HORIZONTAL DIRECTIONAL DRILLING SPECIFICATION
WATER AND SEWER INSTALLATION

1.0 GENERAL

1.1 SCOPE OF WORK

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.

1.2 DESCRIPTION OF SYSTEM

Installation of pipelines below wetlands and creeks 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 that 50% of manufacturer's recommended maximum deflection.

2.0 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

2.1 The following standards contain provisions that, through reference in this text, constitute provisions of these guidelines. All standards are subject to revision, and users of these guidelines are cautioned to use the latest revisions.

2.2 American National Standards Institute (ANSI)/American Water Works Association (AWWA)

2.2.1 C150/A21.50 – Standard for the Thickness Design of Ductile-Iron Pipe

2.2.2 C151/A21.51 – Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water

2.2.3 C111/A21.11 – Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

2.2.4 C104/A21.4 – Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.

2.2.5 C105-A21.5 – Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems

2.2.6 C153/A21.53 – Standard for Ductile-Iron Compact Fittings, 3-inch through 24-inch and 54-inch through 64-inch, for Water Service.

2.2.7 C600 – Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances

3.0 SUBMITTALS

3.1 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 in the event that an individual is unavailable), 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), an environmental protection plan and contingency plans for possible problems. Work plan shall be comprehensive, realistic and based on actual working conditions for this particular project. Plan shall document the thoughtful planning required to successfully complete the project.

3.2 Specifications on material to be used shall be submitted to Engineer and 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.

3.3 PRODUCTS

3.4 GENERAL

3.4.1 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.

3.4.2 Prior to the start of drilling, reaming and pipe placement operations, the Contractor shall properly locate and identify all existing utilities 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.

3.50 PIPE AND FITTINGS

3.5.1 Pipe and fittings shall meet the requirements of AWWA/ANSI C151/A21.51 and ANSI/AWWA C153/A21.53, respectively. Pipe used for directional drilling shall be Class 350 ductile iron pipe, or as specified by the engineer, with pipe manufacturer designed restrained flexible joints and smoothly contoured bells. Joints with bulky glands or flanges that may prevent the smooth flow of the drilling fluid/soil slurry over the joint shall not be acceptable. Pipe shall be US Pipe TR FLEX® or approved equal.

3.60 LININGS AND COATINGS

3.6.1 Ductile iron water pipe shall be lined with cement mortar per ANSI/AWWA C104.A21.4. Ductile iron piping shall be furnished with a standard asphalt external coating approximately one mil thick in accordance with ANSI/AWWA C151/A21.51.

3.6.2 Pipe for sewer applications shall be Cement-Mortar lined in accordance with ANSI/AWWA C104/A21.4 or if required by the engineer, lined with PROTECTO 401®.

4.0 EQUIPMENT AND EXPERTISE

4.1 The Contractor shall have equipment and expertise, 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. The Contractor shall also have experience in safety and dependability installing, in similar geology, similar size and length of piping involved.

4.2 DRILLING SYTEMS

4.2.1 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 drill (bore) head. The machine shall have a capacity to adequately complete the 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. 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.

4.2.2 The drill head shall be a steerable type and shall provide the necessary cutting surfaces and drilling fluid jets.

4.2.3 Mud motors shall be adequate power to turn the required drilling tools.

4.3 GUIDANCE SYSTEM

4.3.1 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 feed and accurate within 1.5 meters horizontally.

4.3.2 The Guidance System shall be of a proven type and shall be setup 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.

4.4 DRILLING FLUID (MUD) SYSTEM

4.4.1 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. 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. Mixing system shall continually agitate the drilling fluid during drilling operations.

4.4.2 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.

4.5 OTHER EQUIPMENT

4.5.1 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.

4.5.2 Hydraulic or pneumatic pipe rammers may only be used if necessary and with the authorization of Engineer.

4.5.3 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. Consideration for approval shall be made on an individual basis for each specified location. The proposed device or system shall be evaluated prior to approval or rejection on its potential ability to complete the utility placement satisfactorily without undue stoppage and to maintain line and grade within the tolerances prescribed by the particular conditions of the project.

5.0 JOINTS, INTERCONNECTIONS, AND PULLING BELL ASSEMBLIES

5.1.1 Joints used for directional drilling shall be boltless, flexible, restrained and shall be U. S. Pipe TR FLEX® or approved equal. Pipe and joint seals, when properly assembled and installed, shall be capable of dependably handling the specified internal pressure, as well as vacuum and external pressures that can occur in pipeline operation. Joints shall exhibit such performance attributes in straight alignment or at maximum rated joint deflection. The pipe pulling head shall be made of ductile-iron and designed and furnished by the pipe manufacturer or an approved equal. The pulling head assembly shall have the same performance characteristics as the pipe to which it is connecting. It shall also be supplied with a filling/testing port, of appropriate size, for testing of the pipe after it is pulled through the bore path.

5.1.2 For pipe that is installed using the Assembly Line method or Ramp Method, described as follows, 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.

6.0 PROOF-OF-DESIGN TESTS

6.1 The Manufacturer shall have representative proof-of-design tests of flexible restrained pipe joints.

6.2 POLYETHYLENE ENCASEMENT

6.2.1 If the drill area has a history of corrosive soil or a soil survey determines the soil to be corrosive, the ductile iron pipe to be installed by horizontal directional drilling shall be installed with a single or double polyethylene encasement (PE) per ANSI/AWWA C105/A21.5. Any damage that occurs to the polyethylene wrap during pipe handling and throughout the construction process shall be repaired prior to pulling the pipe string into the bore path.

7.0 EXECUTION

7.1 GENERAL

7.1.1 The Engineer must be notified 48 hours 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.

7.1.2 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 the 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 avoid conflict or disruption of utility services.

7.2 PERSONNEL REQUIREMENTS

7.2.1 All personnel shall be fully trained in their respective duties as part of the directional drilling crew and in safety. Contractor must show job history and reference list of equal or greater size and length of piping involved. The Supervisor must have at least two years directional drilling experience. A competent and

experienced supervisor representing the Drilling Contractor shall be present at all times during the actual drilling operations. A responsible representative who is thoroughly familiar with the equipment and type work to be performed, must be in direct charge and control of the operation at all times.

7.3 DRILLING PROCEDURE

7.3.1 Work site as indicated on drawings, within right-of-way, shall be graded or filled to provide a level working area. No alterations beyond what is required for operations are to be made. Contractor shall confine all activities to designated work areas.

7.3.2 Entire drill path shall be accurately surveyed with entry and exit stakes placed in the appropriate locations within the areas indicated on drawings. If Contractor is using a magnetic guidance system, drill path shall be surveyed for any surface geo-magnetic variations or anomalies.

7.3.3 Contractor shall adhere to all applicable state, federal and local safety regulations and all operations shall be conducted in a safe manner.

7.3.4 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.

7.3.5 Pilot hold shall be drilled on bore path with no deviations greater that 5% of depth over a length of 100'. In the event that pilot does deviate from bore path more than 5% of depth in 100', Contractor shall notify Engineer and Engineer may require Contractor to
pull-back and re-drill from the location along bore path before the deviation.

7.3.6 Upon successful completion of pilot hole, 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. Contractor shall not attempt to ream at one time more than the drilling equipment and mud system are designed to safely handle.

7.3.7 After successfully reaming bore hole to the required diameter, 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 Contractor

shall not apply more that the maximum safe pipe pull force at any time. In the event that pipe becomes stuck, Contractor shall notify Engineer. Engineer, Contractor, and/or the maintaining agency shall discuss options and then work shall proceed accordingly.

7.3.8 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, Contractor shall cease operations and shall discuss corrective options with the Engineer and/or maintaining agency, then work shall proceed accordingly.

7.4 BASIC ASSEMBLY/PULLING METHODS

7.4.1 Cartridge Assembly (Option 1) Cartridge assembly option is defined as the assembling of individual sections of flexible restrained joint ductile iron 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 trough the bore path to the exit point.

7.4.2 Assembly-Line or Ramp Method (Option 2) Assembly-line option is defined by the pre-assembly of multiple lengths of flexible restrained joint ductile iron 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 without damaging the PE encasement. The Contractor shall repair any damage to the wrap prior to the pipe section entering the bore path.

7.5 JOINT CLEANING/ASSEMBLIES IN HDD

7.5.1 The Contractor shall be responsible for the proper assembly of all pipe and appurtenances in accordance with the Manufacturers 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.

7.6 PIPE TESTING

7.6.1 Following successful pullback of pipe, Contractor shall hydro-test pipe.

7.7 SITE RESTORATION

7.7.1 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.

7.8 RECORD KEEPING

7.8.1 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. As-built drawings shall be certified by the Contractor, for accuracy.