aggregates (Fine Aggregate).
- B. C 40 – Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
- C. C 42 – Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
- D. C 94 – Standard Specification for Ready-Mixed Concrete.
- E. C 123 – Standard Test Method for Lightweight Particles in Aggregate.
- F. C 142 – Standard Test Method for Clay Lumps and Friable Particles in Aggregates.
- G. C 150 – Specification for Portland Cement.
- H. D 558 – Standard Test Method for Moisture-Density (Unit Weight) Relations of Soil Cement-Mixtures.
- I. D 1632 – Standard Practice for Making and Curing Soil-Cement Compression and Flexure Test Specimens in the Laboratory.
- J. D 1633 – Standard Test Methods for Compressive Strength of Molded Soil-Cement Cylinders.
- K. D 2487 – Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).

- L. D 6938 – Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- M. D 3665 – Standard Practice for Random Sampling of Construction Materials.
- N. D 4318 – Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

1.4 SUBMITTALS

- A. Conform to requirements of Section 01 33 00 – Submittals.
- B. Submit proposed target cement content and production data for sand-cement mixture in accordance with requirements of Paragraph 2.3, Materials Qualifications.

1.5 DESIGN REQUIREMENTS

- A. Use sand-cement mixture producing minimum unconfined compressive strength of 100 pounds per square inch (psi) in 48 hours containing no less than 2.5 sacks of cement per cubic yard of mixture.
 - 1. Where potable water lines cross wastewater lines, embed wastewater line with cement stabilized sand in accordance with Texas Administrative Code §290.44(e)(4)(B):
 - a. Provide minimum of 10% cement per cubic yard of cement stabilized sand mixture, based on loose dry weight volume. Use at least 2.5 sacks of cement per cubic yard of mixture (2 sacks per ton of dry sand).
 - b. Unless otherwise shown on Drawings, embed wastewater main or lateral minimum of six inches above and below.
 - c. Use brown coloring in cement stabilized sand for wastewater main or lateral bedding for identification of pressure rated wastewater mains during future construction.
- B. Design will be based on strength specimens molded in accordance with ASTM D558 at moisture content within 3 percent of optimum and within 4 hours of batching.

1.6 WARRANTY (NOT USED)

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cement: Type I Portland cement conforming to ASTM C 150.

- B. Sand: Clean, durable sand meeting grading requirements for fine aggregates of ASTM C 33, or requirements for bank run sand of Section 31 23 33 – Trenching, Backfilling, and Compacting for Utilities, and the following requirements:
 - 1. Classified as SW, SP, SW-SM, SP-SM, or SM by United Soil Classification System of ASTM D 2487.
 - 2. Deleterious materials:
 - a. Clay lumps, ASTM C 142; less than 0.5 percent.
 - b. Lightweight pieces, ASTM C 123; less than 5.0 percent.
 - c. Organic impurities, ASTM C 40, color no darker than standard color.
 - 3. Plasticity index of 4 or less when tested in accordance with ASTM D 4318.
- C. Water: Potable water, free of oils, acids, alkalis, organic matter or other deleterious substances, meeting requirements of ASTM C 94.

2.2 MIXING MATERIALS

- A. Add required amount of water and mix thoroughly in pugmill-type mixer.
- B. Stamp batch ticket at plant with time of loading. Reject material not placed and compacted within 4 hours after mixing.

2.3 MATERIAL QUALIFICATION

- A. Determine target cement content of material as follows:
 - 1. Obtain samples of sand-cement mixtures at production facility representing range of cement content consisting of at least three points.
 - 2. Complete molding of samples within 4 hours after addition of water.
 - 3. Perform strength tests (average of two specimens) at 48 hours and 7 days.
 - 4. Perform cement content tests on each sample.
 - 5. Perform moisture content tests on each sample.
 - 6. Plot average 48-hour strength vs. cement content.
 - 7. Record scale calibration date, sample date, sample time, molding time, cement feed dial settings, and silo pressure (if applicable).
- B. Test raw sand for following properties at point of entry into pug-mill:
 - 1. Gradation
 - 2. Plasticity index
 - 3. Organic impurities

4. Clay lumps and friable particles
 5. Lightweight pieces
 6. Moisture content
 7. Classification
- C. Present data obtained in format similar to that provided in sample data form attached to this Section.
- D. The target content may be adjusted when statistical history so indicates. For determination of minimum product performance use formula:

$$f'_c + \frac{1}{2} \text{ standard deviation}$$

PART 3 - EXECUTION

3.1 PLACING

- A. Place sand-cement mixture in maximum 8-inch-thick loose lifts and compact to 95 percent of maximum density as determined in accordance with ASTM D 558, unless otherwise specified. Refer to related specifications for thickness of lifts in other applications. Target moisture content during compaction is ± 3 percent of optimum. Perform and complete compaction of sand-cement mixture within 4 hours after addition of water to mix at plant.
- B. Do not place or compact sand-cement mixture in standing or free water.

3.2 FIELD QUALITY CONTROL

- A. Testing will be performed under provisions of Section 01 45 29 – Testing Laboratory Services.
- B. One sample of cement stabilized sand shall be obtained for each 150 tons of material placed per day with no less than one sample per day of production. Random samples of delivered cement stabilized sand shall be taken in the field at point of delivery in accordance with ASTM 3665. Obtain three individual samples of approximately 12 to 15 pounds each from the first, middle, and last third of the truck and composite them into one sample for test purposes.
- C. Prepare and mold four specimens (for each sample obtained) in accordance with ASTM D 558, Method A, without adjusting moisture content. Samples will be molded at approximately same time material is being used, but no later than 4 hours after water is added to mix.
- D. After molding, specimens will be removed from molds and cured in accordance with ASTM D 1632.

- E. Specimens will be tested for compressive strength in accordance with ASTM D 1633, Method A. Two specimens will be tested at 48 hours plus or minus 2 hours and two specimens will be tested at 7 days plus or minus 4 hours.
- F. A strength test will be average of strengths of two specimens molded from same sample of material and tested at same age. Average daily strength will be average of strengths of all specimens molded during one day's production and tested at same age.
- G. Precision and Bias: Test results shall meet recommended guideline for precision in ASTM D 1633 Section 9.
- H. Reporting: Test reports shall contain, as a minimum, the following information:
 - 1. Supplier and plant number
 - 2. Time material was batched
 - 3. Time material was sampled
 - 4. Test age (exact hours)
 - 5. Average 48-hour strength
 - 6. Average 7-day strength
 - 7. Specification section number
 - 8. Indication of compliance/non-compliance
 - 9. Mixture identification
 - 10. Truck and ticket numbers
 - 11. The time of molding
 - 12. Moisture content at time of molding
 - 13. Required strength
 - 14. Test method designations
 - 15. Compressive strength data as required by ASTM D 1633
 - 16. Supplier Mixture identification
 - 17. Specimen diameter and height, in.
 - 18. Specimen cross-sectional area, sq. in.

3.3 ACCEPTANCE

- A. Strength level of material will be considered satisfactory if:
 - 1. The average 48-hour strength is greater than 100 psi with no individual strength test below 70 psi.

2. All 7-day individual strength tests (average of two specimens) are greater than or equal to 100 psi.
- B. Material will be considered deficient when 7-day individual strength test (average of two specimens) is less than 100 psi, but greater than 70 psi. See Paragraph 3.4 Adjustment for Deficient Strength.
- C. The material will be considered unacceptable and subject to removal and replacement at Contractor's expense when individual strength test (average of two specimens) have 7-day strength less than 70 psi.
- D. When moving average of three daily 48-hour averages falls below 100 psi, discontinue shipment to project until plant is capable of producing material, which exceeds 100 psi at 48 hours. Five, 48-hour strength tests shall be made in this determination with no individual strength tests less than 100 psi.
- E. Testing laboratory shall notify Contractor, Owner's Representative, and material supplier by facsimile of tests indicating results falling below specified strength requirements within 24 hours.
- F. If any strength test of laboratory cured specimen falls below the specified strength, Contractor may, at his own expense, request test of cores drilled from the area in question in accordance with ASTM C42. In such cases, three (3) cores shall be taken for each strength test that falls below the values given in 3.3A.
- G. Cement stabilized sand in an area represented by core tests shall be considered satisfactory if the average of three (3) cores is equal to at least 100 psi and if no single core is less than 70 psi. Additional testing of cores extracted from locations represented by erratic core strength results will be permitted.

3.4 ADJUSTMENT FOR DEFICIENT STRENGTH

- A. When mixture produces 7-day compressive strength greater than or equal 100 pounds per square inch, then material will be considered satisfactory and bid price will be paid in full.
- B. When mixture produces 7-day compressive strength less than 100 pounds per square inch and greater than or equal to 70 pounds per square inch, material shall be accepted contingent on credit in payment. Compute credit by the following formula:

$$\text{Credit per Cubic Yard} = \frac{\$30.00 \times 2 (100 \text{ psi} - \text{Actual psi})}{100}$$

When mixture produces 7-day compressive strength less than 70 pounds per square inch, then remove and replace cement-sand mixture and paving and other necessary work at no cost to the Owner.

3.5 WARRANTY (NOT USED)

END OF SECTION

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SECTION 31 41 00
TRENCH SAFETY SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes

1. Trench safety system for construction of trench excavations. For structural excavations which fall under provisions of State and Federal trench safety laws.
2. Specification Section is applicable to 33 11 13.

B. Related Specification Sections include, but are not necessarily limited to:

1. Division 00 – Bidding Requirements, Contract Forms, and Conditions of the Contract.
2. Division 01 – General Requirements.

1.2 MEASUREMENT AND PAYMENT

A. Unit Price

1. Measurement for trench safety systems used on trench excavations is on a per linear foot basis measured along centerline of trench, including manholes and other line structures.
2. No payment will be made for Trench Safety Systems for structural excavations, tunnel shafts, auger pits, or excavation for trenchless installations under this section. Include payment for Trench Safety Systems in applicable structural or utility installation sections.

1.3 DEFINITIONS

- A. Trench. Narrow excavation (in relation to its depth) made below surface of ground. In general, depth is greater than width, but width of trench (measured at bottom) is not greater than 15 feet.
- B. Trench safety system requirements shall apply to larger open excavations if erection of structures or other installations limits space between excavation slope and installation to dimensions equivalent of a trench as defined.
- C. Trench safety systems include, but are not limited to sloping, sheeting, trench boxes or trench shields, sheet piling, cribbing, bracing, shoring, dewatering or diversion of water to provide adequate drainage. Trench safety system is Contractor's methods and means of construction.
- D. Trench Safety Program is the safety procedures governing the presence and activities of individuals working in and around trench excavations.

1.4 SUBMITTALS

- A. Conform to requirements of Section 01 33 00 – Submittals.
- B. Submit trench safety program specifically for construction of trench excavation. Design trench safety program in accordance with OSHA 29 CFR standards.
- C. Trench safety system and special designs containing deviations from OSHA standards to be sealed by a Professional Engineer registered by State of Texas.
- D. Review of trench safety system by Owner's Representative shall only be in regards to compliance with this specification and shall not constitute approval by Owner's Representative nor relieve Contractor of obligations under State and Federal trench safety laws
- E. Submit certification that trench safety system will not be subjected to loads exceeding those which the system was designed to withstand according to the available construction and geotechnical information. When trench box is used in a manner other than what is indicated and certified in manufacturer's technical data, submit trench box manufacturer certifications of proposed usage.

1.5 REGULATORY REQUIREMENTS

- A. Install and maintain trench safety systems in accordance with detail specifications set out in provision of Excavations, Trenching, and Shoring, Federal Occupation Safety and Health Administration (OSHA) Standards, 29CFR, Part 1926, Subpart P, as amended, including Final Rule, published in Federal Register Vol. 54, No. 209 on October 31, 1989. Sections that are incorporated into these specifications by reference include Sections 1926-650 through 1926-652.
- B. Reproduction of OSHA standards included in "Subpart P - Excavations" from Federal Register Vol. 54, No. 209 is available upon request to Contractors bidding on projects. The Owner assumes no responsibility for accuracy of reproduction. Obtain copy of this section of the Federal Register.
- C. Legislation enacted by Texas Legislature with regard to Trench Safety Systems, is hereby incorporated, by reference, into these specifications. Refer to Texas Health and Safety Code Ann., §756.021 (Vernon 1991).

1.6 INDEMNIFICATION

- A. Contractor to indemnify and hold harmless the Owner and the Owner's Representative, its employees and agents, from any and all damages, costs (including, without limitation, legal fees, court costs, and cost of investigation), judgments or claims by anyone for injury or death of persons resulting from collapse or failure of trenches constructed under this Contract.
- B. Contractor acknowledges and agrees that this indemnity provision provides indemnity for the Owner and the Owner's Representative, its employees and agents, in case the Owner and the Owner's Representative is negligent either

by act or omission in providing for trench safety, including, but not limited to safety program and design reviews, inspections, failures to issue stop work orders, and hiring of Contractor.

1.7 WARRANTY (NOT USED)

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install and maintain trench safety systems in accordance with provisions of OSHA 29 CFR.
- B. Install specially designed trench safety systems in accordance with Contractor's trench excavation safety program for locations and conditions identified in program.
- C. A competent person, as identified in Contractor's Trench Safety Program, to verify that trench boxes and other pre-manufactured systems are certified for actual installation conditions.

3.2 INSPECTION

- A. Contractor, or Contractor's independently retained consultant, to make daily inspections of trench safety systems to ensure that installed systems and operations meet OSHA 29 CFR and other personnel protection regulations requirements.
- B. If evidence of possible cave-ins or slides is apparent, immediately stop work in trench and move personnel to safe locations until necessary precautions have been taken to safeguard personnel entering trench.
- C. Maintain permanent record of daily inspections.

3.3 FIELD QUALITY CONTROL

- A. Verify specific applicability of selected or specially designed trench safety systems to each field condition encountered on project.

3.4 OWNER TRAINING (NOT USED)

END OF SECTION

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SECTION 32 90 00

SEEDING, SODDING AND LANDSCAPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Seeding, sodding and landscape planting:
2. Specification Section is applicable to 01 74 23.
3. Specifier: Delete or modify the following list of work items which do not apply to the project. Include notes about limits of work on Drawings.
 - a. Soil preparation.
 - b. Lawn-type seeding.
 - c. Sodding

B. Related Specification Sections include, but are not necessarily limited to:

1. Division 00 – Bidding Requirements, Contract Forms, and Conditions of the Contract.
2. Division 01 – General Requirements.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Price.** No separate payment will be made for this item. Include the cost in associated items for this project.

1.3 QUALITY ASSURANCE

A. Referenced Standards:

1. American Nursery and Landscape Association/American National Standards Institute (ANLA/ANSI):
 - a. Z60.1 – American Standard for Nursery Stock.
2. AOAC International (AOAC – Association of Official Agricultural Chemists.).
3. ASTM International (ASTM):
 - a. D2028 – Standard Specification for Cutback Asphalt (Rapid-Curing Type).
 - b. D5276 – Standard Test Method for Drop Test of Loaded Containers by Free Fall.

B. Quality Control:

1. Fertilizer:
 - a. If Owner's Representative determines fertilizer requires sampling and testing to verify quality, testing will be done at Contractor's expense, in accordance with current methods of the AOAC.
 - b. Upon completion of Project, a final check of total quantities of fertilizer used will be made against total area seeded.
 - c. If minimum rates of application have not been met, Contractor will be required to distribute additional quantities to make up minimum application specified.

1.4 SUBMITTALS

- A. See Specification Section 01 33 00 – Submittals for requirements for the mechanics and administration of the submittal process.
- B. Product technical data including:
 1. Acknowledgement that products submitted meet requirements of standards referenced.
 2. Manufacturer's installation instructions.
 3. Signed copies of vendor's statement for seed mixture required, stating botanical and common name, place of origin, strain, percentage of purity, percentage of germination, and amount of Pure Live Seed (PLS) per bag.
 4. Type of herbicide to be used during first growing season to contain annual weeds and application rate.
 5. Source and location of sod, plants, and plant material, as per Section 3.2 - Installation and Section 3.3 - Planting Trees, Shrubs, and Ground Covers of this Specification Section.
 6. Certification that each container of seed delivered will be labeled in accordance with Federal and State Seed Laws and equals or exceeds Specification requirements.

1.5 SEQUENCING AND SCHEDULING

- A. Installation Schedule:
 1. Provide schedule showing when trees, shrubs, groundcovers and other plant materials are anticipated to be planted.
 2. Show schedule of when lawn type and other grass areas are anticipated to be planted.
 3. Indicate planting schedules in relation to schedule for irrigation system installation, finish grading and topsoiling.
 4. Indicate anticipated dates Owner's Representative will be required to review installation for initial acceptance and final acceptance.
- B. Pre-installation Meeting:

1. Meet with Owner's Representative and other parties as necessary to discuss schedule and methods, unless otherwise indicated by Owner's Representative.

1.6 WARRANTY (NOT USED)

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS AND SUPPLIERS

- A. Subject to compliance with the Contract Documents, the manufacturers and suppliers listed in the applicable Articles below are acceptable.
- B. Submit request for substitution in accordance with Specification Section 01 25 13 – Product Substitutions.

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2.2 MATERIALS

BOTANICAL AND COMMON NAME	PERCENT BY WEIGHT (PLS)	MINIMUM PERCENT GERMINATION	MINIMUM PERCENT PURITY
Kentucky Bluegrass (Poa pratensis)	60	85	95
Fescue, Tall, KY 31 (Festuca arundinacea 'KY 31')	30	85	98
Ryegrass, Perennial (Lolium perenne)	10	90	95

- A. Asphalt Binder: Emulsified asphalt per State specifications.
- B. Water:
 - 1. Water free from substances harmful to grass or sod growth.
 - 2. Provide water from source approved prior to use.

PART 3 - EXECUTION

3.1 SOIL PREPARATION

- A. General:
 - 1. Limit preparation to areas which will be planted soon after.
 - 2. Provide facilities to protect and safeguard all persons on or about premises.
 - 3. Protect existing trees designated to remain.
 - 4. Verify location and existence of all underground utilities.
 - a. Take necessary precaution to protect existing utilities from damage due to construction activity.
 - b. Repair all damages to utility items at no cost to Owner.
 - 5. Provide facilities such as protective fences and/or watchmen to protect work from vandalism.
 - a. Contractor to be responsible for vandalism until acceptance of work in whole or in part.
- B. Preparation for Lawn-Type Seeding, Sprigging, Plugging or Sodding:
 - 1. Loosen surface to minimum depth of 4 IN.

2. Remove stones over 1 IN in any dimension and sticks, roots, rubbish, and other extraneous matter.
3. Prior to applying fertilizer, loosen areas to be seeded with a double disc or other suitable device if the soil has become hard or compacted.
4. Correct any surface irregularities in order to prevent pocket or low areas which will allow water to stand.
5. Distribute fertilizer uniformly over areas to be seeded:
 - a. For lawn-type seeding: 30 LBS per 1000 SF.
 - b. For pasture seeding: 200 LBS per acre.
6. Incorporate fertilizer into soil to a depth of at least 2 IN by disking, harrowing, or other approved methods.
7. Remove stones or other substances from surface which will interfere with turf development or subsequent mowing operations.
8. Grade lawn areas to a smooth, even surface with a loose, uniformly fine texture.
 - a. Roll and rake, remove ridges and fill depressions, as required to meet finish grades.
 - b. Limit fine grading to areas which can be planted soon after preparation.
9. Restore lawn areas to specified condition if eroded or otherwise disturbed after fine grading and before planting.
10. Spread limestone uniformly over designated areas at a rate of 100 LBS per 1000 SF.
11. Distribute fertilizer as specified uniformly over areas to be seeded at a rate of 12 LBS per 1000 SF.

3.2 INSTALLATION

A. Lawn-Type and Pasture Seeding:

1. Do not use seed which is wet, moldy, or otherwise damaged.
2. Perform seeding work from April 20 to May 15 for spring planting, and August 1 to September 15 for fall planting, unless otherwise approved by Owner's Representative.
3. Employ satisfactory methods of sowing using mechanical power-driven drills or seeders, or mechanical hand seeders, or other approved equipment.
4. Distribute seed evenly over entire area at rate of application not less than 4 LBS (PLS) of seed per 1000 SF, 50 percent sown in one direction, remainder at right angles to first sowing.
5. Stop work when work extends beyond most favorable planting season for species designated, or when satisfactory results cannot be obtained because of drought, high winds excessive moisture, or other factors.

- a. Resume work only when favorable conditions develop.
6. Lightly rake seed into soil followed by light rolling or cultipacking.
7. Immediately protect seeded areas against erosion by mulching.
 - a. Spread mulch in continuous blanket using 1-1/2 tons per acre to a depth of 4 or 5 straws.
8. Protect seeded slopes against erosion with erosion netting or other methods approved by Owner's Representative.
 - a. Protect seeded areas against traffic or other use by erecting barricades and placing warning signs.
9. Immediately following spreading mulch, anchor mulch using a rolling coulter or a wheatland land packer having wheels with V-shaped edges to force mulch into soil surface, or apply evenly distributed emulsified asphalt at rate of 10-13 GAL/1000 SF.
 - a. SS-1 emulsion in accordance with ASTM D5276 or RC-1 cutback asphalt in accordance with ASTM D2028 are acceptable.
 - b. If mulch and asphalt are applied in one treatment, use SS-1 emulsion with penetration test range between 150-200.
 - c. Use appropriate shields to protect adjacent site improvements.

3.3 PLANTING TREES, SHRUBS, AND GROUND COVERS

A. Notification:

1. Notify Owner's Representative of source of plants and plant materials at least 30 days prior to planting to permit Owner's Representative inspection of source qualifications.

B. Preparation:

1. Handle plants so that roots or balls are adequately protected from breakage of balls, from sun or drying winds.
 - a. Ensure tops or roots of plants are not permitted to dry out.
2. During transportation, protect materials from wind and sun to prevent tops and roots from drying out.
3. Protect tops of plants from damage. Plants with damaged tops will be rejected.
4. For purpose of inspection and planting identification, attach durable, legible labels to bundle or container of plant material delivered at the planting site. State correct plant name and size of each plant in weather-resistant ink on labels.
5. Do not prune trees and shrubs at nursery.

C. Planting Season:

1. Plant deciduous shade trees and shrubs any time the ground is suitable between October 15 and June 1.
2. Plant evergreen material between September 1 and June 1.
3. Plant ground covers between March 15 to June 1.

D. Planting Procedure:

1. Indicate locations of plants for approval by Owner's Representative before excavating plant locations.
2. In event underground construction, utilities, obstructions, or rock are encountered in excavation of plantings, secure alternate locations from Owner's Representative
 - a. Make said changes without additional compensation.
 - b. Where tree locations fall under existing overhead wires, or crowd existing trees, adjust locations as directed by Owner's Representative.
3. Excavate pits and beds as necessary and in accordance with ANLA/ANSI Z60.1.
 - a. Loosen bottom of pits prior to planting.
 - b. Excavation is unclassified; excavate all materials without additional cost.
4. Tree and shrub pits to be circular in shape with vertical sides at least 1 FT greater in diameter than ball diameter.
 - a. Pit to be of sufficient depth to provide 6 IN of planting soil under ball when set to natural grade.
5. Shrub and ground cover beds:
 - a. Plant shrubs used in mass plantings in individual holes of required size.
 - b. Strip all sod from among mass planting.
 - c. For ground cover beds, remove sod from within limits of bed.
 - d. Add soil amendments as specified and mix or rototill with existing topsoil to a depth of 6 IN.
6. Set plants straight or plumb, in locations when indicated and at such level that after settlement they bear same relationship to finished grade as they did in their former setting.
 - a. Carefully tamp planting soil under and around base of balls to prevent voids.
 - b. Remove burlap, rope and wires from top of balls.
 - c. Do not remove burlap from sides and bottom of balls.

7. Backfill plants with planting soil.
 - a. Tamp to 1/2 depth of pit and thoroughly water and puddle before bringing backfill to proper grade.
 - b. After planting has been completed, flood pit again so that backfill is thoroughly saturated and settled.
8. After planting is complete, form a level saucer 3 IN high around each tree extending to limit of plant pit for watering purposes.
9. Mulch plant pit after saucer has been shaped.
 - a. Mulch to limits of pit and uniformly over ground cover beds to a depth of 3 IN.
 - b. In mass plantings of shrubs, mulch entire area uniformly among shrubs to a depth of 3 IN.
 - c. If mulching is delayed and soil has dried out, water plants thoroughly before spreading mulch.
10. Staking: Stake trees immediately after planting as detailed on Drawings or in accordance with Nursery Standards.
11. Wrap deciduous trees 2 IN or more in caliper by neatly overlapping wrapping material between ground line and second branch. Place ties at top and bottom of wrapping material and not more than 12 IN apart between top and bottom ties.
12. Remove dead or damaged branches.
 - a. Thin deciduous material to about two-thirds of initial branching.
 - b. Remove only dead or damaged branches from evergreens.
13. Water plants during planting operations.
 - a. Water each plant a minimum of once each week until final acceptance.
 - b. Apply sufficient water to moisten backfill about each plant so that moisture will extend into the surrounding soil.

3.4 MAINTENANCE AND REPLACEMENT

A. General:

1. Begin maintenance of planted areas immediately after each portion is planted and continue until final acceptance or for a specific time period as stated below, whichever is the longer.
2. Provide and maintain temporary piping, hoses, and watering equipment as required to convey water from water sources and to keep planted areas uniformly moist as required for proper growth.
3. Protection of new materials:

- a. Provide barricades, coverings or other types of protection necessary to prevent damage to existing improvements indicated to remain.
 - b. Repair and pay for all damaged items.
4. Replace unacceptable materials with materials and methods identical to the original specifications unless otherwise approved by the Owner's Representative.

B. Seeded or Sodded Lawns:

1. Maintain seeded lawns: 90 days, minimum, after installation and review of entire project area to be planted.
2. Maintenance period begins at completion of planting or installation of entire area to be seeded or sodded.
3. Owner's Representative will review seeded or sodded lawn area after installation for initial acceptance.
4. Maintain lawns by watering, fertilizing, weeding, mowing, trimming, and other operations such as rolling, regrading, and replanting as required to establish a smooth, uniform lawn, free of weeds and eroded or bare areas.
5. Lay out temporary lawn watering system and arrange watering schedule to avoid walking over muddy and newly seeded areas.
 - a. Use equipment and water to prevent puddling and water erosion and displacement of seed or mulch.
6. Mow lawns as soon as there is enough top growth to cut with mower set at recommended height for principal species planted.
 - a. Repeat mowing as required to maintain height.
 - b. Do not delay mowing until grass blades bend over and become matted.
 - c. Do not mow when grass is wet.
 - d. Time initial and subsequent mowings as required to maintain a height of 1-1/2 to 2 IN.
 - e. Do not mow lower than 1-1/2 IN.
7. Remulch with new mulch in areas where mulch has been disturbed by wind or maintenance operations sufficiently to nullify its purpose.
 - a. Anchor as required to prevent displacement.
8. Unacceptable plantings are those areas that do not meet the quality of the specified material, produce the specified results, or were not installed to the specified methods.
9. Replant bare areas using same materials specified.

10. Owner's Representative will review final acceptability of installed areas at end of maintenance period.
11. Maintain repaired areas until remainder of maintenance period or approved by Owner's Representative, whichever is the longer period.

3.5 OWNER TRAINING (NOT USED)

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SECTION 32 92 13
HYDRO-MULCHING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Seeding, fertilizing, mulching, and maintenance of areas indicated on Drawings.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 – Bidding Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Division 01 – General Requirements.
 - 3. Section 32 90 00 – Seeding, Sodding, and Landscaping.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Price. No separate payment will be made for this item. Include the cost in associated items for this project.

1.3 SUBMITTALS

- A. Conform to requirements of Section 01 33 00 – Submittals.
- B. Submit certification from supplier that each type of seed conforms to these specifications and requirements of Texas Seed Law. Certification shall accompany seed delivery.
- C. Submit certificate stating that fertilizer complies with these specifications and requirements of Texas Fertilizer Law.

1.4 WARRANTY (NOT USED)

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Seed: Conform to U.S. Department of Agriculture rules and regulations of Federal Seed Act and Texas Seed Law. Seed shall be certified 90 percent pure and furnish 80 percent germination and meet following requirements:
 - 1. Rye: Fresh, clean, Italian rye grass seed (*lollium multi-florum*), mixed in labeled proportions. As tested, minimum percentages of impurities and germination must be labeled. Deliver in original unopened containers.

2. Bermuda: Extra-fancy, treated, lawn type common bermuda (*Cynodon dactylon*). Deliver in original, unopened container showing weight, analysis, name of vendor, and germination test results.
3. Wet, moldy, or otherwise damaged seed will not be accepted.
4. Seed requirements, application rates, and planting dates are:

TYPE	APPLICATION RATE POUNDS/A	PLANTING DATE
Hulled Common Bermuda Grass 98/88	40	Jan 1 to Mar 31
Unhulled Common Bermuda Grass 98/88	40	
Hulled Common Bermuda Grass 98/88	40	Apr 1 to Sep 30
Hulled Common Bermuda Grass 98/88	40	Oct 1 to Dec 31
Unhulled Common Bermuda Grass 98/88	40	
Annual Rye Grass (Gulf)	30	

- B. Fertilizer: Dry and free flowing, inorganic, water soluble commercial fertilizer, which is uniform in composition. Deliver in unopened containers which bear manufacturers guaranteed analysis. Caked, damaged, or otherwise unsuitable fertilizer will not be accepted. Fertilizer shall contain minimum percentages of following elements:
1. Nitrogen: 10 Percent
 2. Phosphoric Acid: 20 Percent
 3. Potash: 10 Percent
- C. Mulch:
1. Virgin wood cellulose fibers from whole wood chips having minimum of 20 percent fibers 0.42 inches in length and 0.01 inches in diameter.
 2. Cellulose fibers manufactured from recycled newspaper and meeting same fiber content and size as for cellulose fibers from wood chips.
 3. Dye mulch green for coverage verification purposes.
- D. Soil Stabilizer: "Terra Tack 1" or approved equal.
- E. Weed control agent: Pre-emergent herbicide for grass areas, such as "Benefin," or approved equal.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Place and compact topsoil in accordance with requirements of Section 32 91 05 – Topsoiling and Finished Grading.
- B. Dispose of objectionable and waste materials in accordance with Section 01 74 19 – Construction Waste Management and Disposal.

3.2 APPLICATION

- A. Seed: Apply uniformly at rates given in Paragraph 2.1 B for type of seed and planting date.
- B. Fertilizer: Apply uniformly at rate of 500 pounds per acre.
- C. Mulch: Apply uniformly at rate of 50 pounds per 1,000 square feet.
- D. Soil Stabilizer: Apply uniformly at rate of 40 pounds per acre.
- E. Weed Control Agent: Apply at manufacturer's recommended rate prior to hydro mulching.
- F. Sod: Lay single row of sod along perimeter where top soil and pavement intersect. Apply in conformance to Section 32 90 00 – Seeding, Sodding, and Landscaping.
- G. Suspend operations under conditions of drought, excessive moisture, high winds, or extreme or prolonged cold. Obtain Owner's representative approval before resuming operations.

3.3 MAINTENANCE

- A. Maintain grassed areas minimum of 90 days, or as required to establish acceptable growth. For areas seeded in fall, continue maintenance following spring until acceptable lawn is established.
- B. Maintain grassed areas by watering, fertilizing, weeding, and trimming.
- C. Repair areas damaged by erosion by regrading, rolling, and replanting.
- D. Reseed small, sparse grass areas. When sparse areas exceed 20 percent of planted area, reseed by hydro mulch.
- E. Mow grass when height reaches 3½ inches or greater on average before final acceptance. Mow to height of 2½ inches.

3.4 OWNER TRAINING (NOT USED)

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SECTION 33 05 23.13

WATER LINE HORIZONTAL DIRECTIONAL DRILLING

Part 1 - GENERAL

1.1 SUMMARY

- A. Section includes
 - 1. Methods and materials for installing water mains by the horizontal directional drilling (HDD).
- B. Related Specifications Sections include, but are not necessarily limited to:
 - 1. Division 00 – Proposing Requirements, Contract Forms, and conditions of the Contract.
 - 2. Division 01 – General Requirements
 - 3. Section 31 21 33 – Trenching, Backfilling, and Compacting for Utilities.
 - 4. Section 33 11 12.01 – Fusible PVC Pipe.
 - 5. Section 33 11 15 – High Density Polyethylene (HDPE) Solid and Profile Wall Pipe.
 - 6. Section 33 11 13 – Water Main Construction.
 - 7. Section 33 11 13.04 – Hydrostatic Testing of Pipelines.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Price. No separate payment will be made for this item. Include the cost in associated items for this project.
 - 1. See Section 33 11 13 – Water Main Construction for payment of waterlines constructed by trenchless methods (including horizontal directional drilling).

1.3 DEFINITIONS

- A. Work Plan: Written description, together with supporting documentation that defines plans and procedures for tunnel method operations which will allow the Owner's Representative and the Engineer to verify the proposed method will meet the requirements of the Drawings and Specifications.
- B. Contractor's Engineer: Professional Engineer licensed in the State of Texas employed or subcontracted by the Contractor to prepare designs on behalf of the Contractor

1.4 REFERENCE STANDARDS

- A. The publications listed below form a part of this specification to extent referenced. Publications are referred to in the text by abbreviations only:
 - 1. American National Standards Institute (ANSI)
 - a. ANSI B16.1 Cast-Iron Pipe Flanges and Flanged Fittings

2. ASTM International (ASTM):
 - a. ASTM A240 – Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate Sheet and Strip for Pressure Vessels and for General Applications
3. American Petroleum Institute
 - a. API Spec. 13A, Specification for Oil Well Drilling Fluids
4. NSF National Sanitation Foundation
 - a. NSF Standard 61 – Drinking Water System – Health Components
5. American Association of State Highway and Transportation Officials (AASHTO). Load and Resistance Factor Bridge Design Specification
6. American Railway Engineering and Maintenance-of-Way Association (AREMA) Manual for Railway Engineering

1.5 REGULATORY REQUIREMENTS

- A. Conform to TxDOT requirements for installations under State Highways.
- B. Installations Under Railroads:
 1. Secure and comply with requirements of right-of-entry for crossing railroad company's easement or right-of-way from railroad companies affected. Comply with railroad permit requirements.
 2. Damages due to delays caused by railroad requesting work to be done at hours which will not inconvenience railroad will be at no additional cost to Owner.
 3. Maintain equipment and excavations minimum 35-foot clearance from centerline of tracks.

1.6 SUBMITTALS

- A. Conform to requirements of 01 33 00 – Submittals.
- B. Work Plan: Submit a work plan for work covered under this section. Work Plan shall describe common items of work for all sites on this project and specific items of work for each particular work site if substantially different conditions exist. The contractor may request changes to the proposed vertical and horizontal alignment of the installation and the location of the entry and exit points. Proposed changes shall be submitted in the Work Plan and must receive written approval prior to construction. If the proposed entry point is within an easement, it must remain wholly within the easement and the pipeline route and exit must remain in the easement shown on the construction drawings. Contractor shall not commence work on items described in Contractor's Work Plan until submittals have been reviewed. Review by the Owner's Representative and Engineer shall not be construed to relieve Contractor of any responsibilities under Contract. All structural designs and other engineered components prepared by the Contractor must be designed, signed and sealed by the Contractor's Engineer

1. Include written description identifying details of proposed method of construction and sequence of operations to be performed to demonstrate the proposed materials and procedures will meet requirements of the Drawings and Specifications
2. Include arrangement drawings and technical specifications of equipment to be used and a list of experience (projects with similar size and scope) with this type of equipment and method for both Contractor and proposed operator. Include description of method for accurately monitoring location of pilot bore throughout bore using electronic detection system. Electronic detection equipment must be capable of achieving accuracy within 0.1 feet at all points throughout bore..
3. Include Fusion Technician qualifications and fusing procedures.
4. Include Boring Technicians qualifications and experience record
5. Include a plan and profile drawing at 1"= 40' horizontal and 1"= 4' vertical scale for each trenchless location that indicates the pit/shaft or entrance and exit locations, stationing and elevation of the beginning and end of the carrier pipe and casing (if applicable). Include on the plan and profile, locations and elevations of existing utilities and lines from the Critical Location Report (See Section 31 21 33 – Trenching, Backfilling, and Compacting for Utilities) and other utilities as on the Drawings or as located in the field and the elevations of the proposed pipe or casing at each of the utility locations. The proposed vertical and horizontal clearances between the bored pipe and any existing/proposed conflicting pipes, conduits or obstructions cannot exceed the guidance system accuracy tolerance by a minimum of 100%.
6. Address the location of the drill rig setups and for multiple bores, the lengths of each bore based on soil condition, equipment used, topography, etc
7. Include layout and design details of any proposed access pits or shafts (if applicable) including dimensions and elevations with respect to the pipe and casing installation.
8. Drill Path Design: Show finished grade, deflection and radiuses of the pilot bore.
9. Include a installation plan with a sequence of operations, number and duration of shifts planned to be worked each day, description of the noise reduction program, solids control plan, pilot hole drilling plan, the reaming operation, method for insertion of the pipe into the opened bore hole. This plan shall also include pullback procedure, ballasting, use of rollers, side booms and side rollers, coating protection, internal cleaning, internal gauging, hydrostatic tests, dewatering, purging, and disinfection prior to placing pipe in service.
10. Include data on pipe materials to be used (from the specified approved options for pipe materials) and data on casing materials including diameter and thickness of casings.

- a. Provide joining details for casings sections (if applicable).
 - b. Provide details for joining pipe used for trenchless construction to pipe used for open cut construction, if different materials are proposed.
 - c. Pipe Size.
 - d. Dimensionality.
 - e. Pressure Class per applicable standard.
 - f. Color.
 - g. Recommended minimum bending radius.
 - h. Recommended maximum safe pulling force and controls that help not exceed that force.
11. Include a drilling fluid plan which details types of drilling fluids, cleaning and recycling equipment, estimated flow rates, and procedures for minimizing drilling fluid escape.
 12. Include description of the method of controlling line and grade of excavation and the reference points used to check line and grade for each site.
 13. Include description of muck and fluid removal methods, including type of equipment and method of soil transportation and storage type and number and locations of disposal sites.
 14. Include ground water control system details in accordance with Section 01 57 23.02 – Control of Ground Water and Surface Water (if applicable).
 15. Include monitoring plan describing monitoring to assess and detect and record ground settlement or movement. Monitoring plans are not required for pipes or casings less 100 feet in length or less than 6 inches in diameter unless required by a railroad or TxDOT or other agency permit. Plan to indicate location of proposed monitoring points and initial survey readings.
 16. Include any additional Geotechnical Investigation the Contractor performs at his own expense to adequately assess the sub surface conditions
 17. Include description of any special activities at utility crossings or potentially affecting other facilities where special precautions must be taken during construction.
- C. Post construction submittals shall contain at least the following:
1. As-built plan and profile of installed water line with located fittings, bends, and appurtenances at 1"= 40' horizontal and 1"= 4' vertical scale.
 2. Fusion joint documentation containing the following:
 - a. Pipe size and thickness installed.
 - b. Machine identification and size
 - c. Fusion Technician identification.

- d. Job identification.
- e. Fusion joint number.
- f. Fusion, heating and drag pressure setting.
- g. Heat plate temperature.
- h. Time stamp indicating time of day and date for fusion and for installation.
- i. Heating and cool down time of fusion.
- j. Ambient temperature.
- k. Daily reports of HDD operations.

1.7 DESIGN CRITERIA

- A. Contractor is responsible for design of horizontal directional drilling system and meeting the minimum criteria provided in the Contract Drawings and these specifications. Contractor's Engineer to design for appropriate loading conditions, including, but not limited to: overburden and lateral earth pressures, handling and installation stresses, loads imposed by horizontal drilling operations, subsurface soil and water loads, and all other conditions of service.
- B. If HDD is permitted by the railroad, use Cooper E-80 locomotive loading distributions in accordance with AREMA specifications for criteria at railroad crossings or other loadings in accordance with permit. Account for additive loadings for multiple tracks in design, if applicable.
- C. If HDD is permitted by TxDOT, use HL93 vehicle loading distributions for truck loading criteria in accordance with AASHTO.
- D. Compatibility of Methods: Use HDD methods that are compatible with the balance of the project and restrictions on work, such as influence on existing installations or potential groundwater contamination.

1.8 QUALIFICATIONS

- A. Directional drilling and pipe installation shall be done only by an experienced personnel or subcontractor specializing in directional drilling and whose key personnel have at least five (5) years experience in HDD work. Personnel or HDD subcontractor shall have installed directionally drilled pipe at least as large as the size of pipe being installed in this contract and, have performed installations at least as long as the pipe being installed in this contract.
- B. Fusion Technician shall be fully qualified by the pipe supplier to install fusible pipe of the type and size being used. Qualification shall be current as of the actual date of fusion performance on the project.

1.9 WARRANTY (NOT USED)

Part 2 - PRODUCTS

2.1 MATERIALS

A. Pipe materials

1. Unless a specific pipe material is indicated on the Drawings the Contractor shall select from the allowable pipe materials listed in the Sections below based on the requirements of the Work and his construction means and methods. Only one type of pipe material may be used from the material alternates allowed. Contractor is responsible to ensure type of pipe selected and resulting methods and means comply with requirements and limitations set forth herein and on Drawings.
 - a. Section 33 11 12.01 – Fusible Polyvinyl Chloride (PVC) Pipe
 - b. Section 33 11 15 – High Density Polyethylene (HDPE) Solid and Profile Wall Pipe
2. Pipe Manufacturer: Selected manufacturer performance history shall be minimum 5 years of successful field installations with proposed pipe diameter and proposed type of pipe joint.
3. Pipe Material standards: Conform to American National Standards Institute/National Sanitation Foundation (ANSI/NSF) Standard 61 and have certified by an organization accredited by ANSI.
4. Coordinating pipe materials with other contractors and differing pipe materials:
5. When Contractor's selected pipe material joins to pipes of different material and/or different coatings to be constructed by others, Contractor shall request the Owner's representative to identify the type of pipe in the adjoining contract.
 - a. If the adjoining contract is scheduled to complete the adjoining waterline first, Contractor shall provide an approved connection with insulating kit and isolation test station at no additional cost to the Owner.
 - b. If Contractor's pipe is scheduled to complete first the other contractor will provide the insulating kit and isolation test station.

Part 3 - EXECUTION

3.1 ALIGNMENT

- A. The proposed plan and profile installation locations are based on alignments to accommodate acquired easements, to avoid obstructions, and to properly maintain operation flow velocities.

3.2 PROCEDURES

- A. All pipe shall be cut, fabricated, and installed in strict conformance with the pipe manufacturer's recommendations.

- B. Joining, laying, and pulling of the pipe shall be accomplished by personnel experienced in working with the selected pipe material.
- C. The pipe supplier shall certify in writing that the Contractor is qualified to join the pipe or representative of the pipe manufacturer shall be on site to oversee the pipe joining. Expense for the representative shall be paid for by the Contractor.

3.3 HANDLING PIPE

- A. All of the pipe supplier's guidelines shall be followed for handling the pipe.
- B. The handling of the joined pipeline shall be in such a manner that the pipe is not damaged by dragging it over sharp and cutting objects.
- C. Ropes, fabric, or rubber protected slings and straps shall be used when handling pipes.
- D. Chains, cables, or hooks inserted into the pipe ends shall not be used.
- E. Two slings spread apart shall be used for lifting each length of pipe.
- F. Pipe or fittings shall not be dropped onto rocky or unprepared ground.
- G. Slings for handling the pipeline shall not be positioned at butt-fused joints
- H. Sections of the pipes with cuts and gouges exceeding 10 percent of the pipe wall thickness or kinked sections shall be removed and the ends rejoined.
- I. The open ends of all sections of joined and/or installed pipe (not in service) shall be plugged at night to prevent animals or foreign material from entering the pipe line or pipe section.
- J. Waterproof nightcaps of approved design may be used but they shall also be so constructed that they will prevent the entrance of any type of natural precipitation into the pipe and will be fastened to the pipe in such a manner that the wind cannot blow them loose.
- K. Stuffing cloth or paper in the open ends of the pipe is unacceptable.
- L. Where possible, the pipe shall be raised and supported at a suitable distance back from the open end such that the open end will be below the level of the pipe at the point of support.

3.4 INSTALLATION

- A. The Contractor shall install the pipelines by means of horizontal directional drilling. The Contractor shall assemble, support, and pretest the pipeline prior to installation in the directional drill tunnel.
- B. Horizontal directional drilling shall consist of the drilling of a small diameter pilot hole from one end of the alignment to the other, followed by enlarging the hole diameter for the pipeline insertion. The exact method and techniques for completing the directionally drilled installation shall be determined by the Contractor, subject to the requirements of these Specifications.

- C. The Contractor shall prepare and submit a plan to the Engineer for approval for insertion of the pipe into the opened bore hole. This plan shall include pullback procedure, ballasting, use of rollers, side booms and side rollers, coating protection, internal cleaning, internal gauging, hydrostatic tests, dewatering, purging, and disinfection prior to placing pipe in service.
- D. Size drilling and relief pits to provide adequate room to meet operational requirements for horizontal drilling requirements as well as structures indicated on Drawings. Provide minimum 6-inch space between pipe and walls of drilling and relief pits. Maximum allowable width of drilling and relief pits shall be 5 feet. Width of pit at surface shall not be less than at bottom. Maximum allowable length of drilling pit shall be no more than 5 feet longer than one full section of pipe and shall not exceed 25 feet. Maximum allowable length of relief pit shall be 5 feet.
- E. Do not install drilling and relief pits at street intersection between curb returns.
- F. Replace sidewalks, driveways and, pavement removed for relief pits according to local jurisdiction agency requirements and specification Section 33 11 13 – Water Main Construction.
- G. Provide tees and plugs installed in piping subject to internal hydrostatic heads with suitable anchors, joint harnesses, or other acceptable means of preventing movement of pipe caused by internal pressure. Installation shall be completed so that joints are accessible for repair.
- H. Backfill and compact excavations, including relief pits, in accordance with Specification Section 31 21 33 – Trenching, Backfilling, and Compacting for Utilities.

3.5 DRILLING OPERATIONS

- A. The Contractor shall prepare a plan to be submitted for Engineer approval which describes the noise reduction program, solids control plan, pilot hole drilling procedure, the reaming operation, and the pullback procedure. All drilling operations shall be performed by supervisors and personnel experienced in horizontal directional drilling. All required support, including drilling tool suppliers, survey system, mud cleaning, mud disposal, and other required support systems used during this operation shall be provided by the Contractor.
- B. Drill pipe shall be API steel drill pipe, Range 2, Premium Class or higher, Grade S-135 in a diameter sufficient for the torque and longitudinal loads and fluid capacities required for the work. Only drill pipe inspected under API's Recommended Practice Specification API RP 7G within 30 days prior to start and certified as double white band or better shall be used.
- C. A smooth drilled pilot hole shall follow the design centerline of the pipe profile and alignment described on the construction drawings.

- D. The position of the drill string shall be monitored by the Contractor with the downhole survey instruments. Contractor shall compute the position in the X, Y, and Z axis relative to ground surface from downhole survey data a minimum of once per length of each drilling pipe (approximately 31 foot interval). Deviations from the acceptable tolerances described in the Specifications shall be documented and immediately brought to the attention of the Engineer for discussion and/or approval. The profile and alignment defined on the construction drawings for the bores define the minimum depth and radius of curvature. At no point in the drilled profile shall the radius of curvature of the bore be less than 600 feet. The Contractor shall maintain and provide the Engineer, upon request, the data generated by the downhole survey tools in a form suitable for independent calculation of the pilot hole profile.
- E. Where ground surface access is available the Contractor shall provide and use a separate steering system employing a ground survey grid system, such as "TRU-TRACKER" or equal wherever possible. The exit point shall fall within a rectangle 5 feet wide and 10 feet long centered on the planned exit point.
- F. During the entire operation, waste and leftover drilling fluids from the pits and cuttings shall be dewatered and disposed of in accordance with all permits and regulatory agencies requirements. Remaining water shall be cleaned by Contractor to meet permit requirements.
- G. Technical criteria for bentonite shall be as given in API Spec. 13A, Specification for Oil Well Drilling Fluids Material for fresh water drilling fluids. Any modification to the basic drilling fluid involving additives must describe the type of material to be used and be included in Contractor's drilling plan presented to the Engineer. The Owner retains the right to sample and monitor the waste drilling mud, cuttings, and water.
- H. Location and protection of underground utilities:
1. Correct location of all underground utilities that may impact the HDD installation is the responsibility of the Contractor, regardless of any locations shown on the drawings or previous surveys completed.
 2. Utility location and notification services shall be contacted by the Contractor prior to the start of construction.
 3. All existing lines and underground utilities shall be positively identified, including exposing those facilities that are located within an envelope of possible impact of HDD installation as determined for the project specific site conditions.

3.6 JOINING PIPE SECTIONS

- A. Each length of pipe shall be inspected and cleaned as necessary to be free of debris immediately prior to joining.
- B. Pipes shall be joined to one another by means of thermal butt-fusion. Pipe lengths to be joined by thermal butt-fusion shall be of the same type, grade, and class of compound and supplied from the same raw material supplier.

- C. Each fusion joint shall be recorded and logged by an electronic monitoring device (data logger) connected to the fusion machine. Data not logged by the data logger shall be logged manually and be included in the Fusion Technician's joint report.
- D. Other equipment specifically required for the fusion process shall include the following:
 - 1. A weather protection canopy that allows full machine motion of the heat plate, fusion assembly and carriage shall be provided for fusion in inclement, extreme temperatures, and /or windy weather, per the pipe supplier's recommendations.
 - 2. Fusion machine operations and maintenance manual shall be kept with the fusion machine at all times.
- E. Mechanical connections of the pipe to auxiliary equipment shall be through flanged connections which shall consist of the following:
 - 1. A "sub end" shall be thermally butt-fused to the ends of the pipe.
 - 2. Provide ASTM A240, Type 304 stainless steel backing flange, 125-pound, ANSI B16.1 standard, and gaskets as required by the manufacturer.
 - 3. Stainless steel bolts and nuts of sufficient length to show a minimum of three complete threads when the joint is made and tightened to the manufacturer's standard. Re-torque the nuts after four (4) hours.
 - 4. Butt-Fusion Joining: Butt fusion of pipes shall be performed in accordance with the manufacturer's recommendations as to equipment and technique. Butt-fusion joining shall be 100 percent efficient offering a joint weld strength equal to or greater than the tensile strength of the pipe.
- F. Inner beads resulting from the butt-fuse operations shall be removed using the Pipe Manufacturer's approved bead trimmer equipment.

3.7 REAM AND PULLBACK

- A. Reaming: Reaming operations shall be conducted to enlarge the pilot after acceptance of the pilot bore. The number and size of reaming operations shall be conducted at the discretion of the Contractor. In the event of a drilling fluid fracture, returns loss or other loss of drilling fluid, the Contractor shall be responsible for restoring any damaged property to original condition and cleaning up the area in the vicinity of the damage or loss.
- B. Pulling Loads: The maximum allowable pull exerted on the pipelines shall be measured continuously and limited to 90 percent of the maximum allowed by the pipe manufacturer so that the pipe or joints are not over stressed.
- C. Torsion and Stresses: A swivel shall be used to connect the pipeline to the drill pipe to prevent torsional stresses from occurring in the pipe.
- D. The lead end of the pipe shall be closed during the pullback operation.

- E. Pipeline Support: The pipelines shall be adequately supported by rollers and side booms and monitored during installation so as to prevent over stressing or buckling during the pullback operation. Such support/rollers shall be spaced at a maximum of 60 feet on centers, and the rollers to be comprised of a non-abrasive material arranged in a manner to provide support to the bottom and bottom quarter points of the pipeline allowing for free movement of the pipeline during pullback. Surface damage shall be repaired by the Contractor before pulling operations resume.
- F. The Contractor shall at all times handle the pipe in a manner that does not over stress the pipe. Vertical and horizontal curves shall be limited so that wall stresses do not exceed 50 percent of yield stress for flexural bending of the pipe. If the pipe is buckled or otherwise damaged, the damaged section shall be removed and replaced by the Contractor at his expense. The Contractor shall take appropriate steps during pullback to ensure the pipe will be installed without damage.
- G. Once pull-back operations have commenced, the operation shall continue without interruption until the pipe is completely pulled through the bore hole.

3.8 TESTING

- A. The pipe shall be hydrostatically tested after joining into continuous lengths prior to installation and again after installation. Pressure and temperature shall be monitored with certified instruments during the test. After this test, the water shall be removed with pigs. Erosion prevention procedures shall be used during removal and discharge of the water.
- B. Hydrostatic testing shall be performed in accordance with Section 33 11 13.04 – Hydrostatic Testing of Pipelines, and in accordance with the pipe manufacturer's recommendations and this Specification.
- C. Test pipe with a minimum pressure of 150 psi or the rated working pressure of the pipe, whichever is greater. The initial pressure test shall be applied and allowed to stand without makeup pressure for a sufficient time to allow for diametric expansion or pipe stretching to stabilize (approximately 2 to 3 hours). After this equilibrium period, the test section can be returned to the required testing pressure, the pump turned off and a final test pressure held for 1 to 3 hours.
- D. All costs associated with acquiring water for hydrostatic testing shall be included in the established contract unit price bid prices.

3.9 HANDLING DRILLING FLUIDS AND CUTTINGS

- A. During the drilling, reaming, or pullback operations, the Contractor shall make adequate provisions for handling the drilling fluids, or cuttings at the entry and exit pits. To the greatest extent practical, these fluids must not be discharged into waterways. When the Contractor's provisions for storage of the fluids or cuttings on site are exceeded, these materials shall be hauled away to a suitable legal disposal site. The Contractor shall conduct his directional drilling operation in such a manner that drilling fluids are not forced through the sub bottom into the waterway. After completion of directional drilling work, the entry and exit pit locations shall be restored to original conditions. The Contractor shall comply with all permit provisions.
- B. Pits constructed at the entry or exit point area shall be so constructed to completely contain the drill fluid and prevent its escape.
- C. The Contractor shall utilize drilling tools and procedures which will minimize the discharge of any drill fluids. The Contractor shall comply with all mitigation measures listed in the required permits and elsewhere in these Specifications.
- D. To the extent practical, the Contractor shall maintain a closed loop drilling fluid system. The drill fluid delivery system shall monitor and maintain constant flow rate and pressure to keep solids moving freely during drilling operations. The mixing system shall be able to ensure thorough mixing of the drilling fluid. The drilling fluid reservoir tank shall be sized for adequate storage of the fluid.
- E. The Contractor shall minimize drilling fluid disposal quantities by utilizing a drilling fluid cleaning system which allows the returned fluids to be reused.
- F. As part of the installation plan specified herein before, the Contractor shall submit a drilling fluid plan which details types of drilling fluids, cleaning and recycling equipment, estimated flow rates, and procedures for minimizing drilling fluid escape.

3.10 ENVIRONMENTAL PROVISIONS

- A. The Horizontal Directional Drilling operation is to be operated in a manner to eliminate the discharge of water, drilling mud, and cuttings to the land areas involved during the construction process. The Contractor shall provide equipment and procedures to maximize the recirculation or reuse of drilling mud to minimize waste. All excavated pits used in the drilling operation shall be lined by Contractor with heavy duty plastic sheeting with sealed joints to prevent the migration of drilling fluids and/or ground water.
- B. The Contractor shall visit the site and must be aware of all structures and site limitations at the directional drill crossing and provide a drilling plan outlining procedures to prevent drilling fluid from adversely affecting the surrounding area.

- C. Waste cuttings and drilling mud shall be processed through a solid control plant comprised as a minimum of sumps, pumps, tanks, desalter/desander, centrifuges, material handlers, and haulers all in a quantity sufficient to perform the cleaning/separating operation without interference with the drilling program. The cuttings and excess drilling fluids shall be dewatered and dried by the Contractor to the extent necessary for disposal in offsite landfills. Water from the dewatering process shall be treated by the Contractor to meet permit requirements and disposed of locally. The cuttings and water for disposal are subject to being sampled and tested. The construction site and adjacent areas will be checked frequently for signs of unplanned leaks or seeps.
- D. Equipment (graders, shovels, etc.) and materials (such as groundsheets, hay, bales, booms, and absorbent pads) for cleanup and contingencies shall be provided in sufficient quantities by the Contractor and maintained at all sites for use in the event of inadvertent leaks, seeps or spills.
- E. Waste drilling mud and cuttings shall be dewatered, dried, and stock piled such that it can be loaded by a front end loader, transferred to a truck, and hauled offsite to a suitable legal disposal site. The maximum allowed water content of these solids is 50 percent of weight.
- F. Dewatering and disposal work shall be concurrent with drilling operations. Treatment of water shall satisfy regulatory agencies before it is discharged.

3.11 CONTROL OF LINE AND GRADE

- A. Construction Controls:
 - 1. Establish or re-establish baselines and benchmarks indicated on Drawings. Check baselines and benchmarks at beginning of Work and report any errors or discrepancies to Owner's Representative.
 - 2. Use baselines and benchmarks to establish and maintain construction control points, reference lines and grades for locating casings, carrier pipe, shafts, pits, and structures.
 - 3. Establish construction control points sufficiently far from work so as not to be affected by ground movement caused by tunneling operations.
- B. Bench Mark Movement. If settlement of ground surface occurs during construction which affects accuracy of temporary benchmarks detect, report such movement to the Owner's Representative and reestablish temporary bench marks.
- C. Pipe installed by the directional drilled method must be located in plan as shown on the Drawings, and must be no shallower than shown on the Drawings, unless otherwise approved by the Owner's Representative.

- D. The Contractor shall plot the actual horizontal and vertical alignment of the pilot bore at intervals not exceeding 30 feet. This “as-built” plan and profile shall be updated as the pilot bore is advanced. The Contractor shall at all times provide and maintain instrumentation that will accurately locate the pilot hole and measure drilling fluid flow and pressure. The Contractor shall grant the Owner’s Representative access to all data and readout pertaining to the position of the bore head and the fluid pressures and flows. When requested, the Contractor shall provide explanations of this position monitoring and steering equipment. The Contractor shall employ experienced personnel to operate the directional drilling equipment and, in particular, the position monitoring and steering equipment. No information pertaining to the position or inclination of the pilot bores shall be withheld from the Owner’s Representative.
- E. Each entry and exit point shall be located as shown on the approved Work Plan with an over-length tolerance of 10 feet for directional drills of 1,000 linear feet or less and 40 feet for directional drills of greater than 1,000 linear feet, and an alignment tolerance of 5 feet left/right with due consideration of the position of the other exit points and the required permanent easement. In no instance will the pipe be installed outside the pipeline easement. The alignment of each pilot bore must be approved by the Owner’s Representative before pipe can be pulled. If the pilot bore fails to conform to the above tolerances, the Owner’s Representative may, at his option, require a new pilot boring to be made at no additional cost to the Owner.
- F. After the pipe is in place, cleaning pigs shall be used to remove residual water and debris. After the cleaning operation, the Contractor shall provide and run a sizing pig to check for anomalies in the form of buckles, dents, excessive out-of-roundness, and any other deformations. The sizing pig run shall be considered acceptable if the survey results indicate that there are no sharp anomalies (i.e. dents, buckles, gouges, and internal obstructions) greater than 2 percent of the nominal pipe diameter, or excessive ovality greater than 5 percent of the nominal pipe diameter. For gauging purposes, dent locations are those defined above which occur within a span of five feet or less. Pipe ovality shall be measured as the percent difference between the maximum and minimum pipe diameters. For gauging purposes, ovality locations are those defined above which exceed a span of five feet.

3.12 MONITORING

- A. Surface Settlement Monitoring:
 - 1. Monitor ground surface elevation along length of trenchless operation. Locate and record settlement monitoring points with respect to construction baseline and elevations. Record elevations to accuracy of 0.01 feet for each monitoring point location.
 - a. Railroads: Track subbase (bottom of ballast) at centerline of each track, or as specified in the permit requirements.

- b. Product pipelines: Directly above and 10 feet before and after utility or pipeline intersection, or as specified in the permit requirements.
 - c. TxDOT and County Roads: As specified in the permit requirements
 - d. At other locations requiring trenchless installation of pipes and casing in excess of 100 feet in length: At 10 feet from each end and at two additional points between each end of each installation (a minimum of 4 points but in no case at more than 50 foot intervals). Establish monitoring points referenced to curbs, or medians or other physical features and control points which can be reestablished after the completion of the Work. For other locations with trenchless installation of pipes or casings less than 100 feet in length or less than 6 inches in diameter, no monitoring points are required except as required in paragraphs a, b and c above.
- 2. Reading Frequency and Reporting. Take settlement survey readings:
 - a. Prior to tunnel excavation reaching monitoring point in plan
 - b. After tunnel excavation reaches monitoring point in plan
 - c. After installation of pipe or casing and backfill of pit or shaft is complete.
 - 3. Immediately report to Owner's Representative movement, cracking, or settlement which is detected.
 - 4. Following substantial completion, but prior to final completion, make a final survey of monitoring points and report results to Owner's Representative.

3.13 DISPOSAL OF EXCESS MATERIAL

- A. Conform to applicable provisions of Section 01 74 19 – Construction Waste Management and Disposal.

3.14 OWNER TRAINING (NOT USED)

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SECTION 33 11 10
DUCTILE IRON PIPE AND FITTINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Ductile iron pipe and fittings for water lines, wastewater force mains, gravity sanitary sewers, and storm sewers.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 00 – Proposing Requirements, Contract Forms, and Conditions of the Contract.
2. Division 01 – General Requirements.
3. Section 09 91 00 – Painting and Protective Coatings.

1.2 MEASUREMENT AND PAYMENT

A. Unit Price. No separate payment will be made for ductile iron pipe and fittings under this Section, with the exception of extra fittings in place. Include the cost in associated items for this project.

B. Extra ductile iron compact fittings in place shall be for additional fittings required to complete job. This is not to exclude extension of pipe across driveway or intersection for purpose of terminating line in more advantageous position. This determination shall be at discretion of Owner's Representative. This bid item includes additional fittings as may be necessary to complete job in conformance with intent of Drawings and will be paid according to unit price for "Furnish and Install Extra Ductile Iron Water Line Fittings, All Angles, Complete in Place."

1.3 QUALITY ASSURANCE

A. Referenced Standards:

1. American National Standards Institute/American Water Works Association/ (ANSI /AWWA):
 - a. A 21.4/C 104 – Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings, for Water.
 - b. A 21.10/C 110 – Standard for Ductile-Iron and Gray-Iron Fittings, 3-in. through 48-in.
 - c. A 21.11/C 111 – Standard for Rubber Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - d. A 21.15/A C 115 – Standard for Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges.

- e. A21.16/C 116 – Protective Fusion Bonded Epoxy Coating for the Interior and Exterior Surfaces of Ductile Iron and Grey iron Fittings for Water Supply Service.
 - f. A 21.50/C 150 – Standard for Thickness Design of Ductile Iron Pipe.
 - g. A 21.51/C 151 – Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water and Other Liquids.
 - h. A 21.53/A C 153 – Standard for Ductile Iron Compact Fittings, 3 inches through 24 inches and 54 inches through 64 inches for Water Service.
- 2. American Water Works Association (AWWA)
 - a. C 105 Polyethylene encasement for Ductile Iron Pipe Systems.
 - b. C 300 – Standard for Prestressed Concrete Pressure Pipe, Steel-Cylinder Type, for Water and other Liquids.
 - c. C 600 – Standard for Installation of Ductile Iron Water Mains and Their Appurtenances.
 - 3. American Society of Mechanical Engineers (ASME):
 - a. B 16.1 – Cast Iron Pipe Flanges and Flanged Fittings.
 - 4. ASTM International (ASTM):
 - a. D 1248 – Standard Specification Polyethylene Plastics Molding and Extrusion Materials for Wire and Cable.
 - b. F 477 – Elastomeric Seals (gaskets) for Joining Plastic Pipe.
 - c. G 62 – Standard Test Methods for Holiday Detection in Pipeline Coatings.
 - 5. The Society for Protective Coatings (SSPC):
 - a. SP 6 – Steel Structures Painting Council, Commercial Blast Cleaning.
 - 6. American Railway Engineering and Maintenance-of-Way Association (AREMA) Manual for Railway Engineering.
 - 7. American Association of State Highway Transportation Officials (AASHTO).

1.4 SUBMITTALS

- A. Conform to requirements of Section 01 33 00 – Submittals.
- B. For pipes 16 inches and greater submit shop drawings signed and sealed by Professional Engineer registered in State of Texas showing the following:
 - 1. Manufacturer's pipe design calculations.

2. Provide lay schedule of pictorial nature indicating alignment and grade, laying dimensions, fitting, flange, and special details, with plan and profile view of each pipe segment sketched, detailing pipe invert elevations, horizontal bends, restrained joints, and other critical features. Indicate station numbers for pipe and fittings corresponding to Drawings. Do not start production of pipe and fittings prior to review and approval by Owner's Representative. Provide final approved lay schedule on CDROM in Adobe portable document format (*.PDF).
 3. Calculations and limits of thrust restraint.
 4. Class and length of joint.
- C. Submit manufacturer's certifications that ductile iron pipe and fittings meet provisions of this Section and have been hydrostatically tested at factory and meet requirements of ANSI A 21.51.
 - D. Submit certifications that pipe joints have been tested and meet requirements of ANSI A 21.11.
 - E. Submit affidavit of compliance in accordance with ANSI A21.16 for fittings with fusion bonded epoxy coatings or linings.

1.5 WARRANTY (NOT USED)

PART 2 - PRODUCTS

2.1 DUCTILE IRON PIPE

- A. Ductile Iron Pipe Barrels: Shall conform to AWWA C115, C150, and C151 and bear mark of Underwriters' Laboratories approval. Unless otherwise shown on Drawings, use minimum Pressure Class 150 for water lines and thickness Class 52 for sanitary sewers.
- B. Provide pipe sections in standard lengths, not less than 18 feet long, except for special fittings and closure sections as indicated on shop drawings.
- C. Provide Cathodic Protection System in accordance with Drawings.
- D. Pipe Manufacturer for large diameter water lines: Minimum of 5 years of successful pipe installations in continuous service. Manufacturer must maintain on site or in plant enough fittings to satisfy the following requirements:

Line Diameter	Required Bends*
20 and 24 inches	Four 45° bends per 5,000 LF of water line
> 24 inches	Four 22.5° bends per 10,000 LF of water line

*Based on total length of contract (minimum of four). Any combination of bends may be substituted at manufacturer's option (i.e. two 22.5° bends are equivalent to one 45° bend) and will be counted as one fitting.

- E. Manufacturer or supplier must be capable of delivering bends to job site within 12 hours of notification. Use fittings at direction of Owner's Representative where unforeseen obstacles are encountered during construction. These fittings are in addition to any fittings called out in construction documents and must be available at all times.
- F. Hydrostatic Test of Pipe: AWWA C 151, Section 5.2.1, at point of manufacture. Hold test for a minimum 2 minutes for thorough inspection of pipe. Repair or reject pipe revealing leaks or cracks.
- G. Provide flange adapter with insulating kit as required when connecting new piping to existing piping and piping of different materials, unless otherwise approved by Owner's Representative.
- H. Clearly mark pipe section to show location and thickness/pressure class color coded.
- I. No welding will be permitted on Ductile Iron Pipe except at restrained joint spigots. No field welding is allowed.

2.2 JOINTS

- A. Joint Types: ANSI A 21.11 push-on; ANSI A 21.11 mechanical joint; or ANSI A 21.16 flanged end. Provide push-on joints unless otherwise indicated on the Drawings or required by these specifications. For bolted joints, conform to requirements of AWWA C111; provide minimum 304 stainless steel for restraint joints.
- B. Where required by Drawings, provide approved restrained joints for buried service.
- C. Threaded or grooved-type joints which reduce pipe wall thickness below minimum required are not acceptable.
- D. Provide for restrained joints designed to meet test pressures, as applicable. Provide restrained joints for test pressure or maximum surge pressure as specified, whichever is greater for water lines. Do not use passive resistance of soil in determining minimum restraint lengths.
- E. Electrical Bond Wires: Use stranded, copper cable furnished with high molecular weight polyethylene insulation (HMWPE). Use wire gauge (AWG) as shown on Drawings.

- F. Make curves and bends by deflecting joints. Do not exceed maximum deflection recommended by pipe manufacturer for pipe joints or restraint joints. Submit details of other methods of providing curves and bends for consideration by Owner's Representative. When other methods are deemed satisfactory, install at no additional cost to Owner.

2.3 GASKETS

- A. Furnish, when no contaminant is identified, plain rubber (SBR) gasket material in accordance with ANSI A21.11 or ASTM F 477 (one bolt systems); for flanged joints 1/8-inch-thick gasket in accordance with ANSI A 21.15.
- B. Use appropriate gasket material for installations in potentially contaminated areas.

2.4 FITTINGS

- A. Use fittings of same size as pipe. Reducers are not permitted to facilitate an off-size fitting. Reducing bushings are also prohibited. Make reductions in piping size by reducing fittings. Line and coat fittings as specified for pipe they connect to.
- B. Push-on Fittings: Not permitted on this project.
- C. Flanged Fittings: ANSI 21.10; ductile iron ANSI A 21.11 joints, gaskets, and lubricants; pressure rated at 250 psig.
- D. Mechanical Joint Fittings: ANSI A 21.11; pressure rated at 250 psi.
- E. Ductile Iron Compact Fittings: Shall conform to AWWA C153 and shall be:
 - 1. Fusion bonded epoxy lined or
 - 2. Cement mortar lined
- F. For tangential flanged outlets shown on Drawings, substitute with a tee with an equivalent sized outlet unless otherwise approved by Owner's Representative.

2.5 COATINGS AND LININGS

- A. Water line Interiors: ANSI A21.4, cement lined with seal coat; ANSI A 21.16 fusion bonded epoxy coating for interior; comply with NSF 61.

- a. Provide approved virgin polyethylene conforming to ASTM D 1248, with inert fillers and carbon black to resist ultraviolet degradation during storage; heat bonded to interior surface of pipe and fittings.
- b. Ceramic Epoxy - Protecto 401 or approved equal.

B. Encasement and coating requirements:

1. Open cut construction method:
 - a. Provide double wrap polyethylene encasement in accordance with AWWA C105 or
 - b. Provide Polyurethane coating in accordance with Section 09 91 00 – Painting and Protective Coatings.
 2. Auger or casing construction method: Provide Polyurethane coating in accordance with Section 09 91 00 – Painting and Protective Coatings or use pipe without polyethylene encasement and grout annular space.
- C. Polyethylene Wrap: For buried water lines not cathodically protected provide polyethylene wrap unless otherwise specified or shown.
- D. For flanged joints in buried service, provide petrolatum wrapping system, Denso, or equal, for the complete joint and alloy steel fasteners.
- E. Pipe to be installed in potentially contaminated areas shall have coatings and linings recommended by the manufacturer for maximum resistance to the contaminants identified in the Phase II Environmental Site Assessment Report.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Conform to installation requirements, except as modified in this Section.
- B. Install in accordance with AWWA C 600 and manufacturer's recommendations.
- C. Install double wrap Polyethylene encasement in conformance with requirements of AWWA C105.
- D. Holiday Testing:
 1. Polyurethane: Section 09 91 00 – Painting and Protective Coatings.
 2. Fusion Bonded Epoxy: Conform to requirements for new fittings in ANSI A 21.16.
- E. Provide electrical continuity bonding across buried mechanical and push-on joint assemblies, except where insulating flanges are required by Drawings.

1. Provide minimum number of bond wires shown on Drawings. Remove one inch of HMWPE insulation from each end of bond wire prior to attaching.
2. Secure wire onto pipe using approved Thermite Welding procedures.
3. Coat bare metal and weld metal after weld is secure. Use coal-tar compound or other compatible coating. For polyurethane coated pipe, use compatible polyurethane coating.
4. Visually inspect Thermite Weld connections for electrical continuity, strength and suitable coating prior to backfilling or placing pipe in augered hole or casing.

3.2 FIELD REPAIR OR COATINGS

- A. Polyurethane: Conform to requirements of Section 09 91 00 – Painting and Protective Coatings.
- B. Fusion Bonded Epoxy: Conform to requirements for new fittings in ANSI A 21.16.

3.3 OWNER TRAINING (NOT USED)

END OF SECTION

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SECTION 33 11 12

POLYVINYL CHLORIDE (PVC) PIPE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Polyvinyl chloride pressure pipe for water transmission and distribution, in nominal diameters 4 inches through 30 inches.
2. Polyvinyl chloride pressure pipe for water transmission and distribution, in nominal diameters 4 inches through 30 inches.
3. Polyvinyl chloride pressure pipe for gravity sewers and force mains in nominal diameters 4 inches through 30 inches.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 00 – Proposing Requirements, Contract Forms, and Conditions of the Contract.
2. Division 01 – General Requirements.
3. Section 33 11 10 – Ductile Iron Pipe and Fittings.
4. Section 31 21 33 – Trenching, Backfilling, and Compacting For Utilities.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Price. No separate payment will be made for this item. Include the cost in associated items for this project.

1.3 QUALITY ASSURANCE

A. Referenced Standards:

1. American Water Works Association/American National Standards Institute (AWWA/ANSI):
 - a. C 110 – American National Standard for Ductile-Iron and Gray-Iron Fittings, 3 Inches through 48 Inches for Water.
 - b. C 111 – American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - c. C 605– Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.
 - d. C 900 – Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 Inches through 12 Inches for Water Distribution.
 - e. C 905 – Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 48 In., for Water Transmission and Distribution.

- f. C 909 – Standard for Molecularly-Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 Inches through 12 Inches (100 mm through 300 mm), for Water Distribution
 - g. C 116/A 21.16 – Protective Fusion Bonded Epoxy Coating for the Interior and Exterior Surfaces of Ductile Iron and Grey Iron Fittings for Water Supply Service.
2. ASTM International (ASTM):
- a. D 1248 – Standard Specification for Polyethylene Plastics Molding and Extrusion Materials.
 - b. D 1784 – Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
 - c. D 2241 – Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
 - d. D 2321 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
 - e. D 2444 – Standard Test Method for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight).
 - f. D 2680 – Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping.
 - g. D 3034 – Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 - h. D 3139 – Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
 - i. D 3212 – Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
 - j. F 477 – Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
 - k. F 679 – Standard Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
 - l. F 794 – Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.
 - m. F 949 – Standard Specification for Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with Smooth Interior and Fittings.
 - n. F 1674 – Standard Test Method for Joint Restraint Products for Use with PVC Pipe.
3. PPI TR3 – Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe Materials.

4. Texas Administrative Code (TAC) Rule §290.44 – Texas Commission on Environmental Quality Rules and Regulations for Public Water Systems.

1.4 SUBMITTALS

- A. Conform to requirements of Section 01 33 00 – Submittals.
- B. Submit shop drawings showing design of new pipe and fittings indicating alignment and grade, laying dimensions, fabrication, fittings, flanges, and special details.
- C. For pipes 20 inches in diameter and greater, submit shop drawings signed and sealed by a Professional Engineer registered in the State of Texas showing the following:
 1. Provide lay schedule of pictorial nature indicating alignment and grade, laying dimensions, fitting, flange, and special details, with plan view of each pipe segment sketched, detailing pipe invert calculations, horizontal bends, restrained joints, and other critical features. Indicate station numbers for pipe and fittings corresponding to Drawings. Provide final approved lay schedule on CD-ROM in Adobe portable document format (*.pdf).
 2. Certification that calculations and limits of thrust restraint were performed in accordance with applicable design standards.
 3. Class and length of joint.

1.5 QUALITY CONTROL

- A. Submit manufacturer's certifications that PVC pipe and fittings meet requirements of this Section and AWWA C 900, AWWA C 909 or AWWA C 905 for pressure pipe applications, or appropriate ASTM standard specified for gravity sewer pipe.
- B. Submit manufacturer's certification that every standard length of PVC pressure pipe for water lines and force mains has been hydrostatically pressure tested in accordance with either AWWA C 900, AWWA C 909 or AWWA C 905. Hydrostatically test each length of pipe, including the integral bell, to four (4) times the rated pressure for minimum two (2) minutes. For 14-inch diameter and greater (AWWA C 905), maximum pressure for hydrostatic test shall not exceed 500 psi.
- C. When foreign manufactured material is proposed for use, have material tested for conformance to applicable ASTM requirements by certified independent testing laboratory located in United States. Certification from another source is not acceptable. Furnish copies of test reports to Owner's Representative for review. Cost of testing paid by Contractor.
- D. Markings: All PVC pipe shall be clearly marked in accordance with the pipe standard. Intervals shall not exceed 5 feet.
- E. Acceptance: Pipe may be rejected for failure to comply with any requirement of this specification.

1.6 WARRANTY (NOT USED)

PART 2 - PRODUCTS

2.1 MATERIAL

- A. Use PVC compounds in manufacture of pipe that contain no ingredient in amount that has been demonstrated to migrate into water in quantities considered to be toxic.
- B. Furnish PVC pressure pipe manufactured from Class 12454 PVC compound as defined in ASTM D 1784, latest version. PVC pipe conforming to AWWA C 900, AWWA C905, and AWWA C909 shall carry the National Sanitation Foundation (NSF) seal of approval and shall be listed with Underwriters Laboratories, Inc. (U.L.). Use compounds qualifying for rating of 4000 psi for water at 73.4 F per requirements of PPI TR3. Provide pipe which is homogeneous throughout, free of any significant voids, cracks, inclusions, and other defects, uniform as commercially practical in color, density, and other physical properties. Deliver pipe with surfaces free from nicks and scratches that are deeper than 10 percent of the minimum wall thickness. Joining surfaces of spigots and joints must be free of gouges and imperfections which could cause leakage.
- C. Water Distribution.
 - 1. Provide PVC pipe that bears Underwriters' Laboratories mark of approval and is acceptable without penalty to Texas State Fire Insurance Committee for use in fire protection lines.
- D. Gaskets:
 - 1. Gaskets shall meet requirements of ASTM F 477. Use elastomeric factory-installed gaskets to make joints flexible and watertight.
 - 2. Flat Face Mating Flange: Full faces 1/8 inch thick ethylene propylene (EPR) rubber.
 - 3. Raised Face Mating Flange: Flat ring 1/8 inch ethylene propylene (EDR) rubber, with filler gasket between OD of raised face and flange OD to protect flange from bolting moment.
- E. Lubricant for rubber-gasketed joints: Water soluble, non-toxic, non-objectionable in taste and odor imparted to fluid, non-supporting of bacteria growth, having no deteriorating effect on PVC or rubber gaskets.
- F. Do not use PVC in potentially or known contaminated areas unless proof of acceptable chemical resistance of the pipe and gasket are provided to the Owner's Representative.
- G. Do not use PVC in areas exposed to direct sunlight unless a suitable coating is applied to the pipe.

2.2 WATER DISTRIBUTION AND TRANSMISSION PIPE

- A. Pipe 4-inch through 12-inch in diameter: AWWA C 900, AWWA C 909, Class 150, DR 18; AWWA C 900, Class 200, DR 14 as alternate to offset pipe sections; nominal 20-foot lengths; cast-iron equivalent outside diameters.
- B. Pipe 14-inch through 30-inch in diameter: AWWA C 905; Pressure Rated 150 psi; DR 25 minimum; nominal 20-foot lengths; cast-iron equivalent outside diameter.
- C. Make curves and bends by deflecting joints, using high deflection couplers, or large angle fittings, unless otherwise specified. Do not exceed maximum deflection
- D. Hydrostatic Test: Per AWWA C 900, AWWA C 905, AWWA C 909, ANSI A 21.10 (AWWA C 110); at point of manufacture; submit manufacturer's written certification. Perform hydrostatic test in accordance with Paragraph 1.5 B of this Section.

2.3 GRAVITY SEWER PIPE

- A. PVC gravity sanitary sewer pipe and storm sewer pipe shall be in accordance with provisions in following table:

Wall Construction	Manufacturer	ASTM Designation	SDR (Max.)/ Stiffness (Min.)	Diameter Size Range
Solid	JM Eagle CertainTeed Can-Tex Carlton Diamond Plastics North American	D3034	SDR 26 / PS 115	4" to 15"
		D3034	SDR 35 / PS 46	4" to 15"
		F679	SDR 35 / PS 46	18" to 48"
		AWWA C900	DR 18 / N/A	4" to 12"
		AWWA C909	PC150 / N/A	6" to 12"
		AWWA C905	DR 18 / N/A	14" to 36"
Truss (Gasketed)	Contech	D2680	N/A /200 psi	8" to 15"
Profile	Contech A-2000	F949	N/A / 46 psi	12" to 36"
	Contech A-2026	F949	N/A / 115 psi	8" to 10"
	JM Eagle, Ultra-Rib	F794	N/A / 46 psi	8" to 24"
	JM Eagle, Ultra-Corr	F794/F949	N/A / 46 psi	21" to 36"

- B. When solid wall PVC pipe 18 inches to 48 inches in diameter is required in PS 115, provide pipe conforming to ASTM F 679, except provide wall thickness as required for SDR 26 and pipe stiffness of 115 psi.

- C. For sewers crossing water lines, conform to requirements of Texas Administrative Code (TAC) Rule § 290.44.
- D. Joints: Spigot and integral wall section bell with solid cross section elastomeric or rubber ring gasket conforming to requirements of ASTM D 3212 and ASTM F 477, or ASTM D 3139 and ASTM F 477. Gaskets shall be factory-assembled and securely bonded in place to prevent displacement. Manufacturer shall test sample from each batch conforming to requirements ASTM D 2444.
- E. Fittings: Provide PVC gravity sewer sanitary bends, tee, or wye fittings for new sanitary sewer construction. PVC pipe fittings shall be full-bodied, either injection molded or factory fabricated. Saddle-type tee or wye fittings are not acceptable.
- F. Conditioning. Conditioning of samples prior to and during tests are subject to approval by Owner's Representative. When referee tests are required, condition specimens in accordance with Procedure A in ASTM D 618 at 73.4 degrees F plus or minus 3.6 degrees F and 50 percent relative humidity plus or minus 5 percent relative humidity for not less than 40 hours prior to test. Conduct tests under same conditions of temperature and humidity unless otherwise specified.
- G. Pipe Stiffness. Determine pipe stiffness at 5% deflection in accordance with Test Method D 2412. Minimum pipe stiffness shall be 46psi. For diameters 4 inches through 18 inches, test three specimens, each a minimum of 6 inches (152 mm) in length. For diameters 21 inches through 48 inches, test three specimens, each a minimum of 12 inches (305 mm) in length.
- H. Flattening. Flatten three specimens of pipe, prepared in accordance with Paragraph 2.04F, in suitable press until internal diameter has been reduced to 60 percent of original inside diameter of pipe. Rate of loading shall be uniform. Test specimens, when examined under normal light and with unaided eye, shall show no evidence of splitting, cracking, breaking, or separation of pipe walls or bracing profiles. Perform the flattening test in conjunction with pipe stiffness test.
- I. Joint Tightness. Test for joint tightness in accordance with ASTM D 3212, except that joint shall remain watertight at minimum deflection of 15%. Manufacturer will be required to provide independent third party certification for joint testing each diameter of storm sewer pipe.
- J. Purpose of Tests. Flattening and pipe stiffness tests are intended to be routine quality control tests. Joint tightness test is intended to qualify pipe to specified level of performance.

2.4 SANITARY SEWER FORCE MAIN PIPE

- A. Provide approved PVC pressure pipe conforming to requirements for water service pipe, and conforming to minimum working pressure rating specified for Sanitary Sewage Force Mains.

- B. Acceptable pipe joints are integral bell-and-spigot, containing a bonded-in elastomeric sealing ring meeting requirements of ASTM F 477. In designated areas requiring restrained joint pipe and fittings, use approved joint restraint device conforming to ASTM F 1674, for PVC pipe 30-inch diameter and less.
- C. Fittings: Provide ductile iron fittings as per Section 33 11 10 – Ductile Iron Pipe and Fittings, Paragraph 2.4, except furnish fittings with one of following internal linings:
 - 1. Nominal 40 mils (35 mils minimum) virgin polyethylene complying with ASTM D 1248, heat fused to interior surface of fitting
 - 2. Nominal 40 mils (35 mils minimum) polyurethane
 - 3. Nominal 40 mils (35 mils minimum) ceramic epoxy
 - 4. Nominal 40 mils (35 mils minimum) fusion bonded epoxy
- D. Exterior Protection: Provide polyethylene wrapping of ductile-iron fittings as required by Section 33 11 10 – Ductile Iron Pipe and Fittings.
- E. Hydrostatic Tests: Hydrostatically test pressure rated pipe in accordance with Paragraph 2.2E.

2.5 BENDS AND FITTINGS FOR PVC PRESSURE PIPE

- A. Bends and Fittings: ANSI A 21.10 or ANSI A 21.53, ductile iron; ANSI A 21.11 single rubber gasket push-on type joint; minimum 150 psi pressure rating. PVC integral restrained joints, 250 psi, may be provided for up to 12 inches in diameter (water or sanitary).
- B. Provide approved restrained joint fittings: Integral restrained joint fittings and pipe do not require secondary restraint.
- C. For 24-inch and larger ductile iron fittings, provide 32-lb zinc anode on each ductile iron fitting in accordance with Cathodic Protection plans or provide polyethylene wrap in accordance with Section 33 11 10 – Ductile Iron Pipe and Fittings.

PART 3 - EXECUTION

3.1 PROTECTION

- A. Store pipe under cover out of direct sunlight and protect from excessive heat or harmful chemicals in accordance with manufacturer's recommendations.

3.2 INSTALLATION

- A. Conform to requirements of applicable section.
- B. Install PVC pipe in accordance with Section 31 21 33 – Trenching, Backfilling, and Compacting For Utilities, AWWA C 605, ASTM D 2321 for Sewer Pipe, and manufacturer's recommendations.

- C. Install PVC water service pipe to clear utility lines and have minimum depth of cover below property line grade of street, unless otherwise required by Drawings:
 - 1. Water service pipe 12 inches in diameter and smaller 4 feet of cover.
 - 2. Water service pipe 16 inch thru 30-inch in diameter, 6 feet of cover.
- D. Avoid imposing strains that will overstress or buckle pipe when lowering pipe into trench.
- E. Hand shovel pipe bedding under pipe haunches and along sides of pipe barrel and compact to eliminate voids and ensure side support.
- F. Store PVC pipe under cover out of direct sunlight. Protect pipe from excessive heat or harmful chemicals. Prevent damage by crushing or piercing.
- G. Allow PVC pipe to cool to ground temperature before backfilling when assembled out of trench to prevent pullout due to thermal contraction.

3.3 PVC PIPE WITH INTEGRAL RESTRAINED JOINTS

- A. For low-profile coupling with spline-type joints.
 - 1. Do not apply lubricant to spline or pipe or coupling spline grooves.
 - 2. Do not use excessive force while inserting the spline through coupling.
 - 3. Insert spline until it is fully seated around circumference of pipe.
- B. Field Cutting of Pipe Ends:
 - 1. Perform by workers certified by manufacturer.
 - 2. Use a PVC pipe cutter and provide square ends.
 - 3. If disassembly of restrained joint is required after it has been locked in place, follow manufacturer's recommendations for removal.
 - 4. For low-profile coupling with spline-type joint, use manufacturer approved power routing and grooving tool to field fabricate required pipe groove.

3.4 OWNER TRAINING (NOT USED)

END OF SECTION

SECTION 33 11 12.01
FUSIBLE POLYVINYL CHLORIDE (PVC) PIPE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fusible Polyvinyl chloride pressure pipe for water transmission and distribution, in nominal diameters 4 inches through 12 inches.
2. Fusible Polyvinyl chloride pressure pipe for water transmission and distribution, in nominal diameters 14 inches through 36 inches.
3. Fusible Polyvinyl chloride pressure pipe for gravity sewers and force mains in nominal diameters 4 inches through 36 inches.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 00 – Proposing Requirements, Contract Forms, and Conditions of the Contract.
2. Division 01 – General Requirements.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Price. No separate payment will be made for this item. Include the cost in associated items for this project.

1.3 QUALITY ASSURANCE

A. Referenced Standards:

1. American Water Works Association/American National Standards Institute (AWWA/ANSI):
 - a. C 110 – American National Standard for Ductile-Iron and Gray-Iron Fittings, 3 Inches Through 48 Inches for Water.
 - b. C 111 – American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - c. C 605 –Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.
 - d. C 900 – Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 Inches Through 12 Inches for Water Distribution.
 - e. C 905 – Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 48 In., for Water Transmission and Distribution.

- f. C 116/A 21.16 – Protective Fusion Bonded Epoxy Coating for the Interior and Exterior Surfaces of Ductile Iron and Grey Iron Fittings for Water Supply Service.
- g. M 23 – PVC Pipe Manual Design and Installation
- 2. ASTM International (ASTM):
 - a. D 1248 – Standard Specification for Polyethylene Plastics Molding and Extrusion Materials.
 - b. D 1784 – Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
 - c. D 1785 – Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
 - d. D 2152 – Standard Test Method for Adequacy of Fusion of Extruded Poly(Vinyl Chloride) (PVC) Pipe and Molded Fittings by Acetone Immersion
 - e. D 2241 – Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
 - f. D 2321 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
 - g. D 2444 – Standard Test Method for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight).
 - h. D 2680 – Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping.
 - i. D 2837 – Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products
 - j. D 3034 – Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 - k. D 3139 – Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
 - l. D 3212 – Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
 - m. F 477 – Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
 - n. F 679 – Standard Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
 - o. F 794 – Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.

- p. F 949 – Standard Specification for Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with Smooth Interior and Fittings.
- q. F 1674 – Standard Test Method for Joint Restraint Products for Use with PVC Pipe.
- 3. NSF International
 - a. Standard 14: Plastics Piping System Components and Related Materials
 - b. Standard 61: Drinking Water System Components - Health Effects
- 4. Plastics Pipe Institute (PPI)
 - a. TR2 PVC Range Composition Listing of Qualified Ingredients
 - b. TR3 – Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe Materials.
- 5. Texas Administrative Code (TAC) Rule §290.44 – Texas Commission on Environmental Quality Rules and Regulations for Public Water Systems.

1.4 SUBMITTALS

- A. Conform to requirements of Section 01 33 00 – Submittals.
- B. Submit shop drawings showing design of pipe and fittings including specials fittings required to achieve alignment and grade as shown on the Drawings, pipe section lengths, fabrication, fittings, flanges, gasket material, and special details.
- C. Submit details of Pipe Joints and jointing procedure for PVC pipe

1.5 QUALITY CONTROL

- A. Submit manufacturer's certifications that PVC pipe and fittings meet all applicable requirements of this Section and AWWA C 900, or AWWA C 905 for pressure pipe applications, or appropriate ASTM standard specified for gravity sewer pipe.
- B. Submit manufacturer's certification that every standard length of PVC pressure pipe for water lines and force mains has been hydrostatically pressure tested in accordance with either AWWA C 900, or AWWA C 905. Hydrostatically test each length of pipe, including the integral bell, to four (4) times the rated pressure for minimum two (2) minutes. For 14-inch diameter and greater (AWWA C 905), maximum pressure for hydrostatic test shall not exceed 500 psi.
- C. When foreign manufactured material is proposed for use, have material tested for conformance to applicable ASTM requirements by certified independent testing laboratory located in United States. Certification from another source is not acceptable. Furnish copies of test reports to Owner's Representative for review. Cost of testing paid by Contractor.
- D. Acceptance: Pipe may be rejected for failure to comply with any requirement of this specification.

- E. Technician Qualifications: Fusion Technician shall be fully qualified by the pipe supplier to install fusible PVC pipe of the type(s) and size(s) being used. Qualification shall be current as of the actual date of fusion performance on the project.

1.6 WARRANTY (NOT USED)

PART 2 - PRODUCTS

2.1 MATERIAL

- A. Use PVC compounds in manufacture of pipe that contain no ingredient in amount that has been demonstrated to migrate into water in quantities considered to be toxic.
- B. Furnish PVC pressure pipe manufactured from Class 12454 PVC compound as defined in ASTM D 1784, latest version. PVC pipe conforming to AWWA C 900, and AWWA C905 shall carry the National Sanitation Foundation (NSF) seal of approval and shall be listed with Underwriters Laboratories, Inc. (U.L.). Use compounds qualifying for a Hydrostatic Design basis (HDB) rating of 4000 psi for water at 73.4 F per requirements of PPI TR3.
- C. Provide pipe which is homogeneous throughout, free of any significant voids, cracks, inclusions, and other defects, uniform as commercially practical in color, density, and other physical properties. Deliver pipe with surfaces free from nicks and scratches that are deeper than 10 percent of the minimum wall thickness.
- D. PVC pipe shall be extruded with plain ends. The ends shall be square to the pipe and free of any bevel or chamfer. There shall be no bell or gasket of any kind incorporated into the pipe.
- E. PVC pipe shall be manufactured in a standard 40' nominal length, or custom lengths as specified in the plans.
- F. PVC pipe shall be blue in color for potable water use.
- G. Water Distribution.
1. Provide PVC pipe that bears Underwriters' Laboratories mark of approval and is acceptable without penalty to Texas State Fire Insurance Committee for use in fire protection lines.
- H. Do not use PVC in potentially or known contaminated areas unless proof of acceptable chemical resistance of the pipe and gasket are provided to the Owner's Representative.
- I. Do not use PVC in areas exposed to direct sunlight unless a suitable coating is applied to the pipe.
- J. Markings: All PVC pipe shall be clearly marked in accordance with the pipe standard. Intervals shall not exceed 5 feet.

1. Nominal pipe size
2. PVC
3. Dimension Ratio (DR), Standard Dimension Ratio (SDR), or Schedule
4. AWWA pressure class, or standard pressure rating for non-AWWA pipe, as applicable
5. AWWA standard designation number, or pipe type for non-AWWA pipe, as applicable
6. NSF-61 mark verifying suitability for potable water service
7. Extrusion production-record code
8. Trademark or trade name
9. Cell Classification 12454 and/or PVC material code 1120 may also be included
10. Underwriters' Laboratories mark (as applicable).

2.2 WATER DISTRIBUTION AND TRANSMISSION PIPE

- A. Pipe 4-inch through 12-inch in diameter: AWWA C 900, Class 165, DR 25; AWWA C 900, Class 235, DR 18 as alternate to offset pipe sections; nominal 40-foot lengths; cast-iron equivalent outside diameters.
- B. Pipe 14-inch through 36-inch in diameter: AWWA C 905; Pressure Rated 165 psi; DR 25 minimum; nominal 40-foot lengths; cast-iron equivalent outside diameter.
- C. Hydrostatic Test: Per AWWA C 900, AWWA C 905, ANSI A 21.10 (AWWA C 110); at point of manufacture; submit manufacturer's written certification. Perform hydrostatic test in accordance with Paragraph 1.5 B of this Section.

2.3 GRAVITY SEWER PIPE

- A. PVC gravity sanitary sewer pipe and storm sewer pipe shall be in accordance with Fusible polyvinylchloride pipe for non-potable water or pressurized wastewater not conforming to AWWA C905 dimensionality shall conform to AWWA C900, ASTM D2241 or ASTM D1785 for standard dimensionality, as applicable. Testing shall be in accordance with the referenced AWWA standards.
- B. For sewers crossing water lines, conform to requirements of Texas Administrative Code (TAC) Rule § 290.44.
- C. Fittings: Provide PVC gravity sewer sanitary bends, tee, or wye fittings for new sanitary sewer construction. PVC pipe fittings shall be full-bodied, either injection molded or factory fabricated. Saddle-type tee or wye fittings are not acceptable.

2.4 SANITARY SEWER FORCE MAIN PIPE

- A. Provide approved PVC pressure pipe conforming to requirements for water service pipe, and conforming to minimum working pressure rating specified for Sanitary Sewage Force Mains.
- B. Fittings: Provide ductile iron fittings as per Section 33 11 10 – Ductile Iron Pipe and Fittings, Paragraph 2.4, except furnish fittings with one of following internal linings:
 - 1. Nominal 40 mils (35 mils minimum) virgin polyethylene complying with ASTM D 1248, heat fused to interior surface of fitting
 - 2. Nominal 40 mils (35 mils minimum) polyurethane
 - 3. Nominal 40 mils (35 mils minimum) ceramic epoxy
 - 4. Nominal 40 mils (35 mils minimum) fusion bonded epoxy
- C. Exterior Protection: Provide polyethylene wrapping of ductile-iron fittings as required by Section 33 11 10 – Ductile Iron Pipe and Fittings.
- D. Hydrostatic Tests: Hydrostatically test pressure rated pipe in accordance with Paragraph 2.2E.

2.5 BENDS AND FITTINGS FOR PVC PRESSURE PIPE

- A. Bends and Fittings: ANSI A 21.10 or ANSI A 21.53, ductile iron; ANSI A 21.11 single rubber gasket push-on type joint; minimum 150 psi pressure rating.
- B. Provide approved restrained joint fittings.
- C. For 24-inch and larger ductile iron fittings, provide 32-lb zinc anode on each ductile iron fitting in accordance with Cathodic Protection plans or provide polyethylene wrap in accordance with Section 33 11 10 – Ductile Iron Pipe and Fittings.

2.6 FUSION JOINTS

- A. Unless otherwise specified, fusible PVC pipe lengths shall be assembled in the field with butt-fused joints. The Contractor shall follow the pipe supplier's written guidelines for this procedure. All fusion joints shall be completed as described in this specification.

2.7 CONNECTION AND FITTINGS FOR PRESSURE APPLICATIONS

- A. Connection:
 - 1. Connections shall be defined in conjunction with the coupling of project piping, as well as the tie-ins to other piping systems.
- B. Ductile Iron Mechanical and Flanged Fittings
 - 1. Acceptable fittings for use with fusible PVC pipe shall include standard ductile iron fittings conforming to AWWA/ANSI C110/A21.10, or AWWA/ANSI C153/A21.53 and AWWA/ANSI C111/A21.11.

- a. Connections to fusible PVC pipe may be made using a restrained or non-restrained retainer gland product for PVC pipe, as well as for MJ or flanged fittings.
- b. Bends, tees and other ductile iron fittings shall be restrained with the use of thrust blocking or other means as indicated in the construction documents.
- c. Ductile iron fittings and glands must be installed per the manufacturer's guidelines.

C. Sleeve-Type Couplings

1. Sleeve-type mechanical couplings shall be manufactured for use with PVC pressure pipe, and may be restrained or unrestrained as necessary.
2. Sleeve-type couplings shall be rated at the same or greater pressure carrying capacity as the pipe itself.

D. Expansion and Flexible Couplings

1. Expansion-type mechanical couplings shall be manufactured for use with PVC pipe, and may be restrained or unrestrained as necessary.
2. Expansion-type mechanical couplings shall be rated at the same or greater pressure carrying capacity as the pipe itself.

E. Connection Hardware

1. Bolts and nuts for buried service shall be made of non-corrosive, high-strength, low-alloy steel having the characteristics specified in ANSI/AWWA C111/A21.11, regardless of any other protective coating.

2.8 CONNECTIONS FOR GRAVITY SANITARY SEWER AND NON-PRESSURE APPLICATIONS

- A. The following connections are to be used in conjunction with tie-ins to other non-pressure, gravity sewer piping and/or structures, and shall be as indicated in the construction documents.

B. PVC Gasketed, Push-On Couplings

1. Acceptable couplings for joining fusible PVC pipe to other sections of fusible PVC pipe or other sections of PVC pipe shall include gasketed PVC, push-on type couplings as necessary.
2. PVC gasketed, push-on fittings and/or restraint hardware must be installed per the manufacturer's guidelines.

C. Sleeve-Type Couplings

1. Sleeve-type mechanical couplings shall be manufactured for use with PVC pipe, and may be restrained or unrestrained as necessary.

D. Expansion and Flexible Couplings

1. Expansion-type mechanical couplings shall be manufactured for use with PVC pipe, and may be restrained or unrestrained as necessary.
- E. Connection Hardware
 1. Bolts and nuts for buried service shall be made of non-corrosive, high-strength, low-alloy steel having the characteristics specified in ANSI/AWWA C111/A21.11, regardless of any other protective coating.
- F. Connection to Sanitary Sewer Manholes and Structures
 1. Fusible PVC pipe shall be connected to manholes and other structures to provide a leak-free, properly graded flow into or out of the manhole or structure.
 2. Connections to existing manholes and structures shall be as indicated in the construction documents.
 3. For a cored or drilled opening provide a flexible, watertight connection that meets and/or exceeds ASTM C923.
 4. For a knock out opening, provide a watertight connection (waterstop or other method) meeting the material requirements of ASTM C923 that is securely attached to the pipe with stainless steel bands or other means.
 5. Grout opening in manhole wall with non-shrink grout. Pour concrete collar around pipe and outside manhole opening. Provide flexible pipe joint or flexible connector within 2 feet of the collar.
 - a. Connections to a new manhole or structure shall be as indicated in the construction documents.
 6. A flexible, watertight gasket per ASTM C 923 shall be cast integrally with riser section(s) for all precast manhole and structures.
 7. Drop connections shall be required where shown on drawings.
 8. Grout internal joint space with non-shrink grout.

PART 3 - EXECUTION

3.1 PROTECTION

- A. Store pipe under cover out of direct sunlight and protect from excessive heat or harmful chemicals in accordance with manufacturer's recommendations.
- B. Pipe shall be off-loaded, loaded, installed, handled, stored and stacked per the pipe supplier's guidelines. These guidelines include compliance with the minimum recommended bend radius and maximum safe pull force for the specific pipe being used.

3.2 FUSION PROCESS

- A. Fusible PVC pipe will be handled in a safe and non-destructive manner before, during, and after the fusion process and in accordance with this specification and pipe supplier's guidelines.
- B. Fusible PVC pipe will be fused by qualified fusion technicians holding current qualification credentials for the pipe size being fused, as documented by the pipe supplier.
- C. Pipe supplier's procedures shall be followed at all times during fusion operations.
- D. Each fusion joint shall be recorded and logged by an approved electronic monitoring device (data logger) connected to the fusion machine, which utilizes a current version of the pipe supplier's recommended and compatible software.
- E. Only appropriately sized and outfitted fusion machines that have been approved by the pipe supplier shall be used for the fusion process. This includes requirements for safety, maintenance, and operation with modifications made for PVC.

3.3 INSTALLATION - GENERAL

- A. Installation guidelines from the pipe supplier shall be followed for all installations.
- B. The fusible PVC pipe will be installed in a manner so as not to exceed the recommended bending radius guidelines.
- C. Where fusible PVC pipe is installed by pulling in tension, the recommended maximum safe pulling force, established by the pipe supplier, shall not be exceeded.

3.4 INSTALLATION – OPEN CUT

- A. Conform to requirements of applicable section.
- B. Install PVC pipe in accordance with Section 31 21 33 – Trenching, Backfilling, and Compacting for Utilities, AWWA C 605, ASTM D 2321 for Sewer Pipe, and manufacturer's recommendations.
- C. Install PVC water service pipe to clear utility lines and have minimum depth of cover below property line grade of street, unless otherwise required by Drawings:
 - 1. Water service pipe 12 inches in diameter and smaller 4 feet of cover.
 - 2. Water service pipe 16 inch thru 30-inch in diameter, 6 feet of cover.
- D. Avoid imposing strains that will overstress or buckle pipe when lowering pipe into trench.
- E. Hand shovel pipe bedding under pipe haunches and along sides of pipe barrel and compact to eliminate voids and ensure side support.

- F. Prevent damage by crushing or piercing.
- G. Allow PVC pipe to cool to ground temperature before backfilling when assembled out of trench to prevent pullout due to thermal contraction.

3.5 OWNER TRAINING (NOT USED)

END OF SECTION

SECTION 33 11 13
WATER MAIN CONSTRUCTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Construction of water mains
2. Coordination and interface with existing facilities and utilities.
3. Connections to existing water lines.
4. Testing, flushing and disinfection.
5. Specification Section is applicable to 33 05 23.13, 33 11 10, 33 11 12, 33 11 12.01, and 33 11 15.

B. Related Specification Sections include, but are not necessarily limited to:

1. Division 00 – Proposing Requirements, Contract Forms, and Conditions of the Contract.
2. Division 01 – General Requirements.
3. Section 02 41 13.13 – Removing Existing Pavements and Structures.
4. Section 31 21 33 – Trenching, Backfilling, and Compacting for Utilities.
5. Section 33 05 23.13 – Water Line Horizontal Directional Drilling.
6. Section 33 11 10 – Ductile Iron Pipe and Fittings.
7. Section 33 11 12 – Polyvinyl Chloride (PVC) Pipe.
8. Section 33 11 12.01 – Fusible PVC Pipe.
9. Section 33 11 15 – High Density Polyethylene (HDPE) Solid and Profile Wall Pipe.
10. Section 33 11 13.04 – Hydrostatic Testing of Pipelines.
11. Section 33 12 16 – Gate Valves.
12. Section 33 12 18 – Air Release and Vacuum Relief Valves.
13. Section 33 12 19 – Fire Hydrant.
14. Section 33 13 00 – Disinfection of Waterlines.

1.2 TRENCHLESS CONSTRUCTION METHODS

A. Designated requirements

1. Drawings indicate the open cut (trenched) construction unless otherwise noted. Where the Drawings indicate trenchless construction the Contractor shall select from the allowable trenchless methods described in the Sections below:
 - a. Section 33 05 23.13 – Water Line Horizontal Directional Drilling
2. Contractor shall determine the type of trenchless construction to be performed based on Work requirements and his preferred means and methods and shall submit all plans and material approval documents as indicated in the individual sections.
3. Where casings or tunnel liners are indicated on the Drawings, Contractor shall install casing or tunnel liner by trenchless methods. Contractor may only install casing by open cut, if specifically indicated on the plan/profile as casing installed by open cut.
- B. Where waterlines in casings or tunnel liners are indicated on the Drawings, Contractor shall install casing or tunnel liner by trenchless methods unless otherwise indicated. Contractor may only install casing/liner by open cut if specifically indicated on the plan/profile as to be installed by open cut.
- C. Where waterlines in casings or tunnel liners are indicated on the Drawings, Contractor may propose alternate trenchless methods which may not include casings/tunnel liners. Where such alternate methods do not include a casing/liner and are approved by the Owner, a deductive change order will be negotiated in accordance with Section 00 72 00 – Standard General Conditions of the Construction Contract.
- D. Where waterlines in casings or tunnel liners are indicated on the Drawings, Contractor may adjust the final length of casings/liners as follows:
 1. For Contractor convenience and as approved by Owner:
 - a. If length of casing/tunnel is increased for Contractor convenience, a no cost Change Order or Field Order will be negotiated in accordance with Section 00 72 00 – Standard General Conditions of the Construction Contract.
 - b. If length of casing/tunnel is decreased for Contractor convenience, a deductive Change Order will be negotiated in accordance with Section 00 72 00 – Standard General Conditions of the Construction Contract.
 2. To accommodate a differing site condition or as directed by the Owner:
 - a. If length of casing/tunnel is increased for a differing site condition or as directed by the Owner, a Change Order will be negotiated in accordance with Section 00 72 00 – Standard General Conditions of the Construction Contract.

- b. If length of casing/tunnel is decreased for a differing site condition or as directed by the Owner, a deductive Change Order will be negotiated in accordance with Section 00 72 00 – Standard General Conditions of the Construction Contract.

1.3 MEASUREMENT AND PAYMENT

A. Measurement:

1. Mains: Measure along axis of pipe and including through fittings and valves.
2. Branch Pipe: Measure from axis of water main to end of branch, through fittings, bends, adapters and valves.

B. Unit Prices:

1. Payment for water lines installed by open-cut is on a linear foot basis for each size of pipe installed.
2. Payment for water lines installed by trenchless construction using tunneling, microtunneling, augering or horizontal directional drilling which include a casing or primary liner is on linear foot basis for each size of pipe installed.
3. Payment for water lines installed by trenchless construction by augering or horizontal direction drilling which do not include a casing is on linear foot basis for each size of pipe installed.
4. Payment for pipe offset sections installed to avoid unforeseen obstacles and when authorized by Owner's representative shall be based on the following:
 - a. Each extra fitting authorized by Owner's Representative and delivered to jobsite and installed will be paid according to unit price for "Extra Fittings in Place" for each size of pipe installed
 - b. Payment for waterline between fittings will be paid for at applicable price for open cut waterlines and included in the payment for waterlines above.
5. Payment for each size connection to an existing water main by removal of a plug and clamp or other closure piece is on a lump sum basis for each connection shown on the Drawings. Work includes removal of existing plug and clamp or other closure piece, drainage or dewatering of water lines, repair of damaged linings, chlorination or re-chlorination as items incidental to the connection.
6. Payment for each size connection to an existing water main using a tapping sleeve and valve is on a lump sum basis for each tapping sleeve and valve shown on the Drawings. Work includes installation of the valve assembly and connection of the new line to the existing line, repair to coatings, chlorination or rechlorination as items incidental to the connection.
7. No separate payment is to be made for pavement removal and replacement of surface improvement necessary for augering, tunneling, or other trenchless methods of installation including removal and replacement of

surface improvements for pits or shafts or recovery shafts. Include cost of removal and replacement of these surface improvements in price for waterlines by trenchless construction.

8. No separate payment is to be made for sanitary sewer crossings. Include cost in bid unit price for water main.
9. No separate payment for tree removal, fence restoration, mailbox restoration or sign restoration. Include cost in bid unit price for Site Restoration.
10. Payment for Air Release and Vacuum Relief Valves, Butterfly Valves, Gate Valves, Flushing Hydrants and the appurtenances associated with these items will be made in accordance with the particular Sections for each of these items.

1.4 QUALITY ASSURANCE

A. Referenced Standards:

1. American National Standards Institute (ANSI)
 - a. ANSI A 21.11/AWWA C111 – Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - b. ANSI/NSF Standard 61 – Drinking Water System – Health Components.
2. ASTM International (ASTM):
 - a. A 36 – Standard Specification for Carbon Structural Steel.
 - b. A 126 – Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
 - c. A 536 – Standard Specification for Ductile Iron Castings.
 - d. E 165 – Standard Test Method for Liquid Penetrant Examination.
 - e. E 709 – Standard Guide for Magnetic Particle Examination.
 - f. F 1674 – Standard Test Method for Joint Restraint Products for use with PVC Pipe
3. American Water Works Association (AWWA)
 - a. B 300 – Standard for Hypochlorites.
 - b. B 301 – Standard for Liquid Chlorine.
 - c. C 206 – Standard for Field Welding of Steel Water Pipe.
 - d. C 207 – Standard for Steel Pipe Flanges for Waterworks Service – Sizes 4 inches through 144 inches.
 - e. C 651 – Standard for Disinfecting Water Mains.
4. NSF National Sanitation Foundation

1.5 SUBMITTALS

- A. Conform to requirements of Section 01 33 00 – Submittal Procedures.
- B. Conform to submittal requirements of applicable Section for type of pipe used.
- C. Submit the Critical Location report per Section 31 21 33 – Trenching, Backfilling, and Compaction and provide the elevation and location of conflicts prior to the manufacture of the pipe.
- D. Submit Lone Star notification transmittal number prior to beginning excavation.
- E. Submit restrained joint details and confirm restrained joints will be appropriate for the hydrostatic testing plan to be used for this project.
- F. Submit details of elliptical plug or plug and clamp devices, as applicable, and confirm plugs will be appropriate for hydrostatic testing to be used for this project.
- G. Submit details of connections to each differing type materials its pipe will connect to, including insulating details as a miscellaneous submittal.
- H. Submit, a minimum of 15 days before beginning pipe laying operations, layout drawing identifying proposed sections for disinfecting, hydrostatic testing and site restoration for entire project for review and approval. Layout drawing to identify sequence of sections for:
 - 1. Disinfection; not to exceed 4,000 linear feet per section.
 - 2. Hydrostatic testing and transfer of services; to immediately follow sequence of disinfected section.
 - 3. Site restoration; not to exceed limits specified; sequence in order of disturbance.
- I. For pipe with bell-and-spigot ends with rubber gasket, submit complete joint details with dimensions and tolerances and performance history indicating the proposed joint has performed satisfactorily under similar conditions.
- J. Submit results of the leakage tests, identifying the specific length of pipe tested, the test pressure, the duration of test and the amount of leakage.
- K. Submit satisfactory bacteriological test reports on disinfection requirements.
- L. Operation and Maintenance Manuals:
 - 1. See Specification Section 01 33 00 – Submittals 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 MATERIALS

- A. Pipe materials

1. Section 33 11 10 – Ductile Iron Pipe and Fittings
2. Section 33 11 12 – Polyvinyl Chloride (PVC) Pipe
3. Section 33 11 12.01 – Fusible PVC Pipe
4. Section 33 11 15 – High Density Polyethylene (HDPE) Solid and Profile Wall Pipe
5. Pipe Manufacturer: Selected manufacturer performance history shall be minimum 5 years of successful field installations with proposed pipe diameter and proposed type of pipe joint.
6. Pipe Material standards: Conform to American National Standards Institute/National Sanitation Foundation (ANSI/NSF) Standard 61 and have certified by an organization accredited by ANSI.
7. Coordinating pipe materials with other contractors and differing pipe materials:
 - a. When Contractor's selected pipe material joins to pipes of different material and/or different coatings to be constructed by others, Contractor shall request the Owner's representative to identify the type of pipe in the adjoining contract.
 - b. If the adjoining contract is scheduled to complete the adjoining waterline first, Contractor shall provide an approved connection with insulating kit and isolation test station at no additional cost to the Owner.
 - c. If Contractor's pipe is scheduled to complete first the other contractor will provide the insulating kit and isolation test station.
- B. In-line isolation valves: Refer to Specification Sections.
 1. Section 33 12 16 – Gate Valves
- C. Air Release and Vacuum Relief Valves: Refer to Specification Section 33 12 18 – Air Release and Vacuum Relief Valves.
- D. Flushing Hydrants: Refer to Section 33 12 19 – Fire Hydrant
- E. Factory Tests (EXAMPLE):
 1. Adjustable speed units:

2.2 RESTRAINED JOINTS

- A. Prestressed Concrete Cylinder Pipe, Bar-Wrapped and Steel Pipe: Welded Joints.
- B. Restrained Joints on DIP and PVC pipe are allowed with the following requirement as an alternative to the pipe with an integral restrained joint system:
 1. Restraint devices: Manufacture of high strength ductile iron, ASTM A 536 up to 24 inches, and ASTM A 36 for sizes greater than 30 inches. Working pressure rating twice that of design test pressure.

- C. Bolts and connecting hardware: High strength low alloy material in accordance with ANSI A21.11/AWWA C111.
- D. Ductile iron pipe in auger holes must be provided with integral restrained joints at both the bell and the spigot.

2.3 PLUG AND CLAMP

- A. Provide a manufactured plug device appropriate for the size and type of pipe.
 - 1. If used as a permanent plug and under pressure use ductile iron pipe and appropriate plug rated for the test pressure of the application.
 - a. For ductile iron pipe, plug shall be
 - 1) Tyton plug or Trim Tyton plug manufactured by US Pipe and Foundry Company
 - 2) Restrained plug manufactured by American Cast Iron Pipe Company.
 - 3.) Or Approved Equal.
 - 2. If used as a temporary plug and not under pressure, Contractor shall submit low pressure plugs, such as wing nut or hand tightened plugs for review and approval.

2.4 WARRANTY (NOT USED)

PART 3 - EXECUTION

3.1 PREPARATION

- A. Conform to applicable installation specifications for type(s) of pipe used.
- B. Employ workmen who are skilled and experienced in laying pipe of type and joint configuration being furnished. Provide watertight pipe and pipe joints.
- C. Install water main to the line and grade on the Drawings.
 - 1. Water mains to be staked at a minimum 100 FT interval with depth of cuts monitored.
- D. Field verify location and depth of utilities that will be crossed.
 - 1. Adjust water main elevation as required during construction.
 - 2. The Contractor shall contact the "One-Call" system and comply with all applicable rules and regulations.
 - 3. Prior to the start of construction and preparation of pipe layout sheets, the Contractor shall perform Critical Location investigations at all locations shown on the Drawings in accordance with Section 31 21 33 – Trenching, Backfilling, and Compaction for Utilities. The Contractor shall complete the

Critical Location report to provide the elevation and location of conflicts prior to the manufacture of the pipe.

4. Contractor shall communicate with the local representative of the utility companies including, but not limited to the oil companies, gas company, electric company, telephone company, water utilities, sanitary sewer utilities, and any other public and private utility companies affected by proposed construction in order to obtain the assistance of the utility companies in locating utility lines and in the avoidance of conflicts with utility lines in accordance with Section 01 11 13 – Work Covered by Contract Documents.
5. No additional compensation will be considered for lowering or raising the pipe grade to accommodate existing utilities shown on the Drawings. The Drawings show the estimated location of existing utilities as determined from limited field surveys and record data from utility companies. The fact that some utilities are not shown or are incorrectly shown in no way relieves the Contractor from his responsibility to locate all existing utilities.
6. The Contractor shall advise the Owner's Representative of any existing utilities which are not shown on the plans, incorrectly shown, and which "affect the pipe layout." Contractor shall also propose a resolution of the utility conflict. Utilities which "affect the pipe layout" will be interpreted by the Owner's representative as follows:
 - a. Utilities which conflict with the grade of the proposed pipe and clearances will be interpreted as "affecting the pipe layout."
 - b. Utilities which would conflict with operations and maintenance of the proposed pipe will be interpreted as "affecting the pipe layout."
7. The Owner's Representative will determine if the existing utility should be relocated, or whether the proposed pipeline alignment or grade will be revised.
8. If the proposed horizontal alignment is adjusted by deflection of pipe joints within tolerances of the manufacturer, no adjustment in contract price will be made.
9. If the proposed horizontal alignment of the pipeline is adjusted by the addition of fittings or special pieces, an adjustment in contract price will be made by adjusting quantities for the various unit price pay items. If additional adjustments are required a contract price adjustment will be made in accordance with Section 00 72 00 – Standard General Conditions of the Construction Contract.
10. If the proposed pipe grade is adjusted by two vertical feet or less by additional excavation or backfill and deflection of joints within tolerances of the manufacturer, no contract price adjustment will be made.
11. If the proposed pipe grade is adjusted by more than two vertical feet, an adjustment will be made, if possible, by utilizing the pipe offset method using additional fittings. If additional adjustments are required a contract price

adjustment will be made in accordance with Section 00 72 00 – Standard General Conditions of the Construction Contract.

12. No separate payment will be made for field verification or adjustment of main depths as required.
- E. Where existing utilities are to be relocated as part of this contract the owner of each utility will provide, at no cost to Contractor, operations involving opening and closing valves for wet connections and for chlorination. Contractor is responsible for handling necessary installations and removal of chlorination and testing taps and risers.
- F. For pipe diameters 36 inches and greater, clearly mark each section of pipe and fitting with unique designation on outside of pipe along with pressure class. Locate unique identifying mark minimum of five feet away from either end of each section of pipe. Provide one unique identifying mark in middle of each fitting. Place markings at consistent locations. Use permanent contrasting color paint and minimum letter height of 4 inches to mark designations.
- G. Contractor will restore all existing structures or services damaged by Contractor's operations at no cost to Owner.
- H. Contractor is responsible for assuring chosen manufacturer fulfills requirements for extra fittings and, therefore, Contractor is responsible for costs due to downtime if requirements are not met.
- I. Do not remove plugs or clamps during months of peak water demands; June, July and August, unless otherwise approved by Owner's Representative.
- J. Protection of Pipeline: Securely place stoppers or bulkheads in openings and in end of line when construction is stopped temporarily and at end of each day's work.

3.2 HANDLING, CLEANING AND INSPECTION

A. Handling:

1. Place pipe along project site where storm water or other water will not enter or pass through pipe.
2. Load, transport, unload, and otherwise handle pipe and fittings to prevent damage of any kind. Handle and transport pipe with equipment designed, constructed and arranged to prevent damage to pipe, lining and coating. Do not permit bare chains, hooks, metal bars, or narrow skids or cradles to come in contact with coatings. Where required, provide pipe fittings with sufficient interior strutting or cross bracing to prevent deflection under their own weight.
3. Hoist pipe from trench side into trench by means of sling of smooth steel cable, canvas, leather, nylon or similar material.

4. For large diameter water lines, handle pipe only by means of sling of canvas, leather, nylon, or similar material. Sling shall be minimum 36 inches in width. Do not tear or wrinkle tape layers.
 5. Use precautions to prevent injury to pipe, protective linings and coatings.
 - a. Package stacked pipe on timbers. Place protective pads under banding straps at time of packaging.
 - b. Pad fork trucks with carpet or other suitable material. Use nylon straps around pipe for lift when relocating pipe with crane or backhoe.
 - c. Do not lift pipe using hooks at each end of pipe.
 - d. Do not place debris, tools, clothing, or other materials on pipe.
 6. Repair damage to pipe or protective lining and coating before final acceptance.
 7. For cement mortar line and coated steel pipe and PCCP, permit no visible cracks longer than 6 inches, measured within 15 degrees of line parallel to pipe longitudinal axis of finished pipe, except:
 - a. In surface laitance of centrifugally cast concrete.
 - b. In sections of pipe with steel reinforcing collars or wrappers.
 - c. Within 12 inches of pipe ends.
 8. Contractor shall inspect and reject pipe with visible cracks (not meeting exceptions) and remove from project site.
- B. Cleaning: Thoroughly clean and dry interior of pipe and fittings of foreign matter before installation, and keep interior clean until Work has been accepted. Keep joint contact surfaces clean until jointing is completed. Do not place debris, tools, clothing or other materials in pipe. After pipe laying and joining operations are completed, clean inside of pipe and remove debris.
- C. Inspection: Before installation, inspect each pipe and fitting for defects. Reject defective, damaged or unsound pipe and fittings and remove them from site.

3.3 EARTHWORK

- A. Conform to applicable provisions of:
1. Section 33 05 23.13 – Water Line Horizontal Directional Drilling
- B. Backfill: Use bank run sand or earth or native soil as specified in Section 31 21 33 -Trenching, Backfilling and Compacting for Utilities. Backfill excavated areas in same day excavated. When not possible, cover excavated areas using steel plates on paved areas and other protective measures elsewhere.
- C. Place material in uniform layers of prescribed maximum loose thickness and wet or dry material to approximately optimum moisture content. Compact to prescribed density. Water tamping is not allowed.

D. Pipe Embedment: As shown on Drawings.

3.4 PIPE CUTTING

- A. Cut pipe 12 inches and smaller with standard wheel pipe cutters.
- B. Cut pipe larger than 12 inches in manner recommended by the pipe manufacturer and approved by Owner's Representative. Make cuts smooth and at right angles to axis of pipe. Where appropriate for the type of pipe, bevel plain end with heavy file or grinder to remove sharp edges.

3.5 PIPE INSTALLATION

A. General Requirements:

- 1. Lay pipe in excavation subgrade free of water.
- 2. Make adjustments of pipe to line and grade by scraping away subgrade or filling in with granular material.
- 3. Properly form bedding to fully support bell without wedging or blocking up bell.
- 4. Open Cut Construction: Keep pipe trenches free of water which might impair pipe laying operations. Grade pipe to provide uniform support along bottom of pipe. Excavate for bell holes after bottom has been graded and in advance of placing pipe.
- 5. Use adequate surveying methods and equipment; employ personnel competent in use of this equipment. Horizontal and vertical deviations from alignment as indicated on Drawings shall not exceed 0.10 feet. Measure and record "as-built" horizontal alignment and vertical grade at maximum of every 100 feet on record drawings.
- 6. Before assembling joints or couplings, lightly coat pipe ends and outside of gaskets with NSF61 approved lubricant to facilitate installation. Prior to proceeding with critical tie-ins, submit sequence of work based on findings from "Critical Location" investigations.

B. Install pipe continuously and uninterrupted along each street on which work is to be performed. Obtain approval of Owner's Representative prior to skipping any portion of Work.

C. Protection of Pipeline: Securely place stoppers or bulkheads in openings and in end of line when construction is stopped temporarily and at end of each day's work.

D. For water line smaller than 36 inches in diameter:

- 1. Lay not more than 300 feet of pipe in trench ahead of backfilling operations.
- 2. Cover or backfill laid pipe if pipe laying operations are interrupted and during non-working hours.
- 3. Place backfill carefully and simultaneously on each side of pipe to avoid lateral displacement of pipe and damage to joints.

4. If adjustment of pipe is required after it has been laid, remove and re-lay as new pipe.
- E. For water line 36 inches and larger in diameter:
 1. Lay no more than 50 feet of pipe in trench ahead of backfilling operations.
 2. Dig trench to proper width as shown on Drawings. When trench width below top of pipe becomes 4 feet wider than specified, install higher class of pipe or improved bedding, as determined by Owner's Representative. No additional payment will be made for higher class of pipe or improved bedding.
 3. Prevent damage to coating when placing backfill. Use backfill material free of large rocks or stones, or other material which could damage coatings.
- F. Perform following additional procedures when working on plant sites.
 1. Seventy-two hours prior to each plant shutdown or connection, schedule coordination meeting with Owner's Representative and Plant Operations personnel. At this meeting, present proposed sequencing of Work and verification of readiness to complete Work as required and within time permitted. Do not proceed with Work until Owner's Representative agrees key personnel, equipment and materials are on hand to complete Work.
 2. Prior to fully excavating around existing piping, excavate as minimal as possible to confirm type and condition of existing joints. Verify size, type, and condition of pipe prior to ordering materials or fully mobilizing for Work.
 3. Do not proceed with connections to existing piping and identified critical stages of work unless approved by Owner's Representative and Plant Operator is present to observe.
 4. Coordinate with Plant Operator to obtain reduction in operating pressures prior to performing connections to existing piping.
 5. Make connections to existing piping only when two valves are closed off between connection and source of water pressure. Do not make connection relying solely on one valve, unless otherwise approved by Owner's Representative and Plant Operator.
 6. Perform critical stages of Work identified on Drawings at night or during low water demand months as specified in Section 01 11 13 – Work Covered by Contract Documents.
 7. Excavation equipment used on plant sites to have smooth bucket; no teeth or side cutters.
 8. Before each "dig" with mechanical excavator, probe ground to determine potential obstructions. Repeat procedure until existing pipe is located or excavation reaches desired elevation. Perform excavations within one foot to existing piping by hand methods.

9. Provide adequate notice to pipe manufacturer's representative when connecting or modifying existing prestressed or pretension concrete cylinder pipe.
 10. Provide field surveyed (horizontal and vertical elevations) "as-builts" of new construction and existing underground utilities encountered. Submit in accordance with Section 01 33 00 – Submittals.
 11. Prior to performing plant work to be done on weekend, provide list of sites and contact person with phone numbers to 'Owner's Representative by noon on Thursday of week. Contact person must be accessible during weekend by phone, and be authorized to make emergency decisions.
 12. No night work or plant shutdown will be scheduled to begin two working days before or after designated San Jacinto River Authority Holidays.
- G. For tie-ins to existing water lines, provide necessary material on hand to facilitate connection prior to shutting down existing water line. Provide Owner's Representative and utility owner's representative a minimum of two weeks notice prior to shutting down existing water line.

3.6 INTERRUPTION OF SERVICE

- A. Interruption of service to water users shall not exceed 4 hours.
1. Notify affected property owners or occupants of interruption a minimum of 24 hours in advance.

3.7 UNDERGROUND SERVICES

- A. Notify utility representative prior to construction to obtain available information on location of existing utilities.
1. Contractor shall be responsible for locating all utilities.
- B. Existing water services are to be connected to the new water mains.
1. Damage to existing water service to be repaired, using copper pipe and union the same size as existing service.

3.8 DRIVEWAY REMOVAL AND REPLACEMENT

- A. All pavements to be removed for water main construction shall be removed in accordance with Section 02 41 13.13 – Removing Existing Pavements and Structures for utility construction and:
1. Cut by sawing, vertical cut to be one inch minimum.
 2. The remaining depth of section may be broken out in a manner subject to Owner's representative's approval.
 3. Where pavement removed is part of a traveled roadway and any portion of a lane is to be removed, pavement is to be removed and repaired/replaced to the nearest longitudinal joint.

4. Where pavement removed is not part of a traveled roadway (parking lot, driveway, ditch liner) the width of section removed to be either:
 - a. As shown on the Drawings.
 - b. Width not greater than the outside diameter of the water main plus 4 feet.
- B. Replace Portland cement concrete and asphalt equal to or better than original paving plus 2 IN or remove to the nearest joint as authorized by the Owner's representative.
- C. Concrete pavement removed and repaired/replaced for water main construction shall be in accordance with Section 03 09 00 – Concrete for utility construction.
- D. Remove and haul away debris resulting from the above operations in a manner that conforms with applicable laws and regulations.
- E. Include driveway removal and replacement in cost of the bid unit price of the water main.

3.9 GRAVEL SURFACED DRIVES AND ROADWAYS

- A. Contractor shall restore all damaged gravel surfaced drives and roadways with similar material to a condition equal to or better than original to limits and depth shown on Drawings.
 1. Payment to be at bid unit price for this item.
 2. Replacement gravel gradation.

3.10 PROTECTION OF EXISTING UTILITIES

- A. Contractor to verify the location of all underground utilities.
 1. Omission from, or the inclusion of utility locations on the plans is not to be considered as the nonexistence of or a definite location of existing underground utilities.
- B. Notify a representative of the underground utilities 24 HRS in advance of crossings.

3.11 CONNECTIONS TO EXISTING WATER MAIN

- A. Make connections to existing water main as shown on Drawings, by attaching to existing fitting or providing proposed fittings.
 1. Cost for making connections shall include cost of all fittings including flexible couplings, and shall be included in the bid unit price of the water main.

- B. Where the connection is made to an existing water main which can be adequately isolated from the distribution system, it shall be considered a "dry connection." Cost for making dry connections shall include cost of all fittings including flexible couplings and shall be included in the bid unit price of the water main.
- C. Contractor is responsible for controlling and disposing of water in the trench resulting from wet connections at no additional cost to the Owner.

3.12 SANITARY SEWER CROSSINGS

- A. Water main crossing house sewers, storm sewers or sanitary sewers shall be laid to provide a vertical separation of at least 18 IN between the bottom of the water main and the top of the sewer, whenever possible.
 - 1. A water main may be laid closer than 10 FT if the crown of the sewer is at least 18 IN below the water main invert.
 - 2. In the event 18 IN of vertical separation cannot be provided at a sewer crossing, the sewer shall be removed for a distance of 10 FT on each side of the water main and replaced with one 20 FT length of ductile iron pipe of the same size.
- B. Confirm that nine feet minimum separation from gravity sanitary sewers and manholes or separation of four feet minimum from force mains in all directions as a part of the Critical Location investigation per Section 31 21 33 – Trenching, Backfilling, and Compacting for Utilities unless other special design is provided on Drawings.
- C. Where clearances cannot be attained, and special design has not been provided on Drawings, obtain direction and authorization from Owner's Representative before proceeding with construction.
- D. Concrete collars shall be provided at each end of the ductile iron pipe to connect to the existing sewer pipe as shown on the Drawings.
- E. Payment for crossings shall be included in the bid unit price of the water main.

3.13 TREES

- A. Do not remove trees without written instructions from the Owner's representative unless tree removal is shown on Drawings.

3.14 SITE RESTORATION

- A. Restoring the site to its pre-construction conditions shall be in accordance with Section 01 74 23 – Restoration of Site and include repair or replacement of all damaged fences, signs, mailboxes, sprinkler systems to their original or better condition.

3.15 FENCES, SIGNS, MAILBOXES, ETC.

- A. Restore all damaged fences, signs, mailboxes, etc., to their original conditions.
 - 1. No separate payment will be made for these items.

3.16 CATHODIC PROTECTION APPURTENANCES (NOT USED)

3.17 SECURING, SUPPORTING AND ANCHORING

- A. Support piping, as shown on Drawings and as specified in this Section, to maintain line and grade and prevent transfer of stress to adjacent structures.

- B. Anchor pipe fittings and bends installed on water line by welding consecutive joints of pipe together to the restrained joint length on each side of bend, fitting or fixed point as shown on the Drawings. The restrained length shown on Drawings assumes the installation of pipe and subsequent hydrostatic testing begin upstream and proceed downstream, with respect to normal flow of water in pipe. If installation and testing differs from this assumption, submit for approval revised method of restraining pipe joints upstream and downstream of device used to test against (block valve, blind flange or dished head plug).
- C. Use adequate temporary blocking of fittings when making connections to distribution system and during hydrostatic tests. Use sufficient anchorage and blocking to resist stresses and forces encountered while tapping existing water line.

3.18 SEALING, CLEANING, FLUSHING AND DISINFECTION FIELD QUALITY CONTROL.

- A. Sealing, Flushing, and Disinfection of Potable Water Systems:
 - 1. Maintain interior of all pipes, fittings and other accessories free from dirt and foreign material at all times.
 - a. If, in the opinion of the Owner's Representative, the pipe contains dirt that will not be removed by flushing, the pipe interior shall be cleaned and swabbed with bactericidal solution.
 - b. At close of each day's work or whenever workmen are absent from jobsite, plug, cap or otherwise provide watertight seal from open ends of pipe to prevent ingress of foreign material.
 - c. If water is in trench, seal shall remain in place until trench is pumped dry.
- B. Cleaning
 - 1. Refer to Section 01 74 13 – Cleaning
 - 2. Remove construction debris or foreign material and thoroughly clean installed water main systems. Provide temporary connections, equipment and labor for cleaning. Owner's Representative will inspect water line for cleanliness prior to flushing and filling.
- C. Testing and Disinfection
 - 1. After favorable performance of pressure test per Section 33 11 13.04 – Hydrostatic Testing of Pipelines and prior to final acceptance, thoroughly flush the entire potable water piping system and perform disinfection as specified.
 - 2. Perform all work including preventative measures during construction in full compliance to AWWA C651.

3. Flush each segment of the system to provide a flushing velocity of not less than 2.5 FT per second.
4. Drain flushing water to location approved by the Owner.
5. Perform disinfection using one of the following forms:
 - a. Application of chlorine gas-water mixture by means of solution-feed chlorinating device.
 - 1) Liquid chlorine shall comply with AWWA B301.
 - b. Application of calcium hypochlorite, or sodium hypochlorite.
 - 1) Chlorine compounds shall comply with AWWA B300.
6. Disinfect pipe with chlorinated water as per AWWA C651.
 - a. Method of application of chlorine shall be by continuous feed method or slug method.
 - b. During disinfection procedure, ensure that initial and residual chlorine concentrations meet AWWA C651 requirements by testing by an approved method as directed by the Owner.
 - c. Cost of testing shall be included in the Bid Unit Price for water main and no separate payment will be made for this item.
7. Tag the system during the disinfection procedure.
8. Following disinfection for required contact period, neutralize chlorine residual in water by treating with reducing agent.
 - a. Refer to AWWA C651.
 - b. Flush all treated water from pipeline at its extremities until replacement water throughout pipe, upon test is proved comparable in quality to water in existing system.
 - c. Take two (2) samples to test for bacteriological quality as directed by Owner's representative.
 - d. Repeat disinfection procedure until two (2) satisfactory results are obtained.
 - e. Quality of water delivered by the new water main to remain satisfactory for a minimum period of two (2) days.
9. Secure satisfactory bacteriological reports on samples from the system.
 - a. Ensure all sampling and testing procedures are in full compliance to AWWA C651, and applicable requirements of the State of Texas.
 - b. No separate payment will be made for this item.
10. The Owner will coordinate provision of the water required to fill the water main initially and will pay for the water required to flush the water main once.

- a. Filling and flushing shall be performed during periods of low usage, between the hours of midnight and 4:00 AM.
- b. Flushing water provided will be based on a maximum of 8 hours total.
- c. Any additional refilling or reflushing to be at the Contractor's expense.
- d. Drain flushing water to location approved by the Owner's Representative
- e. Payment will be made through use of Contractor Cash Allowance.

3.19 OWNER TRAINING (NOT USED)

END OF SECTION

Section 33 11 13.03
WET CONNECTIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Wet connections for new water lines and service lines to existing water lines.
 - 2. Specification Section is applicable to 33 11 13.
- B. Related Specification Sections include, but are not necessarily limited to:
 - 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Division 01 - General Requirements.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Price. No separate payment will be made for this item. Include the cost in associated items for this project.
- B. Stipulated Price (Lump Sum). If Contract is a Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

1.3 REFERENCES

- A. AWWA C 800 - Standard for Underground Service Line Valves and Fittings.

1.4 DEFINITIONS

- A. Wet connections consist of isolating sections of pipe to be connected with installed valves, draining isolated sections, and completing connections.
- B. Connection of 2-inch or smaller lines, which may be referred to on Drawings as "2-inch standard connections" or "gooseneck connections"

will be measured as 2-inch wet connections. This item is not to be used as part of 2-inch service line.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Pipe shall conform to requirements of applicable Technical Sections related to piping materials and to water distribution.
- B. Valves shall conform to requirements of Section 40 50 05 - Gate Valves.
- C. Brass fittings shall conform to requirements of AWWA C 800.

PART 3 - EXECUTION

3.1 CONNECTION OPERATIONS

- A. Plan wet connections in manner and at hours with least inconvenience public. Notify Owner's representative at least 72 hours in advance of making connections.
- B. Do not operate valves on water lines in use.
- C. Conduct connection operations when Inspector is at job site. Connection work shall progress without interruption until complete once existing water lines have been cut or plugs have been removed for making connections.

3.2 2-INCH WET CONNECTIONS

- A. Tap water line. Use corporation cocks, saddles, copper tubing as required for line and grade adjustment, and brass fittings necessary to adapt to existing water line. Use 2-inch valves when indicated on Drawings for 2-inch copper gooseneck connections.

END OF SECTION

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SECTION 33 11 13.04
HYDROSTATIC TESTING OF PIPELINES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Field hydrostatic testing of newly installed water pipelines.
 - 2. Specification Section is applicable to 33 11 13.
- B. Related Specification Sections include, but are not necessarily limited to:
 - 1. Division 00 – Proposing Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Division 01 – General Requirements.
 - 3. Section 31 21 33 – Trenching, Backfilling, and Compacting for Utilities.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Price. No separate payment will be made for this item. Include the cost in associated items for this project.

1.3 SUBMITTALS (NOT USED)

1.4 WARRANTY (NOT USED)

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PREPARATION

- A. Disinfect water system pipelines prior to hydrostatic testing.
- B. Hydrostatically test newly installed water pipelines after disinfection, when required, and before connecting to water distribution system.
- C. Water for testing will be supplied by the Contractor.
- D. Test small diameter pipelines in lengths between valves, or plugs, of not more than 1,500 feet. Where valves are located on each branch of a TEE, test TEE with adjacent section of water line.
- E. Conduct hydrostatic tests in presence of Owner's Representative.

3.2 TEST PROCEDURES

- A. Perform hydrostatic pressure and leakage tests using methods, and per performance requirements of Section 5 of AWWA C600 regardless of pipe material tested.
1. Note to Specifier: Determine the acceptable pressure for pressure testing. With high pressure ratings for pipe, 50 percent above the rated pressure may be excessive and may cause damage when testing is done in conjunction with older existing systems. PVC and HDPE piping testing should never be tested above the pressure rating of the pipe. DI pipe can be tested at 50 percent above the maximum working pressure at the lowest elevation of the test section or 25 percent above the maximum working pressure measured at the highest elevation of the test section- and shall not exceed the pressure rating of the valves. Edit this section accordingly.
 2. The pressure required for hydrostatic pressure test shall be 50 percent above the normal working pressure. If the normal working pressure cannot be determined, use the pipe pressure rating as the normal working pressure.
 3. Provide temporary plugs and blocking necessary to maintain the required test pressure. Where piping is cast in the walls for a structure, brace the walls prior to testing as required to prevent load of test pressure from being imposed upon the structure.
 4. Provide corporation cocks at least 3/4 inch in diameter, pipe riser, and angle globe valves at each pipe dead-end in order to bleed air from the line.
 5. Note to Specifier: Use a pipe test duration of 24 hours for concrete cylinder pipe or other pipe with a cement lining where absorption and make up water is involved. Use 4 hours for non-absorbing pipe materials. Two hours are required by standards.
 6. Duration of pressure test shall be at least 8 hours.
 7. Repair any visible leaks regardless of the total leakage shown by the test.
 8. Repair pipelines which fail to meet the test and retest as necessary until the results conform to the test requirements.
 9. Remove and replace defective materials, pipes, valves, and accessories.
 10. Test the pipelines in sections by shutting valves or installing temporary plugs as necessary.
 11. Fill the pipeline with water and remove the air.

12. Maintain the test pressure in the pipe for the entire test period by means of a force pump.
13. Accurately measure the water required to maintain the pressure. The amount of water required is a measure of the leakage.

3.3 ALLOWABLE LEAKAGE FOR WATERLINES

A. During hydrostatic tests, no leakage will be allowed for sections of water lines consisting of welded joints.

1. The maximum allowable leakage is determined by the following formula:

$$L = \frac{SD(P)^{1/2}}{F}$$

Equation Term	Represents	Measure
L	Maximum allowable leakage	gallons per hour
S	Length of pipe tested	feet
D	Nominal diameter of the pipe	inches
P	Test pressure	pounds per square inch gauge
F	Pipe factor	
	Use 148,000 Ductile Iron Pipe and PVC Pipe.	
	Use 133,200 for all other pipe types.	

- a. Leakage is defined as the volume of water provided to maintain the test pressure after the pipe has been filled with water, the air expelled and the pipe brought to test pressure.
 - b. Pipe with visible leaks or leakage exceeding the maximum allowable leakage is considered defective and must be corrected.
2. Water lines with welded and flanged joints only: zero allowable leakage.
 3. No leakage is allowed through any valve.
- B. For meter run installation, when Work cannot be isolated and line fails pressure test, visual inspection of Work by Owner's Representative for leakage during pressure test may be used to fulfill requirements of this section.

3.4 CORRECTION FOR FAILED TESTS

- A. Upon discovering a leak during the hydrostatic test, identify location of pipe leak. Determine magnitude and extent of impact to surrounding soil. Based on this information, Owner's Representative may require additional removal and replacement of surrounding pavement with no separate payment.
- B. Repair joints showing visible leaks on surface regardless of total leakage shown on test. Check valves and fittings to ensure that no leakage occurs that could affect or invalidate test. Remove cracked or defective pipes, fittings, and valves discovered during pressure test and replace with new items.
- C. Owner's Representative may require failed lines to be disinfected after repair and prior to retesting. Conduct and pay for subsequent disinfection operations as specified.
- D. Repeat test until satisfactory results are obtained.

3.5 COMPLETION

- A. Wherever possible, provide temporary blow-off on existing access manway blind flange. Upon satisfactory completion of disinfection and hydrostatic testing, remove risers and cap directly at the water line. Do not leave any portion of riser extending from water line.
- B. Where temporary blow-off is located outside access manhole or vault, backfill excavation promptly. Show blow-off locations on as-built record drawings, and note the type of cap used. If blow-off location is underneath pavement, comply with the following:
 - 1. If pavement is restored prior to completion of disinfection and hydrostatic testing, install temporary pavement over blow-off. Comply with local requirements for dimensions of temporary pavement, if applicable.
 - 2. Backfill excavation with select fill or cement stabilized sand in accordance with Section 31 21 33 – Trenching, Backfilling, and Compacting for Utilities.

3.6 OWNER TRAINING (NOT USED)

END OF SECTION

SECTION 33 11 15

HIGH DENSITY POLYETHYLENE (HDPE) SOLID AND PROFILE WALL PIPE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. High density polyethylene (HDPE) pipe for water mains and sanitary sewer force mains, including fittings.
2. High density polyethylene (HDPE) pipe for gravity sanitary sewers and drains, including fittings.
3. High density polyethylene (HDPE) pipe for gravity storm sewers and drains, including fittings.
4. High density polyethylene (HDPE) pipe for storm sewers culverts.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 00 – Proposing Requirements, Contract Forms, and Conditions of the Contract.
2. Division 01 – General Requirements.
3. Specification Sections:
 - a. Section 31 21 33 – Trenching, Backfilling, and Compacting For Utilities.
 - b. Section 33 05 23.13 – Water Line Horizontal Directional Drilling.
 - c. Section 33 11 10 – Ductile Iron Pipe and Fittings.
 - d. Section 33 11 13 – Water Main Construction.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Price. No separate payment will be made for this item. Include the cost in associated items for this project.

1.3 QUALITY ASSURANCE

A. Referenced Standards:

1. ASTM International (ASTM):
 - a. C906 – Polyethylene (PE) pressure Pipe & Fittings, 4 inch through 63 inch for water
 - b. D 618 – Standard Practice for Conditioning Plastics for Testing.
 - c. D 1248 – Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.
 - d. D 2321 – Standard Recommended Practice for Underground Installation of Flexible Thermoplastic Pipe.

- e. D 2657 – Standard Practice for Heat Fusion Joining Polyolefin Pipe and Fittings.
- f. D 2837 – Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials.
- g. D 3035 – Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
- h. D 3212 – Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
- i. D 3350 – Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
- j. F 477 – Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
- k. F 714 – Standard Specification for Polyethylene Plastic (PE) Pipe (SDR-PR) Based on Outside Diameter.
- l. F 894 – Standard Specification for Polyethylene (PE) Large-Diameter Profile Wall Sewer and Drain Pipe.
- m. F 2306 – Standard Specification for 12 to 60 in. [300 to 1500 mm] Annular Corrugated Profile-Wall Polyethylene (PE) Pipe and Fittings for Gravity-Flow Storm Sewer and Subsurface Drainage Applications.
- n. F 2487 – Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Corrugated High Density Polyethylene Pipelines.
- o. F 2510 – Standard Specification for Resilient Connectors between Concrete Manhole Structures and Corrugated High Density Polyethylene Drainage Pipes.

1.4 SUBMITTALS

- A. Conform to requirements of Section 01 33 00 – Submittals.
- B. Submit shop drawings showing design of pipe and fittings including specials fittings required to achieve alignment and grade as shown on the Drawings, pipe section lengths, fabrication, fittings, flanges, gasket material, and special details.
- C. Submit details of Pipe Joints and jointing procedure for HDPE pipe.

1.5 QUALITY CONTROL

- A. Provide manufacturer's certificate of conformance to Specifications.
- B. Furnish pipe and fittings that are homogeneous throughout and free from visible cracks, holes, foreign inclusions, or other injurious defects. Provide pipe as uniform as commercially practical in color, opacity, density, and other physical properties.

- C. Owner's Representative reserves right to inspect pipes or witness pipe manufacturing. Inspection shall in no way relieve manufacturer of responsibilities to provide products that comply with applicable standards and these Specifications.
 - 1. Manufacturer's Notification: Should Owner's Representative wish to witness manufacture of specific pipes, manufacturer shall provide Owner's Representative with minimum three weeks notice of when and where production of those specific pipes will take place.
 - 2. Failure to Inspect. Approval of products or tests is not implied by Owner's Representative's decision not to inspect manufacturing, testing, or finished pipes.
- D. Pipe manufacturer to provide services of experienced, competent, and authorized representative to visit site to advise and consult Contractor during jointing and installation of pipe if requested by the Owner.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this section with documented experience of minimum 5 years of pipe installations that have been in successful, continuous service for same type of service as proposed Work.

1.7 WARRANTY (NOT USED)

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide solid wall and profile wall HDPE pipe based on the intended service as described herein.
- B. Mark each standard and random length of pipe in compliance with these Specifications with following information:
 - 1. Pipe size.
 - 2. Pipe class.
 - 3. Production code.
 - 4. Material designation.
- C. Warranty
 - 1. The pipe shall be warranted one year by the pipe supplier.
 - 2. The fusion services (if applicable) shall be warranted for one year by the fusion service provider.

2.2 MATERIALS FOR WATER LINES

- A. HDPE pipe for water service shall be "DRISCOPLEX Series" as manufactured by Performance Pipe, or approved equal.
- B. Furnish solid wall pipe with plain end construction for heat joining (butt fusion) conforming to ASTM D 2657 for pressure applications. Utilize controlled temperatures and pressures for joining to produce fused leak-free joint.
- C. Furnish solid wall pipe for water mains and sanitary sewer force mains with minimum working pressure rating of 150 psi, and with inside diameter equal to or greater than nominal pipe size indicated on Drawings
- D. All piping system components shall be the products of one manufacturer and shall conform to the latest edition of ASTM D 1248, ASTM D 3350, ASTM F 714, and AWWA C 906.
- E. Piping and bends shall be extruded from a polyethylene compound and shall conform to the following requirements:
 - 1. The polyethylene resin shall meet or exceed the requirements of ASTM D 3350 for PE 3408 material with a cell classification of 335434C, or better.
 - 2. The polyethylene compound shall be suitably protected against degradation by ultraviolet light by means of carbon black, well dispersed by precompounding in a concentration of not less than 2 percent.
 - 3. The maximum allowable hoop stress shall be 800 psi at 73.4 degrees F.
 - 4. The pipe manufacturer shall be listed with the Plastic Pipe Institute as meeting the recipe and mixing requirements of the resin manufacturer for the resin used to manufacture the pipe in this project.
 - 5. The pipe and bends shall have a minimum standard dimension ratio (SDR) wall thickness of SDR 11 and a minimum working pressure of 150 psi.
 - 6. Joining shall be performed by thermal butt-fusion in accordance with the manufacturer's recommendations.
 - 7. Water pipe exterior shall be blue in color or contain blue striping.
- F. Each HDPE pipe section for water service shall also be marked with:
 - 1. Dimension ratio or standard dimension ratio.
 - 2. AWWA pressure class.
 - 3. AWWA standard designation number.
 - 4. NSF-61 mark verifying suitability for potable water service.
 - 5. Extrusion production record code.
 - 6. Trademark or trade name.
 - 7. Cell classification of HDPE material code.
- G. Connections and fittings for pressure application

1. See Section 33 11 10 - Ductile Iron Pipe and Fittings.

2.3 MATERIALS FOR GRAVITY SANITARY SEWERS

- A. Furnish profile-wall gravity sanitary sewer pipe with bell-and-spigot end construction conforming to ASTM D 3212. Joining will be accomplished with elastomeric gasket in accordance with manufacturer's recommendations. Use integral bell-and-spigot gasketed joint designed so that when assembled, elastomeric gasket, contained in machined groove on pipe spigot, is compressed radially in pipe bell to form positive seal. Design joint to avoid displacement of gasket when installed in accordance with manufacturer's recommendations
- B. Pipe and Fittings: High density, high molecular weight polyethylene pipe material meeting requirements of Type III, Class C, Category 5, Grade P34, as defined in ASTM D 1248. Material meeting requirements of cell classification in accordance with ASTM D 3350 are also suitable for making pipe products under these specifications.
- C. Jointing:
 1. Gaskets:
 - a. Meet requirements of ASTM F 477. Use gasket molded into circular form or extruded to proper section and then spliced into circular form. When no contaminant is identified, use gaskets of properly cured, high-grade elastomeric compound. Basic polymer shall be natural rubber, synthetic elastomer, or blend of both.
 - b. HDPE Pipes are not allowed to be installed in potentially contaminated areas, unless submitted and approved by Owner's Representative. Where approved provide gaskets as indicated below:

CONTAMINANT	GASKET MATERIAL REQUIRED
Petroleum (diesel, gasoline)	Nitrile Rubber
Other Contaminants	As recommended by pipe manufacturer

2. Lubricant. Use lubricant for assembly of gasketed joints which has no detrimental effect on gasket or on pipe, in accordance with manufacturer's recommendations.

- D. Other Pipe Materials: Materials other than those specified may be used as part of profile construction, e.g., as core tube to support shape of profile during processing, provided that these materials are compatible with base polyethylene material and are completely encapsulated in finished product and in no way compromise performance of pipe products in intended use. Examples of suitable material include polyethylene and polypropylene.

2.4 MATERIALS FOR FORCE MAIN SANITARY SEWERS

- A. All piping system components shall be the products of one manufacturer and shall conform to the latest edition of ASTM D 1248, ASTM D 3350, ASTM F 714, and AWWA C 906.
- B. Furnish solid wall pipe with plain end construction for heat joining (butt fusion) conforming to ASTM D 2657 for pressure applications. Utilize controlled temperatures and pressures for joining to produce fused leak-free joint.
- C. Furnish solid wall pipe for sanitary sewer force mains with minimum working pressure rating of 150 psi, and with inside diameter equal to or greater than nominal pipe size indicated on Drawings
- D. Piping and bends shall be extruded from a polyethylene compound and shall conform to the following requirements:
1. The polyethylene resin shall meet or exceed the requirements of ASTM D 3350 for PE 3408 material with a cell classification of 335434C, or better.
 2. The polyethylene compound shall be suitably protected against degradation by ultraviolet light by means of carbon black, well dispersed by precompounding in a concentration of not less than 2 percent.
 3. The maximum allowable hoop stress shall be 800 psi at 73.4 degrees F.
 4. The pipe manufacturer shall be listed with the Plastic Pipe Institute as meeting the recipe and mixing requirements of the resin manufacturer for the resin used to manufacture the pipe in this project.
 5. The pipe and bends shall have a minimum standard dimension ratio (SDR) wall thickness of SDR 11 and a minimum working pressure of 150 psi.
 6. Joining shall be performed by thermal butt-fusion in accordance with the manufacturer's recommendations.
 7. Water pipe exterior shall be blue in color or contain blue striping.

2.5 MATERIALS FOR GRAVITY STORM SEWERS AND STORM SEWER CULVERTS

- A. Furnish corrugated profile-wall polyethylene (CPP) pipe for gravity storm sewer and storm sewer culvert pipe.
- B. Pipe and Fittings High density, high molecular weight polyethylene HDPE virgin compound material meeting requirements of cell class outlined in ASTM D 3350. Manufacturing shall meet requirements of ASTM F 2306.

- C. Joints shall be installed such that connection of pipe sections will form continuous line free from irregularities in flow line. Suitable joints are:
- D. Integral Bell and Spigot. Bell shall overlap minimum of two corrugations of spigot end when fully engaged.
- E. Exterior Bell and Spigot. Bell shall be fully welded to exterior of pipe and overlap spigot end so that flow lines and ends match when fully engaged.

PART 3 - EXECUTION

3.1 TRANSPORTATION AND STORAGE

- A. All of the pipe supplier's guidelines shall be followed for transportation and storage of the pipe.
- B. Care shall be taken during transportation of the pipe to ensure that it is not cut, kinked, or otherwise damaged.
- C. Pipes shall be stored on level ground free of sharp objects which could damage the pipe.
- D. Stacking of the pipe shall be limited to a height that will not cause excessive deformation of the bottom layers of pipes under anticipated temperature condition.
- E. Where necessary due to ground conditions, the pipe shall be stored on wooden sleepers, spaced suitably and of such widths as not to allow deformation of the pipe at the point of contact with the sleeper or between supports.
- F. Any pipe damage during transportation or storage shall be replaced by the contractor at the contractor's expense.

3.2 INSTALLATION

- A. Conform to requirements of following Sections:
 - 1. Section 33 05 23.13 – Water Line Horizontal Directional Drilling
 - 2. Section 33 11 13 – Water Main Construction
- B. Install pipe in accordance with the manufacturers recommended installation procedures and ASTM D 2774.
- C. Bedding and backfill: Conform to requirements of Section 31 21 33 – Trenching, Backfilling, and Compacting for Utilities.
- D. Use only workmen trained in the installation of HDPE Pipe.
- E. Do not store pipe uncovered direct in direct sunlight. Allow pipe temperature to approach ground temperature before each individual pipe section is terminally connected.

F. Fusion joints: Meet minimum requirements of manufacturer for cool down time and other fusing requirements. Socket fusion and extrusion welding or hot gas welding will not be accepted. Join sections of HDPE pipe into continuous lengths above ground by thermal butt fusion method in accordance with AWWA C906 and pipe manufacturer's recommendations for specified service.

G. Cutting pipe: Comply with pipe manufacturer's recommendations. After cutting, leave end pipe in accordance with manufacturer's recommendations.

3.3 OWNER TRAINING (NOT USED)

END OF SECTION

SECTION 33 12 16

GATE VALVES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Gate valves
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 – Proposing Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Division 01 – General Requirements.
 - 3. Section 09 91 00 Painting and Protective Coatings.
 - 4. Section 33 11 13.04 – Hydrostatic Testing of Pipelines.
 - 5. Section 31 21 33 – Trenching, Backfilling, and Compacting for Utilities.

1.2 MEASUREMENT AND PAYMENT

- A. Unit Price.
 - 1. Payment for gate valves including valve box or supports is included in the price for the pipeline, component or device of which they are a sub component or part except:
 - a. Payment for 150 psig pressure rated Isolation Gate Valve Assembly for valves 12 inches and larger in diameter including valve, valve box, cover, flanges, fittings, and appurtenances and is on a unit price basis for each assembly installed.
 - b. Payment for 2-inch blow-off valves including box used for disinfection and flushing to bring water line into service is incidental to the water line for which it is installed for each assembly installed.

1.3 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. ASTM International (ASTM):
 - a. A 307 – Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.
 - b. B 62 – Standard Specification for Composition Bronze or Ounce Metal Casting.
 - c. D 429 – Standard Test Methods for Rubber Property-Adhesion to Rigid Substrates.

- d. B 763 – Standard Specification for Copper Alloy Sand Casting for Valve Application.
- 2. American Water Works Association (AWWA):
 - a. C 500 – Standard for Metal-Seated Gate Valves for Water Supply Service.
 - b. C 509 – Standard for Resilient-Seated Gate Valves for Water Supply Service.
 - c. C 515 – Standard for Reduced Wall, Resilient- Seated Gate Valves for Water Supply Service.
 - d. C 550 – Standard for Protective Epoxy Interior Coatings for Valves and Hydrants.

1.4 SUBMITTALS

- A. Conform to requirements of Section 01 33 00 – Submittals.
- B. Submit manufacturer's product data for proposed valves for approval.
- C. Provide detailed drawings of gearing mechanism for 20-inch and larger gate valves.

1.5 QUALITY CONTROL

- A. Submit manufacturer's affidavit that gate valves are manufactured in the United States and conform to stated requirements of AWWA C 500, AWWA C 509, AWWA C 515, and this Section, and that they have been satisfactorily tested in the United States in accordance with AWWA C 500, AWWA C 509, and AWWA C 515.

1.6 WARRANTY (NOT USED)

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Gate Valves: AWWA C 500, AWWA C 509, AWWA C 515 and additional requirements of this Section. All valves open counterclockwise.
- B. If type of valve is not indicated on Drawings, use gate valves as line valves for sizes 20-inches and smaller. When type of valve is indicated, no substitute is allowed.
- C. Gate Valves 1½ Inches in Diameter and Smaller: 125 psig or 250 psig to match adjacent piping; bronze; rising-stem; single-wedge; disc type; screwed ends.

- D. Coatings for Gate Valves 2 Inches and Larger: AWWA C 550 non-toxic, imparts no taste to water, functions as physical, chemical, and electrical barrier between base metal and surroundings, minimum 8-mil-thick, fusion-bonded epoxy. Prior to assembly of valve, apply protective coating to interior and exterior surfaces of body.
- E. Gate Valves 2 Inches to 12 Inches in Diameter: Non-directional, standard-wall resilient seated (AWWA C 509), parallel seat double disc (AWWA C 500), or reduced-wall resilient seated gate valves (AWWA C 515), 225 psig pressure rating, bronze mounting, flanged or mechanical connection ends with rubber joint rings, and nut-operated unless otherwise specified. Provide approved standard-wall resilient seated valves. Provide approved reduced-wall resilient seated valves. Provide double disc valves. Comply with following requirements unless otherwise specified in Drawings:
1. Design: Fully encapsulated rubber wedge or rubber seat ring mechanically attached with minimum 304 stainless-steel fasteners or screws; threaded connection isolated from water by compressed rubber around opening.
 2. Body: Cast or ductile iron, flange bonnet and stuffing box together with ASTM A 307 Grade B bolts. Manufacturer's initials, pressure rating, and year manufactured shall be cast in body.
 3. Bronze: Valve components in waterway to contain not more than 15 percent zinc and not more than 2 percent aluminum.
 4. Stems: ASTM B 763 bronze, alloy number 995 minimum yield strength of 40,000 psi; minimum elongation in 2-inches of 12 percent, non-rising.
 5. O-rings: For AWWA C 500, Section 3.12.2. For AWWA C 509, Sections 2.2.6 and 4.8.2. For AWWA C 515, Section 4.2.2.5.
 6. Stem Seals Consist of three O-rings, two above and one below thrust collar with anti-friction washer located above thrust collar for operating torque.
 7. Stem Nut: Independent or integrally cast of ASTM B 62 bronze.
 8. Resilient Wedge: Molded, synthetic rubber, vulcanized and bonded to cast or ductile iron wedge or attached with 304 stainless steel screws tested to meet or exceed ASTM D 429 Method B; seat against epoxy-coated surface in valve body.
 9. Bolts: AWWA C 500 Section 3.4, AWWA C 509 Section 4.4 or AWWA C 515 Section 4.4.4; stainless steel; cadmium plated, or zinc coated.
- F. Gate Valves 14 inch and larger in Diameter: AWWA C 500; parallel seat double disc gate valves with flanged or mechanical joint ends with rubber rings and nut-operated unless otherwise specified. Provide approved double disc valves with 150 psig or 250 psig pressure rating to match adjacent piping. Comply with following requirements unless otherwise specified on Drawings:

1. Body: Cast iron or ductile iron; flange together bonnet and stuffing box with ASTM A 307 Grade B bolts. Cast following into valve body manufacturer's initials, pressure rating, and year manufactured. When horizontally mounted, equip valves greater in diameter than 12 inches with rollers, tracks, and scrapers.
 2. O-rings: For AWWA C 500, Section 3.12.2. For AWWA C 515, Section 4.2.2.5.
 3. Stems: ASTM B 763 bronze, alloy number 995 minimum yield strength of 40,000 psi; minimum elongation in 2-inches of 12 percent, non-rising.
 4. Stem Nut: Machined from ASTM B 62 bronze rod with integral forged thrust collar machined to size; non-rising.
 5. Stem Seals: Consist of three O-rings, two above and one below thrust collar with anti-friction washer located above thrust collar for operating torque.
 6. Bolts: AWWA C 500 Section 3.4 or AWWA C 515 Section 4.4.4; stainless steel; cadmium plated, or zinc coated.
 7. Discs: Cast iron with bronze disc rings securely peened into machined dovetailed grooves.
 8. Wedging Device: Solid bronze or cast-iron, bronze-mounted wedges. Thin plates or shapes integrally cast into cast-iron surfaces are acceptable. Other moving surfaces integral to wedging action shall be bronze monel or nickel alloy-to-iron.
 9. Provide bypass for valve 24 inches and larger.
 10. Bronze Mounting: Built as integral unit mounted over, or supported on, cast-iron base and of sufficient dimensions to be structurally sound and adequate for imposed forces.
 11. Gear Cases: Cast iron; furnished on 18-inch and larger valves and of extended type with steel side plates, lubricated, gear case enclosed with oil seal or O-rings at shaft openings.
 12. Stuffing Boxes: Located on top of bonnet and outside gear case.
- G. Gate Valves 14 Inches to 24 Inches: Provide AWWA C 515; reduced-wall, resilient seated gate valves with 250 psig pressure rating. Furnish with spur or bevel gearing.
1. Mount valves horizontally if proper ground clearance cannot be achieved by normal vertical installation. For horizontally mounted gate valves, provide bevel operation gear mounted vertically for above ground operation.
 2. Use valve body, bonnet, wedge, and operator nut constructed of ductile iron. Fully encapsulate exterior of ductile iron wedge with rubber.
 3. Ensure wedge is symmetrical and seals equally well with flow in either direction.

4. Provide ductile iron operator nut with four flats at stem connection to apply even input torque to the stem.
5. Bolts: AWWA C515, Section 4.4.4, Stainless Steel; cadmium plated or zinc coated.
6. Provide high strength bronze stem and nut.
7. O-rings: AWWA C515, Section 4.2.2.5, pressure O-rings as gaskets.
8. Provide stem sealed by three O-rings. Top two O-rings are to be replaceable with valve fully open at full rated working pressure.
9. Provide thrust washers to the thrust collar for easy valve operation.
- H. Gate Valves Extension Stem: When shown on Drawings, provide non-rising, extension stem having coupling sufficient to attach securely to operating nut of valve. Upper end of extension stem shall terminate in square wrench nut no deeper than 4 feet from finished grade or as shown on Drawings. Support extension stem with an arm attached to wall of manhole or structure that loosely holds extension stem and allows rotation in the axial direction only.
- I. Gate Valves in Factory Mutual (Fire Service) Type Meter Installations: Conform to provisions of this specification; outside screw and yoke valves; carry label of Underwriters' Laboratories, Inc.; flanged, Class 125; clockwise to close.
- J. Gate Valves for Tapping Steel Pipe: Provide double disc gate valve. Resilient wedge gate valve not permitted unless otherwise approved by Owner's Representative.
- K. Provide flanged joints when valve is connected to steel or PCCP.
- L. Key valve stem into the operator nut.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Earthwork. Conform to applicable provisions of Section 31 21 33 – Trenching, Backfilling, and Compacting for Utilities.
- B. Operation. Do not use valves for throttling without prior approval of manufacturer.

3.2 SETTING VALVES AND VALVE BOXES

- A. Remove foreign matter from within valves prior to installation. Inspect valves in open and closed positions to verify that parts are in satisfactory working condition.
- B. Install valves and valve boxes where shown on Drawings. Set valves plumb and as detailed. Center valve boxes on valves. Carefully tamp earth around each valve box for minimum radius of 4 feet, or to undisturbed trench face when less than 4 feet. Install valves completely closed when placed in water line.

- C. For pipe section of each riser, use only 6-inch, ductile iron Class 51, or DR18 PVC pipe cut to proper length. Riser must be installed to allow complete access for operation of valve. Assemble and brace box in vertical position as indicated on Drawings.

3.3 DISINFECTION AND TESTING

- A. In the presence of Owner's Representative, perform disinfection of valves and appurtenances and test as required by Section 33 11 13.04 – Hydrostatic Testing of Pipelines.
- B. Double-Disc Gate Valves: Apply hydrostatic test pressure equal to twice rated working pressure of valve between discs. Valve shall show no leakage through metal, flanged joints, or stem seals. Test at rated working pressure, applied between discs. Valve shall show no leakage through metal, flanged joints, or stem seals. Do not exceed leakage rate of 1 oz/hr/inch of nominal valve size.
- C. Solid-Wedge Gate Valves: Apply hydrostatic pressure equal to twice rated working pressure of valve with both ends bulkheaded and gate open. Valve shall show no leakage through metal, flanged joints, or stem seals. Test at rated working pressure, applied through bulkheads alternately to each side of closed gate with opposite side open for inspection. Valve shall show no leakage through metal, flanged joints, or stem-seals. Do not exceed leakage rate of 1 oz/hr/inch of nominal valve size.
- D. Repair or replace valves which exceed leakage rate.

3.4 PAINTING OF VALVES

- A. Paint valves in accordance with Section 09 91 00 Painting and Protective Coatings.

3.5 OWNER TRAINING (NOT USED)

END OF SECTION

Section 33 13 00
DISINFECTION OF WATER LINES

PART 1 -GENERAL

1.1 SUMMARY

A. Section Includes

1. Disinfection of potable water lines.
2. Specification Section is applicable to 33 11 13.

B. Related Specification Sections include, but are not necessarily limited to:

1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
2. Division 01 - General Requirements.

1.2 MEASUREMENT AND PAYMENT

A. Unit Price. No separate payment will be made for this item. Include the cost in associated items for this project.

1.3 QUALITY ASSURANCE

A. Referenced Standards:

1. American Water Works Association (AWWA):
 - a. C 651 - Standard for Disinfecting Water Mains.

PART 2 -PRODUCTS (NOT USED)

PART 3 -EXECUTION

3.1 CONDUCTING DISINFECTION

- A. Promptly disinfect water lines constructed before tests are conducted on water lines and before water lines are connected to water distribution system. For pre-chlorinated pipe, perform disinfection procedure on sealed pipe according to AWWA standards and receive passing results (to be submitted to Owner) prior to installation.
- B. Water for disinfection and flushing will be furnished by the Owner for the first disinfection. If first disinfection fails, Contractor will reimburse Owner for additional water required for subsequent disinfections until passing results are obtained.

- C. Contractor will conduct disinfection operations.
- D. Coordinate chlorination operations through Owner's representative.

3.2 PREPARATION

- A. Provide temporary blind flanges, cast-iron sleeves, plugs, necessary service taps, copper service leads, risers and jumpers of sizes, location and materials, and other items needed to facilitate disinfection of new water lines.
- B. Install temporary blow-off valves and remove promptly upon successful completion of disinfection and testing.
- C. Slowly fill each section of pipe with water in manner approved by Owner's representative. Average water velocity when filling pipeline should be less than one foot per second and shall not, under any circumstance, exceed 2 feet per second. Before beginning disinfection operations, expel air from pipeline.
- D. Backfill excavations immediately after installation of risers or blow-offs.
- E. Install blow-off valves at end of water line to facilitate flushing of dead-end water lines. Install permanent blow-off valves according to Drawings.

3.3 DISINFECTION BY CONTRACTOR

- A. The following procedure will be used when disinfection by Contractor is required by Contract Documents:
 - 1. Use not less than 100 parts of chlorine per million parts of water.
 - 2. Introduce chlorinating material to water lines in accordance with AWWA C 651.
 - 3. After contact period of not less than 24 hours, flush system with clean water until residual chlorine is no greater than 1.0 part per million parts of water.
 - 4. Open and close valves in lines being sterilized several times during contact period.
 - 5. If chemical compound is used for sterilizing agent, place in pipes as directed by Owner's representative.

3.4 BACTERIOLOGICAL TESTING

- A. After disinfection and flushing of water lines, perform bacteriological tests by testing laboratory in accordance with Section 01 45 29 - Testing Laboratory Services. When test results indicate need for additional disinfection of water lines based upon Texas Department of Health requirements, perform additional disinfection operations.

3.5 COMPLETION

- A. Wherever possible, provide temporary blow-off on existing access manway blind flange. Upon satisfactory completion of disinfection and hydrostatic testing, remove risers and cap directly at the water line, except those approved for use in subsequent hydrostatic testing. Do not leave any portion of riser extending from water line.
- B. Where temporary blow-off is located outside access manhole or vault, backfill excavation promptly. Show blow-off locations on as-built record drawings, and note the type of cap used. If blow-off location is underneath pavement, comply with the following:
 - 1. If pavement is restored prior to completion of disinfection and hydrostatic testing, install temporary pavement over blow-off. Comply with local requirements for dimensions of temporary pavement, if applicable.
 - 2. Backfill excavation with select fill or cement stabilized sand in accordance with Section 31 21 33 – Trenching, Backfilling and Compacting for Utilities.

END OF SECTION

12-Inch Water Line Replacement Across Panther Branch at Grogan's Point Road Location Map



FILE: \\sra01\Unrestricted Resources\User Secured Directory\sarjmand\Water Line Looping\Production\2. General Notes.dwg LAYOUT: SARA General Notes DATE: 7/14/2017 2:22:47 PM BY: SARJMAND

GENERAL CONSTRUCTION NOTES

1. THERE WILL BE NO SEPARATE PAYMENT FOR WORK SHOWN ON THESE PLANS, UNLESS SPECIFICALLY ESTABLISHED IN THE BID SECTION OF THE CONTRACT DOCUMENTS. CONTRACTOR SHALL INCLUDE COST OF THIS WORK IN THE CONTRACT UNIT PRICE FOR ITEMS OF WHICH THIS WORK IS A COMPONENT OR INCIDENTAL.
2. CONTRACTOR SHALL DIAL 811 TO CONTACT EITHER TEXAS811 OR LONESTAR811 ONE-CALL CENTERS TO PROCESS UTILITY LOCATION REQUESTS A MINIMUM OF 48 HOURS PRIOR TO CONSTRUCTION TO HAVE MAIN AND SERVICE LINES FIELD LOCATED.
3. CONTRACTOR SHALL COMPLY WITH ALL FEDERAL, STATE, AND LOCAL LAWS AND ALL REGULATIONS OF UTILITY COMPANIES CONCERNING SAFETY AND HEALTH PRACTICES.
4. CONTRACTOR SHALL REMOVE ALL MUD, DIRT AND DEBRIS DEPOSITED OR DROPPED ON EXISTING PAVEMENT DUE TO HIS CONSTRUCTION ACTIVITY DAILY. MATERIAL THAT IS HAZARDOUS TO TRAFFIC SHALL BE REMOVED IMMEDIATELY.
5. THESE PLANS DO NOT EXTEND TO OR INCLUDE DESIGNS OR SYSTEMS PERTAINING TO THE SAFETY OF THE CONTRACTOR OR ITS EMPLOYEES, AGENTS, OR REPRESENTATIVES IN THE PERFORMANCE OF THE WORK. THE SEAL OF THE LICENSED PROFESSIONAL ENGINEER DOES NOT EXTEND TO ANY SUCH SAFETY SYSTEMS THAT MAY NOW OR HEREAFTER BE INCORPORATED IN THESE PLANS. THE CONTRACTOR SHALL PREPARE OR OBTAIN THE APPROPRIATE SAFETY SYSTEM(S).
6. CONTRACTOR SHALL PROTECT ALL TREES WITHIN THE WORK AREA. NO TREES WITHIN THE WORK AREA SHALL BE REMOVED WITHOUT PERMISSION OF OWNER.
7. CONTRACTOR SHALL GIVE NOTICE TO ALL AUTHORIZED INSPECTORS, SUPERINTENDENTS, OR PERSONS IN CHARGE OF PRIVATE AND PUBLIC UTILITIES OR RAILROADS AFFECTED BY HIS OPERATIONS PRIOR TO COMMENCEMENT OF WORK. CONTRACTOR SHALL OBTAIN ALL CONSTRUCTION PERMITS PRIOR TO STARTING CONSTRUCTION.
8. CONTRACTOR SHALL OBTAIN ALL PERMITS REQUIRED BY REGULATION OF MONTGOMERY COUNTY, TEXAS FOR FLOOD PLAIN MANAGEMENT PRIOR TO STARTING CONSTRUCTION.
9. CONTRACTOR SHALL OBTAIN ALL PERMITS REQUIRED BY MONTGOMERY COUNTY, TEXAS PRIOR TO STARTING CONSTRUCTION OF UTILITIES AND/OR CULVERTS WITHIN COUNTY ROAD RIGHTS-OF-WAY, IF APPLICABLE.
10. MONTGOMERY COUNTY ENGINEERING DEPARTMENT SHALL BE NOTIFIED BY WRITTEN NOTIFICATION BY THE CONTRACTOR 48 HOURS IN ADVANCE OF STARTING CONSTRUCTION, FOLLOWED BY TELEPHONE NOTIFICATION 24 HOURS IN ADVANCE OF STARTING CONSTRUCTION.
11. CONTRACTOR SHALL NOTIFY THE SAN JACINTO RIVER AUTHORITY CONSTRUCTION MANAGER IN WRITING, AND AT (936-588-3111) AT LEAST 48 HOURS PRIOR TO START OF CONSTRUCTION.
12. CONTRACTOR SHALL NOTIFY THE WOODLANDS TOWNSHIP IN WRITING AT LEAST 48 HOURS PRIOR TO START OF CONSTRUCTION, AS APPLICABLE.
13. A COPY OF ALL WRITTEN NOTIFICATIONS SHALL BE SENT TO THE OWNER.
14. CONTRACTOR SHALL PROTECT AND/OR BRACE ALL UTILITY POLES AND OTHER STRUCTURES WITHIN AND ADJACENT TO THE WORK ZONE, AS NECESSARY TO COMPLETE THE WORK.

CONTRACTOR WORK ZONE NOTES

1. CONTRACTOR WILL BE REQUIRED TO MAINTAIN TWO LANES OPEN WHEN WORKING IN BOULEVARD SECTIONS. RESIDENTIAL SECTIONS WILL MAINTAIN ONE LANE OPEN WITH ADEQUATE SIGNAGE AND FLAGMEN TO FACILITATE USE OF THE LANE. REFER TO DETAIL SHEET 1B.
2. DRIVEWAY ACCESS WILL BE MAINTAINED OPEN AFTER WORKING HOURS. A MINIMUM OF ONE DRIVEWAY ACCESS WILL BE MAINTAINED OPEN AT ALL TIMES TO COMMERCIAL, APARTMENTS, AND/OR NON-RESIDENTIAL HOMES.
3. THE LENGTH OF THE WORK ZONE MUST BE MINIMIZED WITHIN THE MONTGOMERY COUNTY ROW OR EASEMENTS. THERE SHALL NOT BE MORE THAN 200-FEET OF TRENCH OPEN AT ANY ONE TIME. THE CONSTRUCTION ZONE WILL BE A ROLLING CONSTRUCTION ZONE WITH APPROPRIATE TRANSITIONS ON EACH END.
4. SIGNALIZED INTERSECTIONS: LANES WILL NOT BE CLOSED AT A SIGNALIZED INTERSECTION, UNLESS APPROVED BY THE COUNTY ENGINEER. AN APPROPRIATE TRANSITION AS DEFINED IN THE APPROVED TRAFFIC CONTROL PLAN WILL BE PROVIDED AT SIGNALIZED INTERSECTIONS.
5. TEMPORARY PAVEMENT MARKERS: TEMPORARY EPOXY-GLUED BUTTONS OR "CONSTRUCTION GRADE" TAPE PAVEMENT MARKERS SHOULD BE USED ON PERMANENT PAVEMENT.
6. CONTRACTOR TO SUBMIT PLAN FOR APPROVAL TO ENSURE THAT PEDESTRIAN TRAFFIC CARE SHALL BE TAKEN TO PROVIDE FOR TEMPORARY PEDESTRIAN TRAFFIC AND CROSSING AT AREAS SUCH AS SCHOOLS, PARKS, AND SHOPPING AREAS.

WATER LINE CONSTRUCTION NOTES

1. CONTRACTOR SHALL ALLOW A MINIMUM OF 2-FOOT VERTICAL AND 4-FOOT HORIZONTAL CLEARANCE BETWEEN PROPOSED WATER LINES AND OTHER UTILITIES.
2. WHEN A WATER LINE IS PLACED NEAR A SANITARY SEWER MANHOLE, IT SHALL HAVE A MINIMUM OF 9 FEET WALL TO WALL SEPARATION. WHERE A WATER LINE PARALLELS A SANITARY SEWER, 9 FEET OF SEPARATION WILL BE MAINTAINED IN ALL DIRECTIONS. IF THE 9-FOOT SEPARATION CANNOT BE ACHIEVED, BOTH THE SEWER PIPE AND JOINTS SHALL HAVE PRESSURE RATING OF 150 P.S.I. AND MANHOLES SHALL BE WATER TIGHT. THE VERTICAL SEPARATION SHALL BE A MINIMUM OF 2 FEET BETWEEN OUTSIDE DIAMETERS AND THE HORIZONTAL SEPARATION SHALL BE A MINIMUM OF 4 FEET BETWEEN OUTSIDE DIAMETERS. THE SEWER SHALL BE LOCATED BELOW THE WATER LINE.
3. SEPARATION DISTANCES FOR INSTALLATION OF POTABLE WATER DISTRIBUTION LINES AND WASTEWATER COLLECTION LINES, WASTEWATER FORCE MAINS AND OTHER CONVEYANCES/APPURTENANCES IDENTIFIED AS POTENTIAL SOURCES OF CONTAMINATION MUST CONFORM TO CURRENT COMMISSION (TCEQ) RULES.

WHEN A NEW WATERLINE CROSSES UNDER A WASTEWATER MAIN OR LATERAL, THE WATERLINE SHALL BE ENCASED OR CONSTRUCTED OF DUCTILE IRON OR STEEL PIPE WITH MECHANICAL OR WELDED JOINTS AS APPROPRIATE. WHEN ENCASED, ALL SECTIONS OF WASTEWATER MAIN OR LATERAL WITHIN NINE FEET HORIZONTALLY OF THE WATERLINE SHALL BE ENCASED IN AN 18-FOOT (OR LONGER) SECTION OF PIPE. FLEXIBLE ENCASED PIPE SHALL HAVE A MINIMUM PIPE STIFFNESS OF 115 PSI AT 5.0% DEFLECTION. THE ENCASED PIPE SHALL BE CENTERED ON THE WATERLINE AND SHALL BE AT LEAST TWO NOMINAL PIPE DIAMETERS LARGER THAN THE WASTEWATER MAIN OR LATERAL. THE SPACE AROUND THE CARRIER PIPE SHALL BE SUPPORTED AT FIVE-FOOT (OR LESS) INTERVALS WITH SPACERS OR BE FILLED TO THE SPRINGLINE WITH WASHED SAND. EACH END OF THE CASING SHALL BE SEALED WITH WATERTIGHT NON-SHRINK CEMENT GROUT OR A MANUFACTURED WATERTIGHT SEAL. AN ABSOLUTE MINIMUM SEPARATION DISTANCE OF SIX INCHES BETWEEN THE ENCASEMENT PIPE AND THE WATERLINE SHALL BE PROVIDED. AN ABSOLUTE MINIMUM SEPARATION DISTANCE OF ONE FOOT BETWEEN THE WATERLINE AND THE WASTEWATER MAIN OR LATERAL SHALL BE PROVIDED. BOTH THE WATERLINE AND WASTEWATER MAIN OR LATERAL MUST PASS A PRESSURE AND LEAKAGE TEST AS SPECIFIED IN AWWA C600 STANDARDS.

WHERE A NEW POTABLE WATERLINE CROSSES AN EXISTING PRESSURE RATED WASTEWATER MAIN OR LATERAL, ONE SEGMENT OF THE WATERLINE PIPE SHALL BE CENTERED OVER THE WASTEWATER MAIN OR LATERAL SUCH THAT THE JOINTS OF THE WATERLINE PIPE ARE EQUIDISTANT AND AT LEAST NINE FEET HORIZONTALLY FROM THE CENTERLINE OF THE WASTEWATER MAIN OR LATERAL. THE POTABLE WATERLINE SHALL BE AT LEAST SIX INCHES ABOVE THE WASTEWATER MAIN OR LATERAL. WHENEVER POSSIBLE, THE CROSSING SHALL BE CENTERED BETWEEN THE JOINTS OF THE WASTEWATER MAIN OR LATERAL. IF THE EXISTING WASTEWATER MAIN OR LATERAL SHOWS SIGNS OF LEAKING, IT SHALL BE REPLACED FOR AT LEAST NINE FEET IN BOTH DIRECTIONS (18 FEET TOTAL) WITH AT LEAST 150 PSI PRESSURE RATED P.P.E.
4. ALL WATER LINES SHALL HAVE A MINIMUM 6 FOOT DEPTH OF COVER IN IMPROVED AREAS. ALL WATER LINES SHALL HAVE A MINIMUM OF 8 FOOT DEPTH OF COVER IN UNIMPROVED AREAS.
5. CONSTRUCT WATER LINES WITH ONE JOINT OF PIPE BEYOND VALVES, PLUG AND CLAMP FOR FUTURE LINES, UNLESS SHOWN ON PLANS OTHERWISE.
6. BACKFILL OF EXISTING STORM SEWER: WHEN CROSSING AN EXISTING STORM SEWER USING THE OPEN CUT METHOD, THE WATER LINE TRENCH ZONE SHALL BE BACKFILLED FOR 3 TO 5 FEET EITHER SIDE OF THE STORM SEWER WITH CEMENT STABILIZED SAND TO THE SPRING LINE OF THE STORM SEWER.
7. ADEQUATE DRAINAGE SHALL BE MAINTAINED AT ALL TIMES DURING CONSTRUCTION AND ANY DRAINAGE DITCH OR STRUCTURE DISTURBED DURING CONSTRUCTION SHALL BE RESTORED TO THE SATISFACTION OF THE OWNING AUTHORITY. ALL CONSTRUCTION STORM RUNOFF SHALL COMPLY WITH THE STORM WATER MANAGEMENT HANDBOOK FOR CONSTRUCTION ACTIVITIES AND SHALL BE IN COMPLIANCE WITH THE TEXAS POLLUTANT DISCHARGE ELIMINATION SYSTEM (TPDES) REQUIREMENTS.
8. ALL VALVES OPEN COUNTER CLOCKWISE.

PAVING CONSTRUCTION NOTES

1. REPLACEMENT PAVEMENT TO BE CONSTRUCTED IN ACCORDANCE WITH RULES, REGULATIONS AND REQUIREMENTS OF THE APPROPRIATE JURISDICTION.
2. ALL ROAD WIDTHS, CURB RADII AND CURVE ALIGNMENT SHOWN INDICATES BACK OF CURB. T.C. INDICATES TOP OF CURB ELEVATION AND T.P. INDICATES TOP OF PAVEMENT ELEVATION.
3. WHERE PROPOSED PAVEMENT IS TO MATCH EXISTING PAVEMENT, EXISTING REBARS OR DOWELS PROJECTING FROM EXISTING PAVEMENT TO BE CLEANED AND TIED INTO PROPOSED PAVEMENT. IF NO REINFORCING STEEL EXISTS, USE HORIZONTAL DOWELS. HORIZONTAL DOWELS SHALL BE #6 BARS, 24 INCHES LONG, DRILLED AND EMBEDDED 8 INCHES INTO THE CENTER OF THE EXISTING SLAB WITH "PO ROC EPOXY" OR EQUAL AT 18 INCHES CENTER TO CENTER.

UTILITY NOTES

ENTERGY (ELECTRICAL FACILITIES):

1. OVERHEAD LINES MAY EXIST ON THE PROPERTY. WE HAVE NOT ATTEMPTED TO MARK THOSE LINES SINCE THEY ARE CLEARLY VISIBLE, BUT YOU SHOULD LOCATE THEM PRIOR TO BEGINNING ANY CONSTRUCTION. TEXAS LAW SECTION 752. HEALTH AND SAFETY CODE FORBIDS ALL ACTIVITIES IN WHICH PERSONS OR THINGS MAY COME WITHIN SIX (6) FEET OF LIVE OVERHEAD HIGH VOLTAGE LINES AND OPERATING A CRANE, DERRICK, POWER SHOVEL, DRILLING RIG, PILE DRIVER, HOISTING EQUIPMENT, OR SIMILAR APPARATUS WITHIN (10) FEET OF LIVE OVERHEAD HIGH VOLTAGE LINES. PARTIES RESPONSIBLE FOR THE WORK, INCLUDING CONTRACTORS ARE LEGALLY RESPONSIBLE FOR THE SAFETY OF CONSTRUCTION WORKERS UNDER THIS LAW. THIS CARRIES BOTH CRIMINAL AND CIVIL LIABILITY.
2. CONTRACTOR SHALL COORDINATE WITH ENTERGY BEFORE WORKING WITHIN TEN (10) FEET OF OVERHEAD POWER LINES. CONTACT ENTERGY REPRESENTATIVE RICK GREENE AT (936) 525-2055. FOR POLES TO BE BRACED AND LINES TO BE DE-ENERGIZED AND/OR MOVED. CONTRACTOR SHALL BE RESPONSIBLE TO ENTERGY FOR ANY COSTS ASSOCIATED WITH BRACING OF POWER POLES OR DE-ENERGIZING AND/OR MOVING ANY CONFLICTING OVERHEAD POWER LINES.
3. TO STAKE ENTERGY UNDERGROUND FACILITIES, CONTRACTOR SHALL DIAL 811 TO CONTACT EITHER TEXAS811 OR LONESTAR811 ONE-CALL CENTERS TO PROCESS UTILITY LOCATION REQUESTS A MINIMUM OF 48 HOURS PRIOR TO CONSTRUCTION TO HAVE MAIN AND SERVICE LINES FIELD LOCATED, BEFORE STARTING EXCAVATION.
4. PRIVATE UNDERGROUND ELECTRICAL FACILITIES MAY EXIST IN THE AREA AND THESE WILL NOT BE STAKED BY ENTERGY PERSONNEL.

CENTERPOINT ENERGY (GAS FACILITIES):

1. LOCATIONS OF CENTERPOINT ENERGY MAIN LINES (TO INCLUDE CENTERPOINT ENERGY INTRASTATE PIPELINE LLC WHERE APPLICABLE) ARE SHOWN IN AN APPROXIMATE LOCATION ONLY. SERVICE LINES ARE USUALLY NOT SHOWN. OUR SIGNATURE ON THESE PLANS ONLY INDICATES THAT OUR FACILITIES ARE SHOWN IN APPROXIMATE LOCATION. IT DOES NOT IMPLY THAT A CONFLICT ANALYSIS HAS BEEN MADE. CONTRACTOR SHALL DIAL 811 TO CONTACT EITHER TEXAS811 OR LONESTAR811 ONE-CALL CENTERS TO PROCESS UTILITY LOCATION REQUESTS A MINIMUM OF 48 HOURS PRIOR TO CONSTRUCTION TO HAVE MAIN AND SERVICE LINES FIELD LOCATED.
2. WHEN CENTERPOINT ENERGY P.P.E. LINE MARKINGS ARE NOT VISIBLE, CALL (713)967-8037(7:00 AM TO 4:30 PM). FOR STATUS OF LINE LOCATION REQUEST BEFORE EXCAVATION BEGINS.
3. WHEN EXCAVATING WITHIN EIGHTEEN INCHES (18") OF THE INDICATED LOCATION OF CENTERPOINT ENERGY FACILITIES, ALL EXCAVATION MUST BE ACCOMPLISHED USING NON-MECHANIZED EXCAVATION PROCEDURES.
4. WHEN CENTERPOINT ENERGY FACILITIES ARE EXPOSED, SUFFICIENT SUPPORT MUST BE PROVIDED TO THE FACILITIES TO PREVENT EXCESSIVE STRESS ON THE PIPING.
5. THE CONTRACTOR IS FULLY RESPONSIBLE FOR ANY DAMAGES CAUSED BY THE CONTRACTOR'S FAILURE TO EXACTLY LOCATE AND PRESERVE THESE UNDERGROUND FACILITIES.

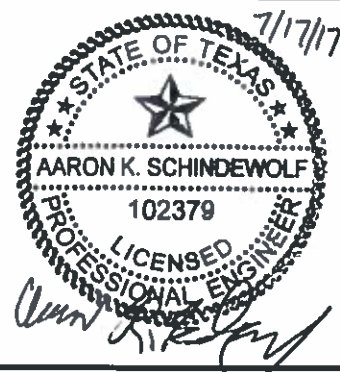
AT&T TEXAS/SWBT FACILITIES:

1. THE LOCATIONS OF AT&T TEXAS/SWBT FACILITIES ARE SHOWN IN AN APPROXIMATE WAY ONLY. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION BEFORE COMMENCING WORK. HE AGREES TO BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE OCCASIONED BY THIS FAILURE TO EXACTLY LOCATE AND PRESERVE THESE UNDERGROUND UTILITIES.
2. CONTRACTOR SHALL DIAL 811 TO CONTACT EITHER TEXAS811 OR LONESTAR811 ONE-CALL CENTERS TO PROCESS UTILITY LOCATION REQUESTS A MINIMUM OF 48 HOURS PRIOR TO CONSTRUCTION TO HAVE UNDERGROUND LINES FIELD LOCATED.
3. WHEN EXCAVATING WITHIN EIGHTEEN INCHES (18") OF THE INDICATED LOCATION OF AT&T TEXAS/SWBT FACILITIES, ALL EXCAVATIONS MUST BE ACCOMPLISHED USING NON-MECHANIZED EXCAVATION PROCEDURES. WHEN BORING, THE CONTRACTOR SHALL EXPOSE THE AT&T TEXAS/SWBT FACILITIES.
4. WHEN AT&T TEXAS/SWBT FACILITIES ARE EXPOSED, THE CONTRACTOR WILL PROVIDE SUPPORT TO PREVENT DAMAGE TO THE CONDUIT DUCTS OR CABLES. WHEN EXCAVATING NEAR TELEPHONE POLES THE CONTRACTOR SHALL BRACE THE POLE FOR SUPPORT.
5. THE PRESENCE OR ABSENCE OF AT&T TEXAS/SWBT UNDERGROUND CONDUIT FACILITIES OR BURIED CABLE FACILITIES SHOWN ON THESE PLANS DOES NOT MEAN THAT THERE ARE NO DIRECT BURIED CABLES OR OTHER CABLES IN THE AREA.
6. PLEASE CONTACT THE AT&T TEXAS DAMAGE PREVENTION MANAGER MR. ROOSEVELT LEE JR. AT (713)567-4552 OR EMAIL H.W. AT RL7259@ATT.COM, IF THERE ARE QUESTIONS ABOUT BORING OR EXCAVATING NEAR OUR AT&T TEXAS/SWBT FACILITIES.

COMMUNICATION CABLES:

1. THE LOCATION OF VARIOUS COMMUNICATION FACILITIES ARE SHOWN IN AN APPROXIMATE WAY ONLY. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION BEFORE COMMENCING WORK. HE AGREES TO BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE OCCASIONED BY THIS FAILURE TO EXACTLY LOCATE AND PRESERVE THESE UNDERGROUND UTILITIES.
2. CONTRACTOR SHALL DIAL 811 TO CONTACT EITHER TEXAS811 OR LONESTAR811 ONE-CALL CENTERS TO PROCESS UTILITY LOCATION REQUESTS A MINIMUM OF 48 HOURS PRIOR TO CONSTRUCTION TO HAVE MAIN AND SERVICE LINES FIELD LOCATED.
3. WHEN EXCAVATING WITHIN EIGHTEEN INCHES (18") OF THE INDICATED LOCATION OF COMMUNICATION FACILITIES, ALL EXCAVATIONS MUST BE ACCOMPLISHED USING NON-MECHANIZED EXCAVATION PROCEDURES. WHEN BORING THE CONTRACTOR SHALL EXPOSE THE COMMUNICATION FACILITIES.
4. WHEN COMMUNICATION FACILITIES ARE EXPOSED, THE CONTRACTOR WILL PROVIDE SUPPORT TO PREVENT DAMAGE TO THE CONDUIT DUCTS OR CABLES. WHEN EXCAVATING NEAR TELEPHONE POLES THE CONTRACTOR SHALL BRACE THE POLE FOR SUPPORT.

GROGAN'S
POINT ROAD 12"
WL
REPLACEMENT



SAN JACINTO RIVER AUTHORITY
WOODLANDS DIVISION



ISSUE	DATE	DESCRIPTION
SJRA PROJECT NO:	WDPROD901003.2N001	
FILE NAME:	2. General Notes.dwg	
DRAWN BY:		
CHECKED BY:		
SCALE:	AS SHOWN	

GENERAL NOTES

SHEET 1 OF 6

RECORD DRAWING 1 OF 5
(SEE SHEETS 3-4 FOR PROJECT
LOCATION AND DETAILS)

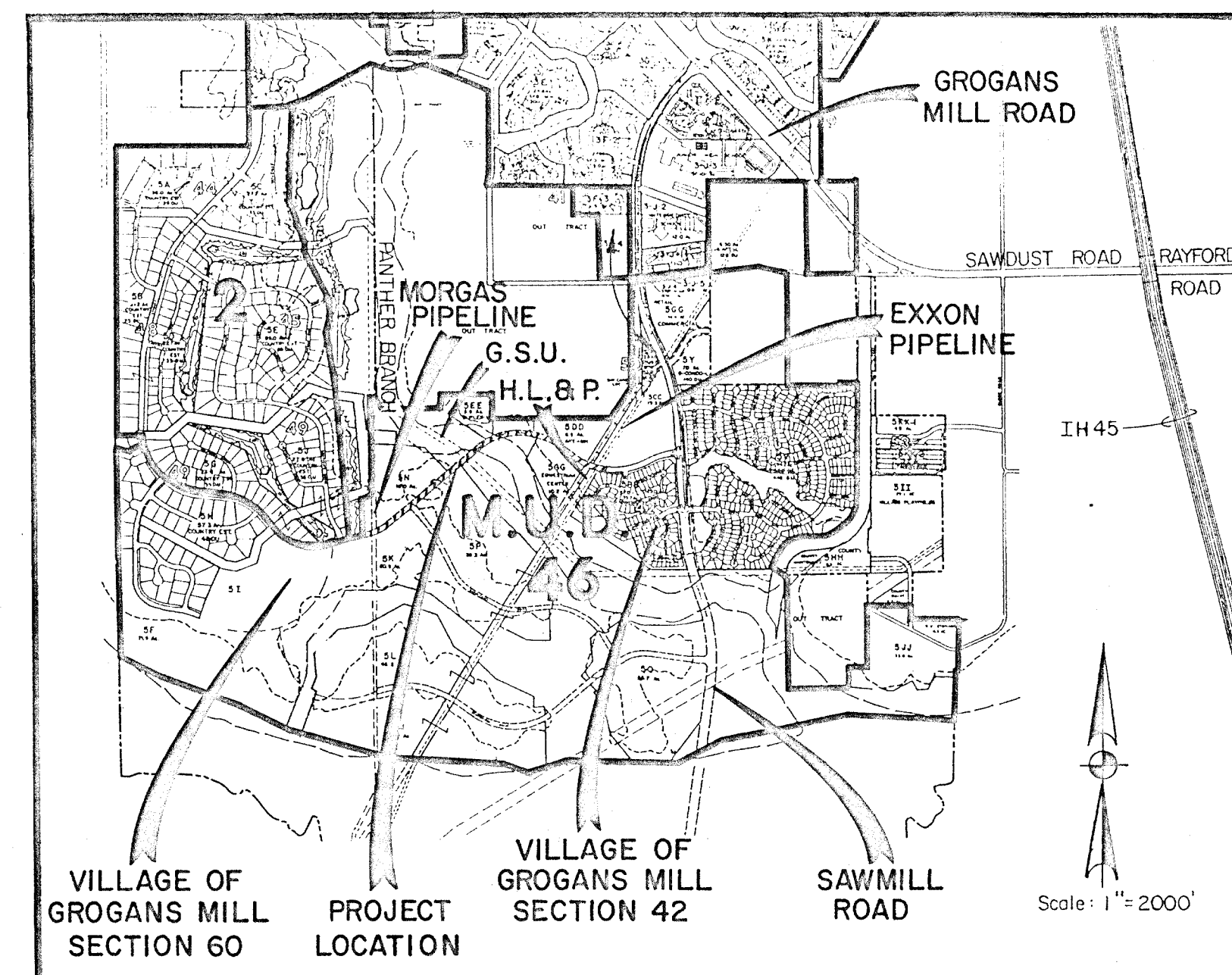
THE WOODLANDS CORPORATION
FOR THE SAN JACINTO RIVER AUTHORITY
PLANS FOR CONSTRUCTION OF
12 - INCH WATERLINE
TO SERVE
GROGANS POINT ROAD
MONTGOMERY COUNTY, TEXAS

06201990_LINE_DWG_VOGM_
GrogansPointRd_12WL_SF05a
wdust_WOfGolfCourse

SGSR Construction Company, Inc.
CONTRACTOR
By *[Signature]*
Title *V.P.*
Date *7-2-90*

The Woodlands Corporation
OWNER
By *[Signature]*
Title *S.P.*
Date *7-11-90*

SUR000238



MAP REF.: KEY MAP 412 & 452

INDEX OF DRAWINGS

SHEET NO.	SHEET TITLE
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2 OF 5	STANDARD LEGEND AND CONSTRUCTION NOTES AND MISCELLANEOUS DETAILS
3 OF 5	GROGANS POINT ROAD WATERLINE LAYOUT
4 OF 5	P & P - GROGANS POINT ROAD WATERLINE STA. 9+95 TO STA. 36+00
5 OF 5	P & P - GROGANS POINT ROAD WATERLINE STA. 36+00 TO STA. 46+20

Turner Collier & Braden Inc.
ENGINEERS • PLANNERS

JOB NO. 23-01180-260 CONTRACT NO. 1
DATE: FEBRUARY, 1990

GROGAN'S POINT 12" WL
REPLACEMENT
SHEET 2 OF 6

ID - 317 - Grogans Point Road
12" WL, VOGM, 1990
South of Sawdust Road, West of golf course

RECORD DRAWING 2 OF 5

LEGEND

FIGURE (By Field)	FIGURE (By Office)	FIGURE (By Office)
<p>Face of Curb & Inlet W/ Direction of Flow</p>	<p>Face of Curb & Inlet W/ Direction of Flow</p>	<p>Face of Curb & Inlet W/ Direction of Flow</p>
<p>Waterline Valve, Flushing Valve, Plug, Stop-Off & Plug</p>	<p>Waterline Valve, Flushing Valve, Reducer, Stop-Off & Plug</p>	<p>Waterline Valve, Flushing Valve, Reducer, Stop-Off & Plug</p>
<p>Storm Sewer, Manhole & Plug (Smaller than 30")</p>	<p>Storm Sewer, Manhole & Plug (Smaller than 30")</p>	<p>Storm Sewer, Manhole & Plug (Smaller than 30")</p>
<p>Storm Sewer, Manhole & Plug (30" & Larger)</p>	<p>Storm Sewer, Manhole & Plug (30" & Larger)</p>	<p>Storm Sewer, Manhole & Plug (30" & Larger)</p>
<p>Sanitary Sewer, Plug, Manhole, Stack, Valve & Clean Out</p>	<p>Sanitary Sewer, Plug, Manhole, Stack, Valve & Clean Out</p>	<p>Sanitary Sewer, Plug, Manhole, Stack, Valve & Clean Out</p>
<p>Travel Way Shoulder</p>	<p>Travel Way Shoulder</p>	<p>Travel Way Shoulder</p>
<p>Edge of Asphalt Pavement</p>	<p>Edge of Asphalt Pavement</p>	<p>Edge of Asphalt Pavement</p>
<p>Curb & Direction of Flow</p>	<p>Curb & Direction of Flow</p>	<p>Curb & Direction of Flow</p>




MISCELLANEOUS PLAN

GENERAL CONSTRUCTION NOTES

1. Alignment, centerline curve data and stationing to be verified from approved subdivision plat, or approved plot.
2. Contractor to verify location and elevation of existing facilities prior to construction of proposed facilities. No separate pay.
3. Contractor will take all due precautions to protect existing facilities from damage. Any damage to existing facilities incurred as a result of construction operations will be repaired by the Contractor at his own expense.
4. The survey information upon which the design of these plans are based was provided by The Woodlands Corporation. Turner Collie & Braden disclaims any responsibility for the accuracy of the data provided.
5. Contractor to obtain all construction permits required by the regulations of Montgomery County, Texas at his expense prior to commencement of work.
6. Contractor shall give notice to all authorized inspectors, superintendents, or persons in charge of private and public utilities or railroads affected by his operations prior to commencement of work. Contractor shall assure himself that all construction permits have been obtained prior to commencement of work. Required permits that can only be issued to Contractor will be obtained at his expense.
7. Montgomery County Engineering Department to be notified 48 hours in advance of construction, telephone number 409-539-7833.
8. Note - Contractor shall contact the following a minimum of 48 hours prior to beginning construction:

Gulf States Utilities Mr. John Petitjean 713-353-0207
S.W. Bell Telephone Mr. Dewey Lawhorn 713-320-1247
WDLCS Cable TV Mr. Ron Crowe 713-363-0975
Entex Mr. Masoom Ali 713-654-5146

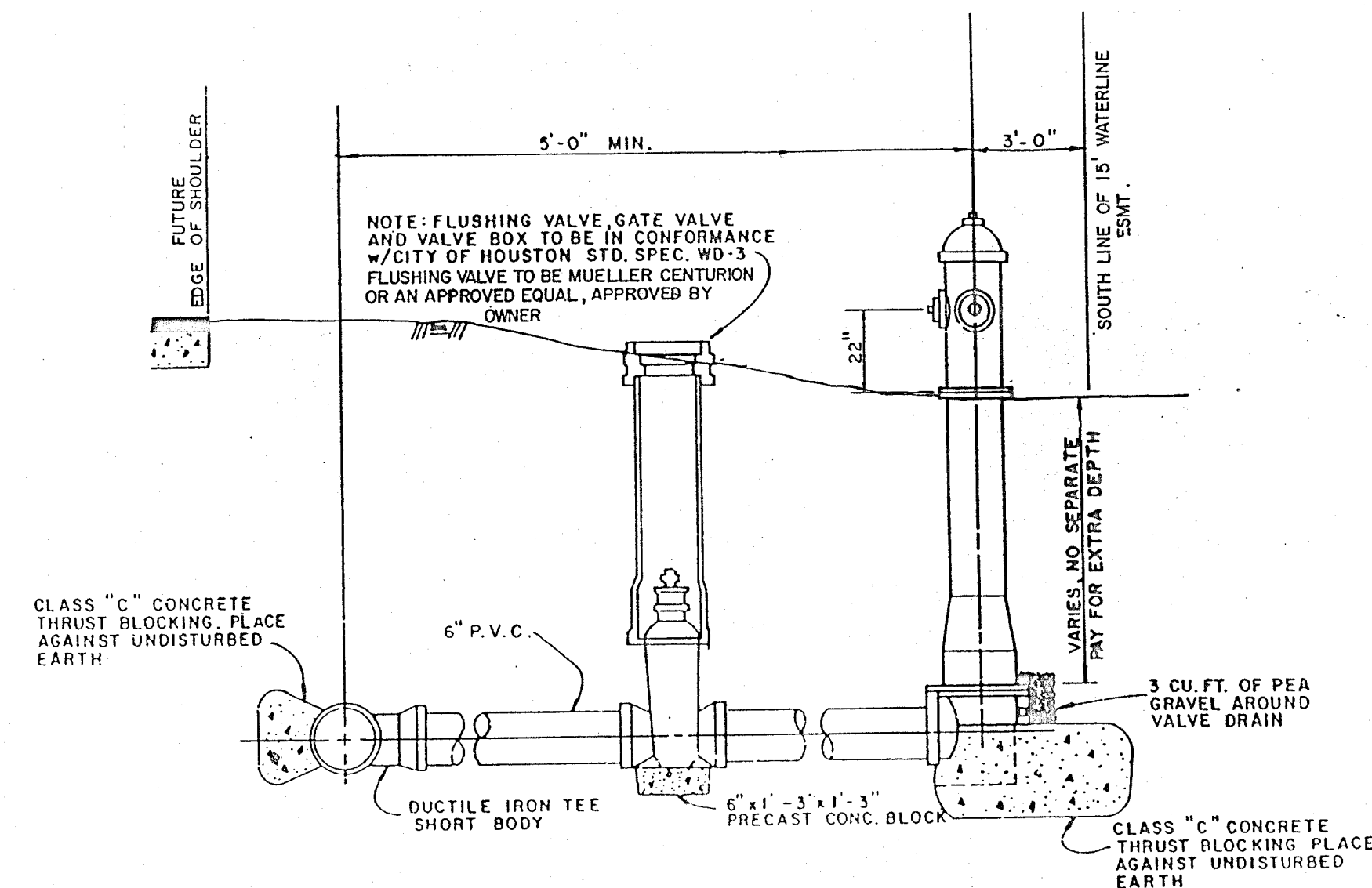
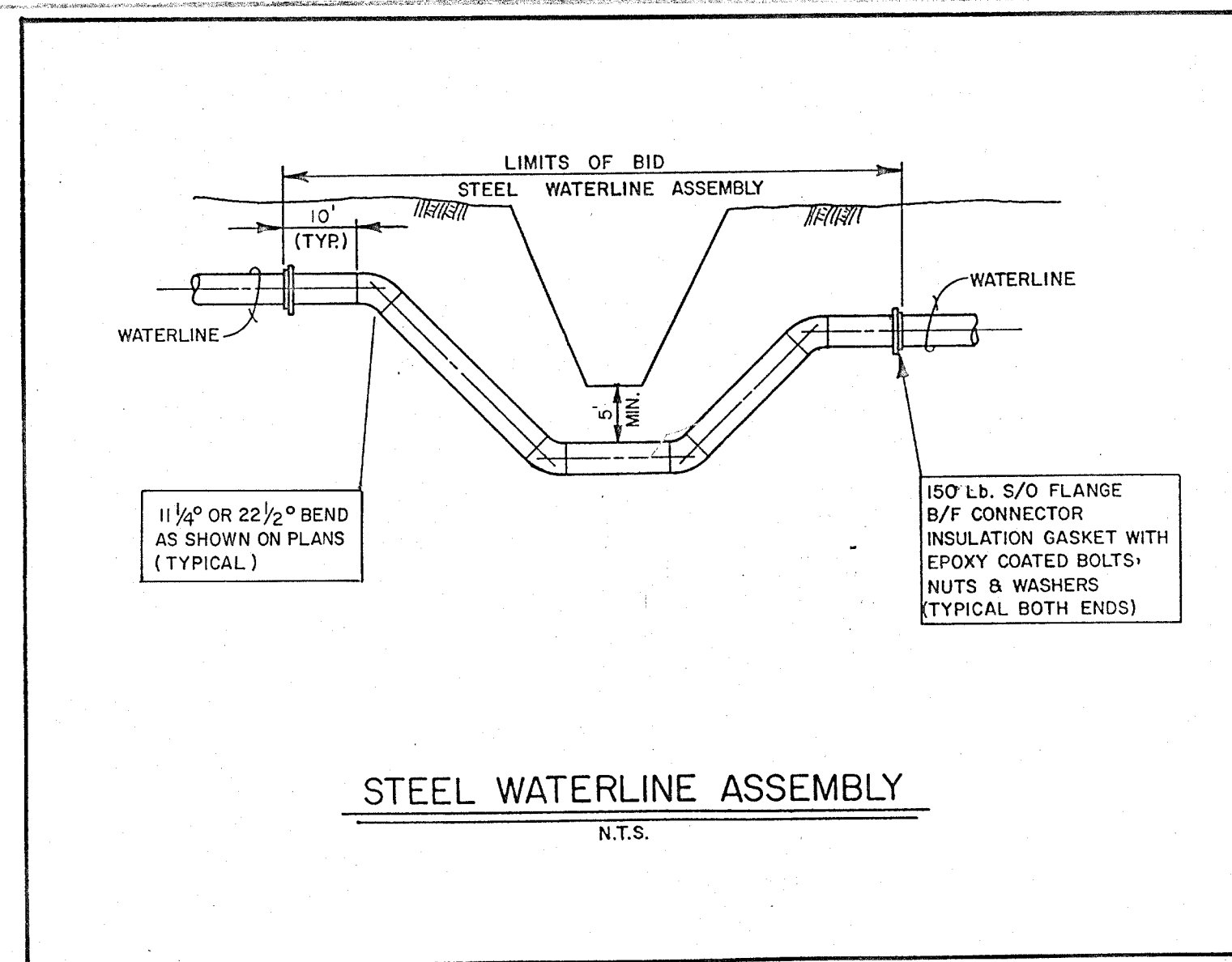
Montgomery Co. Engr.	Mr. Mark Mooney	713-353-9792
Montgomery Co. Precinct No. 3		713-367-3977
SJRA	Mr. David Abernethy	713-367-9511
Utility Coordination Committee		713-223-4567
Houston Lighting & Power	Mr. Sam Sullivan	713-623-3106
Morgas (Moran Pipeline)	Mr. Dale Kelldorf	409-756-4431 1-800-752-8036
Exxon Pipeline Co.	Mr. Domingo Gutierrez	713-470-4486

9. These Plans, prepared by Turner Collie & Braden, Inc., do not extend to or include designs or systems pertaining to the safety of the Contractor or its employees, agents or representatives in the performance of the work. The seal of Turner Collie & Braden Inc.'s Registered Professional Engineer's hereon does not extend to any such Safety Systems that may now or hereafter be incorporated in these Plans. The Contractor shall prepare or obtain the appropriate safety systems, including the plans and specifications required by the "House Bill 667" and 665 enacted by the Texas Legislature in the 70th Legislature Regular Session."
10. Contractor will clear to limits as shown on sht. 3 of 5. 
11. Contractor shall seed entire clearing limits and any other areas he has disturbed. (No Separate Pay.) 
12. All excess excavation shall be spread evenly and sloped to drain over entire clearing limits except between sta. 24+00 to sta. 31+00 and except across 80' drainage easement. (No Separate Pay.) 
13. All excavated areas within Panther Branch and 89' Drainage Easement to be replaced to its original condition.

14. When installing waterline across Panther Branch and 80' channel easement, contractor may be required to construct site grading, cofferdams, ditches and/or other suitable means to prevent surface water from flowing into excavation or ponding in area where waterline trench will be located. No separate pay. Include cost of site drainage and/or surface water control in contract cost of waterline construction. Contractor is responsible for maintaining Panther Branch and 80' channel easement and restoration of disturbed areas to their original condition, at no additional cost to Owner.

WATERLINE CONSTRUCTION NOTES

1. Waterline construction, testing, and materials to be in accordance with City of Houston Water Division Specifications for water main Construction WD-3, dated October, 1985 (latest revision November 6, 1989 and latest amendment thereto) Contractor to provide adequate concrete thrust blocking at all Tees, Wyes, Bends, Crosses, Flushing Valves, Valves and offsets to withstand test pressure as specified in WD-3. No separate pay.
2. Waterline trenches shall be excavated, BEDDED and BACKFILLED in accordance with the special provision to WD-3 (latest revision APRIL II, 1990) INCLUDE COST OF BEDDING AND BACKFILL IN UNIT PRICE BID PER LINEAR FOOT OF PIPE.
3. All pipe joints to be gasketed push-on type unless otherwise noted.
4. Fittings to be ductile iron (all bell) unless otherwise noted, and wrapped with polyethylene in accordance with WD-3. Cost of fittings to be included in unit price bid per linear foot of waterline pipe.
5. Waterline to have normal cover as shown on plans.
6. Steel waterline to conform to WD-3 and AWWA C-200. All other waterline to be Polyvinyl Chloride (PVC), AWWA C900, DR18, Class 150.
7. Valves are to be equipped with operating nut extensions to within two (2) feet of natural ground.
8. Centerline of flushing valves to be located three (3) feet inside 15' waterline easement with centerline of steamer nozzle twenty-two (22) inches above finished grade. See Detail.
9. Flushing valve unit consists of: One line size x (by) six (6) inch tee, six (6) inch lead, six (6) inch gate valve with box, and one flushing valve with 5 feet minimum bury. See Detail.
10. Flushing valve top assembly shall be painted reflective white color equal to 3M Scotch Lite Reflective Liquid #7216 and the lower assembly, below hood or its equivalent, to ground line shall be painted green color equal to Pratt & Lambert "Jungle Green" #G601-A. For twelve (12) inch lines or larger, paint the hose connection closest to the pavement reflective white.
11. All flushing valves to be Mueller Centurion type or an approved equal, approved by Owner.



STANDARD FLUSHING VALVE UNIT DETAIL
FOR OPEN DITCH STREETS

SCALE: N.T.S

MONTGOMERY COUNTY
 COUNTY ENGINEER J. D. Blanton
 DATE: 6-22-90
 APPROVED FOR CITY OF HONOLULU
 DEPARTMENT OF PUBLIC WORKS
 D. Henderson 5-16-90
 Assistant Engineer
 E. H. Helms 5.11.90
 William J. B. 5.19.90
 Assistant Director, Water Use
 Assistant Engineer
 Date: 6-19-90
 OTHER DEPT'S

5-23-90 REVISE GEN. CONST. NOTES NO. 10, II, AND 12 PER ADDENDUM NO. I.

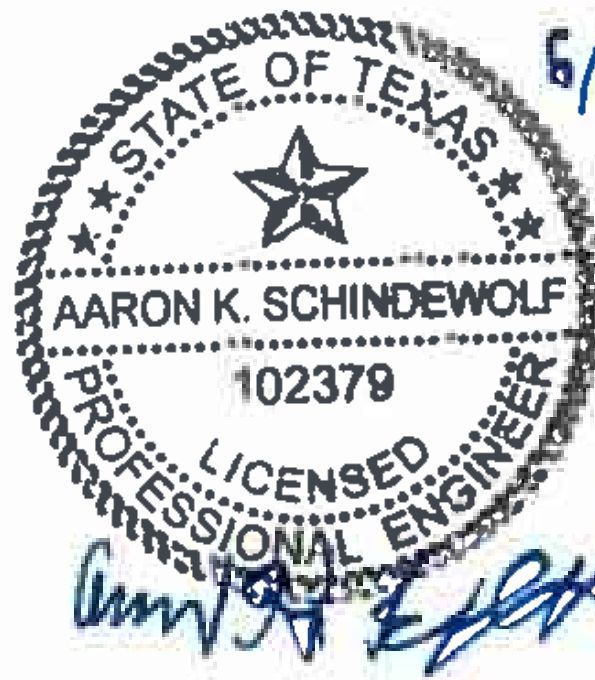
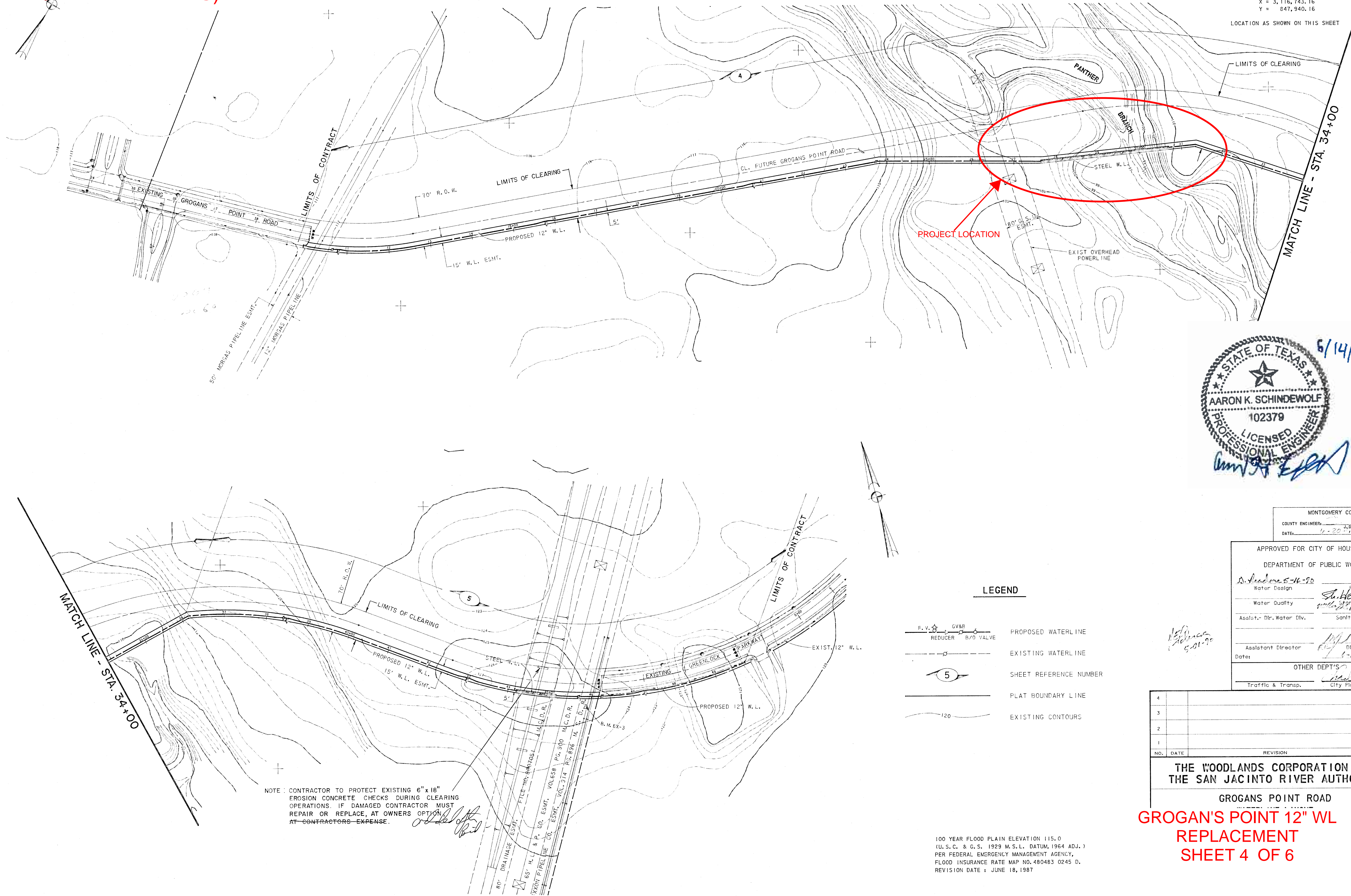
THE WOODLANDS CORPORATION FOR
THE SAN JACINTO RIVER AUTHORITY

GROGANS POINT ROAD WATERLINE STANDARD LEGEND, CONSTRUCTION NOTES AND MISCELLANEOUS DETAILS

**GROGAN'S POINT 12" WL
REPLACEMENT
SHEET 3 OF 6**

RECORD DRAWING 3 OF 5
(SEE SHEETS 3-4 FOR PROJECT
LOCATION AND DETAILS)

WOODLANDS CORPORATION MONUMENTATION
U.S.C. & G.S. 1929 M.S.L. DATUM (1964 ADJ.)
CONCRETE MONUMENT WITH BRASS CAP.
BENCH MARK NO. EX-3
ELEVATION : 125.39
X = 3,116,743.16
Y = 847,940.16
LOCATION AS SHOWN ON THIS SHEET



LEGEND

- F.V. REDUCER GV&B B/O VALVE
- PROPOSED WATERLINE
- EXISTING WATERLINE
- 5 SHEET REFERENCE NUMBER
- PLAT BOUNDARY LINE
- EXISTING CONTOURS

NOTE: CONTRACTOR TO PROTECT EXISTING 6"x18" EROSION CONCRETE CHECKS DURING CLEARING OPERATIONS. IF DAMAGED CONTRACTOR MUST REPAIR OR REPLACE, AT OWNERS OPTION, AT CONTRACTORS EXPENSE.

MONTGOMERY COUNTY		
COUNTY ENGINEER:	J. G. Stanton	
DATE:	6-20-18	
APPROVED FOR CITY OF HOUSTON 9		
DEPARTMENT OF PUBLIC WORKS:		
Water Design	D. Anderson 5-16-18	
Water Quality	S. Helms 5/1/18	
Asst. Dir. Water Div.	Sanitary Sewer	
Asst. Director	Director	
DATE:	6-17-18	
OTHER DEPT'S		
Traffic & Transp.	City Planning Dept.	

THE WOODLANDS CORPORATION FOR
THE SAN JACINTO RIVER AUTHORITY
GROGANS POINT ROAD
GROGAN'S POINT 12" WL
REPLACEMENT
SHEET 4 OF 6

100 YEAR FLOOD PLAIN ELEVATION 115.0
(U.S.C. & G.S. 1929 M.S.L. DATUM, 1964 ADJ.)
PER FEDERAL EMERGENCY MANAGEMENT AGENCY,
FLOOD INSURANCE RATE MAP NO. 480483 0245 D.
REVISION DATE : JUNE 18, 1987



Diagram illustrating a highway curve layout. The curve is defined by a dashed line and a solid line. Key features include:

- Match Line:** Indicated by a diagonal line labeled "MATCH LINE - - STA. 36+00".
- Curve Data:**
 - STA. 36+15.00
 - X. 3, 115, 093.71
 - Y. 048, 399.49
- Stationing:**
 - 36
 - 37
 - 38
 - 39
 - 40
- Curve Data Box:**
 - STA. 38+30
 - 12" x 6" TEE
 - 12" G. V. & R.
 - 6" G. V. & B.
 - F. V. (6' MIN. BURY)
- Curve Data Table:**

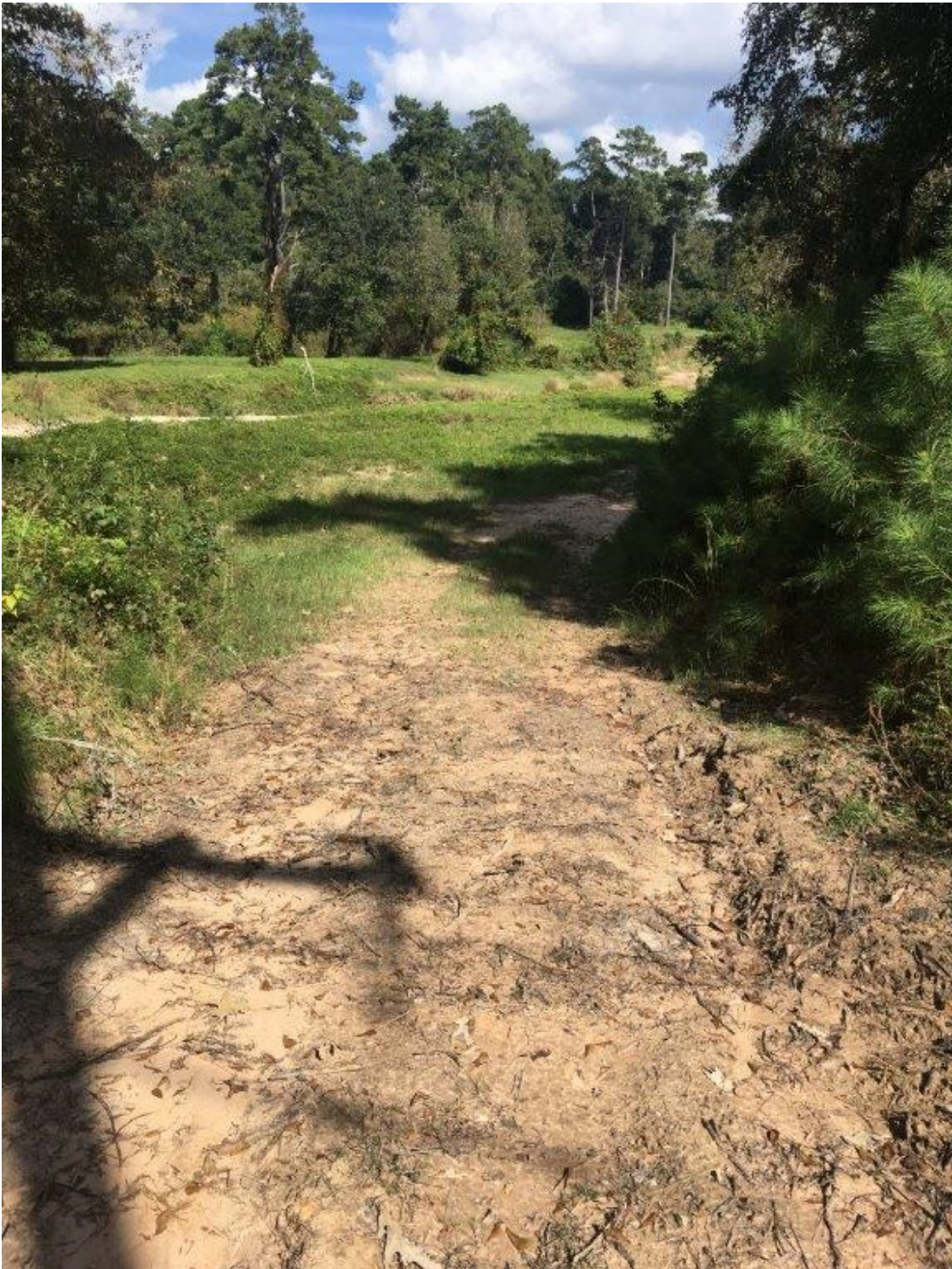
E CURVE DATA	
L=	397.28'
Δ=	26° 18' 55"
R=	661.00'
- Other Labels:**
 - 12" x 11 1/4" BEND
 - 3'
 - 3'



REVISION	APPROVAL

PLAN & PROFILE
GROGANS POINT ROAD WATERLINE





ACCESS

TO PROJECT SITE FROM DEAD-END OF GROGAN'S POINT ROAD (WEST END) (PAGE 3 OF 10)

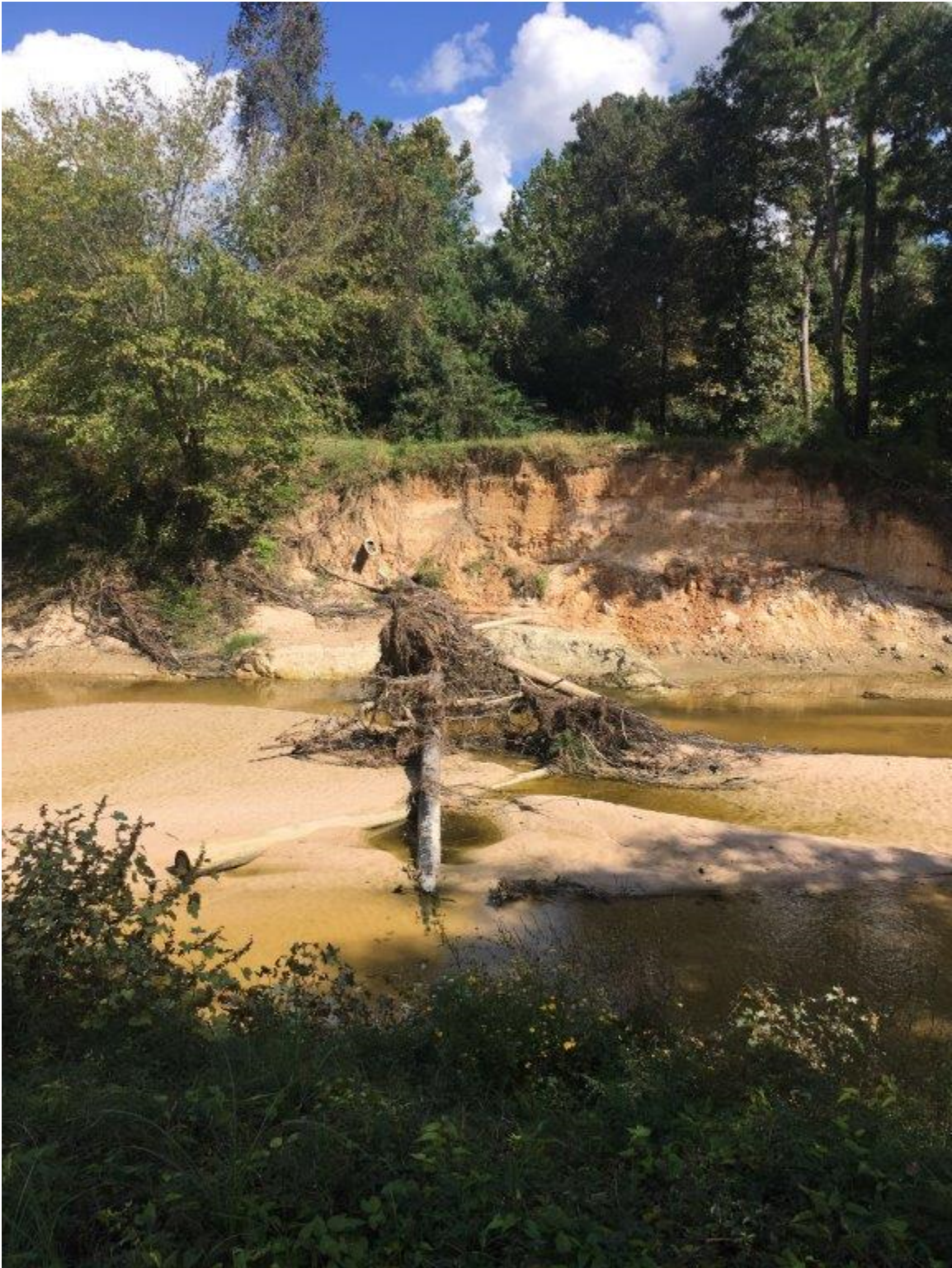


















































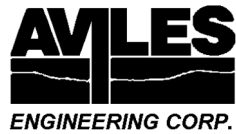












**GEOTECHNICAL INVESTIGATION
SAN JACINTO RIVER AUTHORITY
12 INCH WATER LINE REPLACEMENT CROSSING
PANTHER BRANCH AT GROGAN'S POINT ROAD
THE WOODLANDS, TEXAS**

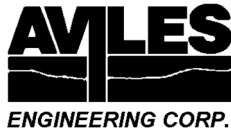
**Reported to
SJRA Technical Services Department
The Woodlands, Texas**

by

**Aviles Engineering Corporation
5790 Windfern
Houston, Texas 77041
713-895-7645**

REPORT NO. G152-18

November 2018



5790 Windfern Road
Houston, Texas 77041
Tel: (713)-895-7645
Fax: (713)-895-7943

November 5, 2018

Mr. Aaron K. Schindewolf, P.E.
SJRA Technical Services Department
2436 Sawdust Road
The Woodlands, TX, 77380

**Reference: Geotechnical Investigation
 San Jacinto River Authority
 12 inch Water Line Replacement crossing
 Panther Branch at Grogan's Point Road
 The Woodlands, Texas
 AEC Report No. G152-18**

Dear Mr. Schindewolf,

Aviles Engineering Corporation (AEC) is pleased to present this report of the results of our geotechnical investigation for the above referenced project. This investigation was authorized to proceed by you on September 4, 2018. The project terms and conditions are based upon the Professional Services Agreement (Contract No. 18-0039) between SJRA and AEC dated March 26, 2018, and the scope of work was performed in accordance with SJRA Work Order No. 2 dated August 13, 2018, based upon AEC Proposal No. G2018-07-07, dated July 20, 2018.

AEC appreciates the opportunity to be of service to you. Please call us if you have any questions or comments concerning this report or when we can be of further assistance.

Respectfully submitted,
Aviles Engineering Corporation
(TBPE Firm Registration No. F-42)

A handwritten signature in black ink, appearing to read "Jacob Garza".

Jacob Garza, E.I.T.
Staff Engineer



A handwritten signature in blue ink, appearing to read "Wilber L. Wang".

Wilber L. Wang, P.E.
Senior Engineer

Reports Submitted: 1 SJRA Technical Services Department (electronic)
 1 File (electronic)

Z:\ENGINEERING\REPORTS\2018\G152-18 12 INCH WATER LINE REPLACEMENT CROSSING PANTHER BRANCH AT GROGAN'S POINT ROAD - SJRA (JACOB)\G152-18 FINAL.DOCX

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Appendix A

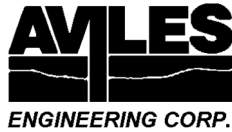
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**GEOTECHNICAL INVESTIGATION
SAN JACINTO RIVER AUTHORITY
12 INCH WATER LINE REPLACEMENT CROSSING
PANTHER BRANCH AT GROGAN'S POINT ROAD
THE WOODLANDS, TEXAS**

1.0 INTRODUCTION

1.1 Project Description

This report presents the results of a geotechnical investigation performed by Aviles Engineering Corporation (AEC) for the proposed water line replacement crossing Panther Branch at Grogan's Point Road. The project is located to the northeast of the intersection of Grogan's Point Road and North Tranquil Path, in The Woodlands, Texas. A vicinity map is presented on Plate A-1, in Appendix A.

AEC understands that an existing San Jacinto River Authority (SJRA) 12 inch diameter water line crossing Panther Branch has been exposed and damaged due to severe erosion within Panther Branch. Based on the schematic drawings provided by SJRA Technical Services Department on June 14, 2018, approximately 760 linear foot of 12 inch diameter water line crossing beneath Panther Branch will be replaced. The replacement water line will be installed by horizontal directional drill (HDD) method. In addition, AEC anticipates that the replacement water line will require two pits to connect the new line with the existing water line on either end.

1.2 Purpose and Scope

The purpose of this geotechnical investigation is to evaluate the subsurface soil and ground water conditions at the project site and to develop geotechnical engineering recommendations for the replacement water line. The scope of this geotechnical investigation is summarized below:

1. Drilling and sampling two soil borings ranging from a depth of 40 to 50 feet below existing grade;
2. Performing soil laboratory testing on selected soil samples;
3. Engineering recommendations for the replacement water line to be installed by HDD, including design parameters, loadings on the water line, and face stability;
4. Engineering recommendations for the pits, including excavation, shoring, and backfill;
5. Construction guidelines for the water line and the pits, including dewatering recommendations.

Recommendations for restoration of Panther Branch at the water line crossing is beyond AEC's scope of service.

2.0 SUBSURFACE EXPLORATION

Subsurface conditions at the site were investigated by drilling two soil borings ranging from a depth of 40 to 50 feet below existing grade in the proximity of the proposed replacement water line. The approximate boring locations are shown on the Boring Location Plan on Plate A-2, in Appendix A. Boring survey data was not available at the time this report was prepared; however, AEC compared the GPS coordinates against as built drawings (dated February 1990) provided by SJRA in order to estimate the approximate surface elevation of the borings.

AEC notes that Borings B-1 and B-2 were drilled along the approximate alignment of the proposed replacement water line on the south side of Panther Branch only. Due to site access issues, borings were not able to be performed on the north side of Panther Branch. AEC notes that the soil and groundwater conditions along channels in the Greater Houston area vary significantly. It is possible that different soil and groundwater conditions could be encountered during construction of the water line on the north side of Panther Branch. AEC recommends that additional soil borings be performed on the north side of Panther Branch in order to provide additional coverage of the proposed replacement water line alignment. If additional soil borings are not performed, AEC will not be liable if changed soil or groundwater conditions are encountered at areas along the project alignment that are not currently covered by AEC's current borings.

The borings were drilled using a truck-mounted drill rig and were advanced using dry auger method and then completed using wet rotary method once groundwater was encountered or the borings began to cave in. Undisturbed samples of cohesive soils were obtained from the borings by pushing 3-inch diameter thin-wall, seamless steel Shelby tube samplers in accordance with ASTM D 1587. Granular soils were sampled with a 2-inch split-barrel sampler in accordance with ASTM D 1586. Standard Penetration Test resistance (N) values were recorded for the granular soils as "Blows per Foot" and are shown on the boring logs. The undisturbed samples of cohesive soils were extruded mechanically from the core barrels in the field and wrapped in aluminum foil; all samples were sealed in plastic bags to reduce moisture loss and disturbance. The samples were then placed in core boxes and transported to the AEC laboratory for testing and further study. After completion of drilling, the boreholes were left open overnight so that a 24 hour groundwater reading could be obtained. Afterwards, the borings were backfilled with bentonite chips. Details of the soils encountered in the borings are presented on Plates A-3 and A-4, in Appendix A.

3.0 LABORATORY TESTING

Soil laboratory testing was performed by AEC personnel. Samples from the borings were examined and classified in the laboratory by a technician under supervision of a geotechnical engineer. Laboratory tests were performed on selected soil samples in order to evaluate the engineering properties of the foundation soils in accordance with applicable ASTM Standards. Atterberg limits, moisture contents, percent passing a No. 200 sieve, sieve analysis, and dry unit weight tests were performed on representative samples to establish the index properties and confirm field classification of the subsurface soils. Strength properties of cohesive soils were estimated by means of unconfined compression (UC) and Unconsolidated-Undrained (UU) triaxial tests performed on undisturbed samples. The test results are presented on their representative boring logs. A key to the boring logs, classification of soils for engineering purposes, terms used on boring logs, and reference ASTM Standards for laboratory testing are presented on Plates A-5 through A-8, in Appendix A. The results of the sieve analyses are presented on Plates A-9 through A-11, in Appendix A.

Double Hydrometer Tests: To evaluate the dispersive characteristics of clayey soil at Panther Branch, a double hydrometer test was performed on a selected soil sample in accordance with ASTM D 4221. The results of the double hydrometer test is summarized in Table 1, and is presented on Plate A-12, in Appendix A. When the percent dispersion is less than 30, it indicates that the soil is non-dispersive. When the percent dispersion is equal to 30 but less than 50, it indicates that the soil is intermediately dispersive. When the percent dispersion is greater than 50, it indicates that the soil is dispersive.

Table 1. Summary of Double Hydrometer Test Results at Panther Branch

Sample ID and Description	Dispersion (%)	Dispersion Classification
B-2, 10'-12', Sandy Lean Clay (CL)	40.3	Intermediately Dispersive

Crumb Dispersion Tests: To evaluate the dispersive characteristics of clayey soils at Panther Branch, two crumb tests were performed on selected soil samples in accordance with ASTM D 6572, Method A. The results of the crumb tests are summarized on Table 2 and are presented on Plate A-13, in Appendix A.

Table 2. Summary of Crumb Test Results at Panther Branch

Sample ID and Description	Dispersive Grade	Dispersive Classification
B-1, 4'-6', Silty Sand (SM)	2	Intermediate

Sample ID and Description	Dispersive Grade	Dispersive Classification
B-2, 10'-12', Sandy Lean Clay (CL)	4	Highly dispersive

4.0 SITE CONDITIONS

Based on AEC's site visit, the project area is a clearing along the south bank of Panther Branch. The existing banks of Panther Branch have experienced significant erosion. AEC understands that the existing broken water line will be abandoned and the replacement water line will be installed via HDD. The north side of Panther Branch could not be accessed by AEC's drill rig at the time of our site visit.

4.1 Subsurface Conditions

Soil strata encountered in our borings are summarized below:

<u>Boring</u>	<u>Depth (ft)</u>	<u>Description of Stratum</u>
B-1	0 - 4	Fill: medium dense, Silty Sand (SM)
	4 - 16.5	Loose to medium dense, Silty Sand (SM)
	16.5 - 18	Very loose, Clayey Sand (SC), with fat clay pockets, wet
	18 - 21	Soft to firm, Fat Clay (CH)
	21 - 36	Medium dense to very dense, Silty Sand (SM), wet
	36 - 40	Dense, Clayey Sand (SC), with fat clay pockets and gravel, wet
B-2	0 - 2	Poorly Graded Sand with Silt (SP-SM), with roots
	2 - 8	Very loose to loose, Silty Sand (SM)
	8 - 12	Firm to stiff, Sandy Lean Clay (CL), with fat clay pockets
	12 - 14	Very loose, Clayey Sand (SC), wet
	14 - 33	Loose to medium dense, Poorly Graded Sand (SP), wet
	33 - 36	Medium dense, Clayey Sand (SC), with gravel, wet
	36 - 48	Very stiff to hard, Sandy Lean Clay (CL)
	48 - 50	Very stiff to hard, Fat Clay (CH), with lean clay pockets

Details of the soils encountered during drilling are presented on the boring logs. The cohesive soils encountered in the borings have a Liquid Limit (LL) of 38 and Plasticity Index (PI) of 23. The cohesive soils encountered are classified as "CL" and "CH" type soils and the granular soils are classified as "SM", "SC", "SP-SM" and "SP" type soils in accordance with ASTM D 2487. High plasticity clays can undergo significant volume changes due to seasonal changes in moisture contents. "CH" soils undergo significant volume changes due to seasonal changes in moisture contents. "CL" type soils with lower LL (less than 40) and PI (less than 20) generally do not undergo significant volume changes with changes in moisture content. However, "CL" soils with LL

approaching 50 and PI greater than 20 essentially behave as “CH” soils and could undergo significant volume changes.

Groundwater: Groundwater levels and boring cave-in depths encountered during drilling are presented in Table 3. Based on Table 3, groundwater along portions of the alignment is likely to be pressurized.

Table 3. Groundwater Depths below Existing Ground Surface

Boring No.	Date Drilled	Boring Depth (ft)	Groundwater Depth (ft)	Boring Cave in Depth (ft)
B-1	9/21/2018	40	14 (Drilling) 10.4 (9/22/2018)	11.2 (Drilling)
B-2	9/20/2018	50	8 (Drilling) 5.4 (15 min.)	5.4 (Drilling)

The information in this report summarizes conditions found on the dates the borings were drilled. It should be noted that our groundwater observations are short-term; groundwater depths and subsurface soil moisture contents will vary with environmental variations such as frequency and magnitude of rainfall, and the time of year when construction is in progress.

4.2 Hazardous Materials

No signs of visual staining or odors were encountered during field drilling or during processing of the soil samples in the laboratory.

4.3 Subsurface Variations

It should be emphasized that: (i) at any given time, ground water depths can vary from location to location, and (ii) at any given location, ground water depths can change with time. Ground water depths will vary with seasonal rainfall and other climatic/environmental events. Subsurface conditions may vary at locations away from the borings and in between borings.

Clay soils in the Houston area typically have secondary features such as slickensides, calcareous nodules, and contain sand/silt seams/lenses/layers/pockets. It should be noted that the information in the boring logs is based on 3-inch diameter soil samples and the soil samples were obtained continuously at intervals of 2 feet from the ground surface to a depth of 20 feet in the borings, then at intervals of 5 feet thereafter to the boring termination

depths. A detailed description of the soil secondary features may not have been obtained due to the small sample size and sampling interval between the samples. Therefore, while a boring log shows some soil secondary features, it should not be assumed that the features are absent where not indicated on the boring logs.

5.0 ENGINEERING ANALYSIS AND RECOMMENDATIONS

Based on the schematic drawings provided by SJRA on June 14, 2018, AEC understands that the proposed improvement is a replacement 760 linear feet 12 inch diameter water line, to be installed by HDD method. The replacement water line will require the excavation of two pits to connect to existing 12 inch diameter water line on either end. AEC anticipates that the entrance and exit pit will require a minimum depth matching the invert depth of the existing water line. Based on the provided schematic drawings, the existing water line invert depth at the entrance pit (i.e. south bank) is approximately 6 feet while the existing water line invert depth at the exit pit (i.e. north bank) is approximately 6.5 feet.

5.1 Water Lines Installed by Horizontal Directional Drilling Method

We understand that the replacement water line will be installed by HDD beneath Panther Branch. Water line installation by HDD should be performed in accordance with Section 33 05 23.13 of the SJRA Construction Specifications. HDD method utilizes steerable drilling systems to install water lines in 2 steps: (i) a pilot hole is drilled with a diameter of 1 to 5 inches along the proposed design centerline; and (ii) the pilot hole is enlarged by backreaming to the desired diameter with high volume and high pressure bentonite slurry, which maintains the bore and prevents caving of the surrounding soils; the product pipe/conduit is also connected to the end of the drilling rod and backreamer assembly by a swivel and pulled back through the enlarged pilot hole.

The Contractor is responsible for selecting, designing, installing, maintaining and monitoring safe drilling systems and retaining professionals who are qualified and experienced to perform the tasks and who are capable of modifying the system, as required. The following discussion provides general guidelines to the Contractor. The information in this report should be reviewed so that appropriate drilling equipment and techniques can be planned and factored into the construction plan and cost estimate.

5.1.1 Geotechnical Design Parameters

Recommended geotechnical parameters for the subsurface soils to be used for design of the water line is

presented on Plate B-1, in Appendix B. The design values are based on the results of field and laboratory test data on individual boring logs as well as our experience. It should be noted that because of the variable nature of soil stratigraphy, soil types and properties along the alignment or at locations away from a particular boring may vary substantially from what is indicated on the boring logs.

5.1.2 Loadings on Water Line

The water line will support the weight of the soil and water above the crown.

Earth Loads: For underground utilities to be installed using HDD method, the vertical soil load W_e can be calculated as the larger of the two values from Equations (1) and (3):

$$W_e = C_d \gamma B_d^2 \quad \text{.....Equation (1)}$$

$$C_d = [1 - e^{-2K\mu'(H/B_d)}] / (2K\mu') \quad \text{.....Equation (2)}$$

$$W_e = \gamma B_c H \quad \text{.....Equation (3)}$$

where: W_e = trench fill load, in pounds per linear foot (lb/ft);
 C_d = trench load coefficient, see Plate B-2, in Appendix B;
 γ = effective unit weight of soil over the water line, in pounds per cubic foot (pcf);
 B_d = trench width at top of the water line $< 1.5 B_c$ (ft);
 B_c = outside diameter of the water line (ft);
 H = variable height of fill (ft);
when the height of fill above the top of the water line $H_c > 2 B_d$, $H = H_h$ (height of fill above the middle of the water line). When $H_c < 2 B_d$, H varies over the height of the water line; and
 $K\mu'$ = 0.1650 maximum for sand and gravel,
0.1500 maximum for saturated top soil,
0.1300 maximum for ordinary clay,
0.1100 maximum for saturated clay.

When water lines are located below groundwater, the total vertical dead loads should include the weight of the projected volume of water above the water line.

Uplift Resistance: AEC recommends that the water line designer determine if the depth of the water line is deep enough so that the soil overburden load and the dead weight of the water line are greater than the buoyant uplift force from the displaced volume of the water line. The potential loss of overburden pressure due to erosion in the channel scour zone should be included in the uplift resistance analysis. When determining uplift resistance, AEC also recommends that the water line designer consider the groundwater level to be at the top of the channel bank.

Lateral Loads: The lateral soil pressure p_l can be calculated from Equation (4); hydrostatic pressure should be added, if applicable.

$$p_l = K_0 (\gamma H_h + p_s) \quad \text{.....Equation (4)}$$

where: K_0 = Coefficient of earth pressure, at-rest, see Plate B-1, in Appendix B;
 H_h = height of fill above the center of the water line (ft);
 γ = effective unit weight of soil over the water line (pcf);
 p_s = vertical pressure on water line resulting from traffic and/or construction equipment (psf).

5.1.3 Drilling Face Stability during Construction

Based on AEC's borings, the HDD will be installed primarily through granular soils and potentially beneath groundwater. In order to maintain a stable HDD installation, AEC recommends that pressurized bentonite slurry be used to support the HDD pilot hole and backream against caving.

5.1.4 Influence of Drilling on Adjacent Structures

Based on the schematic drawings provided by SJRA, AEC notes that the replacement water line will cross beneath Panther Branch. Care should still be taken to ensure that the drilling/installation operations do not adversely affect any nearby structures or pavements (if any).

Ground Subsidence: Drilling in soft ground can induce some degree of settlement (ground subsidence) of the overlying ground surface if the volume and/or pressure of bentonite slurry is inadequate. If such settlement is excessive, it may cause distress/damage to existing structures and services located above and/or near the drilling zone.

Predicting the amount of loss of ground (or ground subsidence) due to drilling is very difficult, primarily because of the uncertainty involved in the analysis: such as heterogeneous soil properties, subsurface variability, or lack of information about proposed construction equipment and techniques.

Measures to Reduce Distress from Drilling: Impact to existing foundations and structures can be mitigated by following proper drilling procedures. Some methods to mitigate movement and/or distress to existing structures include:

- Supporting the drilling excavation with steel or rigid concrete casing or the pipe material itself, as soon as the excavation is advanced and at short intervals; and
- proper grouting of the annular spaces; the type of equipment and method chosen will require the services of a specialty contractor.

To reduce the potential for the drilling to influence existing structures, we recommend that the outer edge of the influence zone of the water line be a minimum of 5 feet from the outer edge of the bearing (stress) zone of any existing foundations of nearby structures. The bearing (stress) zone is defined by a line drawn downward from the outer edge of an existing foundation and inclined at an angle of 45 degrees to the vertical.

The drilling influence zone is assumed to extend a distance of about 2.5i from the center of the drilled tunnel, as shown on Plate C-8, in Appendix C. We emphasize that the size of the influence zone of the bore hole is difficult to determine because several factors influence the response of the soil to drilling operations including type of soil, ground water level, type of drilling equipment, volume and pressure of drilling fluid, experience of operator and other construction in the vicinity.

We recommend that the following situations be evaluated on a case by case basis, where:

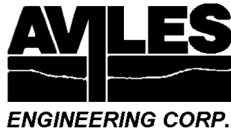
- drilling cannot be located farther than the minimum distance recommended above;
- drilling cannot be located outside the stress zone of the foundations for existing structures;
- unstable soils are encountered near existing structures;
- heavily loaded or critical structures are located close to the influence zone of the bore holes;

As an option, existing structure foundations should be protected by adequate shoring or strengthened by underpinning or other techniques, provided that drilling cannot be located outside the stress zone of the existing foundations.

Disturbance and loss of ground from the drilling operation may create surface soil disturbance and subsidence which in turn may cause distress to existing structures (including pavements) located in the zone of soil disturbance.

5.1.5 Pit Excavation

As noted in Section 5.0 of this report, AEC anticipates that entrance and exit pits will be used to connect the replacement water line to the existing water line on both ends. The Contractor should be responsible for



designing, constructing and maintaining safe excavations. The excavations should be performed in a manner so as to not cause any distress to existing structures and pavements in the vicinity (if any).

Trenches 20 feet and Deeper: The Occupational Safety and Health Administration (OSHA) requires that shoring or bracing for trenches 20 feet and deeper be specifically designed by a licensed professional engineer.

Trenches Less than 20 Feet Deep: Trench excavations that are less than 20 feet deep may be shored, sheeted and braced, or laid back to a stable slope for the safety of workers, the general public, and adjacent structures, except for excavations which are less than 5 feet deep and verified by a competent person to have no cave-in potential. The excavation and trenching should be in accordance with OSHA Safety and Health Regulations, 29 CFR, Part 1926. Recommended OSHA soil types for trench design for existing soils can be found on Plate B-1, in Appendix B. Fill soils are considered OSHA Class 'C'; submerged cohesive soils should also be considered OSHA Class 'C', unless they are dewatered first.

Critical Height is defined as the height a slope will stand unsupported for a short time; in cohesive soils, it is used to estimate the maximum depth of open-cuts at given side slopes. Critical Height may be calculated based on the soil cohesion. Values for various slopes and cohesion are shown on Plate C-1, in Appendix C. Cautions listed below should be exercised in use of Critical Height applications:

1. No more than 50 percent of the Critical Height computed should be used for vertical slopes. Unsupported vertical slopes are not recommended where granular soils or soils that will slough when not laterally supported are encountered within the excavation depth.
2. If the soil at the surface is dry to the point where tension cracks occur, any water in the crack will increase the lateral pressure considerably. In addition, if tension cracks occur, no cohesion should be assumed for the soils within the depth of the crack. The depth of the first waler should not exceed the depth of the potential tension crack. Struts should be installed before lateral displacement occurs.
3. Shoring should be provided for excavations where limited space precludes adequate side slopes, e.g., where granular soils will not stand on stable slopes and/or for deep open cuts.
4. All excavation, trenching and shoring should be designed and constructed by qualified professionals in accordance with OSHA requirements.

The maximum (steepest) allowable slopes for OSHA Soil Types for excavations less than 20 feet are presented on Plate C-2, in Appendix C.

If limited space is available for the required open trench side slopes, the space required for the slope can be

reduced by using a combination of bracing and open cut as illustrated on Plate C-3, in Appendix C. Guidelines for bracing and calculating bracing stress are presented below.

Computation of Bracing Pressures: The following method can be used for calculating earth pressure against bracing for open cuts. Lateral pressure resulting from construction equipment, traffic loads, or other surcharge should be taken into account by adding the equivalent uniformly distributed surcharge to the design lateral pressure. Hydrostatic pressure, if any, should also be considered. The active earth pressure at depth z can be determined by Equation (5). The design soil parameters for trench bracing design is presented on Plate B-1, in Appendix C.

$$p_a = (q_s + \gamma h_1 + \gamma' h_2) K_a - 2c\sqrt{K_a} + \gamma_w h_2 \quad \text{.....Equation (5)}$$

where:

- p_a = active earth pressure (psf);
- q_s = uniform surcharge pressure (psf);
- γ, γ' = wet unit weight and buoyant unit weight of soil (pcf);
- h_1 = depth from ground surface to groundwater table (ft);
- h_2 = $z - h_1$, depth from groundwater table to the point under consideration (ft);
- z = depth below ground surface for the point under consideration (ft);
- K_a = coefficient of active earth pressure;
- c = cohesion of clayey soils (psf); c can be omitted conservatively;
- γ_w = unit weight of water, 62.4 pcf.

Pressure distribution for the practical design of struts in open cuts for clays and sands are illustrated on Plates C-4 through C-6, in Appendix C.

Bottom Stability: In open-cuts, it is necessary to consider the possibility of the bottom failing by heaving, due to the removal of the weight of excavated soil. Heaving typically occurs in soft plastic clays when the excavation depth is sufficiently deep enough to cause the surrounding soil to displace vertically due to bearing capacity failure of the soil beneath the excavation bottom, with a corresponding upward movement of the soils in the bottom of the excavation. In fat and lean clays, heave normally does not occur unless the ratio of Critical Height to Depth of Cut approaches one. In very sandy and silty lean clays and granular soils, heave can occur if an artificially large head of water is created due to installation of impervious sheeting while bracing the cut. This can be mitigated if groundwater is lowered below the excavation by dewatering the area. Guidelines for evaluating bottom stability in clay soils are presented on Plate C-7, in Appendix C.

AEC assumes that the new water line will require an entrance and exit pit to match the invert depths of the

existing water line. Based on the schematic drawings provided by SJRA, the invert depth of the water line at the entrance pit (i.e. south bank) is approximately 6 feet while the invert depth of the water line at the exit pit (i.e. north bank) is approximately 6.5 feet. AEC anticipates that open cut excavations will generally encounter granular soils throughout both pits.

Based on the groundwater levels described in Section 4.1 of this report, AEC anticipates that open cut excavations that are 6 to 6.5 feet (for entrance and exit pits) will generally encounter groundwater within the pit zone in the vicinity of Boring B-2. AEC does not anticipate that groundwater will be encountered within the pit excavation in the vicinity of Boring B-1; however, groundwater was encountered in Boring B-1 immediately below the anticipated pit bottom, and groundwater may be higher at the time of construction. Groundwater control recommendations are presented in Section 6.2 of this report, if required. It should be noted that our groundwater observations are short-term; groundwater depths and subsurface soil moisture contents will vary with environmental variations such as frequency and magnitude of rainfall and the time of year when construction is in progress.

If the excavation extends below groundwater and the soils at or near the bottom of the excavation are mainly sands or silts, the bottom can fail by blow-out (boiling) when a sufficient hydraulic head exists. The potential for boiling or in-flow of granular soils increases where the groundwater is pressurized. To reduce the potential for boiling of excavations terminating in granular soils below pressurized groundwater, AEC recommends that the groundwater table be lowered at least 3 feet below the bottom of the excavation. Groundwater control should be in accordance with Section 01 57 23.02 of the SJRA Construction Specifications. Groundwater control recommendations are presented in Section 6.2 of this report.

5.1.6 Backfill for Excavated Pits

Backfill for the entrance and exit pits should be in accordance with Section 31 21 33 of the SJRA Construction Specifications. Embedment material and backfill should be placed in loose lifts not exceeding 8 inches and compacted in accordance with Section 31 21 33 of the latest edition of the SJRA Construction Specifications.

6.0 CONSTRUCTION CONSIDERATIONS

6.1 **Site Preparation**

To mitigate site problems that may develop following prolonged periods of rainfall, it is essential to have

adequate drainage to maintain a relatively dry and firm surface prior to starting any work at the site. Adequate drainage should be maintained throughout the construction period. Methods for controlling surface runoff and ponding include proper site grading, berm construction around exposed areas, and installation of sump pits with pumps.

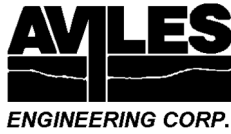
6.2 Groundwater Control

The need for groundwater control will depend on the depth of excavation relative to the groundwater depth at the time of construction. In the event that there is heavy rain prior to or during construction, the groundwater table may be higher than indicated in this report; higher seepage is also likely and may require a more extensive groundwater control program. In addition, groundwater may be pressurized in certain areas of the alignment, requiring further evaluation and consideration of the excess hydrostatic pressures. Groundwater control should be in general accordance with Section 31 21 33 of the latest edition of the SJRA Construction Specifications.

The Contractor should be responsible for selecting, designing, constructing, maintaining, and monitoring a groundwater control system and adapt his operations to ensure the stability of the excavations. Groundwater information presented in Section 4.1 and elsewhere in this report, along with consideration for potential environmental and site variation between the time of our field exploration and construction, should be incorporated in evaluating groundwater depths. The following recommendations are intended to guide the Contractor during design and construction of the dewatering system.

In cohesive soils seepage rates are lower than in granular soils and groundwater is usually collected in sumps and channeled by gravity flow to storm sewers. If cohesive soils contain significant secondary features, seepage rates will be higher. This may require larger sumps and drainage channels, or if significant granular layers are interbedded within the cohesive soils, methods used for granular soils may be required. Where it is present, pressurized groundwater will also yield higher seepage rates.

Groundwater for excavations within saturated sands can be controlled by the installation of wellpoints. The practical maximum dewatering depth for well points is about 15 feet. When groundwater control is required below 15 feet, possible ground water control measures include: (i) multi-staged wellpoints; (ii) deep wells or turbines (in granular soils); (iii) ejectors or educators (for silts); or (iv) water-tight sheet pile cut-off walls. Generally, AEC recommends the groundwater depth be lowered at least 3 feet below the excavation bottom to be able to work on a firm surface when water-bearing granular soils are encountered.



Extended and/or excessive dewatering can result in settlement of existing structures in the vicinity; the Contractor should take the necessary precautions to minimize the effect on existing structures in the vicinity of the dewatering operation. We recommend that the Contractor verify the groundwater depths and seepage rates prior to and during construction and retain the services of a dewatering expert (if necessary) to assist him in identifying, implementing, and monitoring the most suitable and cost-effective method of controlling groundwater.

For open cut construction in cohesive soils, the possibility of bottom heave must be considered due to the removal of the weight of excavated soil. In lean and fat clays, heave normally does not occur unless the ratio of Critical Height to Depth of Cut approaches one. In silty clays, heave does not typically occur unless an artificially large head of water is created through the use of impervious sheeting in bracing the cut. Guidelines for evaluating bottom stability are presented in Section 5.1.5 of this report.

6.3 Construction Monitoring

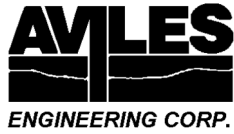
Excavation, bedding, and backfilling of underground utilities should be monitored by qualified geotechnical professionals to check for compliance with project documents and changed conditions, if encountered. AEC should be allowed to review the design and construction plans and specifications prior to release to check that the geotechnical recommendations and design criteria presented herein are properly interpreted.

6.4 Monitoring of Existing Structures

Existing structures in the vicinity of the proposed alignment should be closely monitored prior to, during, and for a period after excavation. Several factors (including soil type and stratification, construction methods, weather conditions, other construction in the vicinity, construction personnel experience and supervision) may impact ground movement in the vicinity of the alignment. We therefore recommend that the Contractor be required to survey and adequately document the condition of existing structures in the vicinity of the proposed alignment.

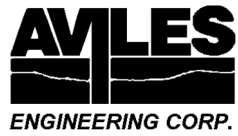
7.0 LIMITATIONS

The information contained in this report summarizes conditions found on the dates the borings were drilled. The attached boring logs are true representations of the soils encountered at the specific boring locations on the dates of drilling. Reasonable variations from the subsurface information presented in this report should be anticipated. If conditions encountered during construction are significantly different from those presented in this report;



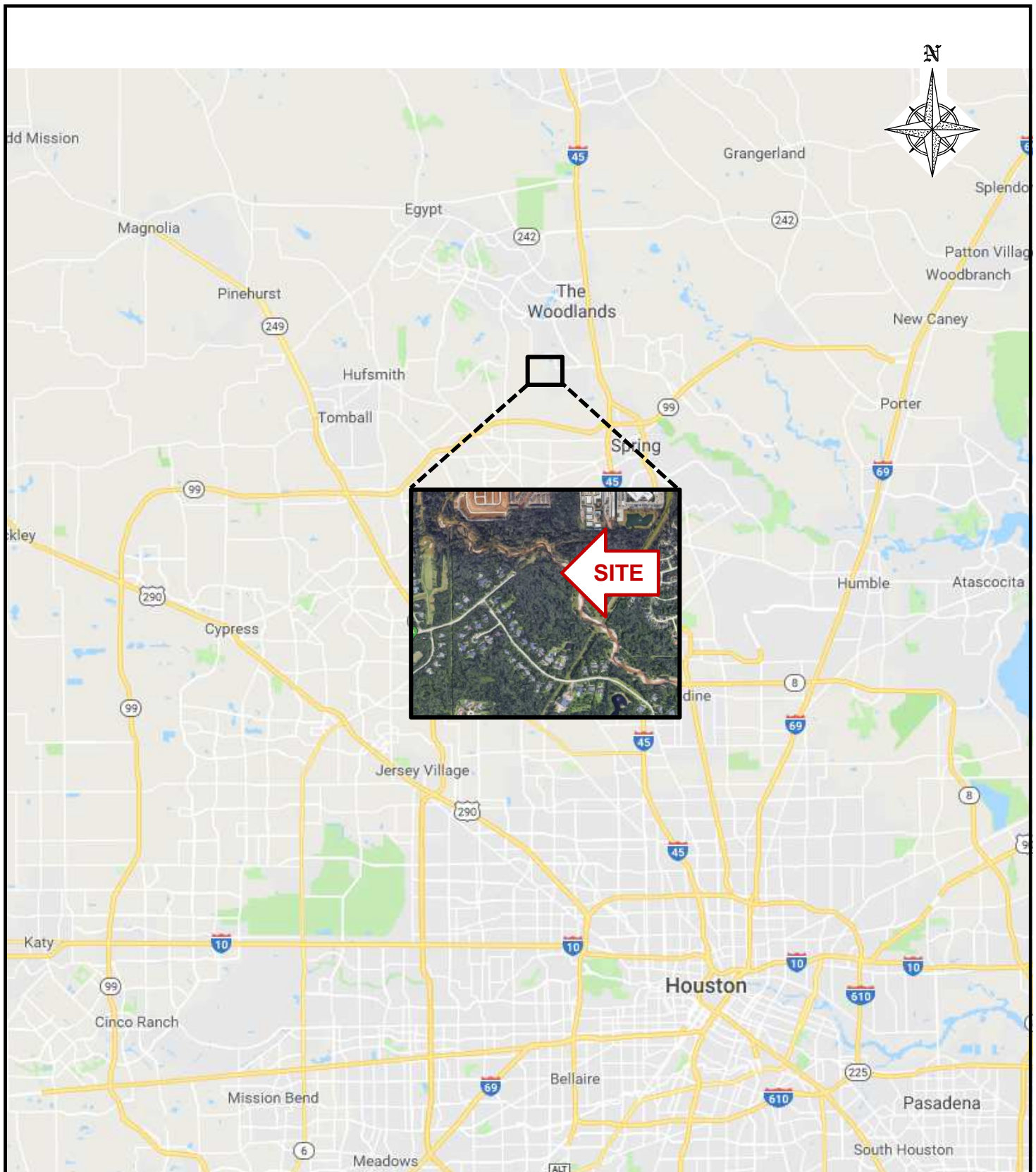
AEC should be notified immediately.

This investigation was performed using the standard level of care and diligence normally practiced by recognized geotechnical engineering firms in this area, presently performing similar services under similar circumstances. This report is intended to be used in its entirety. The report has been prepared exclusively for the project and location described in this report. If pertinent project details change or otherwise differ from those described herein, AEC should be notified immediately and retained to evaluate the effect of the changes on the recommendations presented in this report, and revise the recommendations if necessary. The recommendations presented in this report should not be used for other structures located along these alignments or similar structures located elsewhere, without additional evaluation and/or investigation.



APPENDIX A

Plate A-1	Vicinity Map
Plate A-2	Boring Location Plan
Plates A-3 and A-4	Boring Logs
Plate A-5	Key to Symbols
Plate A-6	Classification of Soils for Engineering Purposes
Plate A-7	Terms Used on Boring Logs
Plate A-8	ASTM & TXDOT Designation for Soil Laboratory Tests
Plates A-9 to A-11	Sieve Analysis Results
Plate A-12	Double Hydrometer Results
Plate A-13	Crumb Dispersion Results



AVILES ENGINEERING CORPORATION

VICINITY MAP

12" WATER LINE REPLACEMENT CROSSING PANTHER
BRANCH AT GROGAN'S POINT ROAD
THE WOODLANDS, TEXAS

AEC REPORT NO.: G152-18	DATE: 10-26-2018	SOURCE DRAWING PROVIDED BY: GOOGLE MAP
APPROX. SCALE: N.T.S.	DRAFTED BY: JG	PLATE NO.: PLATE A-1



0 100 200
GRAPHIC SCALE, FT



LEGEND

B-# (X') BORING NO. AND (DEPTH)

AVILES ENGINEERING CORPORATION

BORING LOCATION PLAN
12" WATER LINE REPLACEMENT CROSSING PANTHER
BRANCH AT GROGAN'S POINT ROAD
THE WOODLANDS, TEXAS

AEC PROJECT NO.: G152-18	DATE: 10-26-18	SOURCE DRAWING PROVIDED BY: GOOGLE EARTH
SCALE: 1" = 200'	DRAFTED BY: BpJ	PLATE NO.: PLATE A-2



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GEOTECHNICAL ENGINEERS

BORING



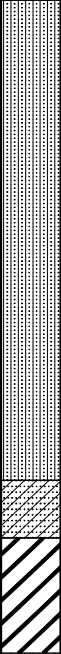






B-1

PROJECT: 12" Water Line Replacement at Panther Branch

DATE 09/21/18

TYPE 4" Dry Auger / Wet Rotary

LOCATION See Boring Location Plan

DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	MOISTURE CONTENT, %	DRY DENSITY, PCF	SHEAR STRENGTH, TSF									
							△	●	○	□						
															Confined Compression	Unconfined Compression
			Approximate Surface Elevation (feet): 104				0.5	1	1.5	2						
0			Fill: medium dense, brown Silty Sand (SM)		13											
			-with sandy clay pockets and roots 0'-2'													
			-with lean clay seams 2'-4'	30	11							41	16	14	2	
5			Loose to medium dense, tannish gray Silty Sand (SM)	23	12											
			-with clayey sand pockets 4'-6'													
			-light grayish tan 6'-10'			28	4									
			-with gravel 8'-10'			22	7						17			
10			-gray 10'-16', with clayey sand pockets 10'-12'		15	14										
			-boring cave-in at 11.2' during drilling		9	17										
																
15			-with gravel and clay pockets 14'-16'		28	16							14	NP	NP	NP
					Very loose, gray and dark gray Clayey Sand (SC), with fat clay pockets, wet	3	19									
20			Soft to firm, yellowish tan Fat Clay (CH)	4	23											
			Medium dense to very dense, light tan Silty Sand (SM), wet													
25			-with clay pockets 23'-25' and gravel pockets 23'-30'	56	20							18	NP	NP	NP	
30			-tan 28'-35', with fat clay pockets 28'-30'	30	20											
35				34	26											

BORING DRILLED TO 14 FEET WITHOUT DRILLING FLUID

WATER ENCOUNTERED AT 14 FEET WHILE DRILLING

WATER LEVEL AT 10.4 FEET AFTER 1 DAY

DRILLED BY Van & Sons DRAFTED BY JG LOGGED BY BTC

PROJECT: 12" Water Line Replacement at Panther Branch

BORING

B-1

DATE 09/21/18

TYPE 4" Dry Auger / Wet Rotary

LOCATION See Boring Location Plan

DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	MOISTURE CONTENT, %	DRY DENSITY, PCF	SHEAR STRENGTH, TSF				-200 MESH	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
							△	●	○	□				
							0.5	1	1.5	2				
			Dense, tan Clayey Sand (SC), with fat clay pockets and gravel, wet											
40				39	23						26			
			Termination Depth = 40 feet											
45														
50														
55														
60														
65														
70														

BORING DRILLED TO 14 FEET WITHOUT DRILLING FLUID

WATER ENCOUNTERED AT 14 FEET WHILE DRILLING

WATER LEVEL AT 10.4 FEET AFTER 1 DAY

DRILLED BY Van & Sons DRAFTED BY JG LOGGED BY BTC

PROJECT: **12" Water Line Replacement at Panther Branch**

BORING

B-2

DATE **09/20/18**

TYPE **4" Dry Auger / Wet Rotary**

LOCATION **See Boring Location Plan**

DEPTH IN FEET	SYMBOL	SAMPLE INTERVAL	DESCRIPTION	S.P.T. BLOWS / FT.	MOISTURE CONTENT, %	DRY DENSITY, PCF	SHEAR STRENGTH, TSF				-200 MESH	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX								
			Approximate Surface Elevation (feet): 98				△	Confined Compression	●	Unconfined Compression	○	Pocket Penetrometer	□	Torvane	0.5	1	1.5	2				
0			Tan Poorly Graded Sand with Silt (SM), with roots		7																	
			Very loose to loose, tan and gray Silty Sand (SM)	2	16																	
			-with clayey sand pockets 2'-4'																			
5			-tannish gray 4'-6', with sandy clay seams 4'-8'	2	22																	
			-boring cave-in at 5.2' during drilling																			
			-gray 6'-8'	5	16																	
			Firm to stiff, gray Sandy Lean Clay (CL), with fat clay pockets	5	27																	
10			-with organic pockets 8'-10'																			
			-dark brownish gray 10'-12'	12	35																	
			Very loose, dark brownish gray Clayey Sand (SC), wet	0	38																	
15			Loose to medium dense, gray and light gray Poorly Graded Sand (SP), wet	10	23																	
			-with gravel and sandy clay pockets 14'-16'																			
			-light gray and tan, with clayey sand pockets 16'-18'	15	21																	
			-tan, with gravel 18'-20'	22	21																	
20																						
			-reddish tan 23'-25'	28	17																	
25																						
			-tan, with clayey sand pockets 28'-30'	23	17																	
30																						
			Medium dense, light gray and tan Clayey Sand (SC), with gravel, wet	31	17																	
35																						

BORING DRILLED TO 8 FEET WITHOUT DRILLING FLUID

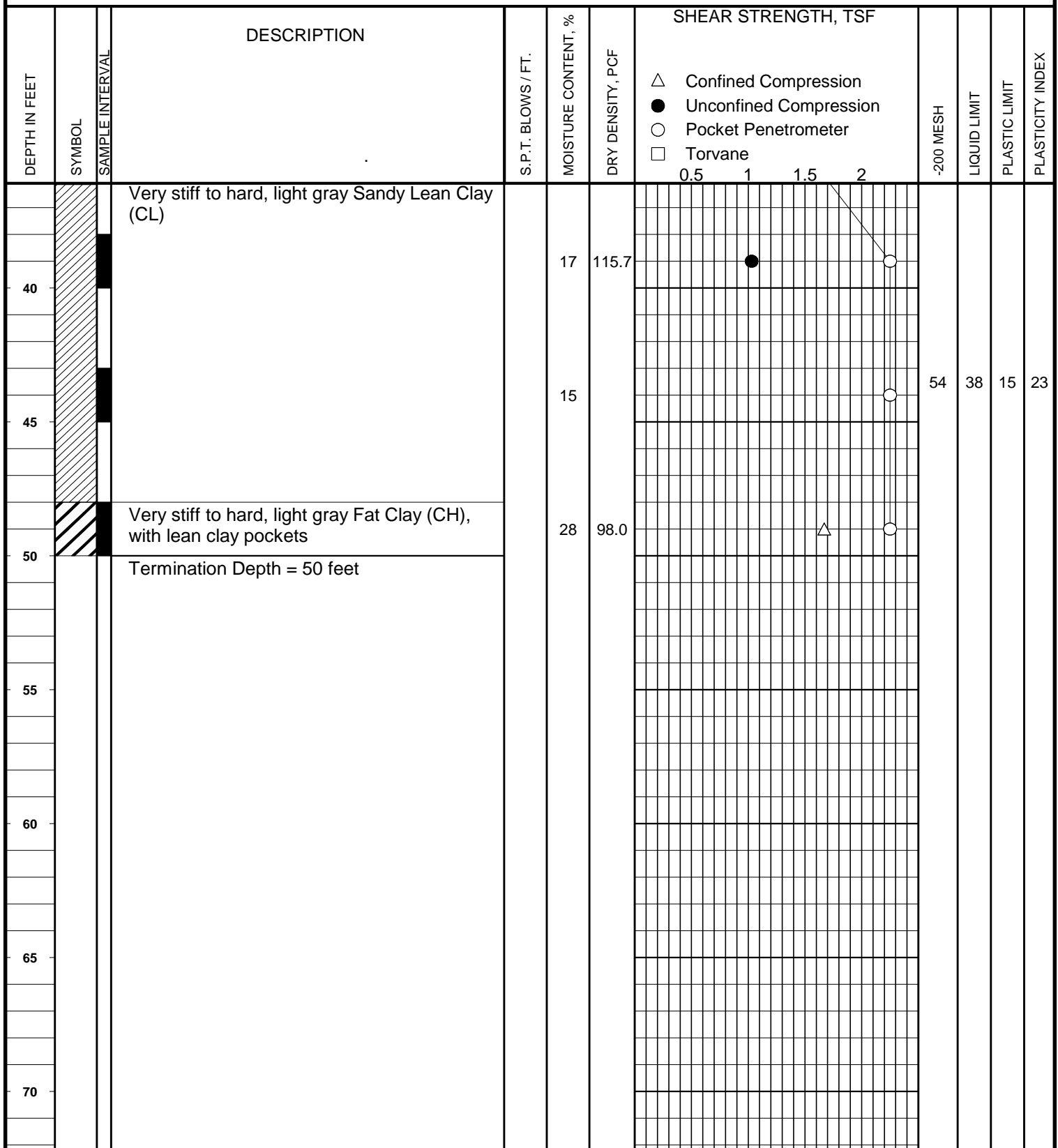
WATER ENCOUNTERED AT 8 FEET WHILE DRILLING

WATER LEVEL AT 5.2 FEET AFTER 15 MIN

DRILLED BY Van & Sons DRAFTED BY JG LOGGED BY BTC

PROJECT: 12" Water Line Replacement at Panther BranchENGINEERING CORP.
GEOTECHNICAL ENGINEERS

BORING

B-2DATE 09/20/18TYPE 4" Dry Auger / Wet RotaryLOCATION See Boring Location PlanBORING DRILLED TO 8 FEET WITHOUT DRILLING FLUIDWATER ENCOUNTERED AT 8 FEET WHILE DRILLINGWATER LEVEL AT 5.2 FEET AFTER 15 MINDRILLED BY Van & Sons DRAFTED BY JG LOGGED BY BTC

KEY TO SYMBOLS

Symbol Description

Strata symbols



Fill



Silty sand



Clayey sand



High plasticity
clay



Poorly graded sand
with silt



Low plasticity
clay



Poorly graded sand

Misc. Symbols



Water table depth
during drilling



Subsequent water
table depth



Pocket Penetrometer



Unconfined Compression



Confined Compression

Soil Samplers



Auger



Standard penetration test

Symbol Description



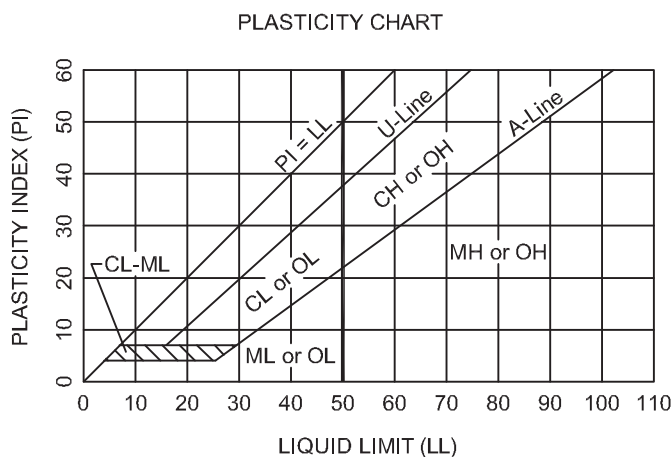
Undisturbed thin wall
Shelby tube

CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES

ASTM Designation D-2487

MAJOR DIVISIONS				GROUP SYMBOL	TYPICAL NAMES
COARSE-GRAINED SOILS (Less than 50% passes No. 200 sieve)	GRAVELS (Less than 50% of coarse fraction passes No. 4 sieve)	CLEAN GRAVELS (Less than 5% passes No. 200 sieve)		GW	Well-graded gravel, well-graded gravel with sand
				GP	Poorly-graded gravel, poorly-graded gravel with sand
		GRAVELS WITH FINES (More than 12% passes No. 200 sieve)	Limits plot below "A" line & hatched zone on plasticity chart	GM	Silty gravel, silty gravel with sand
			Limits plot above "A" line & hatched zone on plasticity chart	GC	Clayey gravel, clayey gravel with sand
	SANDS (50% or more of coarse fraction passes No. 4 sieve)	CLEAN SANDS (Less than 5% passes No. 200 sieve)		SW	Well-graded sand, well-graded sand with gravel
				SP	Poorly-graded sand, poorly-graded sand with gravel
		SANDS WITH FINES (More than 12% passes No. 200 sieve)	Limits plot below "A" line & hatched zone on plasticity chart	SM	Silty sand, silty sand with gravel
			Limits plot above "A" line & hatched zone on plasticity chart	SC	Clayey sand, clayey sand with gravel
FINE-GRAINED SOILS (50% or more passes No. 200 sieve)	SILTS AND CLAYS (Liquid Limit Less Than 50%)		ML	Silt, silt with sand, silt with gravel, sandy silt, gravelly silt	
			CL	Lean clay, lean clay with sand, lean clay with gravel, sandy lean clay, gravelly lean clay	
			OL	Organic clay, organic clay with sand, sandy organic clay, organic silt, sandy organic silt	
	SILTS AND CLAYS (Liquid Limit 50% or More)		MH	Elastic silt, elastic silt with sand, sandy elastic silt, gravelly elastic silt	
			CH	Fat clay, fat clay with sand, fat clay with gravel, sandy fat clay, gravelly fat clay	
			OH	Organic clay, organic clay with sand, sandy organic clay, organic silt, sandy organic silt	

NOTE: Coarse soils between 5% and 12% passing the No. 200 sieve and fine-grained soils with limits plotting in the hatched zone of the plasticity chart are to have dual symbols.



Equation of A-Line: Horizontal at $PI=4$ to $LL=25.5$, then $PI=0.73(LL-20)$

Equation of U-Line: Vertical at $LL=16$ to $PI=7$, then $PI=0.9(LL-8)$

DEGREE OF PLASTICITY OF COHESIVE SOILS

Degree of Plasticity Plasticity Index

None 0 - 4
Slight 5 - 10
Medium 11 - 20
High 21 - 40
Very High..... >40

SOIL SYMBOLS



Fill



Clay (CH)



Clay (CL)



Sand



Silt

TERMS USED ON BORING LOGS

SOIL GRAIN SIZE

U.S. STANDARD SIEVE

6"	3"	3/4"	#4	#10	#40	#200		
BOULDERS	COBBLES	GRAVEL		SAND			SILT	CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE		
152	76.2	19.1	4.76	2.00	0.420	0.074	0.002	

SOIL GRAIN SIZE IN MILLIMETERS

STRENGTH OF COHESIVE SOILS

<u>Consistency</u>	<u>Undrained Shear Strength, Kips per Sq. ft.</u>	<u>SPT Blowcount</u>
Very Soft	less than 0.25	< 2 bpf
Soft	0.25 to 0.50	2-4 bpf
Firm	0.50 to 1.00	4-8 bpf
Stiff	1.00 to 2.00	8-16 bpf
Very Stiff	2.00 to 4.00	16-32 bpf
Hard	greater than 4.00	>32 bpf

RELATIVE DENSITY OF COHESIONLESS SOILS FROM STANDARD PENETRATION TEST

Very Loose	<4 bpf
Loose	5-10 bpf
Medium Dense	11-30 bpf
Dense	31-50 bpf
Very Dense	>50 bpf

SPLIT-BARREL SAMPLER DRIVING RECORD

Blows per Foot

Description

25	25 blows driving sampler 12 inches, after initial 6 inches of seating.
50/7"	50 blows driving sampler 7 inches, after initial 6 inches of seating.
Ref/3"	50 blows driving sampler 3 inches, during initial 6-inches seating interval.

NOTE: To avoid change to sampling tools, driving is limited to 50 blows during or after seating interval.

DRY STRENGTH ASTM D2488

MOISTURE CONDITION ASTM D2488

None	Dry specimen crumbles into powder with mere pressure of handling
Low	Dry specimen crumbles into powder with some finger pressure
Medium	Dry specimen breaks into pieces or crumbles with considerable pressure
High	Dry specimen cannot be broken with finger pressure, it can be broken between thumb and hard surface
Very High	Dry specimen cannot be broken between thumb and hard surface

Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water

SOIL STRUCTURE

Slickensided	Having planes of weakness that appear slick and glossy. The degree of slickensidedness depends upon the spacing of slickensides and the easiness of breaking along these planes.
Fissured	Containing shrinkage or relief cracks, often filled with fine sand or silt; usually more or less vertical.
Friable	Crumbly, can be easily crushed with light pressure.
Blocky	Clays that have a block-like or polyhedral structure.
Pocket	Inclusion of material of different texture that is smaller than the diameter of the sample.
Parting	Inclusion less than 1/8 inch thick extending through the sample.
Seam	Inclusion 1/8 inch to 3 inches thick extending through the sample.
Layer	Inclusion greater than 3 inches thick extending through the sample.
Laminated	Soil sample composed of alternating partings or seams of different soil types.
Interlayered	Soil sample composed of alternating layers of different soil types.
Intermixed	Soil sample composed of pockets of different soil types and layered or laminated structure is not evident.
Calcareous	Having appreciable quantities of calcium material.

ASTM & TXDOT DESIGNATION FOR SOIL LABORATORY TESTS

SOIL TEST	ASTM TEST DESIGNATION	TXDOT TEST DESIGNATION
Unified Soil Classification System	D 2487	Tex-142-E
Moisture Content	D 2216	Tex-103-E
Specific Gravity	D 854	Tex-108-E
Sieve Analysis	D 6913	Tex-110-E (Part 1)
Hydrometer Analysis	D 7928	Tex-110-E (Part 2)
Minus No. 200 Sieve	D 1140	Tex-111-E
Liquid Limit	D 4318	Tex-104-E
Plastic Limit	D 4318	Tex-105-E
Standard Proctor Compaction	D 698	Tex-114-E
Modified Proctor Compaction	D 1557	Tex-113-E
California Bearing Ratio	D 1883	-
Swell	D 4546	-
Consolidation	D 2435	-
Unconfined Compression	D 2166	-
Unconsolidated-Undrained Triaxial	D 2850	Tex-118-E
Consolidated-Undrained Triaxial	D 4767	Tex-131-E
Permeability (constant head)	D 5084	-
Pinhole	D 4647	-
Crumb	D 6572	-
Double Hydrometer	D 4221	-
pH of Soil	D 4972	Tex-128-E
Soil Suction	D 5298	-
Soil Sulfate	C 1580	Tex-145-E
Organics	D 2974	Tex-148-E

AVILES ENGINEERING CORPORATION

Consulting Engineers - Geotechnical, Construction Materials Testing, Environmental

GRAIN SIZE ANALYSIS - SIEVE

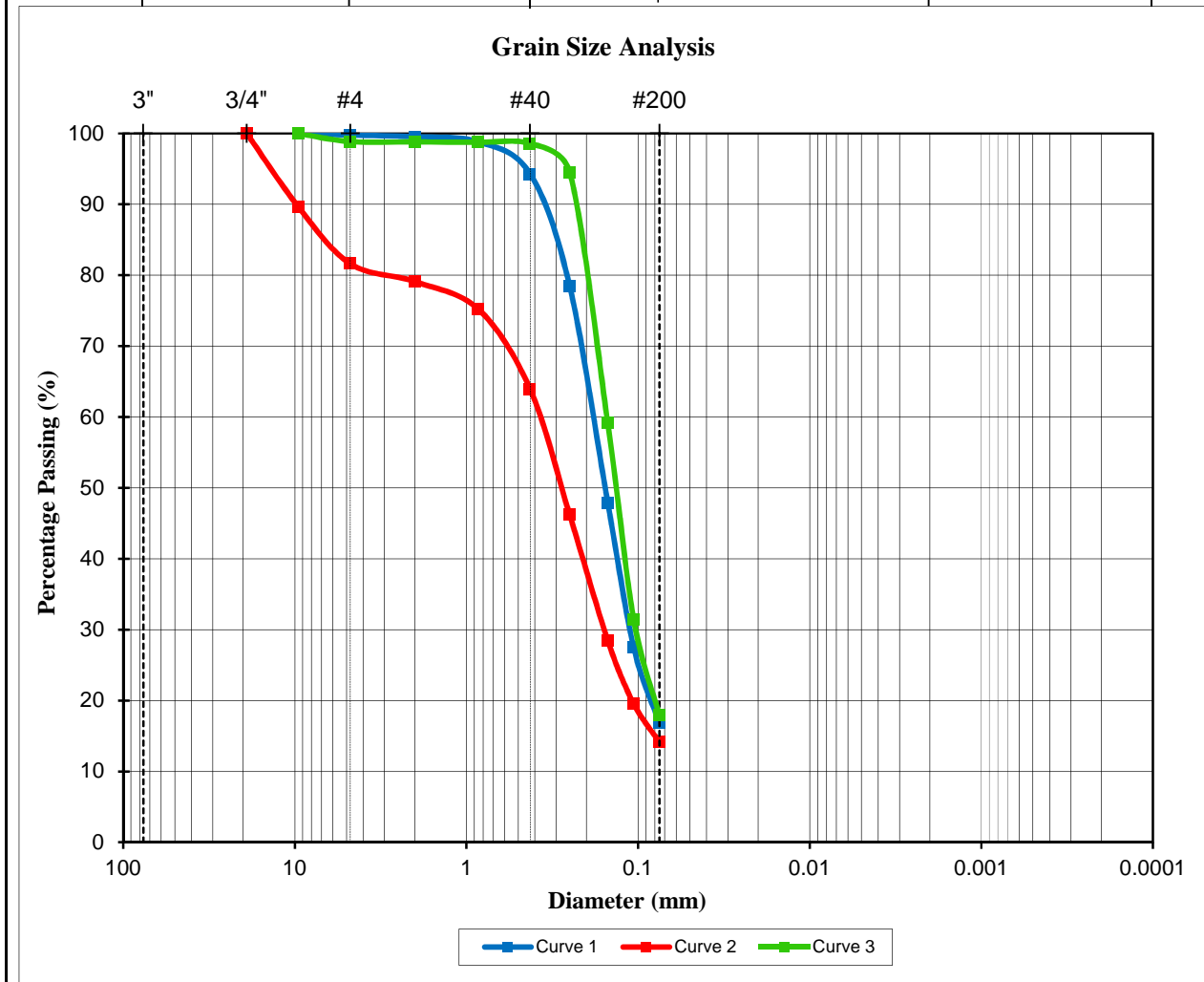
Project : 12" Water Line Replacement at Panther Branch

Job No.: G152-18

Location of Project: The Woodlands, Texas

Date of Testing: 10/1/2018

	Gravel	Sand		Silt	Clay
		Coarse to Medium	Fine		



<u>Curve</u>	<u>Boring</u>	<u>Depth (ft)</u>	<u>Soil Description</u>	<u>Cu</u>	<u>Cc</u>	<u>D₅₀ (mm)</u>
1	B-1	8-10	Silty Sand (SM)	N/A	N/A	0.155
2	B-1	14-16	Silty Sand (SM)	N/A	N/A	0.280
3	B-1	23-25	Silty Sand (SM)	N/A	N/A	0.134

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GRAIN SIZE ANALYSIS - SIEVE

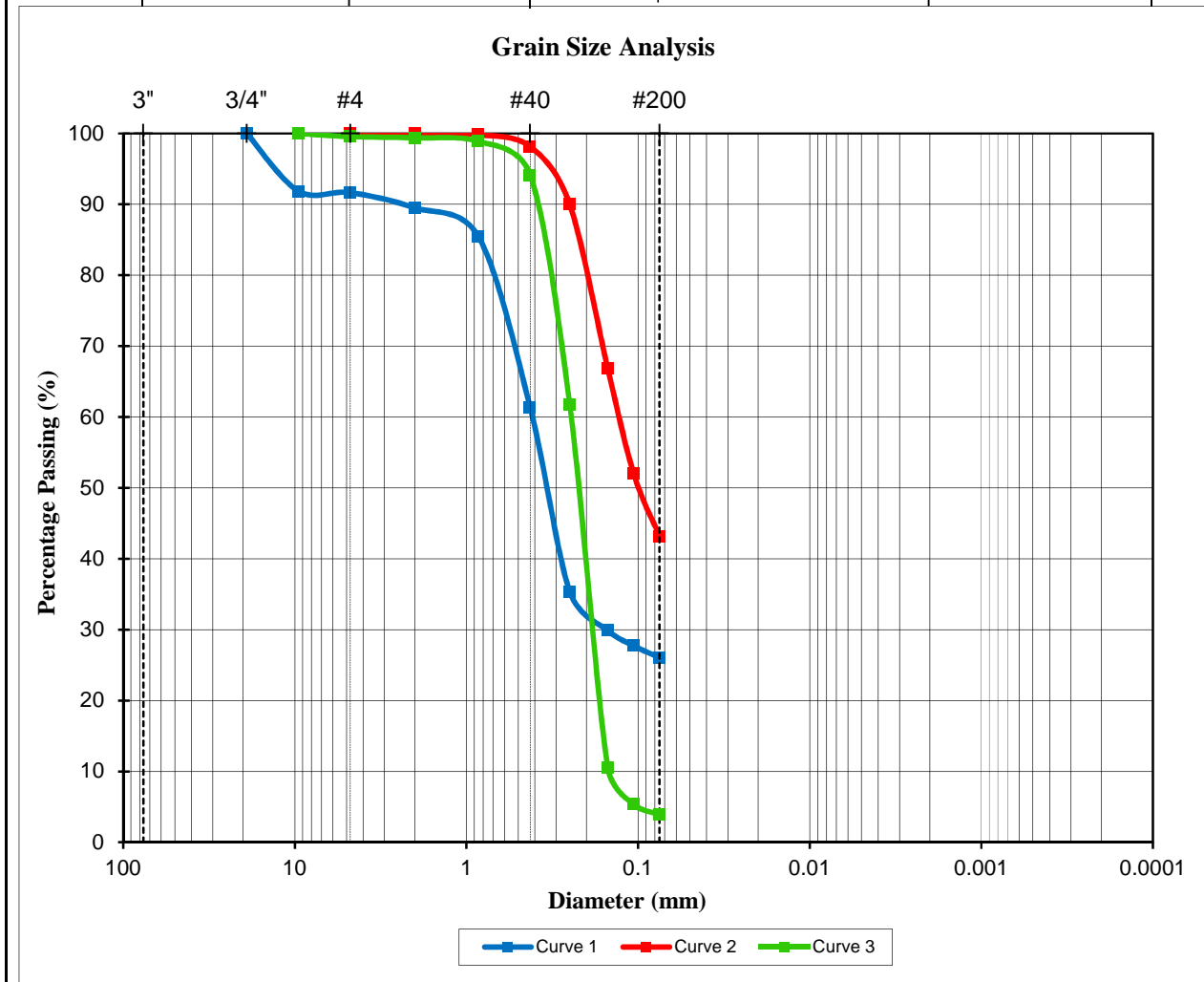
Project : 12" Water Line Replacement at Panther Branch

Job No.: G152-18

Location of Project: The Woodlands, Texas

Date of Testing: 10/1/2018

	Gravel	Sand		Silt	Clay
		Coarse to Medium	Fine		



Curve	Boring	Depth (ft)	Soil Description	Cu	Cc	D_{50} (mm)
1	B-1	38-40	Clayey Sand (SC)	N/A	N/A	0.337
2	B-2	6-8	Silty Sand (SM)	N/A	N/A	0.098
3	B-2	18-20	Poorly Graded Sand (SP)	1.69	0.93	0.222

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GRAIN SIZE ANALYSIS - SIEVE

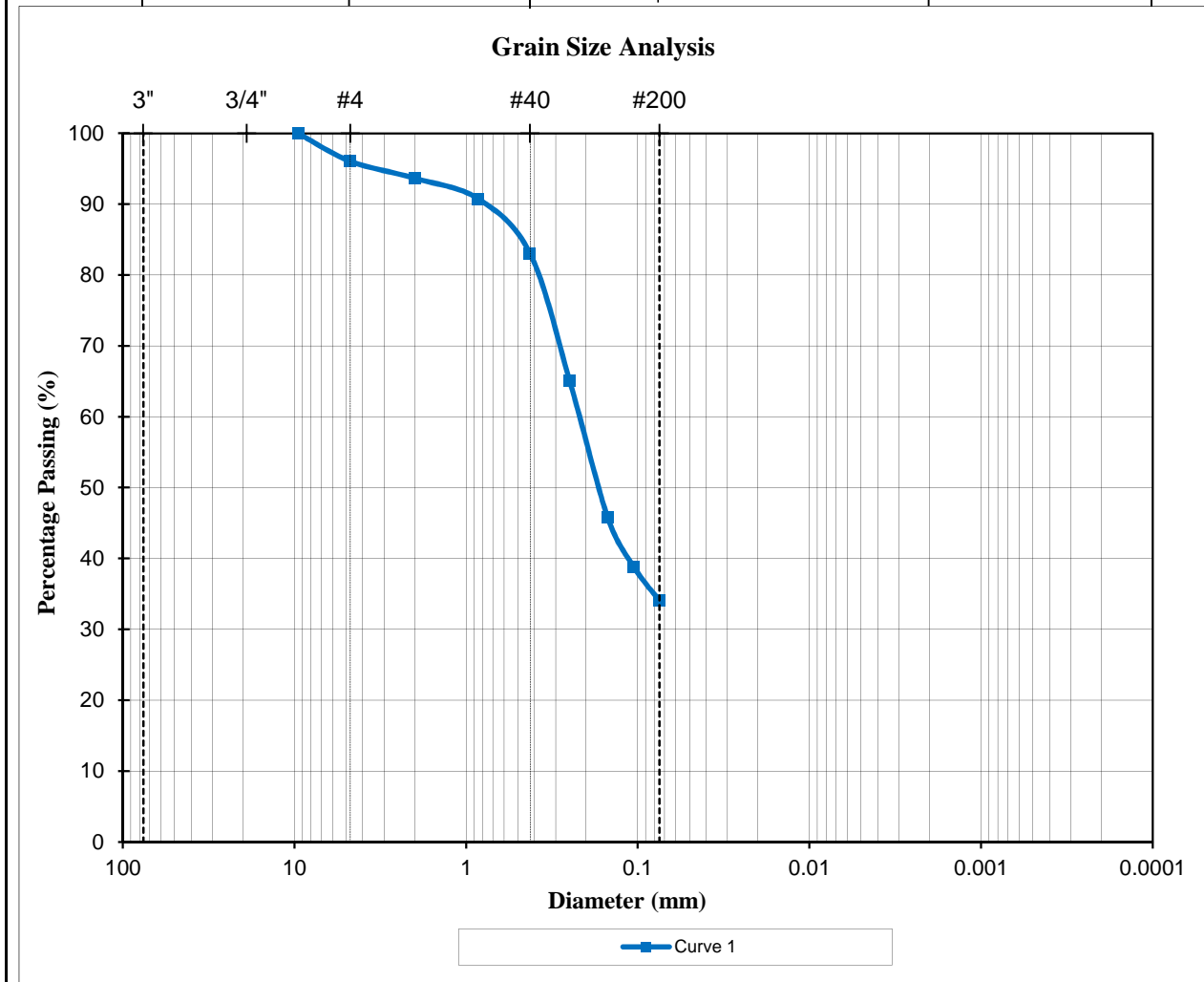
Project : 12" Water Line Replacement at Panther Branch

Job No.: G152-18

Location of Project: The Woodlands, Texas

Date of Testing: 10/1/2018

	Gravel	Sand		Silt	Clay	
		Coarse to Medium	Fine			



<u>Curve</u>	<u>Boring</u>	<u>Depth (ft)</u>	<u>Soil Description</u>	<u>Cu</u>	<u>Cc</u>	<u>D₅₀ (mm)</u>
1	B-2	33-35	Clayey Sand (SC)	N/A	N/A	0.168

AVILES ENGINEERING CORPORATION

Consulting Engineers - Geotechnical, Construction Materials Testing, Environmental

SIEVE & DOUBLE HYDROMETER TESTS (ASTM D 4221)

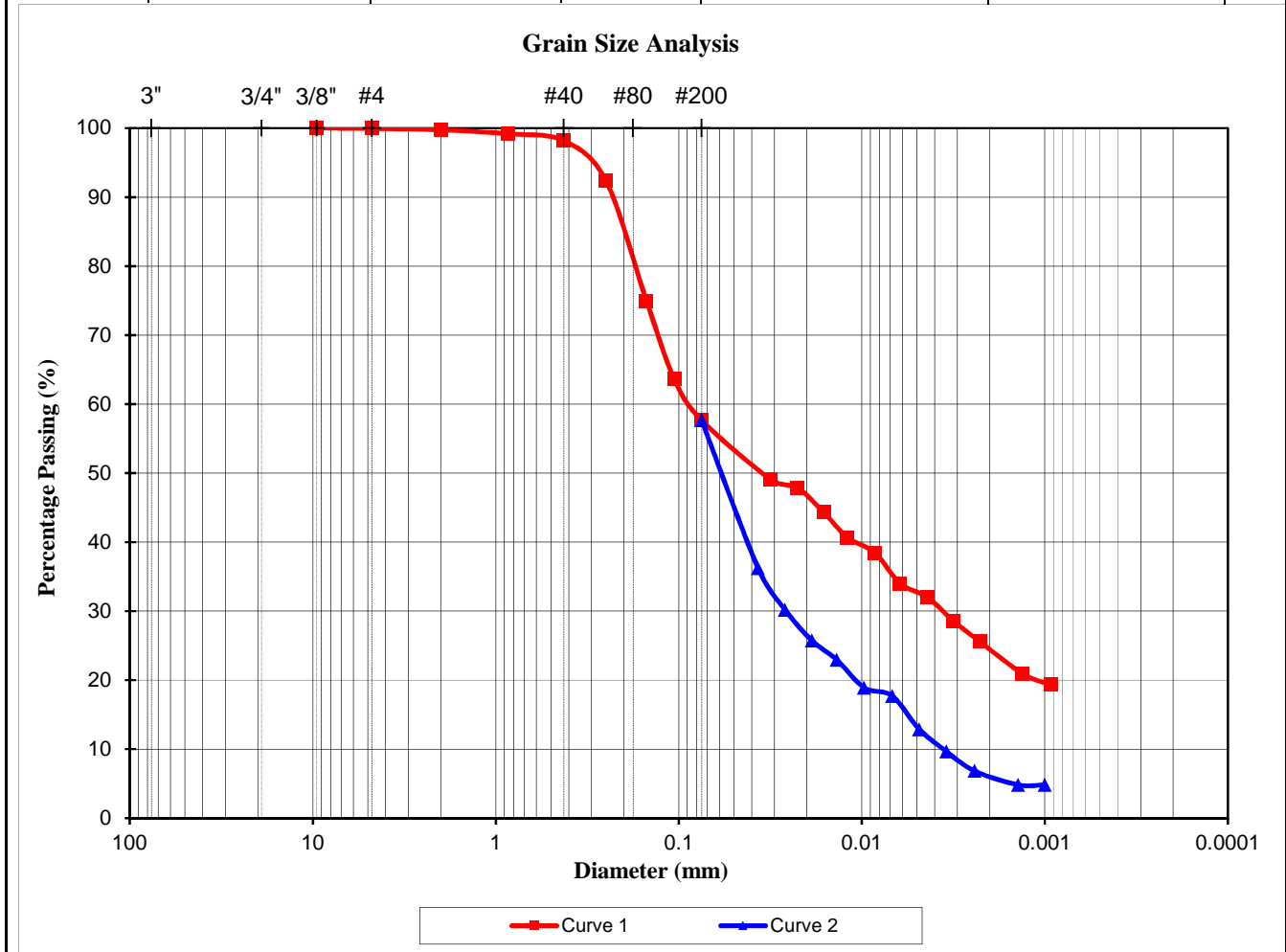
Project: 12" Water Line Replacement at Panther Branch

Job No.: G152-18

Location of Project: The Woodlands, Texas

Date of Testing: 10/1/2018

	Gravel	Sand		Silt	Clay
		Coarse to Medium	Fine		



AVILES ENGINEERING CORPORATION

Consulting Engineers - Geotechnical, Construction Materials Testing, Environmental

RESULTS OF CRUMB TESTS (ASTM D 6572)

Project Name: 12" Water Line Replacement at Panther Branch

Project No.: G152-18

Test Date: 10/5/2018[illegible]

Grade Classification:

Grade 1 Non-dispersive; No reaction

Grade 2 Intermediate; Slight reaction

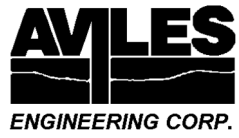
Grade 3 Dispersive; Moderate reaction

Grade 4 Highly Dispersive; Strong reaction

Interpretation:

Under normal conditions, use the 1 hour reading to determine dispersive grade.

However, if the dispersive grade changes from 2 to 3 or from 3 to 4 between the 1 and 6 hour readings, use the 6 hour reading instead.



APPENDIX B

Plate B-1	Recommended Geotechnical Design Parameters
Plate B-2	Load Coefficients for Pipe Loading

G152-18 12" WATER LINE REPLACEMENT CROSSING PANTHER BRANCH, THE WOODLANDS, TEXAS
SOIL PARAMETERS FOR WATERLINE DESIGN AND CONSTRUCTION

Boring	Depth (ft)	Soil Type	γ (pcf)	γ' (pcf)	OSHA Type	Short-Term					Long-Term				
						C (psf)	ϕ (deg)	K_a	K_0	K_p	C' (psf)	ϕ' (deg)	K_a	K_0	K_p
B-1	0-2	Fill: SM	120	58	C	0	26	0.39	0.56	2.56	0	26	0.39	0.56	2.56
	2-4	Fill: medium dense SM	120	58	C	0	32	0.31	0.47	3.25	0	32	0.31	0.47	3.25
	4-10	Medium dense SM	120	58	C	0	30	0.33	0.50	3.00	0	30	0.33	0.50	3.00
	10-15	Loose to medium dense SM	115	53	C	0	28	0.36	0.53	2.77	0	28	0.36	0.53	2.77
B-2	0-8	Very loose to loose SP- SM/SM	115	53	C	0	26	0.39	0.56	2.56	0	26	0.39	0.56	2.56
	8-12	Firm to stiff CL	120	58	C	400	0	1.00	1.00	1.00	25	18	0.53	0.69	1.89
	12-14	Very loose SC	115	53	C	0	26	0.39	0.56	2.56	0	26	0.39	0.56	2.56
	14-15	Medium dense SP	120	58	C	0	28	0.36	0.53	2.77	0	28	0.36	0.53	2.77

(1) γ = Unit weight for soil above water level, γ' = Buoyant unit weight for soil below water level;

(2) C = Soil ultimate cohesion for short term (upper limit of 3,000 psf for design purposes), ϕ = Soil friction angle for short term;

(3) C' = Soil ultimate cohesion for long term (upper limit of 300 psf for design purposes), ϕ' = Soil friction angle for long term;

(4) K_a = Coefficient of active earth pressure, K_0 = Coefficient of at-rest earth pressure, K_p = Coefficient of passive earth pressure;

(5) CL = Lean Clay, SM = Silty Sand, SP = Poorly Graded Sand;

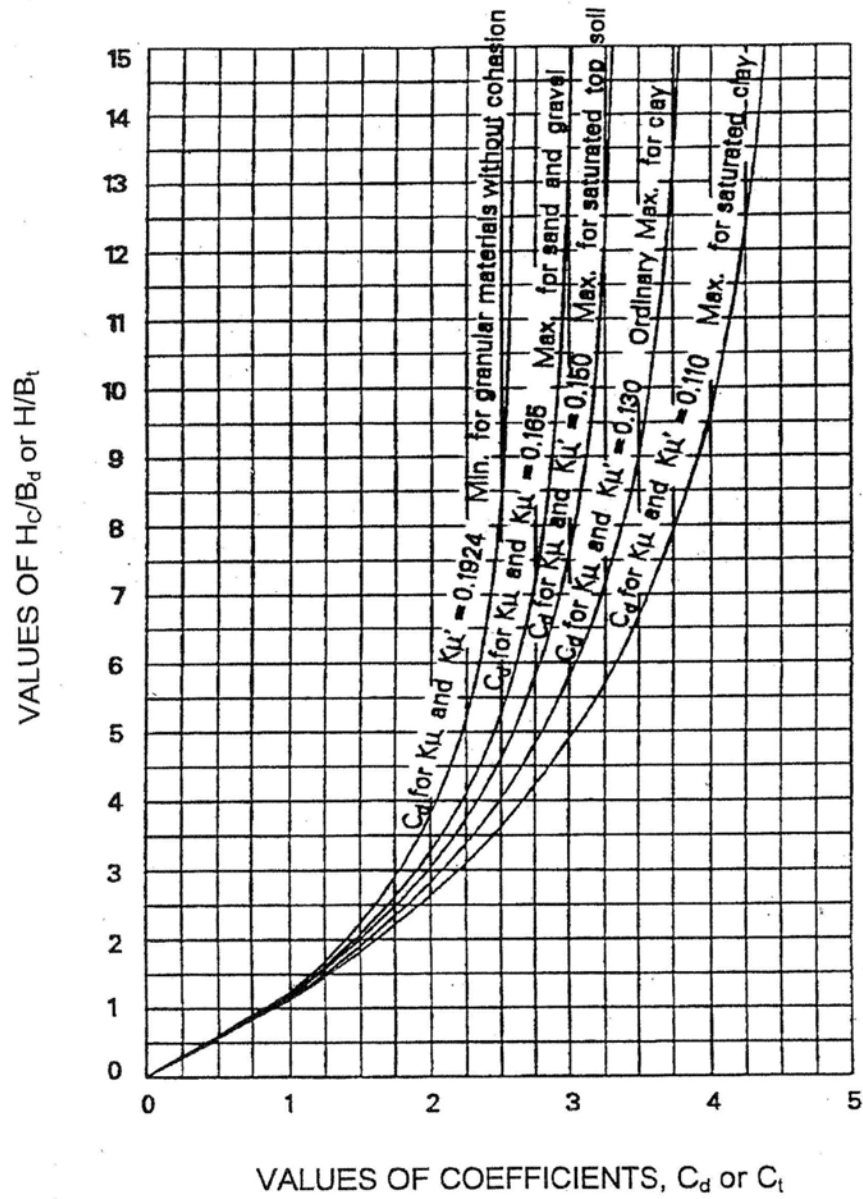
(6) OSHA Soil Types for soils in the top 20 feet below grade:

A: cohesive soils with $q_u = 1.5$ tsf or greater (q_u = Unconfined Compressive Strength of the Soil)

B: cohesive soils with $q_u = 0.5$ tsf or greater

C: cohesive soils with $q_u =$ less than 0.5 tsf, fill materials, or granular soil

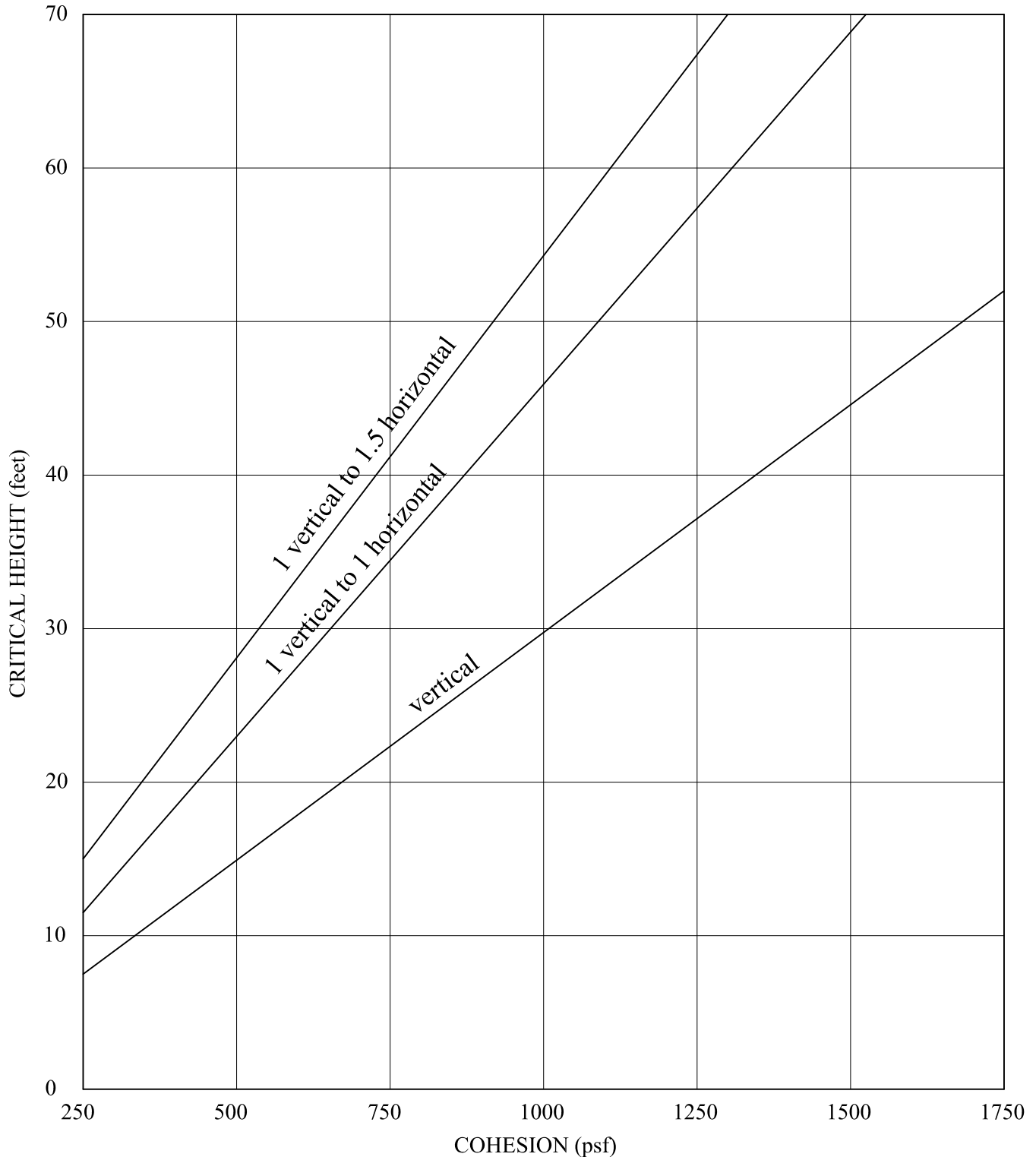
C*: submerged cohesive soils; dewatered cohesive soils can be considered OSHA Type B.



APPENDIX C

Plate C-1	Critical Heights of Cut Slopes in Nonfissured Clays
Plate C-2	Maximum Allowable Slopes
Plate C-3	A Combination of Bracing and Open Cuts
Plate C-4	Lateral Pressure Diagrams for Open Cuts in Cohesive Soil-Long Term Conditions
Plate C-5	Lateral Pressure Diagrams for Open Cuts in Cohesive Soil-Short Term Conditions
Plate C-6	Lateral Pressure Diagrams for Open Cuts in Sand
Plate C-7	Bottom Stability for Braced Excavation in Clay
Plate C-8	Relation between the Width of the Surface Depression and the Depth of the Cavity for Tunnels

Critical Heights of Cut Slopes in Nonfissured Clays



Note: The charts are calculated based on NAVFAC DM7.1, Page 7.1-319, assuming the critical circles are toe circles, and wet unit weight of soils = 125pcf.

MAXIMUM ALLOWABLE SLOPES

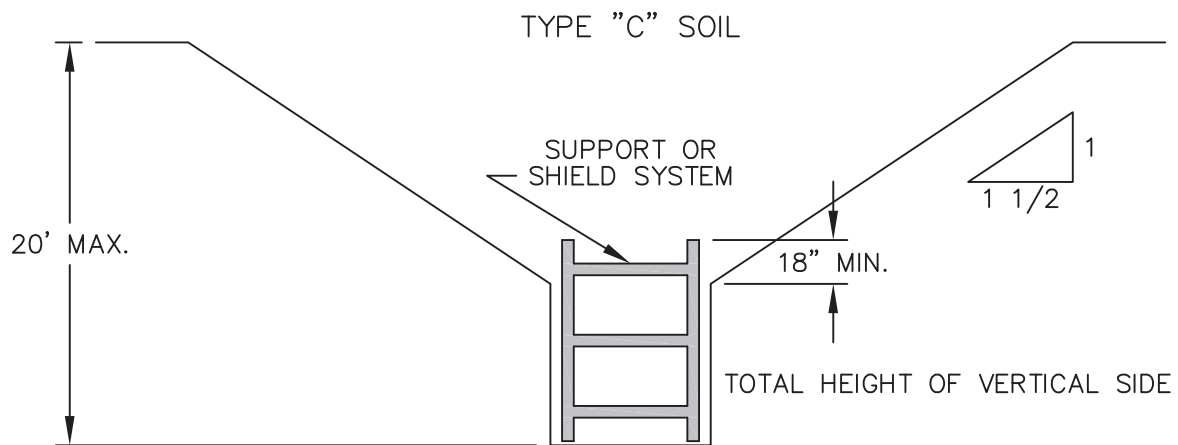
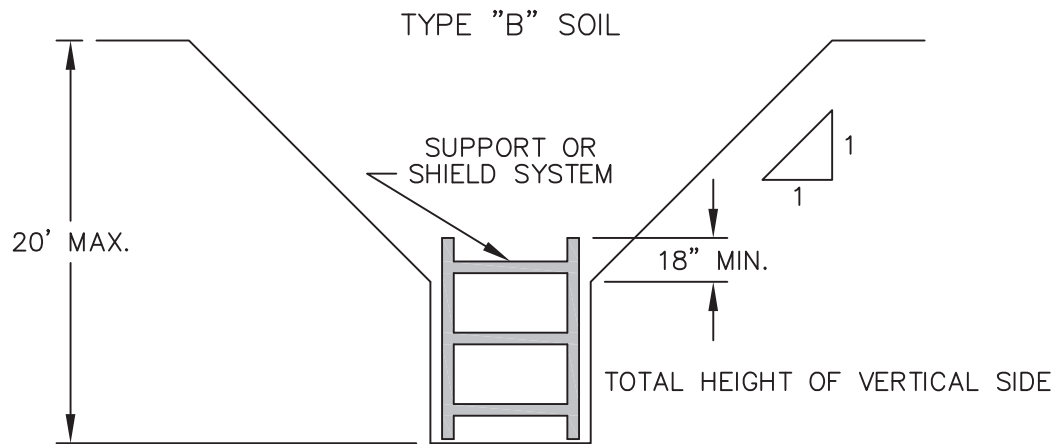
TYPE A SOILS	TYPE B SOILS	TYPE C SOILS	SHORT TERM	LONG TERM
			<p>12' MAX. 0.5 (H) : 1 (V)</p>	<p>20' MAX. 0.75 (H) : 1 (V)</p>
			N/A	<p>20' MAX. 1 (H) : 1 (V)</p>
			N/A	<p>20' MAX. 1.5 (H) : 1 (V)</p>
			SHORT TERM	LONG TERM

NOTES:

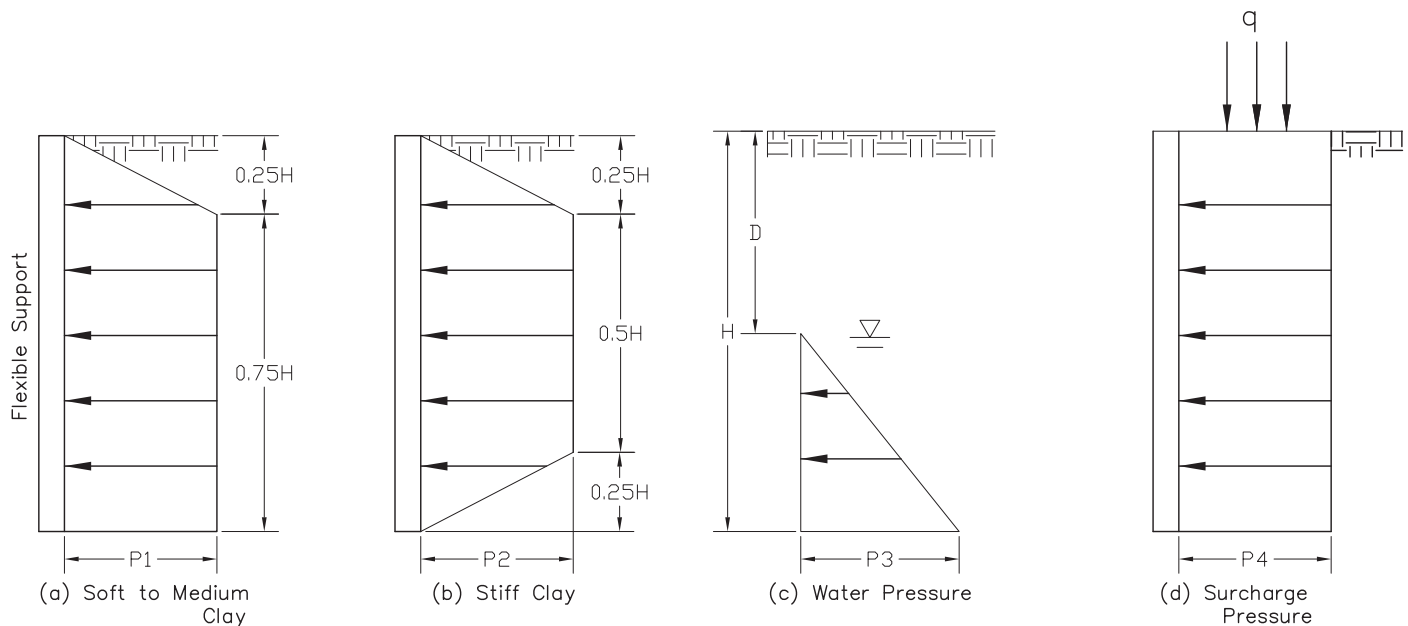
(1) For Type A soils, a short term maximum allowable slope of 0.5 (H) : 1 (V) is allowed in excavations that are 12 feet or less in depth; short term (24 hours or less) maximum allowable slopes for excavations greater than 12 feet in depth shall be 0.75 (H) : 1 (V).

(2) Maximum depth for above slopes is 20 feet. For slopes deeper than 20 feet, trench protection should be designed by the Contractor's professional engineer.

A COMBINATION OF BRACING AND OPEN CUTS



LATERAL PRESSURE DIAGRAMS
FOR OPEN CUTS IN COHESIVE SOIL - LONG TERM CONDITIONS



Empirical Pressure Distributions

Where:

H = Total excavation depth, feet

D = Depth to water table, feet

$P1$ = Lateral earth pressure = $\gamma H - 4C$, psf

$P2$ = Lateral earth pressure = $0.4\gamma H$, psf

$P3$ = Water pressure = $\gamma_w (H - D)$, psf

$P4$ = Lateral earth pressure caused by surcharge = qK_a , psf

γ = Effective unit weight of soil, pcf

γ_w = Unit weight of water, pcf

C = Drained shear strength or cohesion, psf

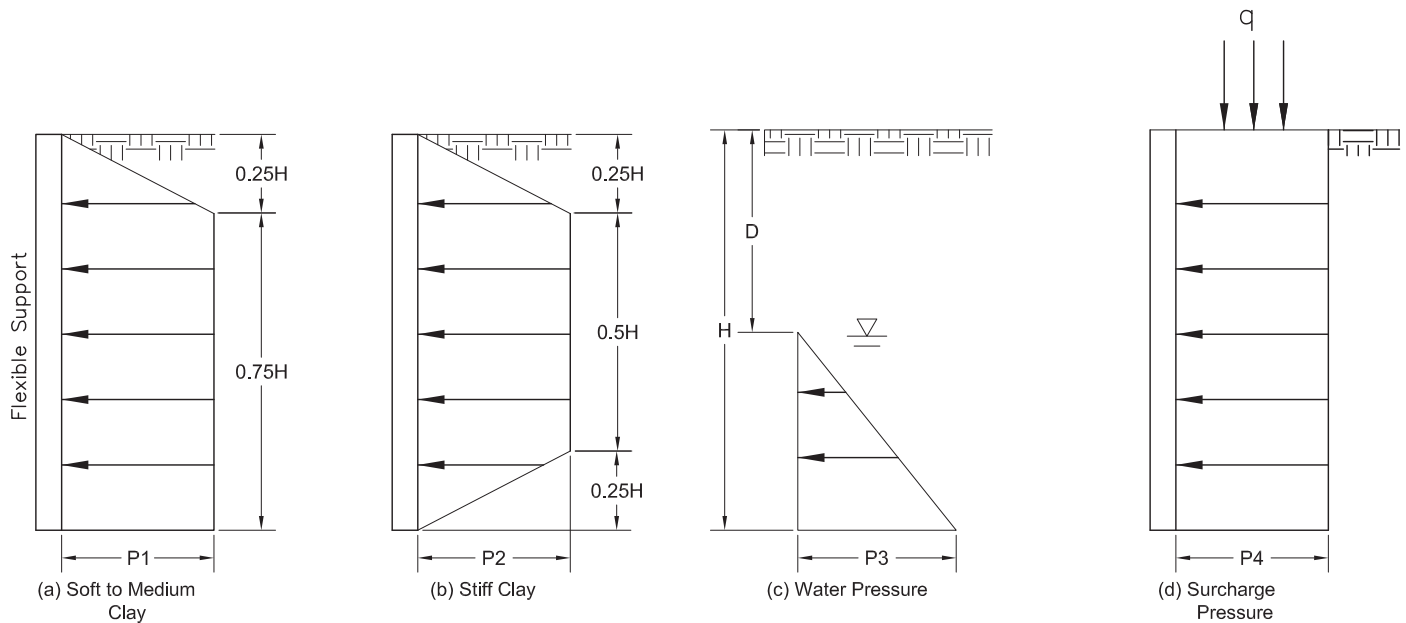
K_a = Coefficient of active earth pressure

Notes:

1. All pressures are additive.
2. No safety factors are included.
3. For use only during long term construction.
4. If $\gamma H/C < 4$, use section (b),
If $4 < \gamma H/C < 6$, use larger of section (a) or (b),
If $\gamma H/C > 6$, use section (a).

Reference: Peck, R.B. (1969), "Deep Excavation and Tunneling in soft Ground", 7th ICSMFE, State of art volume, pp. 225-290.

LATERAL PRESSURE DIAGRAMS
FOR OPEN CUTS IN COHESIVE SOIL - SHORT TERM CONDITIONS



Empirical Pressure Distributions

Where:

H = Total excavation depth, feet

D = Depth to water table, feet

$P1$ = Lateral earth pressure = $\gamma H - 4S_u$, psf

$P2$ = Lateral earth pressure = $0.2\gamma H$, psf

$P3$ = Water pressure = $\gamma_w (H - D)$, psf

$P4$ = Lateral earth pressure caused by surcharge = qK_a , psf

γ = Effective unit weight of soil, pcf

γ_w = Unit weight of water, pcf

S_u = Undrained shear strength = $q_u/2$, psf

q_u = Unconfined compressive strength, psf

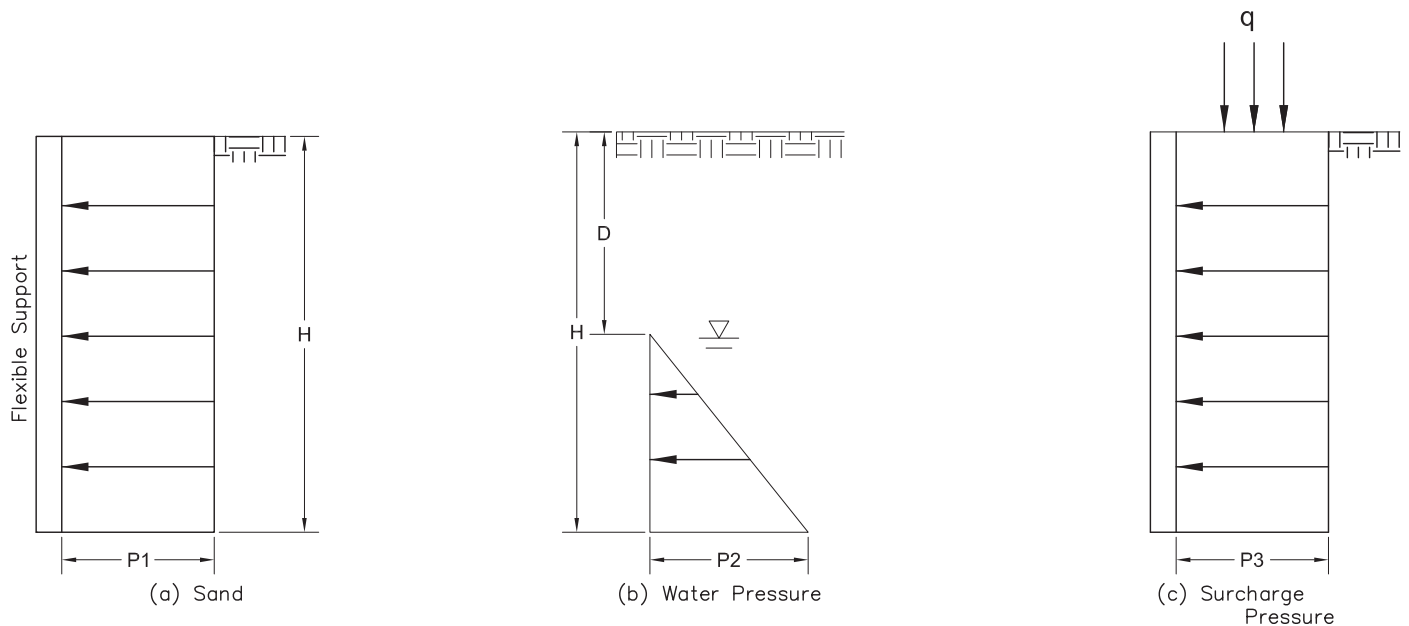
K_a = Coefficient of active earth pressure

Notes:

1. All pressures are additive.
2. No safety factors are included.
3. For use only during short term construction.
4. If $\gamma H/S_u < 4$, use section (b),
If $4 < \gamma H/S_u < 6$, use larger of section (a) or (b),
If $\gamma H/S_u > 6$, use section (a).

Reference: Peck, R.B. (1969), "Deep Excavation and Tunneling in soft Ground", 7th ICSMFE, State of art volume, pp. 225-290.

LATERAL PRESSURE DIAGRAMS FOR OPEN CUTS IN SAND



Empirical Pressure Distributions

Where:

H = Total excavation depth, feet

D = Depth to water table, feet

$P1$ = Lateral earth pressure = $0.65 \cdot \gamma H K_a$, psf

$P2$ = Water pressure = $\gamma_w (H-D)$, psf

$P3$ = Lateral earth pressure caused by surcharge = $q K_a$, psf

γ = Effective unit weight of soil, pcf

γ_w = Unit weight of water, pcf

K_a = Coefficient of active earth pressure = $(1 - \sin \phi) / (1 + \sin \phi)$

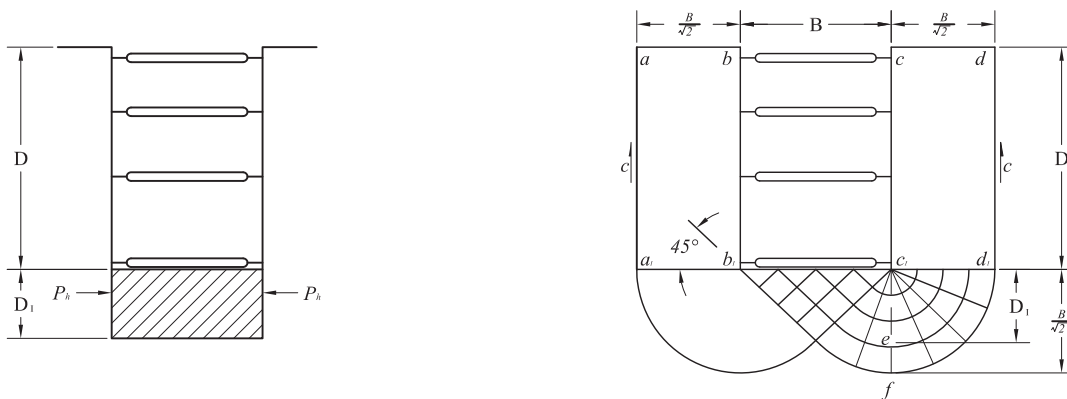
ϕ = Drained friction angle

Notes:

1. All pressures are additive.
2. No safety factors are included.

Reference: Peck, R.B. (1969), "Deep Excavation and Tunneling in soft Ground", 7th ICSMFE, State of art volume, pp. 225-290.

BOTTOM STABILITY FOR BRACED EXCAVATION IN CLAY



Factor of Safety against bottom of heave,

$$F.S = \frac{N_c C}{(\gamma D + q)}$$

where, N_c = Coefficient depending on the dimension of the excavation (see Figure at the bottom)
 C = Undrained shear strength of soil in zone immediately around the bottom of the excavation,
 γ = Unit weight of soil,
 D = Depth of excavation,
 q = Surface surcharge.

If $F.S < 1.5$, sheeting should be extended further down to achieve stability

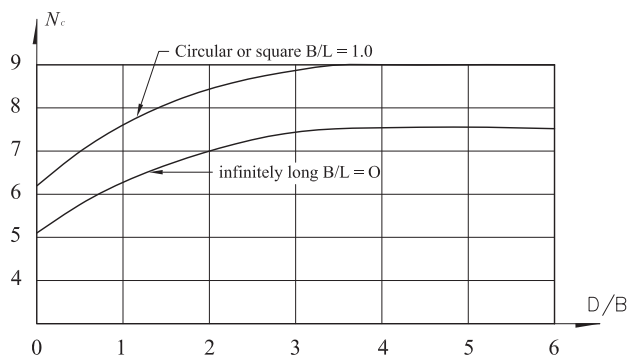
$$\text{Depth of Buried Length, } (D_1) = \frac{1.5(\gamma D + q) - N_c C}{(C/B) - 0.5\gamma} ; D_1 \geq 5 \text{ ft.}$$

Pressure on buried length, P_h :

$$\text{For } D_1 < 0.47B ; P_h = 1.5 D_1 (\gamma D - 1.4 CD/B - 3.14C)$$

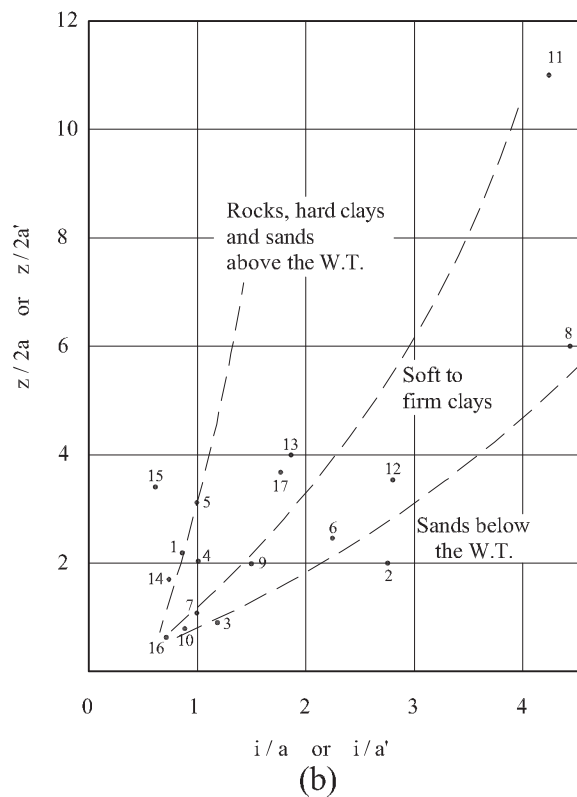
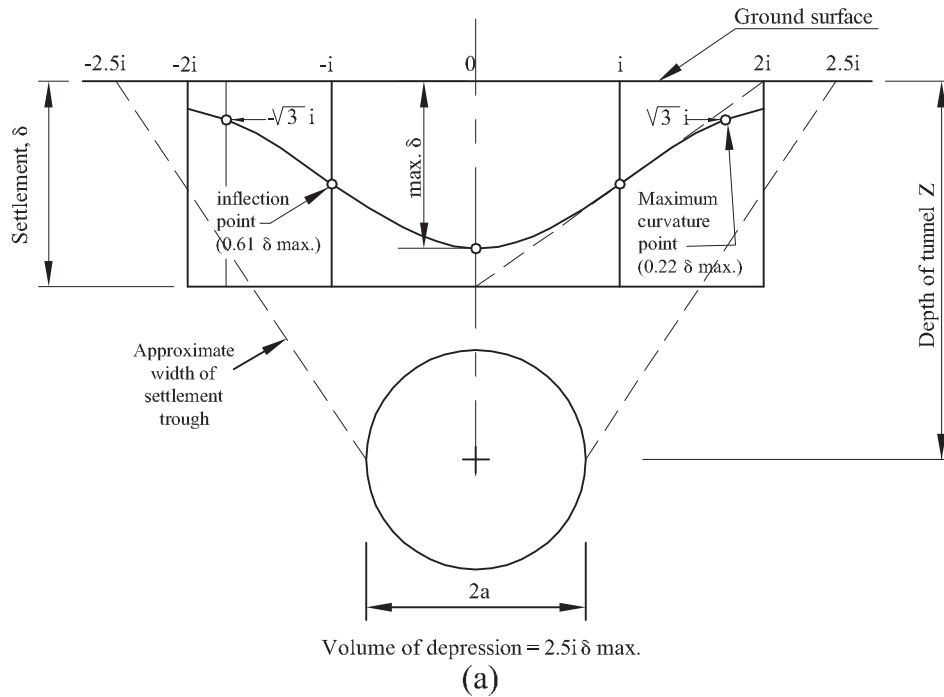
$$\text{For } D_1 > 0.47B ; P_h = 0.7 (\gamma DB - 1.4 CD - 3.14CB)$$

where; B = width of excavation



$$N_c \text{ rectangular} = (0.84 + 0.16B/L) N_c \text{ square}$$

Relation between the Width of the Surface Depression (i/a) and the Depth of the Cavity (z/a) for Tunnels



Reference: Peck, R. B. (1969) "Deep Excavations and Tunneling in Soft Ground," *Proceedings, Seventh International Conference on Soil Mechanics and Foundation Engineering, Mexico City, State of the Art Volume*, pp. 225-290.