SECTION 02350

DIRECTIONAL DRILLING

PART 1 GENERAL

1.1 WORK INCLUDED

A. Furnish all labor, materials and equipment required to install 6" nominal diameter water main pipe or 12" and 14" nominal diameter casing pipe using directional drilling method of installation where shown on the Drawings. DIRECTIONAL DRILLING MAY ALSO BE USED IN LIEU OF THE OPEN CUT METHOD IF DESIRED BY THE CONTRACTOR; HOWEVER, NO ADDITIONAL PAYMENT WILL BE MADE FOR DIRECTIONAL DRILLING (if the contractor elects to directional drill areas called out as open cut, the contractor shall be paid at the contract unit price for open cut for those areas). The pipe size, type and length shall be as specified herein and as shown on the Drawings. Work shall include and not be limited to proper installation, testing, restoration of underground utilities and environmental protection and restoration.

B. The Contractor shall be responsible for all installation processes and procedures associated with the installation by horizontal directional drilling in accordance with this specification.

C. The directional drill shall be accomplished by first drilling a pilot hole to design standards, and then enlarging the pilot hole no larger than 1.5 times larger than the outer diameter of the pipe and fittings to accommodate the pull back of the pipe through the enlarged hole.

D. See CONDITIONS OF THE CONTRACT and GENERAL REQUIREMENTS, which contain information and requirements that apply to the Work specified herein and are mandatory for this project.

1.2 SCOPE

A. This specification covers high density polyethylene pipe (C906, DR 11) and restrained joint polyvinyl chloride pipe (C900, DR-18), with ductile iron inside diameters of 6" - 14"

B. Unless otherwise noticed, references to documents shall mean the documents in effect at the time of design, bid, or construction, whichever is earliest. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

C. American Society for Testing Materials (ASTM)

1. ASTM D1784: Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
2. ASTM D1785: Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

3. ASTM D2122: Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
4. ASTM D2152: Test Method for Degree of Fusion of Extruded Poly(Vinyl Chloride) (PVC) Pipe and Molded Fittings by Acetone Immersion
5. ASTM D2241: Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR)
6. ASTM D2855: Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
7. ASTM D2774-08 Standard Practice for Underground Installation of Thermoplastic Pressure Piping
8. ASTM D2837: Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials
9. ASTM D3034: Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
10. ASTM D3350: Standard Specification for Polyethylene Plastics Pipe and Fitting Materials
11. ASTM F477: Elastomeric Seals (Gaskets) for Joining Plastic Pipe
12. ASTM F1055: Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing
13. ASTM F1057: Standard Practice for Estimating the Quality of Extruded Poly (Vinyl Chloride) (PVC) Pipe by the Heat Reversion Technique
14. ASTM F1290-98a (2004) Standard Practice for Electrofusion Joining Polyolefin Pipe and Fittings
15. ASTM F1962-05e1 Standard Guide for Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit Under Obstacles, Including River Crossings
16. ASTM F2164-02(2007) Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure
17. ASTM F3020-08e1 Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings

D. American Water Works Association (AWWA)

1. AWWA C110: American National Standard for Ductile-Iron and Gray-Iron Fittings, 3-inch through 48-inch, for Water and Other Liquids
2. AWWA C111: American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
3. AWWA C153: AWWA Standard for Ductile-Iron Compact Fittings for Water Service
4. AWWA C605: Standard for Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water
5. AWWA C651: Standard for Disinfecting Water Mains
6. AWWA C900: Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 in. through 12 in. (100mm Through 300mm), for Water Distribution
7. AWWA C906: Standard for Polyethylene (PE) Pressure Pipe and Fittings, 4" Through 63" for Water Distribution and Transmission
8. AWWA M23 : AWWA Manual of Supply Practices PVC Pipe—Design and Installation, Second Edition
9. AWWA M55: AWWA Manual of Water Supply Practices PE Pipe – Design and Installation

E. National Sanitation Foundation (NSF)

1. NSF14: Plastic Pipe System Components and Related Materials
2. NSF61 Drinking Water System Components – Health Effects

F. UNI-PUB-08 Tapping Guide for PVC Pressure Pipe

1.4 REQUIREMENTS

A. General

1. Products delivered under this specification shall be manufactured only from water distribution pipe and couplings conforming to AWWA C900 (PVC) or C906 (HDPE).

B. Materials:

1. HDPE - Pipe and fittings shall be made from virgin resins exhibiting a minimum cell classification of PE 345444C as defined in ASTM D3350 with an established hydrostatic-design-basis of 1600 psi for water at 73ºF. The resin shall be listed by the PPI (Plastic Pipe Institute) in its pipe-grade registry Technical Report (TR) 4, "Listing of Plastic Pipe Compounds"
2. Polyvinyl Chloride Pipe (PVC) – Restrained Joint PVC pipe and couplings shall be made from unplasticized PVC compounds having a minimum cell classification of 12454-B, as defined in ASTM D1784. The compound shall qualify for a Hydrostatic Design Basis (HDB) of 4000 psi for water at 73.4 Degrees F, in accordance with the requirements of ASTM D2837.

C. Approvals:

1. The pipe products shall have been tested and approved by an independent third-party laboratory for continuous use at rated pressure. Copies of Agency approval reports or product listing shall be provided to the Engineer. Products intended for contact with potable water shall be evaluated, tested, and certified for conformance with NSF Standard 61 by an acceptable certifying organization.

D. Dimensions

1. Outside diameters and wall thicknesses shall follow the Dimension Ratio (DR) listed in this specification as prescribed in AWWA C900 for PVC or AWWA C906 for HDPE. HDPE pipe diameters must be ductile iron outside diameter (DIOD). Laying lengths are 20 feet standard for PVC and 40 or 50 feet for HDPE.

E. Joints

HDPE Pipe

1. HDPE pipe shall be fusion joined in accordance with ASTM F2620 for butt fusion or ASTM F1290 for electrofusion. Only flanges or other mechanical joint systems proven for HDPE pipes shall be used.
2. Connections to other pipe materials shall be made with "Harvey Style" HDPE mechanical joint (MJ) adapter kits.

PVC Pipe

1. The pipe shall be joined using non-metallic couplings which, together, have been designed as an integral system for maximum reliability and interchangeability. High-strength flexible thermoplastic splines shall be inserted into matting

precision-machined groves in the pipe and coupling to provide full 360 degree restraint with evenly distributed loading.
2. Couplings shall be designed for use at the rated pressure of the pipe with which they are utilized, and shall incorporate twin elastomeric sealing gaskets meeting the requirements of ASTM F477. Joints shall be designed to meet the leakage test requirements of ASTM D3139.

F. Marking:

1. Pipe shall be legibly and permanently marked with the following information.
   - Manufacturer and Trade Name
   - Nominal Size & DR Rating/Pressure Class
   - (NSF-61)
   - Manufacturing Date Code
2. Pipe and fittings shall also bear the mark of the certifying agency(s) which have tested and approved the product for use in fire protection applications.

G. WORKMANSHIP

1. As defined in AWWA C900, PVC pipe shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters, or other visible deleterious faults.
2. As defined in AWWA C906, PE pipe and fittings shall be homogeneous throughout and free from voids, cracks, inclusions, and other defects, and shall be as uniform as commercially practicable in color, opacity, density, and other physical characteristics.

1.5 LOCATIONS

A. Locations where directional boring is required are indicated on the plans.

B. Directional boring may be utilized in lieu of open cut for areas not specifically indicated as directional bore areas on the plans. No additional payment will be made for utilizing directional bore method in lieu of open cut.

1.6 SUBMITTALS

A. Directional drilling contractor's qualifications and experience.

B. Work plan: Prior to beginning work, the CONTRACTOR must submit to the ENGINEER a work plan detailing the procedure and schedule to be used to execute the project. The work plan should include a description of all equipment to be used, down-hole tools, a list of personnel and their qualification and experience (including backup 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), an environmental protection plan and contingency plans for possible problems. Work plan should be comprehensive, realistic and based on actual working conditions for this particular project. Plan should document the thoughtful planning required to successfully complete the project.

1. Material: Specifications on material to be used shall be submitted to ENGINEER. Material shall include the pipe, fittings and any other item which is to be an

installed component of the project. The following product data is required at a minimum:

   - Pipe Size
   - Dimensionality
   - Pressure Class per applicable standard
   - Color
   - Recommended Minimum Bending Radius
   - Recommended Maximum Safe Pull Force
   - Fusion technician qualification for FPVC

2. Equipment: Submit specifications on directional drilling equipment to be used to ensure that the equipment will be adequate to complete the project. Equipment shall include but not be limited to: drilling rig, mud system, mud motors (if applicable), downhole tools, guidance system, rig safety systems. Calibration records for guidance equipment shall be included. Specifications for any drilling fluid additives that CONTRACTOR intends to use or might use shall be submitted.

1.7 QUALITY ASSURANCE

A. All directional drilling operations shall be done by a qualified directional drilling CONTRACTOR with at least (3) years experience involving work of a similar nature to the work required of this project.

B. Notify ENGINEER and OWNER a minimum of three (3) days in advance of the state of work.

C. All work shall be performed in the presence of the OWNER or ENGINEER.

PART 2 PRODUCTS

2.1 HIGH DENSITY POLYETHYLENE PIPE

A. The polyethylene pipe material shall meet AWWA C906 standards for Polyethylene pipe and fittings with a DR of 11. The pipe OD sizes shall be available in ductile iron pipe sizes (DIPS).

B. The pipe is to be joined by heat fusion, flanges or other mechanical joint systems proven for HDPE pipes. Both pipe and fittings must be NSF listed by the manufacturer with the pipe bearing the "NSF" logo or mark.

C. Where HDPE pipe is upsized to meet the required design ID, ductile iron reducers shall be used to connect to fittings and valves or the fittings and valves may be upsized to meet the pipe OD.

2.2 POLYVINYL CHLORIDE PRESSURE PIPE FOR POTABLE WATER

A. The pipe shall be joined using a separate PVC coupling with beveled edges, built in sealing gaskets and restraining grooves. The restraining splines shall be square and made from Nylon 101.

B. Plyvinylchloride pipe shall be manufactured in a standard 20' nominal length.

C. Polyvinylchloride pipe shall be blue in color for potable water use.

D. Pipe shall be marked as follows:

1. Nominal pipe size
2. PVC
3. Dimension Ratio, Standard Dimension Ratio, or Schedule
4. AWWA pressure class
5. AWWA standard designation number
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. Pipe shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters, or other visible deleterious faults.

2.2.1 JOINTS

A. The pipe shall be joined using non-metallic couplings which, together, have been designed as an integral system for maximum reliability and interchangeability. High-strength flexible thermoplastic splines shall be inserted into matting precision-machined groves in the pipe and coupling to provide full 360 degree restraint with evenly distributed loading.

C. Couplings shall be designed for use at the rated pressure of the pipe with which they are utilized, and shall incorporate twin elastomeric sealing gaskets meeting the requirements of ASTM F477. Joints shall be designed to meet the leakage test requirements of ASTM D3139.

2.2.2 CONNECTIONS AND FITTINGS FOR PRESSURE APPLICATIONS

A. 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

Acceptable fittings for use with fusible polyvinylchloride 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.

1. Connections to fusible polyvinylchloride pipe may be made using a restrained or non-restrained retainer gland product for PVC pipe, as well as for MJ or flanged fittings.
2. 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.
3. Ductile iron fittings and glands must be installed per the manufacturer's guidelines.

C. PVC GASKETED, PUSH-ON FITTINGS

Acceptable fittings for use with fusible polyvinylchloride pipe shall include standard PVC pressure fittings conforming to AWWA C900 or AWWA C905.

1. Acceptable fittings for use joining fusible polyvinylchloride pipe other sections of fusible polyvinylchloride pipe or other sections of PVC pipe shall include gasketed PVC, push-on type couplings and fittings, including bends, tees, and couplings as shown in the drawings.
2. Bends, tees and other PVC fittings shall be restrained with the use of thrust blocking or other restraint products as indicated in the construction documents.
3. PVC gasketed, push-on fittings and mechanical restraints, if used, must be installed per the manufacturer's guidelines.

D. SLEEVE-TYPE COUPLINGS

1. Sleeve-type mechanical couplings shall be manufactured for use with PVC pressure pipe, and shall be restrains as indicated in the construction documents.
2. Sleeve-type couplings shall be rated at the same or greater pressure carrying capacity as the pipe itself.

E. EXPANSION AND FLEXIBLE COUPLINGS

1. Expansion-type mechanical couplings shall be manufactured for use with PVC pipe, and shall be restrained as indicated in the construction documents.
2. Expansion-type mechanical couplings shall be rated at the same or greater pressure carrying capacity as the pipe itself.

F. 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.

2.3 DRILLING SYSTEM EQUIPMENT

A. GENERAL

1. The directional drilling equipment, as a minimum, shall consist of a directional drilling rig of sufficient capacity to perform the bore(s) and pull-back of the pipe(s), a drilling fluid mixing & delivery system of sufficient capacity to successfully complete the crossing, a guidance system to accurately guide boring operations, and trained and competent personnel to operate the system. All equipment shall be in good, safe operating condition with sufficient supplies, materials and spare parts on hand to maintain the system in good working order for the duration of this project. All required equipment shall be included in the emergency and contingency plan as submitted per these specifications.

B. DRILLING RIG

A. The directional drilling machine shall consist of a hydraulically powered system to

rotate, push and pull drill pipe while delivering a pressurized fluid mixture to a drill head. The machine shall be anchored to withstand the pulling, pushing and rotational forces required to complete the project.

B. The drilling rig hydraulic system shall be of sufficient pressure and volume to power drilling operations. The hydraulic system shall be free from leaks.

C. The drilling rig shall have a system to monitor pull-back hydraulic pressure during pull-back operations.

C. DRILL HEAD

A. The horizontal directional drilling equipment shall produce a stable fluid lined tunnel with the use of a steer-able drill head and any subsequent pre-reaming heads.

B. The system must be able to control the depth and direction of the drilling operation.

C. Drill head shall contain all necessary cutters and fluid jets for the operation, and shall be of the appropriate design for the ground medium being drilled.

D. DRILLING FLUID SYSTEM

A. DRILLING FLUID (DRILLING MUD)

a. Drilling fluid shall be composed of clean water and the appropriate additive(s) for the fluid to be used. Water shall be from a clean source and shall meet the mixing requirements of the mixture manufacturer's guidelines.
b. The water and additives shall be mixed thoroughly to assure the absence of any clumps or clocks. No hazardous additives may be used.
c. Drilling fluid shall be maintained at a viscosity sufficient to suspend cuttings and maintain the integrity of bore wall(s).
d. Drilling fluid shall be disposed of off-site in accordance with local, state and federal requirements and/or permit conditions.
e. No additional chemicals or polymer surfactants shall be allowed to be added to the drilling fluid unless they have been submitted per this specification.

E. MIXING SYSTEM

1. Drilling fluid mixing system shall be of sufficient size to mix and deliver drilling fluid for the project.
2. 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.
3. The mixing system shall continually agitate the drilling fluid during drilling operations.

F. DRILLING FLUID DELIVERY AND RECOVERY SYSTEM

1. The drilling fluid pumping system shall have a minimum capacity to supply drilling

B. A competent and experienced supervisor representing the CONTRACTOR and Drilling Subcontractor shall be present at all times during the actual drilling operations. A responsible representative who is thoroughly familiar with the equipment and type of work to be performed must be in direct charge and control of the operation at all times. In all cases, the supervisor must be continually present at the job site during the actual Directional Bore operation. The CONTRACTOR and Subcontractor shall have a sufficient number of competent workers on the job at all times to insure the Directional Bore is made in a timely and satisfactory manner.

C. Personnel who are unqualified, incompetent or otherwise not suitable for the performance of this project shall be removed from the job site and replaced with a suitable person.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

A. The ENGINEER must be notified 3 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'S 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. All work under this specification affecting the Indiana Department of Transportation (INDOT) property, right-of-way or facilities shall be carried out to the full satisfaction of the INDOT authorized representative. The CONTRACTOR shall fully inform himself of all requirements of the INDOT as it pertains to specific project and shall conduct all his work accordingly.

C. All equipment used by the CONTRACTOR on Owner's property and right-of-ways may be inspected by the OWNER or the Owner's Representatives and shall not be used if considered unsatisfactory by OWNER or Owner's Representatives.

D. The Contractor shall be fully responsible for all damages arising from his failure to comply with the regulations and the requirements of these Specifications.

3.2 DELIVERY AND OFF-LOADING

A. All pipe shall be bundled or packaged in such a manner as to provide adequate protection of the ends during transport to the site. Any pipe damaged in shipment shall be replaced as directed by the owner or engineer.

B. Each pipe shipment should be inspected prior to unloading to see if the load has shifted or otherwise been damaged. Notify owner or engineer immediately if more than immaterial damage is found. Each pipe shipment should be checked for quantity and proper pipe size, color, and type.

C. Pipe should be loaded, off-loaded, and otherwise handled in accordance with AWWA M23 or AWWA M55, and all of the pipe supplier's guidelines shall be followed.

D. Off-loading devices such as chains, wire rope, chokers, or other pipe handling implements that may scratch, nick, cut, or gouge the pipe are strictly prohibited.

E. During removal and handling, be sure that the pipe does not strike anything. Significant

impact could cause damage, particularly during cold weather.

F. If appropriate unloading equipment is not available, pipe may be unloaded by removing individual pieces. Care should be taken to insure that pipe is not dropped or damaged. Pipe should be carefully lowered, not dropped, from trucks.

3.3 HANDLING AND STORAGE

A. Any length of pipe showing a crack or which has received a blow that may have caused an incident fracture, even though no such fracture can be seen, shall be marked as rejected and removed at once from the work. Damaged areas, or possible areas of damage may be removed by cutting out and removing the suspected incident fracture area. Limits of the acceptable length of pipe shall be determined by the owner or engineer.

B. Any scratch or gouge greater than 10% of the wall thickness will be considered significant and can be rejected unless determined acceptable by the owner or engineer.

C. Pipe lengths should be stored and placed on level ground. Pipe should be stored at the job site in the unit packaging provided by the manufacturer. Caution should be exercised to avoid compression, damage, or deformation to the ends of the pipe. The interior of the pipe, as well as all end surfaces, should be kept free from dirt and foreign matter.

D. Pipe shall be handled and supported with the use of woven fiber pipe slings or approved equal. Care shall be exercised when handling the pipe to not cut, gouge, scratch or otherwise abrade the piping in any way.

E. If pipe is to be stored for periods of 1 year or longer, the pipe should be shaded or otherwise shielded from direct sunlight. Covering of the pipe which allows for temperature build-up is strictly prohibited. Pipe should be covered with an opaque material while permitting adequate air circulation above and around the pipe as required to prevent excess heat accumulation.

F. Pipe shall be stored and stacked per the pipe supplier's guidelines.

3.4 FUSION PROCESS

A. GENERAL

1. Pipe shall 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.
2. Fusible polyvinylchloride pipe shall be fused by qualified fusion technicians, as documented by the pipe supplier.
3. Each fusion joint shall be recorded and logged by an electronic monitoring device (data logger) connected to the fusion machine.
4. Only appropriately sized and outfitted fusion machines that have been approved by the pipe supplier shall be used for the fusion process. Fusion machines must incorporate the following elements:
   a. HEAT PLATE – Heat plates shall be in good condition with no deep gouges or scratches. Plates shall be clean and free of any debris or contamination. Heater controls shall function properly; cord and plug shall be in good

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. It is the Contractor and HDD system operator's responsibility to determine this envelope of safe offset from existing utilities. This will include, but is not limited to, soil conditions and layering, utility proximity and material, HDD system and equipment, and foreign subsurface material.

C. SITE LOCATION PREPARATION

1. Work site 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
2. Contractor shall confine all activities to designated work areas.

D. DRILLING LAYOUT AND TOLERANCES

1. The drill path shall be accurately surveyed with entry and exit areas placed in the appropriate locations within the areas indicated on drawings. If using a magnetic guidance system, drill path will be surveyed for any surface geomagnetic variations or anomalies.
2. Instrumentation shall be provided and maintained at all times that accurately locates the pilot hole, measures drill-string axial and torsional loads and measures drilling fluid discharge rate and pressure.
3. Entry and exit areas shall be drilled so as not to exceed the bending limitations of the pipe as recommended by the pipe supplier.

E. PILOT HOLE BORE

1. Pilot hole shall be drilled along bore path. In the event that the pilot bore does deviate from the bore path, it may require contractor to pull-back and re-drill from the location along bore path before the deviation.
2. The Contractor shall limit curvature in any direction to reduce force on the pipe during pull-back. The minimum radius of curvature shall be no less than that specified by the pipe supplier and as indicated on the drawings.

F. REAMING

1. After successfully completing the pilot hole, the bore hole shall be reamed to a diameter which meets the requirements of the pipe being installed. The following table is offered as an estimated guide:

Nominal Pipe Diameter	Bore Hole Diameter

condition. The appropriately sized heat plate shall be capable of maintaining a uniform and consistent heat profile and temperature for the size of pipe being fused, per the pipe supplier's guidelines.
   b. CARRIAGE – Carriage shall travel smoothly with no binding at less than 50 psi. Jaws shall be in good condition with proper inserts for the pipe size being fused. Insert pins shall be installed with no interference to carriage travel.
   c. GENERAL MACHINE - Overview of machine body shall yield no obvious defects, missing parts, or potential safety issues during fusion.
   d. DATA LOGGING DEVICE – An approved datalogging device with the current version of the pipe supplier's recommended and compatible software shall be used. Datalogging device operations and maintenance manual shall be with the unit at all times. If fusing for extended periods of time, an independent 110V power source shall be available to extend battery life.
5. Other equipment specifically required for the fusion process shall include the following:
   a. Pipe rollers shall be used for support of pipe to either side of the machine
   b. 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.
   c. An infrared (IR) pyrometer for checking pipe and heat plate temperatures.
   d. Fusion machine operations and maintenance manual shall be kept with the fusion machine at all times.
   e. Facing blades shall be used for fusible polyvinylchloride pipe, which are specifically designed for cutting FPVC.

B. JOINT RECORDING

Each fusion joint shall be recorded and logged by an electronic monitoring device (data logger) connected to the fusion machine. The fusion data logging and joint report shall be generated by software developed specifically for the butt-fusion process. The software shall register and/or record the parameters required by the pipe supplier and these specifications. Data not logged by the data logger shall be logged manually and be included in the Fusion Technician's joint report.

3.5 DRILLING OPERATIONS

A. GENERAL

1. Bore path and alignment are as indicated in the contract documents. The path of the bore may be modified based on field and equipment conditions. Entry and exit locations and control-point elevations shall be maintained as indicated in the contract documents unless approved otherwise by Owner or Engineer.

B. LOCATION AND PROTECTION OF UNDERGROUND UTILITIES

2. Manually operated or power operated drilling machines may be used.

F. Taps may be performed while the pipeline is filled with water and under pressure ('wet' tap.) or when the pipeline is not filled with water and not under pressure ('dry' tap).

3.11 TESTING

A. Cleaning and flushing are to be done by the CONTRACTOR in accordance with the requirements of the contract.

B. Directional drilling pipe shall be tested by CONTRACTOR after pullback. The average pressure shall be maintained at 150 psi for six hours. The test pump and water supply shall be arranged to allow accurate measurements of the water required to maintain the test pressure. Any material showing seepage or the slightest leakage shall be replaced as directed by the OWNER at no additional expense to the OWNER.

C. Hydrostatic testing of HDPE pipe should be performed in accordance with ASTM F2164.

D. The manufacturer's recommendations on pipe stretch allowances, bend radius and tensile strength, allowable make-up water, and duration of test pressure shall be observed.

E. Pipeline shall be tested end to end.

3.12 DISINFECTION OF THE PIPELINE FOR POTABLE WATER PIPING

After installation, the pipeline, having passed all required testing, shall be disinfected prior to being put into service. Unless otherwise directed by the owner or engineer, the pipeline will be disinfected per AWWA C651. See specification Section 15371 for disinfection requirements.

3.13 PARTIAL TESTING

Segments of the pipe may be tested separately in accordance with standard testing procedure, as approved by the owner and engineer. Testing of each HDD installation prior to connection to the system or other piping is preferred.

3.12 RECORD KEEPING AND AS-BUILTS

A. CONTRACTOR shall maintain a daily project log of drilling operations and a guidance system log with a copy given to the ENGINEER at completion of project.

B. The drilling data shall be recorded every 25-feet during the actual drilling operation. The CONTRACTOR shall furnish "as-built" plan a 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 data shall be certified accurate by the CONTRACTOR to the capability of the drilling system.

C. "As-built" drawings shall be completed and certified by an Indiana registered professional surveyor or engineer at Contractors expense.

END OF SECTION

< 6 inches	Pipe Dia. + 4 inches
8 inches to 24 inches	Pipe Dia. X 1.5
> 24 inches	Pipe Dia. + 12 inches

2. Multiple reaming passes shall be used at the discretion of the Contractor and shall conform to this specification.
3. 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.

3.6 PIPE PULL-BACK AND INSERTION

A. Pipe shall be fused prior to insertion, if the site and conditions allow, into one continuous length.

B. Contractor shall handle the pipe in a manner that will not over-stress the pipe prior to insertion. Vertical and horizontal curves shall be limited so that the pipe does not bend past the pipe supplier's minimum allowable bend radius, buckle, or otherwise become damaged. Damaged portions of the pipe shall be removed and replaced.

C. The pipe entry area shall be graded as needed to provide support for the pipe and to allow free movement into the bore hole.

1. The pipe shall be guided into the bore hole to avoid deformation of, or damage to, the pipe.
2. The pipe may be continuously or partially supported on rollers or other Owner and Engineer approved friction decreasing implement during pulling and insertion, as long as the pipe is not over-stressed or critically abraded prior to, or during installation.
3. A swivel shall be used between the reaming head and the pipe to minimize torsion stress on the pipe assembly.

D. Buoyancy modification shall be at the sole discretion of the Contractor, and shall not exceed the pipe supplier's guidelines in regards to maximum pull force or minimum bend radius of the pipe. Damage caused by buoyancy modifications shall be the responsibility of the Contractor.

E. Once pull-back operations have commenced, the operation shall continue without interruption until the pipe is completely pulled through the bore hole.

F. The pipe shall be installed in a manner that does not cause upheaval, settlement, cracking, or movement and distortion of surface features. Any damages caused by the Contractor's operations shall be corrected by the Contractor.

3.7 CLEANUP

A. Following the installation, the project site shall be returned to a condition equal to or better than the pre-construction condition of the site. All excavations will be backfilled and compacted per the construction documents and jurisdictional standards. All pavement and hardscape shall be repaired per applicable jurisdictional standards, excess materials shall be removed from the site, and disturbed areas shall be re-landscaped. All drilling fluid shall be properly disposed of per these specifications and all applicable

jurisdictional laws.

B. Contractor shall verify that all utilities, structures, and surface features in the project area are sound.

3.8 PREPARATION PRIOR TO MAKING CONNECTIONS INTO EXISTING PIPING SYSTEMS

A. Approximate locations for existing piping systems are shown in the construction documents. Prior to making connections into existing piping systems, the contractor shall:

1. Field verify location, size, piping material, and piping system of the existing pipe.
2. Obtain all required fittings, which may include saddles, sleeve type couplings, flanges, tees, or others as shown in the construction documents.
3. Have installed all temporary pumps and/or pipes in accordance with established connection plans.

B. Unless otherwise approved, new piping systems shall be completely assembled and successfully tested prior to making connections into existing pipe systems.

3.9 PIPE SYSTEM CONNECTIONS

A. Pipe connections shall be installed per applicable standards and regulations, as well as per the connection manufacturer's guidelines and as indicated in the construction documents. Pipe connections to structures shall be installed per applicable standards and regulations, as well as per the connection manufacturer's guidelines.

B. If possible, pipe installed via HDD shall be filled with water prior to making any connections to the existing system or other portions of the project.

3.10 TAPPING FOR POTABLE WATER APPLICATIONS

A. Tapping saddles for HDPE pipe shall be as recommended by the manufacturer, and tapping shall be performed in accordance with the manufacturer's recommendations.

B. Tapping for PVC pipe shall be performed using standard tapping saddles designed for use on PVC piping in accordance with AWWA C605. Tapping shall be performed only with use of lap saddles or sleeves. NO DIRECT TAPPING WILL BE PERMITTED. Tapping for PVC shall be performed in accordance with the applicable sections for Saddle Tapping per Uni-Pub-8.

C. Service saddles shall be bronze or brass and shall be Ford S90/S91, Mueller H-13000, S-13000, or approved equal. Hinged design shall be used for 4" – 8" mains and 2-piece bolted design for 10" mains.

D. All connections requiring a larger diameter than that recommended by the pipe supplier, shall be made with a pipe connection as specified and indicated on the drawings.

E. Equipment used for tapping shall be made specifically for tapping PVC pipe:

1. Tapping bits shall be slotted "shell" style cutters, specifically made for PVC pipe. "Hole saws' made for cutting wood, steel, ductile iron, or other materials are strictly prohibited.

CONTRACTOR SHALL ADHERE AND REFERENCE THE CURRENT FALL CREEK REGIONAL WASTE DISTRICT STANDARDS FOR DESIGN AND CONSTRUCTION OF SANITARY SEWERS.

REVISIONS

DATE	DESCRIPTION	BY

HWC ENGINEERING
INDIANAPOLIS - TERRE HAUTE
LAFAYETTE - MUNCIE - NEW ALBANY
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SPRINGBROOK SECTION 3

SANITARY SEWER SPECIFICATIONS

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PROFESSIONAL ENGINEER

PRELIMINARY NOT FOR CONSTRUCTION

DRAWN BY TS	JOB NUMBER 2017-271-C
CHECKED BY KE	
DATE AUGUST 23, 2019	
SCALE N/A	
SHEET C8.12	

SANITARY SEWER SPECIFICATIONS

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