33 05 23 TRENCHLESS UTILITY INSTALLATION

SECTION 1 – GENERAL

1.1 SUMMARY

A. This specification addresses systems of piping and general requirements for water distribution and sewer collection systems which shall be installed by various trenchless applications.

B. All materials to be installed shall be purchased in accordance with all applicable provisions of the Buy American Act.

C. Pipe Bursting materials and execution are specified in Section 33 01 30.71 Rehabilitation of Sewer Utilities.

D. Pipe Materials for water construction are as specified in Section 33 10 00 Water Piping, Structures & Appurtenances.

E. Pipe Materials for sewer construction are as specified in Section 33 30 00 Sanitary Sewer Piping, Structures & Appurtenances.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Contractor shall comply with Utility requirements.
   2. Contractor shall comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

C. Contractor shall comply with FM Global's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.

D. Contractor shall comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.

E. Contractor shall comply with NSF 14 for plastic potable-water-service piping. Include marking "NSF-pw" on piping.

F. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
G. Steel Piping Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Contractor shall comply with provisions in ASME B31 Series, "Code for Pressure Piping."

2. Contractor shall certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

H. Contractor shall comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

I. Horizontal Directional Drill (HDD) Contractor Qualifications

1. The HDD contractor shall be trained and certified to operate the Horizontal Directional Drilling equipment with at least five years of experience in directional drilling obtained over the last five years.

2. All HDD operations shall be performed under the constant direction of a drilling supervisor who shall remain on site and be in responsible charge throughout the drilling operation. The supervisor shall have supervised directional drilling of a minimum of 50,000 linear feet of pipe of a similar or greater diameter, of similar material and over similar lengths, over the past five years.

1.3 SUBMITTALS

A. The contractor shall submit the following prior to construction and use:

1. Welding Certificates

2. Operation and maintenance data.

3. Field quality-control test reports.

4. Qualifications for the horizontal directional drill (HDD) or Bore and Jack contractor:

   a. Name, business, address and telephone number of the Contractor.

   b. Experience in successfully completing directional drilling operations.

   c. List of similar projects performed over the last two years including the name of contact person and telephone number.

   d. Certification of workman training.
e. Name(s) and experience of all supervisory personnel to be directly involved with the project.

f. The Contractor shall sign and date the information provided and certify that to the extent of his knowledge, the information is true and accurate, and that the supervisory personnel for the HDD operations will be directly involved with this project.

5. Construction Procedure Submittals required for horizontal directional drill (HDD) and Bore & Jack operations:

a. A plan that outlines the proposed sequence of construction, including location and size of entry/exit pits, provisions for bypass pumping (if necessary), reaming process, access points for materials and equipment, control of the drilling fluid, and other items involved with the installation of the main.

b. A list of all equipment to be used, including drilling rig size and capabilities, reamer size, drill pipe, fluid pumps, and drill head monitoring equipment.

c. Grouting techniques to be used for over-excavation if any, including equipment, pumping procedures, grout types, and mixtures.

d. Description of line and grade control, including the proposed method for locating, controlling, and verifying the direction and grade of the drilling operation.

e. Proposed procedures, materials and equipment for lubricating the exterior of the pipe during pulling. Specifically, the proposed drilling fluid design shall be submitted to the Utility prior to commencing work.

f. Details of spoil removal system, including equipment type, number and disposal location.

g. Proposed methods, materials and equipment for removing and clearing obstructions so that the HDD can advance forward.

h. Satisfactory written certification of the Contractor’s compliance with the manufacturer’s standards for all materials, conformance with the methods of the manufacturer, and accordance with all standards specified and referenced herein.

i. Proposed materials and methods for restraining the pipe at the manhole connection.

j. Proposed pipe material to be used.
k. Proposed method to verify that the installed pipe is on line and grade.

6. Reporting:
   a. The Contractor shall maintain and update daily an operator logbook.
   b. The logbook shall include the drill locator’s notes and records of the bore from the steering and tracking system.
   c. The logbook should also include pipe diameter, depth, pitch, steering commands, drilling fluid circulation, drilling fluid composition, ground conditions, date, time on-site, footage obtained during that day, and any pertinent notes.
   d. The logbook shall be legible, accurate, and shall be submitted to the Utility upon completion of the work.

1.4 PROJECT CONDITIONS

A. The Contractor shall not interrupt sewer service to facilities or others unless permitted under the following conditions and then only after arranging to provide temporary or alternative service according to requirements indicated.

1. The Contractor shall notify Utility no fewer than two weeks in advance of proposed interruption of service.

2. The Contractor shall not proceed with interruption of sewer service without Utility’ written permission.

3. Sewer service interruption shall be limited to eight hours or less.

4. In Cases where service is interrupted for longer than four hours, the contractor shall provide portable toilets to the facility being impacted in quantities determined by Utility at no additional cost to Utility.

B. Boring logs and a geotechnical report may be included in the contract documents. If included the boring logs indicate the soil and groundwater conditions at the boring location at the time of the boring. Conditions may change away from the actual boring location and may change with time. The boring logs and geotechnical report are made available to the Contractor for his information to be used at his own risk. The Contractor is responsible for any conclusions to be drawn from the boring logs including the character of the materials to be encountered and the degree of difficulty to be expected in the performance of the work. The Contractor is encouraged to perform his own subsurface investigation.

C. Horizontal Directional Drilling operations shall limit vibrations transmitted to surrounding structures so as not to cause damage. Any damage to any
structures, roadways or any other items shall be repaired at the Contractor's expense.

SECTION 2 – MATERIALS

2.1 BORING AND JACKING MATERIALS

A. Materials to be used shall be appropriate for the installation method chosen by the contractor and meeting specifications of the furnished products use. All materials shall be submitted for approval, prior to the Contractor commencing operations.

B. Dry Boring and Jacking:

1. The casing pipe shall be spiral welded or smooth wall steel pipe in accordance with ASTM A53, Grade B having minimum yield strength of 35,000 psi.

2. The carrier pipe installed for water or force main applications, within the casing pipe shall be CL 52 ductile iron restrained joint pipe. Use of pressure class ductile iron pipe for water mains is acceptable in accordance with Division 33 10 00 – Water Utility Distribution Piping.

3. The material for the gravity sanitary sewer carrier pipe shall be CL 50 ductile iron.

4. Mechanical joint restraint systems are not an acceptable means of restraint within the casing pipe.

5. All carrier pipes shall have the appropriate lining and coating.

6. The casing pipe minimum size and minimum wall thickness shall be in accordance with the following chart unless indicated otherwise on the drawings.

<table>
<thead>
<tr>
<th>CARRIER PIPE</th>
<th>CASING PIPE (O.D.)</th>
<th>WALL THICKNESS</th>
<th>RAILROAD WALL THICKNESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>4&quot;</td>
<td>8&quot;</td>
<td>0.188</td>
<td>0.188</td>
</tr>
<tr>
<td>6&quot;</td>
<td>12&quot; or 12 ¾&quot;</td>
<td>0.188</td>
<td>0.188</td>
</tr>
<tr>
<td>8&quot;</td>
<td>16&quot;</td>
<td>0.250</td>
<td>0.281</td>
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<td>10&quot;</td>
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<td>12&quot;</td>
<td>24&quot;</td>
<td>0.250</td>
<td>0.375</td>
</tr>
<tr>
<td>16&quot;</td>
<td>30&quot;</td>
<td>0.312</td>
<td>0.469</td>
</tr>
<tr>
<td>CARRIER PIPE (O.D.)</td>
<td>CASING PIPE</td>
<td>WALL THICKNESS</td>
<td>RAILROAD WALL THICKNESS</td>
</tr>
<tr>
<td>---------------------</td>
<td>-------------</td>
<td>----------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>24&quot;</td>
<td>36&quot;</td>
<td>0.375</td>
<td>0.531</td>
</tr>
<tr>
<td>30&quot;</td>
<td>42&quot;</td>
<td>0.500</td>
<td>0.625</td>
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<tr>
<td>36&quot;</td>
<td>48&quot;</td>
<td>0.500</td>
<td>0.688</td>
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</tbody>
</table>

7. The Contractor may substitute larger size casing pipe (particularly for sewer mains where grade and alignment are critical) with the proper wall thickness.

8. Casing Spacers
   a. All casing spacers shall be made of 304 stainless steel with nylon or polyester glass reinforced runners, 2-inches wide.
   b. All casing spacers shall be ordered and installed in the “Centered-Restrained” position.
   c. All casing spacers larger than 24-inch shall be factory designed, taking in consideration the weight of the carrier pipe filled with water.
   d. All casing spacers shall have a total design compression strength of not less than 18,000 psi.
   e. Length of the spacers shall be per the manufacturers requirements.
   f. Wooden skids and polyethylene runners are unacceptable.

2.2 HORIZONTAL DIRECTIONAL DRILLING MATERIALS AND EQUIPMENT

A. Cement grout, if required, shall consist of a mixture of one part cement to six parts sand. The amount of cement may be increased or decreased as necessary and as permitted by the Utility to provide good flowing characteristics.

B. Lubricant
   1. Lubricant for horizontal directional drilling and/or bore and jack operations shall be bentonite or polymer based slurry.
   2. It is recommended that the proposed drilling fluid be specified based on the geotechnical reports(s) and the Contractor's evaluation of the site conditions.
3. The fluid manufacturer shall prepare and provide the fluid management plan.

C. All drill rigs and associated equipment shall be in good condition and capable of completing the project without significant delays.

D. Drill Bits

1. All drill bits and reamers shall have a closed face and shall be capable of supporting the excavated area (face) during excavation and shutdown.

2. The bit shall be full directional in both the horizontal and vertical directions from the drill rig so that the alignment can be maintained during the entire drilling operation.

3. All drill bits shall be capable of drilling through all materials encountered including sand, gravel, glacial till and outwash, organics, marine clay, and other materials indicated within the geotechnical report.

2.5 GUIDE PILOT BORE METHOD:

A. Casing Pipe shall not be required.

B. Carrier pipe for all applications shall be integrated bell/spigot ductile iron Class 56 with appropriate liner and coatings

C. Drilling fluids shall be in accordance with drilling machine and pipe manufacturer’s recommendations.

SECTION 3 – EXECUTION

3.1 BORING AND DRILLING PITS

A. All work to construct and maintain the pit shall be the responsibility of the Contractor.

B. Locations and size of the entry and exit pits shall be approved by the Utility prior to beginning construction.

C. All existing utilities shall be located and protected as necessary. The Contractor shall coordinate any utility protection with the respective utility company.

D. All excavation shall conform to OSHA requirements.
3.2 BORING AND JACKING INSTALLATION

A. Installation shall be by dry boring and jacking of a smooth wall steel pipe or by Guided Pilot Boring that is true to line and grade under roadways, where indicated on the plans, all in accordance with these specifications and recommendations of the pipe manufacturer.

B. Casing pipe shall be installed with a minimum vertical separation from top of casing pipe to bottom of pavement as shown on the plans.

C. The Contractor shall notify the Utility's Representative a minimum of seven days prior to any contemplated work and securing any required permits.

D. Installation using the selected method shall be true to line and grade under roadways, where indicated on the plans, all in accordance with these specifications and recommendations of the pipe manufacturer.

E. A manual steering head or other approved guidance system is recommended for casing pipe 30 inches and larger and/or bores exceeding 100 feet in length.

F. The alignment and grade of the jacking shall be carefully established prior to beginning the operation, by provisions of guide rails in the jacking pit, or other methods approved by the Utility.

G. Lubricants, such as bentonite, may be applied to the outside of the pipe to reduce frictional resistance during jacking.

H. The boring auger shall not be a greater diameter than the outside diameter of the encasement and removal of the excavated material ahead of the pipe will be held to a minimum to prevent the formation of voids.

I. Grout holes shall be placed in the top section of the encasement pipe on 10-feet centers and the voids shall be filled with 1 part cement to 3 parts sand Portland cement grout at sufficient pressure to prevent settlement of the roadway or railroad.

J. Ends of the encasement pipe shall be closed with masonry after the carrier pipe placement.

K. Gravity Sewer mains

1. Contractor shall perform each jack and bore before beginning the gravity sewer line construction.

2. A total maximum variation of 0.2-feet in invert elevation between terminating manholes is allowable.

3. The boring shall be performed from the "downstream" to "upstream" direction maintaining the critical downstream invert elevation.
4. Should the bore termination not be on grade, the invert elevations of all manholes may be adjusted "upstream" but any sewer adjustment shall be at the Contractor's expense for any extra depths of cut or extra manhole depth.

5. The sanitary sewer grade shown on the plans is considered the minimum allowable and flatter grades shall not be acceptable without approval of the Utility.

6. Variations more than the allowable for invert elevations or in the allowable slope shall require correction by the Contractor at no additional cost to the Utility.

L. The boring operations shall be conducted at all times in such a manner so as not to create a hazard to nor impede the flow of traffic.

M. The Contractor will be responsible for any repair costs if any settlement or damage to the roadway or railroad bed resulting from the boring operation occurs within one year after completion of the work.

N. The Contractor shall maintain proper insurance as required by the State Department of Transportation and/or the Railroad.

O. The contractor shall submit on the machine specs, the operator qualifications and fusion machine training records as applicable.

P. If a bore and jack operation must be abandoned, then the installed pipe must be cut-off, capped, and filled with 1 part cement to 3 parts sand Portland cement grout.

Q. Casing Spacers
   1. For ductile iron pipe, a minimum of 2 spacers per joint of carrier pipe shall be installed.
   2. For PVC pipe, a minimum of 4 spacers per joint of carrier pipe shall be installed.
   3. Spacers shall be spaced evenly along the carrier pipe such that each spacer shall support the same unit weight.

3.3 HORIZONTAL DIRECTIONAL DRILLING

A. General Requirements
   1. Though the HDD installation process may be licensed or proprietary in nature, the Contractor shall not change any material, thickness, design, values or procedural matters stated in the submittals, without the prior approval of the Utility.
2. The Contractor shall submit, in writing, full details about component materials, their properties and installation procedures and abide by them fully during the entire course of the work.

3. The Contractor shall provide all survey including site layout, inspection and record keeping incidental to the drilling and pipe installation.

B. The HDD shall be installed with no interruption in traffic. Any required traffic control shall be coordinated with the Utility a minimum of 1 week prior to beginning operations.

1. Horizontal directional drilling for gravity sewer systems shall only be used where the proposed grade is greater than or equal to 2 percent, and with prior approval of the Utility.

2. The Contractor shall take all necessary measures to ensure the pipe is not damaged or scarred in any way during delivery, storage, or installation. Any gouges in the pipe shall result in the pipe, or section of the pipe, being rejected and replaced with undamaged pipe at no additional cost to the Utility.

3. Prior to beginning HDD operations, the walkover transmitter and receiver shall be calibrated in accordance with the manufacturer’s recommendations.

4. Contractor shall walk the project site to identify any objects that may interfere with the drilling operations, the proper operation of the receiver and transmitter, and/or pose any other concern with regards to the installation.

5. For gravity sewer pipe, install the pipe from either a pit which allows the pipe installation along the proposed grade directly or by drilling an initial sacrificial tangent section outside the limits of the proposed pipe segment (manhole to manhole) which is then excavated and cut-off or turned down to make the pipe connection at the grades indicated.

6. HDD construction shall include excavation and backfill, diversion pumping (if required), demolition, grouting, site restoration, television inspection of the installed main, reaming, testing of the installed pipe, as necessary to complete the work.

7. The Contractor shall dispose of all waste soils, slurries and other wastes in accordance with applicable regulations. No waste shall be left on-site following completion of the work.

8. The Contractor shall dispose of all groundwater generated by dewatering operations and any surface water entering access pits in accordance with applicable regulations.
C. Ground Surface Monitoring

1. Prior to Beginning the HDD Operation
   a. Contractor shall visually inspect the ground surface along the centerline of the proposed bore. Any signs of settlement or heaving should be noted and reported to the Utility.
   b. The Contractor is encouraged to take pictures and/or videotape existing conditions prior to commencing construction activities. The pictures and/or videotape should include any structures and their condition that are within the limits of construction.

2. During the HDD Operation
   a. The Contractor shall monitor the ground surface along the centerline of the pipe, to observe any signs of settlement or heaving due to the HDD operations.
   b. The Contractor shall make a visual inspection of the ground surface along the centerline of the pipe to look for signs of settlement on an hourly basis during the time of active drilling and backreaming.
   c. The Contractor shall record his visual observations on a daily basis, and provide this report to the Utility upon completion of the HDD operations.
   d. If deemed necessary by the Utility, the Contractor shall establish surface settlement monitoring points along the centerline of the pipe and any additional monitoring points at locations deemed necessary. The monitoring points shall be installed in accordance with the following:
      1) Record location of settlement monitoring points with respect to construction baselines and elevations.
      2) Record elevations to an accuracy of 0.01 feet for each monitoring point location.
      3) Establish monitoring points at locations and by methods that protect them from damage by construction operations, tampering, or other external influences.
   e. Monitoring
      1) Monitor ground settlement directly above and 10 feet before and after any utility or pipeline intersection.
2) The Contractor shall monitor these points during construction, and submit records of daily readings from the various surface settlement monitoring points.

3) The Contractor shall immediately report any loss of ground, roadway cracking, depression or settlement or other unusual activities.

3. Settlement or heave of the ground surface along the HDD alignment shall not exceed 0.5 inches.

D. Drilling

1. The drill rig to be utilized for the directional drill and pipe pullback shall be of sufficient size and capacity to complete the required work.

2. Remote sensing shall be provided at the drill rig to maintain alignment of the drilling operation and provide a profile and plan locations of the as-installed pipe. The plan and profile locations shall be sufficient to verify that the installed pipe meets the line and grade requirements of the contract documents.

3. The pilot hole shall be reamed to a diameter which is sufficiently sized to reduce forces applied to the pipe during pull back. Table below provides recommendations for reamed diameter, based on pipe diameter. Final ream diameters less than 1.5 times the pipe O.D. must be approved by the Utility prior to initiating pullback.

<table>
<thead>
<tr>
<th>Pipe Diameter</th>
<th>Recommended Ream Diameter</th>
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</thead>
<tbody>
<tr>
<td>less than 8”</td>
<td>pipe diameter + 4”</td>
</tr>
<tr>
<td>8” through 24”</td>
<td>1.5 times pipe diameter</td>
</tr>
<tr>
<td>greater than 24”</td>
<td>pipe diameter + 12”</td>
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</tbody>
</table>

4. Fusing of the pipe shall be in accordance with Section 33 10 00 Water Piping, Structures & Appurtenances and/or Section 33 30 00 Sanitary Sewer Piping, Structures & Appurtenances. Final pipe shall be installed as one continuous fused pipe.

5. If pullback equipment is not capable of monitoring pulling forces imposed upon the pipe, a weak link shall be inserted between the pipe and the molehead/reamer in order not to exceed the safe pulling strength as prescribed by the pipe manufacturer.

6. A protective bumper or roller shall be utilized to prevent the pipe from being damaged during the pullback operation. Install a swivel between
the molehead/reamer and pipe connection to minimize torsional stresses imposed on the pipe during the pullback operation.

7. Proper lubrication shall be maintained during pipe pullback to reduce the exterior friction and possibility of the pipe seizing in place.

8. Once the pullback operation has started, the operations shall continue to completion, without allowing the pipe to set in the ground unmoved for more than a 4 hour period.

9. Pipe shall be pulled into place without damaging the pipe joints or pipe sections. Caution shall be taken to prevent stretching of the HDPE pipe beyond the elastic limit of the polyethylene.

10. Any pipe damaged during installation shall be replaced at no additional cost to the Utility.

11. The annular space around the final pipe shall be pressure grouted if the final ream produces a theoretical annular space of more than 0.2 cu ft per linear foot of pipe.

E. Post Drilling

1. After installation, a minimum of 24 hours shall be allowed prior to cutting, in order for the HDPE pipe to experience stress relief.

2. Gravity Sewer
   a. After the stress relief, the HDPE pipe should protrude 6 to 8-inches inside the manhole.
   b. The HDPE pipe shall be restrained in the manhole, in order to prevent the pipe from pulling out of the manhole, in the event of HDPE pipe expansion/contraction.
   c. After the 24 hour period of stress relief, the pipe shall be sealed at the manhole to prevent infiltration of groundwater into the manhole. The sealing materials must be recommended for underwater application and have elastomeric properties. Products used shall be submitted and approved by the Utility.
   d. The Contractor shall then buildup the bench and/or invert as needed to provide a smooth channel for the flow.
   e. Upon completion of the directional drill and connection to the manholes, the Contractor shall conduct a CCTV inspection of the installed pipe. Any section of the installed pipe found not to be in compliance with these specifications shall be completely repaired
or replaced at the Contractor’s expense. Any repairs or replacements shall require a CCTV inspection upon completion.

3. Water Main and Force Main
   a. After the stress relief, the HDPE pipe should be cut in order to install the necessary valves, tees, and fittings as indicated on the drawings.
   b. All connections to the HDPE shall be restrained. In addition, one joint downstream and upstream of the HDD pipe shall be restrained joint pipe.

3.2 GUIDE PILOT BORE METHOD (Free Bore)
   A. Installation shall be accomplished using a Guided Pilot Boring machine such as the Akkerman GBM, Bohrtech BM400, Soltau RVS100 or equivalent.
   B. The process may be 2 or 3 pass, and the overcut shall not be any greater than ¾-inch.
   C. Voids occurring outside the carrier pipe shall be filled with 1 part cement to 3 parts sand Portland cement grout and filled from the surface.
   D. The alignment and grade of the boring shall be carefully established at the beginning of the bore, and shall be maintained using theodolite mounted CCTV, if required by the Utility.

3.3 TESTING
   A. Water Piping
      1. Testing for all other pipe materials utilized in water distribution systems shall be in accordance with all applicable sections of 33 10 00 Water Utilities.
      2. Cleaning and flushing for all other pipe materials utilized in water distribution systems shall be in accordance with all applicable sections of 33 10 00 Water Utilities.
      3. Sterilization for all other pipe materials utilized in water distribution systems shall be in accordance with all applicable sections of 33 10 00 Water Utilities.
   B. Sewer Piping
      1. Testing for all other pipe materials utilized in sanitary sewerage collection systems shall be in accordance with all applicable sections of 33 30 00 Sanitary Sewerage Utilities.
2. Cleaning and flushing for all other pipe materials utilized in sanitary sewerage collection systems shall be in accordance with all applicable sections of 33 30 00 Sanitary Sewerage Utilities.

END OF SECTION 33 05 23