TECHNICAL SPECIFICATIONS

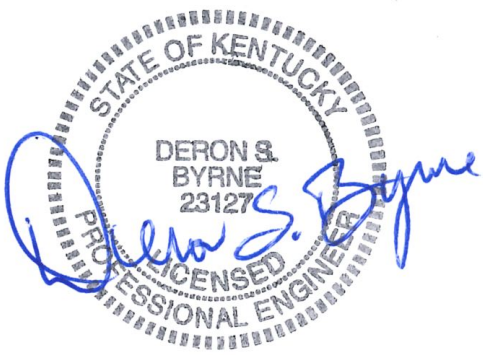
WESTERN ROCKCASTLE WATER ASSOCIATION
ROCKCASTLE COUNTY, KENTUCKY

CONTRACT 12:
WATER SYSTEM EXTENSIONS & IMPROVEMENTS

PROJECT NO. 1935

SEPTEMBER 2023

Monarch Engineering, Inc.



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SECTION 1 - WATER MAINS

1.0 Work Included. Under this item the Contractor shall provide all labor, tools, equipment, and materials to furnish and install the water mains as shown on the drawings and as directed by the Engineer.

1.1 Water Pipe Materials. All pipe materials shall conform to the manufacturer's standard lengths and diameters. Testing when required by the Owner shall be done in accordance with the appropriate ASTM specifications for the material selected. The water main type shall be PVC water pipe or ductile iron.

1.1.1 Polyvinyl Chloride Pipe PVC SDR 17 or SDR 21. PVC pipe shall comply with ASTM D-1784 for material and shall be Class 250 (SDR 17) or Class 200 (SDR 21) as shown on the drawings or indicated on the bid form. All PVC pipe shall conform to the latest revisions of the following specifications:

ASTM D2241 (PVC Plastic Pipe SDR-PR and Class T)
National Sanitation Foundations Testing Laboratories (NSF)

The name of the manufacturer of the plastic pipe to be used must be found on the current listing of Plastic Materials for Potable Water Application, published by the NSF (National Sanitation Foundation), and must meet the requirements of the Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe, D1784, 12454-B (PVC 1120) published by ASTM. Rubber gaskets shall conform to ASTM D3139.

Wall thickness shall be in accordance with ASTM D-2241. Pipe ends shall be beveled to accept the coupling with gasket. The bell section shall be designed to be as strong as the pipe wall.

Samples of pipe physical and chemical data sheets shall be submitted to the Engineer for approval prior to the pipe being purchased.

The pipe shall be homogeneous throughout and free from cracks, holes, foreign inclusions, or other defects. The pipe shall be as uniform as commercially practical in color and shall have a ring painted around the spigot ends in such a manner as to allow field checking of setting depth of the pipe in the socket. Pipe must be delivered to the job site by means that will adequately support it and not subject it to undue stresses. In particular, the load shall be so supported such that the bottom rows of pipe are not damaged by crushing. The pipe shall be unloaded carefully and stored as close to the final point of placement as is practical.

Pipe markings shall include the following marked continuously down the length:

Manufacturer's Name
Nominal Size
Class Pressure Rating
PVC 1120
NSF Logo
Identification Code

The lubricant shall be that as recommended and supplied by the pipe manufacturer.

1.1.2 Polyvinyl Chloride Pipe (PVC) Cast Iron Pipe Size. This pipe shall meet the requirements of AWWA C900-75, latest revision, "Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 inch through 12 inch for Water" and shall be furnished in cast iron pipe equivalent outside diameters with separate couplings including gaskets.

The pipe shall be made from Class 12454-A or Class 12454-B virgin compounds as defined in ASTM D-1784. The standard code designation shall be PVC 1120. The PVC compounds shall be tested and certified as suitable for potable water products by the NSF approval marking.

Solvent cement couplings or joints shall not be used. PVC joints using elastomeric gaskets shall be tested as assembled joints and shall meet the laboratory performance requirements specified in ASTM D-3139.

Pipe shall be pressure Class 200, DR 14 or Class 150, DR 18 as shown on the drawings or the bid form.

Pipe and Couplings shall be marked as follows:

Nominal Size and OD Base
Material Code Designation (PVC 1120)
Dimension Ratio Number
AWWA Pressure Class
AWWA Designation Number (AWWA C900)
Manufacturers Name or Trade Mark and Production Record Code
Seal of the NSF Laboratory

Each standard and random length of pipe shall be proof tested at four times its rated class pressure for a minimum of 5 seconds. Bells or couplings shall be tested with the pipe.

The pipe shall not split, crack, or break when tested by the parallel plato method, and it shall not flake or disintegrate when tested by the acetone immersion method as specified by ASTM D-2241.

1.1.3 Ductile Iron Pipe. Ductile Iron Pipe shall be designed in accordance with AWWA (ASA A21.50) and for the conditions as stated in these specifications and the

pressure rating for the pipe shall be 350 PSI. Ductile iron pipe shall conform to AWWA C-151 (ASA A21.51). Pipe shall be cement lined in accordance with AWWA C104 (ASA A21.4) and all exposed pipe and fittings shall have a shop prime coat applied that is compatible with subsequent field enamel paint coats.

The specified thickness will be determined for the given internal and external loading requirements in accordance with ASA A21.50 and will be shown on the drawings or the bid form.

The net weight, class or nominal thickness and sampling period shall be marked on each pipe.

Pipe joints shall be mechanical joint, rubber ring slip joint, flanged, or locked mechanical joint equal to AWWA C-111.

1.1.4 Fittings. Ductile Iron mechanical joint fittings with appropriate adapters shall be used with PVC pipe and ductile iron pipe. Fittings shall comply with AWWA C-110 or C-111 and shall be manufactured for the size and pressure class of the line on which they are used. Compact fittings are acceptable and they shall conform to the latest AWWA specifications.

Mechanical joint fittings shall be used with ductile iron pipe for below ground burial and flange fittings shall be used for all interior piping where ductile iron pipe is used.

1.1.5 Mechanical Joint Restraints. Restraint devices for mechanical joint fittings shall be utilized with all fittings on both Ductile Iron and PVC pipe. Restraints shall conform to either ANSI/AWWA C111/A21.11 or ANSI/AWWA C153/A2153 and shall be manufactured for size and pressure class of the line on which they are used. Restraint devices for nominal pipe sizes 3-inch through 36-inch shall consist of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of ANSI/AWWA C110/A21.10. All Mechanical joint restraints shall be the MEGALUG® Restraint Series 2000 as manufactured by EBAA Iron, Inc., or approved equal.

1.2 Pipe Handling. Pipe delivered to the site shall be stored, handled, distributed, placed, joined together, etc. in accordance with the manufacturer's recommendation unless directed otherwise by the Engineer.

1.3 Water Main Location. The water main shall be installed in the locations as shown on the drawings and as directed by the Engineer. The Contractor and Engineer shall agree as to the exact location of the water line and there shall be no disputes unless it is clear that the proposed location significantly deviates from the drawings. At those locations where the drawings indicate that a fitting must be installed either by declaration on the drawings or by a defined bend as shown on the drawings, the Contractor shall do so and shall avoid over deflection of the pipe.

1.4 Excavation. The Contractor shall make trench excavations to only such width to provide ample room for proper construction. Sheeting and shoring shall be provided as required for proper safety and compliance with OSHA regulations. Rock excavation shall be taken to a depth of 6 inches below the bottom of the pipe. If poor foundation conditions exist due to unstable subsurface conditions, the trench shall be under excavated to the depth required and filled with stone to obtain proper bearing capacity.

Watchmen or barricades, lanterns, and other such signs and signals as is necessary to warn the public of the dangers in connection with open trenches, excavations and other obstructions shall be provided by and properly maintained at the expense of the Contractor.

Only one half of street crossings and road crossings shall be excavated before placing temporary bridges over the excavation.

1.5 Blasting and Rock Excavation. The Contractor shall make his own investigation as he deems necessary to ascertain the sub surface conditions to be encountered in the work.

All blasting operations shall be conducted in accordance with municipal ordinances, state and federal laws and the applicable blasting codes. Soil particle velocity shall not exceed the limit set by Kentucky law. All explosives shall be stored in conformity with the applicable ordinances, laws and safety regulations. No blasting shall be done within five feet of any water mains, sewer lines, natural or manufactured gas lines, liquid petroleum lines, or other utilities.

The Contractor shall use delay caps or other approved methods to reduce earth vibrations and noise. Mud capping shall not be permitted as a method to breaking boulders. No blasting shall be permitted on Sundays or after dark.

Prior to commencing with the work, the Contractor shall, during a preconstruction conference with the Owner and Engineer, state clearly his approach to performing the excavations on the project. He shall be familiar with the laws and ordinances covering blasting and shall also give consideration to the use of hydraulically operated rock breaking devices in lieu of blasting where considered necessary. If blasting is not handled in an expert manner at all times the Engineer reserves the right to suspend blasting and require the work to proceed without it. Prior to blasting, the Contractor shall make his own detailed preblast survey of adjacent walks, curbs, retaining walls, house foundations, etc. to determine conditions prior to the work. Such a file of information, including photographs, may be certified in such a manner as the Contractor believes necessary. This information if required or performed shall be supplied to the Engineer prior to performing the work.

1.6 Storage of Excavated Material. All excavated material shall be stored in a manner that will not endanger the work and that will avoid obstructing roadways, sidewalks, and driveways. Hydrants under pressure, valve pit covers, valve boxes, curb stop boxes, fire and police call boxes, or other utility controls shall be left unobstructed and accessible.

Gutters shall be kept clear or other satisfactory provisions made for street drainage, and natural watercourses shall not be obstructed.

1.7 Shoring Sheeting and Bracing. The Contractor shall furnish place and maintain such sheeting and bracing as may be required to support the sides of the excavation or to protect other structures from possible damage. All sheeting and bracing shall be removed upon completion of the work unless permitted to be left in place by the Engineer. Any sheeting or bracing left in place shall be cut off at least two feet below the finished ground surface elevation. The cost of furnishing, placing, maintaining, and removing sheeting and bracing shall be included in the unit price bid for water lines and all work shall conform the OSHA requirements.

1.8 Bedding and Backfill. All water mains shall be bedded with select earth backfill or six inches of #9 or approved equal stone under and on both sides of the pipe where it is installed along the unpaved areas. Where the water line is installed along the paved areas the water line shall be backfilled with #9 or approved equal stone. Trenches shall be backfilled immediately after the water main has been installed. No rock larger than two inches will be permitted within six inches of the pipe. In unpaved or unsurfaced areas the remainder of the fill may be mounded over the top of the trench. Where trenches are in paved or traveled areas, or yard areas, compaction shall be performed during backfill. The Contractor at no time shall open up more than 500 feet of trench.

Any damage to underground structures, pipes wires, drains, etc., shall not be backfilled until they have been satisfactorily repaired or replaced to the original serviceability at the Contractor's expense and as approved by the Engineer. Settlement of backfill may be done with water furnished by the Contractor under the direction of the Engineer where such will not endanger traffic of damage property. When excavated rock is used for backfilling, it shall have sufficient dirt or fine material to fill all voids and shall not be used within twelve inches of the pipe.

To be accepted as final cleanup all excess rock one inch and larger shall be removed from the disturbed site.

1.9 Thrust Blocks and Anchorage. Thrust blocks shall be installed at all tees, bends, crosses, dead ends, valves, hydrants, blowoff assemblies, and as directed by the Engineer. The size of the thrust block shall depend on the soil and type of fitting, and shall conform to the pipe manufacturer's recommendations. At any location where a vertical bend is required the Contractor shall install the anchorage as directed by the Engineer in conjunction with the pipe manufacturer.

Thrust blocks shall be constructed of Class B concrete conforming to KBH Specification 601 and placed between the fitting and the trench wall. At no time will sack-crete or pre bagged concrete mixtures be allowed. All thrust block and anchorage concrete shall be delivered to the job site by means of a ready mix concrete truck and placed immediately upon arrival.

The thrust blocks shall be sized as shown on the detail drawings or as directed by the Engineer.

1.10 Temporary Surfacing. All trenches in paved areas shall, following compacted backfill, receive a top layer of compacted dense grade stone as shown on the detailed drawings. Such temporary surfacing shall be maintained and shall be paved as soon as conditions permit.

1.11 Hydrostatic Testing. The water line and appurtenances, as rapidly as valves are installed, shall be hydrostatically tested in accordance with these specifications. Defective joints of pipe shall be replaced as directed by the Engineer. Cracked or defective pipe, fittings, valves, or hydrants shall be replaced by the Contractor and the test shall be repeated until the test results are satisfied. All meter settings and service tubing as shown on the drawings shall be included in the hydrostatic test.

The test pressure shall not be less than 1.25 times the working pressure at the highest point along the test section and the hydrostatic test shall be of at least a two hour duration. The test pressure shall not vary by more that five psi. for the duration of the test.

1.11.1 Pressurization. After the pipe has been installed all or any valved section shall be subjected to the hydrostatic test. Each valved section of the pipe shall be slowly filled with water and the specified test pressure, corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Engineer. As part of the testing equipment a meter shall be installed to measure all water added to the tested section.

1.11.2 Air Removal. Before applying the specified test pressure, air shall be expelled completely from the pipe, valves, and hydrants. If permanent air vents are not located at all high points, the Contractor shall install corporation cocks at such points so that the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall be closed and the test pressure applied. At the conclusion of the pressure test, the corporation cocks shall be removed and plugged or left in place at the discretion of the Owner.

1.11.3 Leakage Defined. Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe or any valved section thereof to maintain pressure within five psi. of the specified test pressure after the pipe has been filled with water and the air has been expelled. Leakage shall not be measured by a drop in pressure in a test section over a period of time.

1.11.4 Allowable Leakage. No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

$$L = \frac{SD\sqrt{P}}{133{,}200}$$

Where:

L = allowable leakage in gallons per hour
S = length of pipe tested in feet
D = nominal diameter of the pipe in inches
P = average test pressure during the leakage test in pounds per square inch

This formula is based on an allowable leakage of 11.65 gpd./mi./in. of nominal diameter at a pressure of 150 psi.

All leaks shall be repaired whenever or wherever the is evidence of a leak. Water used by the Contractor shall be paid for by the Contractor at the rate of $2.00 per 1,000 gallons.

1.12 Sterilization. Upon completion and acceptance of the hydrostatic test of a section of the water main that section shall be thoroughly disinfected before being place in service by the use of chlorine or chlorine compounds in such amounts as to produce a concentration of not less than 50 ppm and a residual of not less than 25 ppm at the end of 24 hours and followed by thorough flushing. Putting small amounts of chlorine in each joint will not be acceptable.

Where shown on the plans or otherwise required, temporary blowoff assemblies shall be constructed by the contractor to facilitate the sterilization & flushing of new water mains. The temporary blowoff assemblies shall consist of valves, PVC piping, and ductile iron fittings and other materials as depicted in the standard drawings. The installation and subsequent removal of these temporary devices shall be considered incidental to the installation of the water lines and no additional payment or bid item will be included for them.

1.13 Other Utilities. Other utilities encountered in the work shall be preserved and protected. Where relocation or repair is required to accommodate the work it shall be made in a manner acceptable to the utility having jurisdiction over the service connection. Accommodation of service connections shall not constitute any basis for extra payment.

Prior to construction, the Contractor shall arrange to meet with representatives of all utilities, and provide them with his anticipated work schedule. The Contractor shall have the utility companies make their best determination of utility locations in the areas in which he is working. Throughout the progress of the work such field markings of utilities shall be kept current.

1.14 Payment for Water. All water used from the Owner shall be metered by meters supplied by the Contractor. The Contractor shall pay for such water at the rate of $2.00 per 1,000 gallons. This shall include any unmetered water lost which shall be computed on the basis of a discharge velocity of seven feet per second, the diameter of the line, and the estimated duration of free uncontrolled discharge or the approved method.

1.15 Cleanup. The Contractor shall provide effective cleanup of the work as it progresses. At the time of final inspection no trenches shall show any undue evidence of the construction. All areas shall be left free of ruts due to construction and shall have a clean and neat appearance without rubble or debris. The areas shall not be mounded and shall be completely restored, and all yards and fields shall be reseeded. Straw and fertilizing shall accompany the seeding and the seed mixture shall match the existing ground cover. If necessary to hasten proper restoration of terraces, principally along ditch lines, the Contractor shall sod such areas at the Engineer's direction.

1.16 Protection of Adjacent Landscape. Reasonable care shall be taken during construction of the process lines to avoid damage to vegetation. Ornamental shrubbery and tree branches shall be temporarily tied back, where appropriate, to minimize damage. Trees which receive damage to branches shall be trimmed of those branches. Tree trunks receiving damage from equipment shall be treated with a tree dressing.

1.17 Underground Detection Wire. At all locations where water lines are installed, a detection wire shall be installed. For open cut installation, tracer wire is to be #12 AWG solid copper with 30 mil blue HDPE insulation. For trenchless installation, tracer wire is to be #12 AWG solid copper clad steel core with 45 mil blue HDPE insulation.

Tracer wire shall be installed with the pipe at the trench bottom and access boxes shall be installed at each valve, hydrant and air release valve. Tracer wire access boxes shall be spaced no further than 1000' apart. A minimum of 3 feet of tracer wire should be coiled up inside of each access box. Tracer wire access boxes shall be magnetized heavy duty type as manufactured by Copperhead Industries, LLC, Snake Pit or approved equal.

1.18 Exposing Existing Water Line. Where the new water line is to be installed parallel to an existing water line the Contractor shall be responsible for exposing the existing water lines at 100 feet intervals.

1.19 Payment. Payment shall be included in the payment for the work to which it is subsidiary in the Bid Schedule.

SECTION 2 - CASING PIPE

2.0 Work Included. Under this item the Contractor shall provide all labor, tools, equipment, and materials to furnish and install casing pipes as shown on the drawings.

2.1 Materials. Bored and jacked casing pipe shall be plain end steel pipe conforming to AWWA Specification C200 with a minimum yield strength of 35,000 psi. The inside diameter of the casing pipe shall be a minimum of four inches greater than the largest outside diameter of the water pipe, joint or coupling.

The minimum wall thickness shall be in accordance with the following table:

Diameter of Casing-Inches	Minimum Wall Thickness-Inches Under Railroads	All Other Uses
12-3/4 and under	0.188	0.188
14	0.250	0.250
16	0.281	0.250
18	0.312	0.250
20 and 22	0.344	0.250

Casing pipe shall have continuously welded joints. Any field welding shall be performed by a certified welder and shall be in accordance with AWWA Specifications C206

2.2 Prior Approvals. Prior to boring and jacking under roadways the Contractor shall submit drawings and other necessary information regarding the proposed construction to the Engineer for approval by the proper authorities if requested.

2.3 Bore and Jack Construction. The Contractor shall investigate the subsurface conditions which will be encountered and shall base his bid on his findings. No distinction shall be made between boring through earth and boring through rock.

The Contractor shall provide a jacking pit, bore through the earth and or rock, and jack the casing pipe into place at the proper line and grade as the bore is being made. "Free boring" will not be allowed unless directed by the Engineer. The carrier pipe shall be pushed through the casing pipe with care being taken to insure that the pipe joints are tight and properly made. Shims attached to the carrier pipe to prevent floating shall be redwood or that as specifically made for the application.

The approach trench shall be large enough to accommodate one section of casing pipe and the jacks and blocking. Two rails or sills shall be laid in the bottom of the trench to keep the casing at the established line and grade.

The installation procedure must be such that the casing pipe is placed concurrently with the removal of the soil. The outside diameter of the lead auger section must not be less than one half inch smaller in diameter than the casing inside diameter.

The ends of the casing pipe shall be plugged and made watertight prior to backfilling. A neoprene gasket that will slip over the cover pipe and allow the carrier pipe to pass through will be considered water tight.

2.4 Traffic Control Devices and Maintenance of Traffic. The proper placement and maintenance of traffic control devices and the maintenance of traffic flows shall comply with the standards set forth under the General Specifications.

The Contractor shall notify the proper City, County, or State officials prior to the commencement of boring and jacking or tunnel operations.

2.5 Open Cut Construction. Where steel casing pipe is to be installed by open cutting rather than by boring or jacking the same casing pipe as described above will be utilized.

2.6 Measurement and Payment. The unit price bid per linear foot for boring and jacking, as measured from end to end of the casing pipe, shall constitute full compensation for the work as specified. Open cut steel casing pipe as measured from end to end of the casing pipe shall constitute full compensation for the work as specified. Carrier pipes shall be furnished under the item as described in other portions of these technical specifications.

SECTION 3 - CREEK CROSSING

3.0 Work Included. Under this item the Contractor shall provide all labor, tools, equipment, and materials to install creek crossings as shown on the drawings and as directed by the Engineer.

3.1 Materials. The creek crossing shall be installed as per the detailed drawings or as described herein and the casing pipe shall be PVC pipe. In the event where a casing pipe is not required the creek crossing shall be installed with ductile iron. All carrier pipe and casing pipe shall be that as described in other sections of these technical specifications or as shown on the plan sheets

3.2 Installation. The creek crossings shall be installed with plastic carrier pipe placed within a plastic casing pipe, or ductile iron carrier pipe without a casing pipe unless specified otherwise. Where a plastic casing pipe is used it shall be of the minimum size to accommodate the carrier pipe. The casing pipe or water line pipe without casing pipe shall be placed a minimum of 30 inches below the bed of the stream, creek, or river and a twelve inch minimum layer of crushed stone shall be placed above the pipe where a casing pipe is not required. Class B concrete shall be placed between the crushed stone and the base of the stream, creek, or river, or between the casing pipe and the base of the waterway. Where concrete is placed, all water from the stream shall be diverted away from the area of concrete placement by means of diversion pipes or temporary embankments.

3.3 Payment. The unit bid shall constitute full compensation for furnishing and installing the creek crossings.

SECTION 4 – VALVE AND VALVE BOX

4.0 Work Included. Under this item the Contractor shall provide all labor, tools, equipment, and materials to install gate valve and valve boxes at the locations as shown on the drawings and as directed by the Engineer.

4.1 Materials. All gate valves shall be resilient wedge seat gate valves which fully comply with the latest revision of AWWA C509, and shall also be UL listed and FM approved. The valves shall be tested and certified to ANSI/NSF 61. The valves shall have a 250 psig working pressure. The valve type shall be NRS (non-rising stem) and the valve shall have an arrow cast on the 2" square operating nut which shows the opening direction. The direction of opening shall be shall to the left. The bolt that attaches the operating nut to the stem shall be recessed into the operating nut so as not to interfere with valve wrench operation.

The valves shall have bolts and nuts for the stuffing box and bonnet with one of the following compositions:

a. Steel, ASTM A-307, Grade B zinc plated.
b. Type 304 stainless steel.
c. Type 316 stainless steel.

Valve stems shall be made of bronze ASTM B-132 alloy C67600 bar stock material. The stem shall have at least one "anti-friction" thrust washer above and below the stem collar to reduce operating torque. The design of the valve stem shall be such that if excessive input torque is applied, stem failure shall occur above the stuffing box at such a point as to enable the operation of the valve with a pipe wrench or other readily available tool. The stem material shall provide a minimum 70,000 psi tensile strength with 15% elongation and yield strength of 30,000 psi. Valves with cast stems or two piece stem collars are not acceptable.

The valves shall have a stuffing box that is o-ring sealed. Two o-rings shall be placed above and one o-ring below the stem thrust collar. The thrust collar shall be factory lubricated. The thrust collar and its lubrication shall be isolated by the o-rings from the waterway and from outside contamination providing permanent lubrication for long term ease of operation. Valves without a stuffing box are unacceptable. Valves without at least three stem o-rings are also unacceptable. The valve body, bonnet, stuffing box, and disc shall be composed of ASTM A-126 Class B grey iron or ASTM A395 or A536 ductile iron. The body and bonnet shall also adhere to the minimum wall thickness as set forth in Table 2, section 4.3.1 of AWWA C509.

The valve disc and guide lugs must be fully (100%) encapsulated in SBR ASTM D2000 rubber material. The peel strength shall not be less than 75 pounds per inch. Guide caps of an acetal bearing material shall be placed over solid guide lugs to prevent abrasion and to reduce the operating torque.

The valves shall have all internal and external ferrous surfaces coated with a fusion bonded thermosetting powder epoxy coating of 10 mils nominal thickness. The coating shall conform to AWWA C550.

Tapping valves shall have an inlet flange conforming to ANSI B16.1 Class 125 for attachment to a tapping sleeve or cross. In addition, the valve inlet flange shall have a machined projection or raised face complying with MSS SP-60 for accurate alignment to the mating recess in the tapping sleeve flange. The seat opening of the tapping valves shall be at least .30" larger than the nominal pipe size to permit full diameter cuts.

The valves shall be warranted by the manufacturer against defects in materials or workmanship for a period of ten (10) years from the date of manufacture. The manufacturing facility for the valves must have current ISO certification.

Each valve shall have the manufacturer's initials, pressure rating, and the year in which manufactured, cast onto the body. The manufacturer shall be Mueller Co. or approved equal

Valve boxes shall be of cast iron extension type with screw or slide adjustments and flared base. The minimum thickness of metal shall be 3/16". The cover shall have the word "WATER" cast in the metal. Valve boxes shall be installed over each outside gate valve unless otherwise shown on the drawings. The boxes shall be of such length as to provide a depth of cover of not less than 30 inches over the pipe.

4.2 Installation. Valve boxes shall be set plumb and straight and with the operating nut directly in the center in thoroughly compacted earth with the top of the box level and projecting one fourth inch above paved streets and one inch above other areas. The valve boxes in unpaved areas shall have a four inch thick concrete slab three feet in diameter around and sloping away from the valve box.

4.3 Payment. The unit price bid shall constitute full compensation for furnishing and installing gate valves, isolation valves, valve boxes, and other related appurtenances.

SECTION 5 – FLUSH HYDRANT

5.0 Work Included. Under this item the Contractor shall provide all labor, tools, equipment, and materials to install the hydrants as shown on the drawings and as directed by the Engineer.

5.1 Materials. Hydrants shall meet or exceed all applicable requirements and tests of ANSI and the latest revisions of AWWA Standard C502. They shall also meet all test requirements and be listed by Underwriters Laboratories Inc. They shall also meet all test requirements and have full approval of Factory Mutual. Hydrants shall be of the compression type, opening against the pressure and closing with the pressure and shall be rated for a minimum working pressure of 250 psi. They shall have a minimum 4-1/2" main valve opening and a minimum inside lower/upper barrel diameter (I.D.) of 6" to assure maximum flow performance. All hydrants shall be three-way in design, having one 4-1/2" pumper nozzle and two 2-1/2" hose nozzle(s). Nozzles shall thread counterclockwise into hydrant barrel utilizing "o" ring seals. A suitable nozzle lock shall be in place to prevent inadvertent nozzle removal.

The hydrant bonnet shall be attached to the upper barrel by not less than eight bolts and nuts and sealed by an "o" ring. The bonnet assembly shall provide an oil reservoir and lubrication system that automatically circulates lubricant to all stem threads and bearing surfaces each time the hydrant is operated. This lubrication system shall be sealed from the waterway and any external contaminants by use of "o "ring seals. An anti-friction washer shall be in place above the thrust collar to further minimize operating torque. The oil reservoir shall be factory filled with a low viscosity, FDA approved non-toxic oil lubricant which will remain fluid through a temperature range of -60^0 F. to $+150^0$ F.

The operating nut shall be a one piece design, pentagon/square in shape manufactured of ASTM B-584 bronze. The operating nut shall be affixed to the bonnet by means of an ASTM B-584 bronze hold down nut. The hold down nut shall be threaded into the bonnet in such a manner as to prevent accidental disengagement during the opening cycle of the hydrant. The use of Allen head set screws as a means of retention is unacceptable. A resilient weather seal shall be incorporated into the hold down nut, for the purpose of protecting the operating mechanism from the elements. The direction of the opening shall be as specified by the counterclockwise. An arrow shall be cast on the bonnet flange to indicate the opening direction.

Hydrants shall be a "traffic-model" having upper and lower barrels joined at the ground line by a separate and breakable "swivel" flange providing 360° rotation of upper barrel for proper nozzle facing. This flange shall employ not less than eight bolts. The safety flange segments shall be located under the upper barrel flange to prevent the segments from falling into the lower barrel when the hydrant is struck. The pressure seal between the barrels shall be an "o" ring. The proper ground line shall be cast clearly on the lower barrel and shall provide not less than 18" of clearance from the centerline of the lowest nozzle to the ground.

The operating stem shall consist of two pieces, not less than 1 1/4" diameter (excluding threaded or machined areas) and shall be connected by a stainless steel safety coupling. The safety coupling shall have an integral internal stop to prevent the coupling from sliding down into the lower barrel when the hydrant is struck. Screws, pins, bolts, or fasteners used in conjunction with the stem couplings shall also be stainless steel. The top of the lower stem shall be recessed 2" below the face of the safety flange to prevent water hammer in the event of a "drive over" where a vehicle tire might accidentally depress the main valve. The lower barrel shall be an integrally cast unit. The use of threaded on or mechanically attached flanges is deemed unacceptable. The hydrant bury depth shall be clearly marked on the hydrant lower barrel.

Composition of the main valve shall be a molded rubber having a durometer hardness of 95 +/- 5 and shall be reversible in design to provide a spare in place. Plastic (polyurethane) main valves are unacceptable. The main valve shall have a cross section not less than 1".

Hydrants shall be equipped with (2) two drain valves which drain the barrel when the hydrant is closed and seal shut when the hydrant is opened. These drain valves shall be an integral part of the one piece bronze upper valve plate. They shall operate without the use of springs, toggles, tubes, levers or other intricate synchronizing mechanisms. The upper valve plate, seat ring and drain ring (shoe bushing) must be ASTM B-584 bronze and work in conjunction to form an all bronze drain way. A minimum of two (2) internal and two (2) external drain openings are required. Drains ported through an iron shoe must be bronze lined. The bronze seat ring shall thread into a bronze drain ring (or shoe bushing) providing a bronze to bronze connection. Seat rings shall be "o" ring pressure sealed

The interior of the shoe including the lower valve plate and stem cap nut shall have a protective coating that meets the requirements of AWWA C-550. If a stem cap nut is utilized, it must be locked in place by a stainless steel lock washer or similar non-corrosive device that will prevent the cap nut from backing-off during normal use.

The hydrant shall be coated with a prime coat and two finish coats of paint as suggested by the manufacturer and approved by the Engineer. The shop drawings shall indicate the coating and color proposal.

Hydrants shall be warranted by the manufacturer against defects in materials or workmanship for a period of ten years (10) from the date of manufacture. Hydrants shall be Mueller Super Centurion 250 or approved equal.

Hydrant adapters shall be the swivel by solid adapter with swivel gland type as manufactured by Tyler Pipe/Union Foundry Company, or approved equal.

Foster adapters shall be constructed of ductile iron and comply with applicable AWWA Standards and shall be lined and coated in accordance with AWWA C104 and C110.

They shall be as manufactured by Infact Corporation, or approved equal and shall be designed for a working pressure of 250 psi.

Mechanical Joint restraints shall be the Grip Ring® Pipe Restrainer as manufactured by Romac Industries, Inc., or approved equal.

The hydrant assembly shall be shown as on the details/drawings and as outlined in the Bid Schedule.

5.2 Installation. The hydrants shall be set in accordance with the detailed drawings complete with gate valve and connecting pipe. The hydrant shall be installed perpendicular to the surrounding ground surface and the hydrant riser shall be completely buried. The depth of bury shall be the same as the adjoining water line. The shoe of the hydrant shall be encased in Class B concrete and the concrete shall extend to undisturbed earth. Gravel shall be placed around the hydrant on top of the concrete thrust restraint and at the weep hole a minimum depth of twelve inches in depth. Select earth backfill shall be compacted to fill the remaining excavated void and the surface shall match the surrounding surface. The hydrant shall be secured to the companion gate valve by means of a hydrant adapter and pipe restrainer or by other approved means. The hydrant adapter shall be the swivel by solid adapter with swivel gland type. The direct connection of mechanical joint (MJ) fittings between the valves and tee shall be made using Foster adapters where flush hydrants are indicated on the Construction Drawings.

5.3 Payment. The unit price bid shall constitute full compensation for furnishing and installing the hydrant, gate valve, up to ten feet of water line, and any associated pipe fittings required to install the hydrant to the main water line.

SECTION 6 – BLOWOFF ASSEMBLY

6.0 Work Included. Under this item the Contractor shall provide all labor, tools, equipment, and materials to install the Blowoff Assemblies as shown on the drawings and as directed by the Engineer.

6.1 Materials. Blowoff Assemblies shall consist of the valve, pipe, and fittings in accordance with these specifications and the corresponding drawings. The gate valve and piping shall be the same size and pressure class as the line it is connected to unless otherwise noted.

6.2 Installation. The Blowoff Assembly shall be installed at the locations as shown on the drawings and as outlined on the detail drawings.

6.3 Payment. The unit price bid shall constitute full compensation for the furnishing and installation of each Blowoff Assembly to include one gate valve, piping, blocking, valve box, fittings and gravel.

SECTION 7 - CONNECTION

7.0 Work Included. Under this item the Contractor shall provide all labor, tools, equipment, and materials to connect and disconnect water mains as shown on the drawings and as directed by the Engineer.

7.1 Materials. The connections and disconnects shall be performed by the use of ductile iron mechanical joint fittings, approved tapping valves and sleeves, and water main pipe as shown on the drawings described elsewhere in these technical specifications. Concrete for thrust restraint shall be Class B concrete and sack-crete shall not be allowed.

7.2 Installation. Unless otherwise noted on the plans, connections shall be made with a tapping sleeve and valve and done so in accordance with the Owners schedule of operation. Once the main line has been tapped the new section of water main shall be valved off from the rest of the system by closing the tapping valve. The tapping valve shall remain closed until the Engineer has been satisfied that the new water main has been installed correctly, met the requirements of the hydrostatic test, been sanitized in accordance with the regulatory requirements, and any water main to be abandoned has been disconnected from the water system. The disconnection of a water main that is to be abandoned shall be accomplished by installing a blind flange at the point of abandonment and secured by means of a concrete thrust block. In the event where the thrust block shall be installed in the area of the abandoned water main a minimum three foot section of the abandoned water main shall be removed and the void replaced with concrete.

7.3 Payment. The unit price bid shall constitute full compensation for furnishing and installing the connections including any abandonment or disconnections of existing water mains. This shall include all fittings but water mains and gate valves shall be paid as per the bid schedule for those respective items.

SECTION 8 -DIRECTIONAL DRILLING / BORING

8.0 Scope of Work. It is intent of this specification to define the acceptable methods and materials for installing water lines by the horizontal directional drilling method and the requirements for high density polyethylene (HDPE) pipe installed by horizontal directional drilling, directional boring, guided boring or in open cut trenches.

8.1 Requirements. Contractor shall provide HDPE pipe conforming to all standards and procedures, and meeting all testing and material properties as described in this specification for installation by horizontal directional drilling.

The estimated length of each directional bore is indicated on the plan sheets. This stated length shall be the footage used for the contractors payment calculation regardless of the actual length required for installation.

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

8.2 Installation Plan. At least 7 days prior to mobilizing equipment, Contractor shall submit his detailed installation plan to the Engineer.

The plan shall also include a listing of major equipment and supervisory personnel and a description of the methods to be used.

8.3 Variations in Plan or Profile. The Contractor may request changes to the proposed vertical and horizontal alignment of the installation and the location of the entry and exit points. Proposed changes shall be submitted in writing to the Engineer and receive approval of the Engineer prior to construction.

8.4 Alignment. The proposed plan and profile installation locations are based on alignments to accommodate acquired right-of-way, to avoid obstructions, and to properly maintain operation flow velocities.

8.5 Qualifications. Directional drilling and pipe installation shall be done only by an experienced Contractor specializing in directional drilling and whose key personnel have at least five (5) years experience in this work. Furthermore, the Contractor shall have installed directional drilled pipe at least as large as 18 inches in diameter, have performed crossings at least 650 feet in length, and successfully installed at least 2000 feet in length.

8.6 Products. High Density Polyethylene (HDPE) pipe accordance to these specifications shall be used in HDD installations. All piping system components shall be the products of one manufacturer and shall conform to the latest edition of ASTM D2447, ASTM D3350, and ASTM F714 for HDPE.

Pipe shall conform to the dimensionality and general characteristics of the mainline carrier piping to which it will be connected to. The inside diameter of the pipe to be used in HDD applications shall be equal to or greater than that of the mainline carrier piping.

8.7 Piping. Piping shall be extruded from a polyethylene compound and shall conform to the following requirements:

The polyethylene resin shall meet or exceed the requirements of ASTM D3350 for PE 3408 material with a cell classification of 335434C, or better. The polyethylene compound shall be suitably protected against degradation by ultraviolet light by means of carbon black, well dispersed by precompounding in a concentration of not less than 2 percent.

The maximum allowable hoop stress shall be 800 psi at 73.4 degrees F.

The pipe manufacturer shall be listed with the Plastic Pipe Institute as meeting the recipe and mixing requirements of the resin manufacturer for the resin used to manufacture the pipe in this project.

Joining shall be performed by thermal butt-fusion in accordance with the manufacturer's recommendations.

8.8 Concrete Restraint Wall. The contractor shall install a concrete restraint wall on each end of the HDPD piping. The wall should be constructed as shown in the miscellaneous detail drawings. Details on concrete construction are included elsewhere in these specifications.

8.9 Execution. All HDD pipes shall be cut, fabricated, and installed in strict conformance with the pipe manufacturer's recommendations. Joining, laying, and pulling of HDD pipe shall be accomplished by personnel experienced in working with HDD pipe being used. The pipe supplier shall certify in writing that the Contractor is qualified to join, lay, and pull the pipe or representative of the pipe manufacturer shall be on site to oversee the pipe joining. Expense for the representative shall be paid for by the Contractor.

8.10 Transportation and Unloading. All pipe shall be bundled or packaged in such a manner as to provide adequate protection of the ends during transportation to the site. Care shall be taken during transportation of the pipe to ensure that it is not cut, kinked, or otherwise damaged. Any pipe damaged in shipment shall be replaced as directed by the owner or engineer.

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.

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

During removal and handling, be sure that the pipe does not strike anything. Significant impact could cause damage, particularly during cold weather.

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.

8.11 Handling and Storage. 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. 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.

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

The open ends of all sections of joined and/or installed pipe (not in service) shall be plugged at night to prevent animals or foreign material from entering the pipe line or pipe section. Waterproof nightcaps of approved design may be used but they shall also be so constructed that they will prevent the entrance of any type of natural precipitation into the pipe and will e fastened to the pipe in such a manner that the wind cannot blow them loose. The practice of stuffing cloth or paper in the open ends of the pipe will be considered unacceptable.

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. Where possible, the pipe shall be raised and supported at a suitable distance back from the open end such that the open end will be below the level of the pipe at the point of support.

8.12 Installation.

The Contractor shall install the pipelines by means of horizontal directional drilling. The Contractor shall assemble, support, and pretest the pipeline prior to installation in the directional drill tunnel.

Horizontal directional drilling shall consist of the drilling of a small diameter pilot hole from one end of the alignment to the other, followed by enlarging the hole diameter for the pipeline insertion. The exact method and techniques for completing the directionally drilled installation will be determined by the Contractor, subject to the requirements of these Specifications.

The Contractor shall prepare and submit a plan to the Engineer for approval for insertion of the HDD pipe into the opened bore hole. This plan shall include pullback procedures, ballasting, use of rollers, side booms and side rollers, coating protection, internal cleaning, internal gauging, hydrostatic tests, dewatering, and purging.

The required piping shall be assembled in a manner that does not obstruct adjacent roadways or public activities. The Contractor shall erect temporary fencing around the entry and exit pipe staging areas.

8.13 Joining Pipe Sections. The joining of pipe sections shall be completed by a Fusion Technician who is fully qualified by the pipe supplier to install the HDD pipe of the type(s) and size(s) being used. Qualification shall be current as of the actual date of fusion performance on the project.

HDD pipe will be handled in a safe and non-destructive manner before, during, and after the fusion process and in accordance with this specification and pipe supplier's guidelines. The fusion process shall be performed by qualified fusion technicians, as documented by the pipe supplier. Each fusion joint shall be recorded and logged by an electronic monitoring device (data logger) connected to the fusion machine.

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:

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 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.

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.

GENERAL MACHINE - Overview of machine body shall yield no obvious defects, missing parts, or potential safety issues during fusion.

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.

Other equipment specifically required for the fusion process shall be used as necessary. Pipe rollers shall be used for support of pipe to either side of the machine. 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. An infrared (IR) pyrometer for checking pipe and heat plate temperatures. Fusion machine operations and maintenance manual shall be kept with the fusion machine at all times. Facing blades specifically designed for cutting HDPE pipe shall be used.

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 of HDPE. 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.

8.14 Testing. The pipe shall be hydrostatically tested after joining into continuous lengths prior to installation and again after installation. Pressure and temperature shall be monitored with certified instruments during the test. After this test, the water will be removed with pigs. Erosion prevention procedures will be used during removal and discharge of the water. Hydrostatic testing shall be performed in accordance with Section 1 of the Specifications. All costs associated with acquiring water for testing shall be included in the established contract unit bid prices.

8.15 Tolerances. Pipe installed by the directional drilled method must be located in plan as shown on the Drawings, and must be no shallower than shown on the Drawings unless otherwise approved. The Contractor shall plot the actual horizontal and vertical alignment of the pilot bore at intervals not exceeding 30 feet. This "as built" plan and profile shall be updated as the pilot bore is advanced. The Contractor shall at all times provide and maintain instrumentation that will accurately locate the pilot hole and measure drilling fluid flow and pressure. The Contractor shall grant the Engineer access to all data and readout pertaining to the position of the bore head and the fluid pressures and flows.

When requested, the Contractor shall provide explanations of this position monitoring and steering equipment. The Contractor shall employ experienced personnel to operate the directional drilling equipment and, in particular, the position monitoring and steering

equipment. No information pertaining to the position or inclination of the pilot bores shall be withheld from the Engineer.

Sags in the pipeline shall not exceed 5 percent of the nominal pipe diameter. Sags will only be allowed where the entering and exiting grades are adequate to provide velocities through the sag area sufficient for moving solids. No more than (1) sag area shall occur between two (2) manholes. The alignment of each pilot bore must be approved by the Engineer before pipe can be pulled. If the pilot bore fails to conform to the above tolerances, the Engineer may, at his option, require new pilot boring to be made.

After the pipe is in place, cleaning pigs shall be use to remove residual water and debris. After the cleaning operation, the Contractor shall provide and run a sizing pig to check for anomalies in the form of buckles, dents, excessive out-of-roundness, and any other deformations. The sizing pig run shall be considered acceptable if the survey results indicate that there are no shaper anomalies (e.g. dens, buckles, gouges, and internal obstruction) greater than 2 percent of the nominal pipe diameter, or excessive ovality greater than 5 percent of the nominal pipe diameter. For gauging purposes, dent locations are those defined above which occur within a span of five feet or less. Pipe ovality shall be measured as the percent difference between the maximum and minimum pipe diameters. For gauging purposes, ovality locations are those defined above which exceed a span of five feet.

8.16 Ream and Pullback.

Reaming: Reaming operations shall be conducted to enlarge the pilot after acceptance of the pilot bore. The number and size of such reaming operations shall be conducted at the discretion of the Contractor.

Pulling Loads: The maximum allowable pull exerted on the HDD pipelines shall be measured continuously and limited to the maximum allowed by the pipe manufacturer so that the pipe or joints are not over stressed.

Torsion and Stresses: A swivel shall be used to connect the pipeline to the drill pipe to prevent torsional stresses from occurring in the pipe. The lead end of the pipe shall be closed during the pullback operation.

Pipeline Support: The pipelines shall be adequately supported by rollers and side booms and monitored during installation so as to prevent over stressing or buckling during the pullback operation. Such support/rollers shall be spaced at a maximum of 60 feet on centers, and the rollers to be comprised of a nonabrasive material arranged in a manner to provide support to the bottom and bottom quarter points of the pipeline allowing for free movement of the pipeline during pullback. Surface damage shall be repaired by the Contractor before pulling operations resume.

The contractor shall at all times handle the HDD pipe in a manner that does not over stress the pipe. Vertical and horizontal curves shall be limited so that wall stresses do not exceed 50% of yield stress for flexural bending of the pipe. If the pipe is buckled or

otherwise damaged, the damaged section shall be removed and replaced by the Contractor at his expense. The Contractor shall take appropriate steps during pullback to ensure that the pipe will be installed without damage.

8.17 Handling Drilling Fluids and Cuttings.

During the drilling, reaming, or pullback operations, the Contractor shall make adequate provisions for handling the drilling fluids, or cuttings at the entry and exit pits. These fluids must not be discharged into the waterway. When the Contractor's provisions for storage of the fluids or cuttings on site are exceeded, these materials shall be hauled away to a suitable legal disposal site. The Contractor shall conduct his directional drilling operation in such a manner that drilling fluids are not forced through the sub-bottom into the waterway. After completion of the directional drilling work, the entry and exit pit locations shall be restored to original conditions. The Contractor shall comply with all permit provisions.

Pits constructed at the entry or exit point area shall be so constructed to completely contain the drill fluid and prevent its escape to the waterway. The Contractor shall utilize drilling tools and procedures which will minimize the discharge of any drill fluids. The Contractor shall comply with all mitigation measures listed in the required permits and elsewhere in these Specifications.

To the extent practical, the Contractor shall maintain a closed loop drilling fluid system.

The Contractor shall minimize drilling fluid disposal quantities by utilizing a drilling fluid cleaning system which allows the returned fluids to be used.

As part of the installation plan specified herein before, the Contractor shall submit a drilling fluid plan which details types of drilling fluids, cleaning and recycling equipment, estimated flow rates, and procedures for minimizing drilling fluid escape.

8.18 Drilling Operations.

The Contractor shall prepare a plan to be submitted for Engineer approval which describes the noise reduction program, solids control plant, pilot hole drilling procedure, the reaming operation, and the pullback procedure. All drilling operations shall be performed by supervisors and personnel experienced in horizontal directional drilling. All required support, including drilling tool suppliers, survey systems, mud cleaning, mud disposal, and other required support systems used during this operation shall be provided by the Contractor.

Drill pipe shall be API steel drill pipe, Range 2, Premium Class or higher, Grade S-135 in a diameter sufficient for the torque and longitudinal loads and fluid capacities required for the work. Only drill pipe inspected under API's Recommended Practice Specification API RP 7G within 30 days prior to start and certified as double white band or better shall be used.

A smoothly drilled pilot hole shall follow the design centerline of the pipe profile and alignment described on the construction drawings.

Between the entry or exit point the Contractor shall provide and use a separate steering system employing a ground survey grid system, such as "TRU-TRACKER" or equal wherever possible. The exit point shall fall within a rectangle 5 feet wide and 10 feet long centered on the planned exit point.

During the entire operation, waste and leftover drilling fluids from the pits and cuttings shall be dewatered and disposed of in accordance with all permits and regulatory agencies requirements. Remaining water shall be cleaned by Contractor to meet permit requirements.

Technical criteria for bentonite shall be as given in API Spec. 13A, Specification or Oil Well Drilling Fluids Material for fresh water drilling fluids. Any modification to the basic drilling fluid involving additives must describe the type of material to be used and be included in Contractor's drilling plan presented to the Engineer. The Owner retains the right to sample and monitor the waste drilling mud, cuttings and water.

8.19 Environmental Provisions.

The Horizontal Directional Drilling operation is to be operated in a manner to eliminate the discharge of water, drilling mud and cuttings to the adjacent creek or land areas involved during the construction process. The Contractor shall provide equipment and procedures to maximize the recirculation or reuse of drilling mud to minimize waste. All excavated pits used in the drilling operation shall be lined by Contractor with heavy duty plastic sheeting with sealed joints to prevent the immigration of drilling fluids and/or groundwater.

The Contractor shall visit the site and must be aware of all structures and site limitations at the directional drill crossing and provide the Engineer with a drilling plan outlining procedures to prevent drilling fluid from adversely affecting the surrounding area.

The general work areas on the entry and exit sides of the crossing shall be enclosed by a berm to contain unplanned spills or discharge.

Waste cuttings and drilling mud shall be processed through a solids control plant comprised as a minimum of sumps, pumps, tanks, desalter/desander, centrifuges, material handlers, and haulers all in a quantity sufficient to perform the cleaning/separating operation without interference with the drilling program. The cutting and excess drilling fluids shall be dewatered and dried by the Contractor to the extent necessary for disposal in offsite landfills. Water from the dewatering process shall be treated by the Contractor to meet permit requirements and disposed of locally. The cuttings and water for disposal of locally. The cuttings and water for disposal are subject to being sampled and tested. The construction site and adjacent areas will be checked frequently for signs of unplanned leaks or seeps.

Equipment (graders, shovels, etc.) and materials (such as groundsheets, hay bales, booms, and absorbent pads) for cleanup and contingencies shall be provided in sufficient quantities by the Contractor and maintained at all sites for use in the event of inadvertent leaks, seeps or spills.

Waste drilling mud and cuttings shall be dewatered, dried, and stock piled such that it can be loaded by a front end loader, transferred to a truck and hauled offsite to a suitable legal disposal site. The maximum allowed water content of these solids is 50% of weight. Due to a limited storage space at the worksite, dewatering and disposal work shall be concurrent with drilling operations. Treatment of water shall satisfy regulatory agencies before it is discharged.

8.20 Payment. Payment shall be included in the payment for the work as shown on the plan sheets and to which it is subsidiary in the Bid Schedule. The estimated length of each directional bore is indicated on the plan sheets. This stated length shall be the footage used for the contractors payment calculation regardless of the actual length required for installation. Where applicable, the unit price for directional boring shall include labor and materials for installation of both the casing and carrier pipe.

SECTION 9 - METER SETTING & METER RECONNECTION

9.0 Work Included. Under this item the Contractor shall provide all labor, tools, equipment, and materials to install the meter settings, meter reconnects, and service tubing as shown on the drawings and as directed by the Engineer.

9.1 Materials. The meter settings shall consist of a saddle, corporation stop, service tubing, coppersetter, meter, meter box, and appurtenances. The corporation stops/ball valves shall be B11-333 as manufactured by Ford with a pack joint for polyethylene pipe. Pack joint inlet couplings shall be C14-33-Q as manufactured by Ford for polyethylene pipe. Saddles shall be equal to the Ford S70 Series with a hinged pin for PVC and 202 Series for ductile iron. The coppersetter shall be equal to the Ford 70 Series Coppersetter VHH72-7W-11-33 with a seven inch rise for a 5/8 inch by 3/4 inch meter and complete with an inlet key valve and outlet dual check valve. A tandem coppersetter to accommodate a pressure reducer and meter shall be used where specified. The pressure reducing valve shall be Mueller, Model No. H-9300 No. 3, or approved equal with a bronze strainer. Each regulator is to have an adjustable pressure range of 60-125 psi and to be set at 70 psi.

The meters shall be solid state, battery operated electromagnetic flow measurement type. They shall conform to American Water Works Standard C-700 and C-710 as most recently revised with respect to accuracy and pressure loss requirements, or other appropriate American Water Works Standard. Must be compliant with NSF/ANSI Standard 61 Annex F and G. System shall operate up to a working pressure of 200 pounds per square inch (psi), without leakage or damage to any parts. The accuracy shall not be affected by variation of pressure up to 200 psi.

The measuring element shall be made of a noncorrosive, lead-free glass fiber reinforced, composite alloy material. A battery powered magnetic flow sensor utilizing silver/silver chloride electrodes will be utilized to measure the velocity of the ater which is linearly proportional to the volume. The measuring element will have no moving parts and will be specific for each size. The register and measuring element will be an integrated unit housed within a thermal plastic external casing. This integrated unit will not be removable from the external housing. The systems shall have the size and direction of water flow through the system imprinted on the external housing.

The register must be an electronic device encapsulated in glass with 9 programmable digits utilizing a liquid crystal display (LCD). It will have indicators for flow direction, empty pipe, battery life and unit of measurement. The register must be hermetically sealed with a heat tempered glass cover and be tamper resistant. The register shall not be removable from the measuring sensor. The register shall utilize a magnetic coupling technology to connect to a touch read, radio read or fixed base meter reading system in either an inside or pit set installation.

The register shall be a true absolute encoder register that provides direct electronic transfer of meter reading information to any number of AMR device options. A Radio Read Meter Transceiver Unit (MXU) shall be provided with each meter. The units shall be a pit set radio signal device which permits off site meter reading via radio signal in a pit set or vault environment. The unit shall allow for installation through the pit lid in order to maximize the units performance. However, in cases where this is not an option the design shall allow for under the lid installations.

Meters shall be Sensus IPearl equipped with a Model 520R Radio Read Meter Transceiver Pit Set Unit (MXU) as manufactured by Sensus Metering Systems. The size of the meter shall be 5/8 inch by 3/4 inch or as shown otherwise on the Plans. Meters and radio transceivers shall be compatible with the Owners current radio read metering system.

The meter boxes shall be green corrugated polyethylene round boxes (un-notched) and shall be 18-inches in diameter and 24-inches deep as manufactured by Hancor, Inc., or approved equal. Meter box settings shall be prefabricated with the copper-setters and fittings as specified ready for connection at the inlet and outlet ends. Meter box settings shall be that as manufactured by Water Works Supplies, Inc., Richmond, Kentucky, or approved equal. Meter boxes shall include a two piece flat cast iron lid and frame, RUSSCO LC-219 as manufactured by Sigma Corporation, or approved equal.

Service tubing shall be 3/4 inch polyethylene or type K copper tubing with a minimum pressure rating of 200 PSI. One-inch and two-inch service lines shall be PVC, PE, or K copper with a minimum pressure rating of 200 PSI. Insert stiffeners shall be used when using polyethylene service tubing and shall be Series 50 or 70 as manufactured by Ford Meter Box Company, Inc., or approved equal.

9.2 Installation. Meters shall be set as shown on the detail drawings with backfill neatly compacted in place. The top of the meter box shall be set 1/2 inch above grade. The meter shall be at least 18 inches below the ground surface.

Service line reconnects shall consist of reestablishing service on the customer side of a new meter. New service line shall be installed to connect the new water main to the existing service line at the closest location possible. The new and existing service line shall be connected using an approved brass compression coupling.

Where applicable, the contractor is also responsible under this bid item for the abandonment of the existing meter settings. This includes disconnection at the direction of the engineer, removing all remnants of the meter box/vault and all other related appurtenances to a point two feet below existing ground level. Any void created by removal of items shall be backfilled with the adjacent area being restored to match the surrounding ground conditions including any incidental pavement replacement which may be required. All existing interior piping, meters, valves, and other appurtenances shall be removed and delivered to the owner prior to demolition and removal of the existing meter box/vault.

Meter reconnects shall consist of reestablishing service to an existing meter after the new water main has been installed. New service line shall be installed to connect the new water main to the existing service line at the closest location possible. The new and existing service line shall be connected using an approved brass compression coupling.

9.3 Payment. The unit price bid shall constitute full compensation for furnishing and installing the meter setting, or meter reconnect, with the above described appurtenances. Service tubing shall be paid by the linear foot. Installation of the service tubing through or beneath paved surfaces shall be considered as an incidental cost for the installation of the service tubing and there shall be no compensation for pavement replacement.

SECTION 10 - STONE AGGREGATE

10.0 Work Included. Under this item the Contractor shall provide all labor, tools, equipment, and materials to install the stone aggregate as shown on the drawings and as directed by the Engineer.

10.1 Materials. The stone aggregate shall be dense grade stone #9 or as directed by the Engineer or as otherwise shown. The stone shall be free of dirt, sand, trash, debris, and free water.

10.2 Installation. The Contractor shall install the aggregate at the locations as shown on the drawings which includes any trenches where the water main or service line disturbs any roadway. This also includes any areas where casing pipe is installed in open trenches or the locations where a bore or receiving pit was excavated. Stone shall be backfilled to top of grade where any trenches disturb paved areas. The Engineer may limit the amount of stone to be placed upon determination that the application is excessive.

10.3 Payment. Stone aggregate shall be incidental to the installation of the water mains, and other appurtenances. There shall be no separate pay item for stone aggregate.

SECTION 11- PAVEMENT REPLACEMENT

11.0 Work Included. Under this item the Contractor shall provide all labor, tools, equipment, and materials to install concrete and bituminous pavement replacement where pavement is disturbed during construction.

11.1 Materials. Pavement replacement for bituminous surfaces shall consist of a prime coat of emulsified asphalt, Class 1 Bituminous Binder, and Class 1 Bituminous Asphalt as specified by the Kentucky Bureau of Highways latest specifications.

Pavement replacement for concrete surfaces shall consist of Class A concrete including reinforcement consisting of No. 4 reinforcing bars placed on twelve inch centers in both directions or otherwise as directed by the engineer.

Support backfill shall be No. 9 stone, dense grade aggregate or flowable fill as per the detailed drawings and specifications herein.

11.2 Installation. Immediately upon placement of the water lines and appurtenances the disturbed traveled way shall be backfilled with No. 9 stone or dense grade aggregate extending from the top of the pipe up to the traveled way surface. The area of disturbance will be repaved once settlement has subsided granted that water line installation, testing and all other cleanup has been completed as dictated by the Engineer.

In preparation for the installation of pavement replacement, the top twelve inches of stone backfill shall be compacted with a mechanical tamping machine. The use of rubber tire or track driven equipment such as backhoes or dozers shall not satisfy the requirement for final compaction.

11.2.1 State Highway Pavement Replacement. Where bituminous pavement replacement is required due to a disturbance of a Kentucky State Highway, the trench shall be backfilled with #9 stone up to 9-inches below the top of the existing pavement. The stone shall be properly compacted and capped with a 6-inch layer of KYDOT approved flowable fill. A 3-inch layer of temporary asphalt pavement shall then be installed flush with the level of the existing pavement. Upon completion of the water line installation, testing and all other cleanup, the Contractor shall mill the temporary asphalt and the existing asphalt in preparation for final pavement replacement. The total width of final pavement replacement shall be a minimum of three feet from the each edge of temporary pavement. Following milling of existing and temporary pavement, the Contractor shall replace void with an approved prime coat of emulsified asphalt applied at a rate of 0.35 gallons per square yard and a 3-inch finish coat asphalt pavement. The pavement shall be rolled to a smooth finish and provide a gentle transition to the existing pavement. A detail illustration regarding the methods described has been included in the standard drawings.

11.2.2 Full Width Pavement Replacement. Where full width bituminous pavement replacement is required, the pipe trench shall be backfilled as described herein. Upon completion of the water line installation, testing and all other cleanup, the Contractor shall install full width pavement replacement in all areas indicated on the plans. In areas where existing curbing is in place, the contractor shall mill the existing paved surface before new asphalt pavement overlay is installed. In areas were curbing is not in place, the contractor shall install asphalt overlay directly atop exiting pavement. An approved prime coat of emulsified asphalt applied at a rate of 0.35 gallons per square yard shall be applied in preparation of for installation of the asphalt overlay. The finish coat of asphalt pavement shall be a minimum of 2-inches across the entire roadway cross-section. The pavement shall be rolled to a smooth finish and provide a gentle transition to all existing pavement.

11.2.3 Incidental Pavement Replacement. Unless specifically noted otherwise, pavement replacement shall be incidental to the cost of installing the water line. This includes all driveways, parking lots, city street crossings, and all other locations where state highway or full-width pavement replacement isn't specifically noted on the plans. Where incidental pavement replacement, including partial pavement replacement, is required, the pipe trench shall be backfilled as described herein. Upon completion of the water line installation, testing and cleanup, the Contractor shall install pavement replacement in all areas where the existing pavement has been disturbed. The total width of pavement replacement shall extend a minimum of three feet outward from each edge of the pipeline trench. Partial pavement replacement will be required when pavement is disturbed along the edge of a paved area. In partial pavement replacement situations the replacement pavement shall extend into the paved area a minimum three feet and toward the pipeline trench to a point equal to that of the existing pavement. In both cases, the transition from the replacement pavement and the existing pavement shall be saw cut with a neat and clean appearance. All existing pavement material within the total width of the pavement replacement area shall be removed prior to installation of new pavement.

Where concrete pavement replacement is required, reinforcing steel shall be placed within three inches of the surface of the existing concrete and it shall be supported with CMU support pieces. The area to be repaved shall be formed to coincide with the adjoining concrete surfaces and the edges of the repaved area shall be smooth and uniform. The concrete shall be placed on top of the compacted gravel at a minimum depth of six inches. The surface finish shall match that of the adjoining concrete. The transition to all adjoining pavement shall be smooth and uniform such that ponding will not occur.

Where bituminous pavement replacement is required the base shall be prepared with a prime coat of emulsified asphalt applied at a rate of 0.35 gallons per square yard. A 2-inch thick layer of bituminous binder shall then be placed above the prime coat. The final coat of bituminous concrete shall then be placed at a depth of 1 1/2 inches. The final coat of pavement shall be rolled to a smooth finish and provide gentle transitions to all existing pavement.

A detail illustration regarding the methods described has been included in the standard drawings.

11.3 Final Acceptance. All pavement replacement shall be inspected prior to the final warranty period expiration. Any pavement replacement found to be deteriorated or not uniform due to settlement of the disturbed subsurface shall be repaired before the work is recommended for final acceptance. It is anticipated that this inspection shall take place on or about the eleventh month of the one year warranty period. The warranty period for all pavement replacement shall not commence until the final warranty period for the project in its entirety is initiated.

11.4 Payment. The unit price bid shall constitute full compensation for furnishing and installing pavement replacement as it is outlined in the bid schedule and specifications herein. Unit measurement of all pavement replacement not considered incidental shall be in linear feet, with the measurement being taken parallel to the corresponding pipeline trench

All disturbed pavement which is not specifically indicated on the plans as receiving state highway or full-width pavement replacement shall be considered incidental to the cost of installing the water lines and shall receive no additional payment.

SECTION 12 - EXPLORATION

12.0 Work Included. Under this item the Contractor shall provide all labor, tools, equipment, and materials to explore for existing water lines and appurtenances that are not as shown on the Drawings.

12.1 Description of Work. In those locations where the existing water lines and appurtenances are not in the locations as shown on the Drawings the Contractor shall explore for the utility at the direction of the Engineer. The Contractor shall utilize all equipment necessary to search for the water line or appurtenance and any disturbance of other utilities shall be the responsibility of the Contractor. Any other work or disturbance created by the Contractor as a result of the exploration shall be incidental to this item.

In locations where new water lines are to be installed parallel to existing lines, the contractor shall locate existing water lines in 100 foot intervals. This particular requirement shall be considered **incidental** to the installation of the water lines and it **shall not be included** in the calculation of this pay item.

12.2 Payment. The unit price bid shall constitute full compensation for the exploration of the water lines and appurtenances. The Resident Engineer shall approve the Contractor to initiate and terminate the exploration and the Resident Engineer shall monitor the amount of time in 15 minute increments.

SECTION 13- PRESSURE REDUCING STATION

13.0 Work Included. Under this item the Contractor shall provide all labor, tools, equipment, and materials to install a pressure reducing station, and appurtenances.

13.1 Materials. All piping for the station within the vault and buried extending to the point of connection to the main line shall be ductile iron with flanged ends. The ductile iron piping shall extend two feet beyond the vault on each side and connect to the main water line with a mechanical joint reducer.

The shutoff valves shall be resilient type and shall be designed for a minimum water working pressure of not less than 250 pounds per square inch. Valves shall be handwheel operated. Gate valves shall have a clear water way equal to the nominal diameter, and shall be opened by turning to the left. The operating wheel shall have an arrow cast in the middle indicating the direction of the opening. Each valve shall have the manufacturer's initials, pressure rating, and the year in which manufactured, cast onto the body.

The primary and secondary pressure reducers shall be 3-Inch and 1½ -Inch in size respectfully and shall be manufactured by Bermad, model 720-V-I or approved equal. The valve shall be equipped with a V-port throttling plug and stem indicator.

The pressure settings shall be as follows:

Sheet Number	Location	Inlet Pressure (PSI)	Outlet Pressure (PSI)	Primary Valve (Inches)	Secondary Valve (Inches)
	Greenfish Hill PRV No. 1				
8 & PRV-1	US Highway 25	130	40	3	1 ½

Pressure gauges shall be that as manufactured by Ashcroft, model number 45-1279ASL or approved equal and they shall have a 4.5" dial housed in a black phenolic case with a bronze tube and 1/4" stem and the case shall be filled with glycerin. The inlet gauges shall have a range of 0-300 PSI and the outlet shall have a range of 0-100 PSI.

The strainers shall be that as manufactured by the Mueller Steam Specialty, Model 125-B15 or approved equal and they shall be basket type.

The concrete vault shall be made of 4,000 PSI strength concrete and shall be of the dimensions as shown of the Drawings. All walls of the vault shall be reinforced with No. 4 bars as shown on the Drawings. The vault shall be equipped with 24-inch by 24-inch hatches, single or tandem as shown on the Drawings with a keyed wrench for opening.

13.2 Installation. The vault with all appurtenances shall be installed at the locations as shown on the Drawings or as directed by the Engineer. The vault shall be placed such that the hatch openings are one inch above the final ground level.

13.3 Payment. The unit price bid shall constitute full compensation for the furnishing and installation of the pressure reducing station.