

SECTION 330507.13 – HORIZONTAL DIRECTIONAL DRILLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract including General and Supplementary Conditions and Division 1 Specifications sections apply to this section.

1.2 DESCRIPTION

- A. This section contains guidelines and specifications applicable to the installation of pipelines using horizontal directional drilling (HDD). It includes minimum requirements for design, materials, and equipment used for the horizontal directional drilling for the substantially trenchless construction of pipelines. The section also includes materials, dimensions, and other pertinent properties of pipe and required accessories. These properties provide minimum performance requirements for various components including joints.
- B. Installation of pipelines shall be carried out by HDD where shown on the drawings and elsewhere by approval of the Engineer. The bore path shall be designed by the drilling contractor to ensure that pipe joints do not deflect more than 50% of manufacturer's recommended maximum deflection.

1.3 QUALITY ASSURANCE

- A. All horizontal directional drilling operations shall be performed by a qualified Contractor having a minimum of five (5) years' experience of installing pipe using directional drilling methods.
- B. The Contractor shall have demonstrated experience and expertise installing pipe using directional drilling methods involving work of a similar nature to the work required by this project including the following:
 - 1. The installation of greater than 2,000 LF of Gravity Flow Sewers.
 - 2. The installation of at least 2,000 LF of 12-inch diameter or greater pipe.
 - 3. The installation of pipe at depth of 20 feet or greater.
- C. All field supervisory personnel employed by the Contractor shall be adequately trained in directional boring methods and have at least three (3) years' experience in the performance of the work and tasks required.
- D. The Contractor shall show demonstrated experience and expertise in directional drilling methods by providing a job list with pipe sizes and depths similar to the specifications required by this project. This list shall also include a name and telephone number for contact.

1.4 SUBMITTALS

- A. Prior to beginning work, the Contractor shall submit to the Engineer a work plan detailing the procedure and schedule to be used to execute the project. The work plan shall include a description of all equipment to be used, down-hole tools, a list of personnel and their qualifications and experience including back-up personnel, a list of subcontractors, a schedule of work activity, a safety plan (including MSDS of any potentially hazardous substances to be used), traffic control plan (if applicable), and environmental protection plan and contingency plans for possible problems. The work plan shall be comprehensive, realistic, and based on actual working conditions for this particular project. The plan shall document the thoughtful planning required to successfully complete the project.
- B. Specifications on material to be used shall be submitted to Engineer. Material shall include the pipe, fittings, drilling mud, drilling additives, and any other item which is to be an installed component of the project or used during construction.
- C. Submittal requirements in 1.3 Quality Assurance as listed above.

PART 2 - PRODUCTS

2.1 GENERAL

- A. The bore path alignment and design for HDD shall be based on the Engineer's plans and other factors. Some of these factors are the pipe bell and barrel diameters, the optimum individual pipe length (18' nominal), bore path inside diameter, and maximum deflection capabilities of the joint.
- B. Prior to the start of drilling, reaming, and pipe placement operations, the Contractor shall properly locate and identify all existing utilities and structures in proximity to the pipeline alignment. The Contractor shall confirm the alignment of all critical utilities using vacuum excavation or other suitable excavation method for further detailed confirmations as necessary.

2.2 MATERIALS

- A. High Density Polyethylene Pipe: Pipe and fittings shall meet the requirements of ASTM C906. Pipe used for directional drilling shall be a minimum thickness equivalent to DR 11 HDPE pipe. Joints shall be butt fusion welded.

2.3 EQUIPMENT

- A. The Contractor shall have equipment appropriate for horizontal directional drilling installations. This includes the preparation and maintenance of the bore path using drilling fluids appropriate for the geology of the soils.

- B. The directional drilling machine shall consist of a hydraulically powered system to rotate, push, and pull hollow drill pipe into the ground at variable angles down to 8 degrees above horizontal, while delivering a pressurized fluid mixture to a guidable drilling and piping installation. The machine shall be anchored to the ground to withstand the pulling, pushing, and rotating pressure required to complete the crossing. The hydraulic power system shall be self-contained with sufficient pressure and volume to power drilling operations. Hydraulic system shall be free of leaks. The rig shall have a system to monitor the maximum pull-back pressure during the pull-back operation. The rig shall be grounded during drilling and pull-back operations. There shall be a system to detect electrical current from the drill string and an audible alarm which automatically sounds when an electrical current is detected.
- C. The drill head shall be a steerable type and shall provide the necessary cutting surfaces and drilling fluid jets.
- D. Mud motors shall be of adequate power to turn the required drilling tools.

2.4 GUIDANCE SYSTEM

- A. A conventional electromagnetic sound walkover system, Magnetic Guidance System (MGS) probe, or proven gyroscopic probe and interface shall be used to provide a continuous and accurate determination of the location of the drill head during the drilling operation. The guidance shall be capable of tracking at the maximum depth required and in any soil condition including hard rock. It shall enable the driller to guide the drill head by providing immediate information to the tool face, azimuth (horizontal direction), and inclination (vertical direction). The guidance system shall be accurate to +/- 2% of the vertical depth of the borehole at sensing position at depths up to one hundred feet and accurate within 1.5 meters horizontally.
- B. The Guidance System shall be of a proven type and shall be set up and operated by personnel trained and experienced with this system. The operator shall be aware of any geo-magnetic anomalies and shall consider such influences in the operation of the guidance system if using a magnetic system.

2.5 DRILLING FLUID SYSTEM

- A. A self-contained, closed, drilling fluid mixing system shall be of sufficient size to mix and deliver drilling fluid composed of bentonite clay, potable water, and appropriate additives. The mixing system shall be able to molecularly shear individual bentonite particles from the dry powder to avoid clumping and ensure thorough mixing. The drilling fluid reservoir tank shall be a minimum of 500 gallons. The mixing system shall continually agitate the drilling fluid during drilling operations.
- B. Additives to drilling fluid such as drill soap, polymers, etc., shall be "environmentally safe" and be approved for such usage. No diesel fuel shall be used.
- C. Unless otherwise authorized, an environmentally safe drilling fluid that does not contain bentonite shall be used for all HDD operations where drilling will be done under any stream, river or other watercourse.

2.6 OTHER EQUIPMENT

- A. Pipe rollers shall be of sufficient size to fully support the weight of the pipe while being hydro-tested and during pull-back operations. Sufficient number of rollers shall be used to prevent excess sagging of pipe. Rollers shall be used as necessary to assist in pull-back operations and in layout/jointing of piping.
- B. Hydraulic or pneumatic pipe rammers may only be used if necessary and with the authorization of Engineer.
- C. Other devices or utility placement systems for providing horizontal thrust other than those previously defined in the preceding sections shall not be used unless approved by the Engineer prior to commencement of the work.

2.7 PROOF-OF-DESIGN TESTS

- A. The pipe manufacturer shall have representative proof-of-design tests of flexible restrained pipe joints.

2.8 TRACER WIRE

- A. All piping shall be installed with a continuous, insulated tracer wire for location of non-metallic pipe with an electronic pipe tracer. Tracer wire shall be #10 AWG extra high strength copper clad steel wire with a minimum 2,032 lb. break load and minimum 30 mil insulation thickness.
- B. The wire insulation color shall be green for sewer and blue for water lines.
- C. Splices, if required, shall be with Buchanan connectors or approved equivalent.
- D. Upon completion, the Contractor shall demonstrate to the Engineer or his representative that the wire is continuous and unbroken through the entire pipe run by providing full signal conductivity when energized. If the wire is broken, the Contractor shall repair it at no additional cost.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The Engineer must be notified three days in advance of starting work. The Directional Bore shall not begin until the Engineer is present at the job site and agrees that proper preparations for the operation have been made. The Engineer approval for beginning the installation shall in no way relieve the Contractor of the ultimate responsibility for the satisfactory completion of the work as authorized under the Contract.

- B. The drawings show existing utilities that are believed to be near the directional drill alignment. There is no guarantee that these utilities are located as shown or that other utilities may not be present. The Contractor is to field locate existing utilities in advance of the work so as not to delay work and to avoid conflict or disruption of utility services.

3.2 DRILLING PROCEDURE

- A. The work site within right-of-way as indicated on drawings shall be graded or filled to provide a level working area. No alterations beyond what is required for operations are to be made. The Contractor shall confine all activities to designated work areas.
- B. The entire drill path shall be accurately surveyed with entry and exit stakes placed in the appropriate locations within the areas indicated on drawings. If the Contractor is using a magnetic guidance system, drill path shall be surveyed for any surface geo-magnetic variations or anomalies.
- C. The Contractor shall adhere to all applicable state, federal, and local safety regulations, and all operations shall be conducted in a safe manner.
- D. Pipe lengths shall be connected together in one length if space permits. Pipe shall be placed on pipe rollers before pulling into bore hole with rollers spaced close enough to prevent excessive sagging of pipe.
- E. The pilot hole shall be drilled on bore path with no deviations greater than 5% of depth over a length of 100 feet. In the event that pilot does deviate from bore path more than 5%, the Contractor shall notify Engineer and Engineer may require Contractor to pull-back and re-drill from the location along bore path before the deviation.
- F. Upon successful completion of pilot hole, the Contractor shall ream bore hole to a minimum of 25% greater than outside diameter of pipe bell for straight pulls and 50% greater for curved or radius pulls using the appropriate tools. Contractor shall have the option to pre-ream or ream and pull back pipe in one operation if conditions allow. The Contractor shall not attempt to ream at one time more than the drilling equipment and mud system are designed to safely handle.
- G. After successfully reaming bore hole to the required diameter, the Contractor shall pull the pipe through the bore hole. In front of the pipe shall be a swivel. Once pull-back operations have commenced, operations must continue without interruption until pipe is completely pulled into bore hole. During pull-back operations the Contractor shall not apply more than the maximum safe pipe pull force at any time. In the event that pipe becomes stuck, the Contractor shall notify the Engineer. The Engineer and Contractor shall discuss options and then work shall proceed accordingly.
- H. Excess pipe shall be removed and the bore hole associated with this excess pipe shall be filled with flowable fill or grout unless the area of the excess pipe is excavated and backfilled as part of the tie-in operations. In the event that a drilling fluid fracture, inadvertent returns, or returns loss occurs during pilot hole drilling operations, the Contractor shall cease operations and shall discuss corrective options with the Engineer; then work shall proceed accordingly.

3.3 BASIC ASSEMBLY/PULLING METHODS.

- A. Cartridge Assembly (Option 1). Cartridge Assembly option is defined as the assembling of individual sections of pipe in a secured entry and assembly pit. The pipe sections are assembled individually and then progressively pulled into the bore path a distance equivalent to a single pipe section. This assembly-pull process is repeated for each pipe length until the entire line is pulled through the bore path to the exit point.
- B. Assembly-Line or Ramp Method (Option 2). Assembly-Line option is defined by the pre-assembly of multiple lengths of pipe with subsequent pulling installation into the bore path as a long pipe string. With this option, the Contractor shall provide an entry ramp to the entrance of the bore path. The ramp shall be of sufficient length and grade such that any one pipe joint does not exceed the allowable joint deflection at any point prior to the pipe string entering the bore path.

The Contractor shall be responsible for providing the necessary equipment or ground surface preparation to allow the pipe to be pulled back along the surface prior to the entry ramp and bore path.

The pulling head may also be used as one of the two (2) bulkheads required for a low pressure air test of the pipe string prior to pull back, if required by the engineer. After complete installation, the pulling head may also be helpful with or without further connection of piping in normal higher pressure hydrostatic testing of the installed piping.

3.4 JOINT CLEANING/ASSEMBLIES IN HDD

- A. The Contractor shall be responsible for the proper assembly of all pipe and appurtenances in accordance with the Manufacturer's written installation procedure and as supplemented by these guidelines. Prior to joint assembly all joints and joint components shall be thoroughly cleaned and examined to ensure proper assembly and performance. In the event that the Contractor is not experienced with the assembly of the type of flexible restrained joint being used, it shall be the responsibility of the Contractor to contact a factory-trained representative for recommendations on the proper and efficient installation of the joint.

3.5 PIPE TESTING

- A. Following the successful pullback of the pipe, the Contractor shall hydro-test pipe from end to end.

3.6 SITE RESTORATION

- A. Following drilling operations, the Contractor shall de-mobilize equipment and restore the work-site to original condition. Any noticeable surface defects, due to the drilling operation, shall be repaired by the Contractor.

3.7 RECORD KEEPING AND RECORD DRAWINGS

- A. The Contractor shall maintain a daily record of the drilling operations and a guidance system log with a copy given to Engineer at completion of boring.
- B. The MGS data shall be recorded during the actual crossing operation. The Contractor shall furnish as-built plan and profile drawing based on these recordings showing the actual location horizontally and vertically of the installation, and all utility facilities found during the installation. The MGS data shall be certified accurate by the Contractor to the capability of the MGS System.
- C. Record drawings shall be completed and reviewed by the Engineer and prepared at the Contractor's expense. The as-built drawings shall be certified by the Contractor for accuracy.

3.8 CONTINGENCY AND RESOURCE PROTECTION PLAN

A. On-Site Monitoring

- 1. During drilling operations, visual inspection along the bore path of the alignment shall take place at all times.
- 2. The Contractor shall supply the following information to the monitoring team throughout the duration of the HDD operation at specific time intervals (e.g. upon completion of each drill rod):
 - a. Position of the drilling head relative to the drilling point of entry;
 - b. Estimated total volume of drilling fluid that has been pumped during the drilling operation;
 - c. Comparison of the current total volume of drilling fluid used and the estimated current total volume of returns;
 - d. Equipment breakdowns and repairs;
 - e. Any abnormal drilling fluid pressure at the time of occurrence; and
 - f. Any change of drilling fluid contents (e.g. new bentonite mixture or introduction of LCMs).

B. Field Response Plan

- 1. During the drilling process, the operator shall adjust the thickness of the bentonite mixture to match the substrate conditions and ensure continuous flow. Subsequently, the operator shall closely monitor drilling pressures and penetration rates so use of fluid pressure shall be optimal to penetrate the formation.
- 2. A complete and sudden loss of returns serves as a signal to both the operator and the monitor that something more significant may be occurring and to watch closely for a possible surface release. This plan uses the loss of returns or pressure, the use of a tracing dye and visual indications, to trigger response and mitigation actions.

3. In the event of a sudden loss of approximately 75 percent of expected returns, or in the event that a surface release of drilling fluid or dye are detected, the Contractor shall immediately cease operations to determine what actions need to be taken. In areas containing sensitive resources, agency notifications shall be made and the decision to resume operations shall be determined in consultation with the appropriate agencies' representatives.
4. All equipment required to contain and clean up a frac-out release shall either be available at the work site or readily available at an off-site location within 10 minutes of the bore site. Required equipment will be made available by manual transport; unless vehicle transportation is required due to magnitude of equipment and access is available. This equipment includes the following:
 - a. Heavy weight plastic clean gravel filled sand bags (at least 20 bags);
 - b. Geotek filter bags 10-by-12 foot size or equivalent (at least 3 bags per segment);
 - c. Several hard plastic (5-gallon) buckets;
 - d. One wide heavy-duty push broom;
 - e. Three flat bladed shovels;
 - f. Silt fence (appropriate coverage up to 40 foot perimeter);
 - g. Certified weed-free hay bales (appropriate coverage up to 40 foot perimeter);
 - h. Two bundles of absorbent pads to use with plastic sheeting for placement beneath motorized equipment while in operation in the vicinity of a riparian/stream zone;
 - i. Straw logs (wattles or fiber rolls) (at least two 10-foot rolls);
 - j. Portage pumps;
 - k. A minimum of 100 feet of hose; and
 - l. Vacuum truck (800 and 3,000 gallon).
5. General responses to frac-out releases related commitments are as follows:
 - a. Directional boring would stop immediately;
 - b. The bore stem would be pulled back to relieve pressure on frac-out;
 - c. The Owner and Owners' site representative would be notified to ensure adequate response actions are taken and notifications are made;
 - d. Terrestrial releases would be cleaned up using on-site equipment;
 - e. A dike/berm may be constructed around the frac-out (terrestrial only) to entrap released drilling fluid;
 - f. Response equipment stored off-site in readily accessible locations (e.g. portable pumps and full equipped 800 or 3,000 gallon vacuum trucks) would be mobilized to recover larger releases of drilling fluid;
 - g. Access to the frac-out release area would be via existing roads and temporary work easements. Additional access needed to perform clean-up activities would be coordinated with and require approval of all regulating entities.

C. Proper Notification and Documentation

1. If frac-out occurs or any degree of dye were detected within the water column of a stream, the Contractor shall immediately notify the appropriate permitting agencies, and additional follow-up response actions would be developed in coordination with agency representatives.
2. Documentation of environmental compliance shall include written reports of observations, documentation of events and follow-up, and project tracking.

D. Training of Personnel

1. Prior to the commencement of construction, the Contractor shall conduct an on-site training session for members of his monitoring team, Owners' personnel and Owners' site representative. The training session shall cover the following topics:
 - a. Details of the information found within the Contractor's safety, traffic control and environmental protection and contingency plans;
 - b. Specific permitting conditions and requirements;
 - c. Requirement to retain copies of all appropriate permits on the site during all operations;
 - d. Sensitive resources located at or near the site;
 - e. Requirement to monitoring during all operations;
 - f. Proper lines of communication;
 - g. Proper lines of authority and responsibility;
 - h. Information the Contractor shall provide to the monitoring personnel and Owners' site representative;
 - i. Contact names and phone numbers of the appropriate individuals and agencies; and
 - j. Types of events that the Contractor is required to report and to whom.
2. The Contractor shall provide an overview of the drilling operation in their work plan. The training session shall ensure that Contractor personnel recognize the authority of the on-site monitors to stop drilling.

END OF SECTION 330507.13