

ITEMIZED SPECIFICATION NUMBER ELEVEN

FORCE MAINS

11.1 **SCOPE** - This item shall include furnishing and installation of the force mains, including all fittings and other appurtenances and the making of all connections and providing temporary service, as herein specified and as shown on the Drawings. The force main may be of ductile iron, Polyvinyl Chloride or Polyethylene Pressure pipe material as described below.

11.2 **DUCTILE CAST IRON PIPE** - Ductile iron pipe shall be designed in accordance with ANSI/AWWA C150/A21.51. The pipe shall be coated with a bituminous material on the outside and shall be cement mortar lined in accordance with ANSI/AWWA C104/A21.4. All pipe shall be thickness Class 50.

11.3 **POLYVINYL CHLORIDE (PVC) PIPE** - PVC pipe shall meet the requirements of ANSI/AWWA C900-97 and shall be DR 18, 150 pressure class, with cast iron pipe equivalent O.D. Pipe shall be of the integral wall-thickened bell end type incorporating elastomeric gaskets to affect the pressure seal. Pipe shall have a nominal laying length of 20 feet. Pipe shall be designed for direct connection into ductile cast iron pipe and fittings.

11.4 **POLYETHYLENE (PE) PRESSURE PIPE** – PE pipe 3” in diameter and smaller shall be constructed of PE 3408 material meeting the requirements of AWWA C901-02, DR-11, 160 pressure class, with a minimum cell classification of PE 334434 and with nominal size 1” and smaller conforming to copper tubing size (CTS) and for nominal size larger than 1” conforming to iron pipe size (IPS). Pipe sections may be joined using mechanical fittings in accordance with AWWA C901, heat-fusion connections in accordance with ASTM D2657 or ASTM F1290. Insert fittings are not acceptable. Pipe shall be marked in accordance with the requirements of AWWA C901, to indicate conformance with this specification.

PE pipe 4” in diameter and larger shall be constructed of PE 3408 material meeting the requirements of AWWA C906-07, DR-11, 160 pressure class, with a minimum cell classification of PE 334434 and with nominal size conforming to ductile iron pipe size (DIPS). Pipe sections may be joined using molded fittings in accordance with AWWA C906 and ASTM and ASTM D2683 for socket type fittings, ASTM D3261 for butt type fittings or ASTM F1055 for electro fusion type fittings or flanged fittings in accordance with AWWA C906. Solvent cement, adhesive or threaded connection methods are not acceptable. When joining PE pipe to other pipe materials, the connection shall be made in accordance with both pipe and fitting material manufacturer’s recommendations. Pipe shall be marked in accordance with the requirements of AWWA C906, to include conformance with this specification.

The CONTRACTOR shall be required to install detectable tracer tape directly over and on the center of the PVC Main for its entire length to provide a reflection path (inductive) to determine pipe alignment and location after installation.

11.5 **DETECTABLE TRACER TAPE** - Detectable tracer tape shall consist of a continuous aluminum foil core inseparably bonded on both sides with tough high density cross laminated plastic films pigmented in blue warning colors. Bond strength of the tracer tape must prevent pitting or degradation after 300 hours continuous testing per ASTM B-117. Tracer tape shall have final elongation of three times its original length before parting. Detectable tracer tape on the above project shall be equal to ALARMATAPE as manufactured by PAUL POTTER WARNING TAPES, INC., Wheaton, Illinois; or equal. Specify catalog numbers #AT-3100-BW, 3" x 1000 foot rolls with identification "BURIED FORCE MAIN BELOW". Identifying printing shall be in 1-1/2 inch high bold black letters repeated every 21 inches. 3" wide ALARMATAPE is to be buried 30 inches deep.

11.6 **TRACER WIRE** - All new non-metal force mains shall be installed with tracer wire. In open trench installations, the wire shall be 12 AWG (min.) copper wire coated with a 30-mil (min.) polyethylene jacket designed specifically for buried use. In directional bore installations, the wire shall be 8 AWG (min.) coated with a 30-mil (min.) polyethylene jacket designed specifically for buried use.

The tracer wire shall be connected to the pipe with tape at 15 foot intervals maximum, the wire shall not be wrapped around the pipe. It shall be installed continuously with access points at 300 feet maximum and any change in direction. The tracer wire shall be brought to the ground surface at the access points and provide an extra 24" of wire. Access points may include a valve box, vault, tracer wire access box or other covered access devices and the covers shall be clearly marked SEWER.

Metallic pipes do not require a tracer wire. Metallic pipe systems require access points along the route for direction connection.

Splices in the tracer wire shall be connected by means of a split bolt or compression type connector to ensure continuity. Wire nuts shall not be used. A waterproof or corrosion-proof connector for direct bury applications shall be used. After installation, the tracer wire shall be tested to verify continuity of the tracer wire system.

The use of tracer wire shall not eliminate the requirement for tracer tape.

11.7 **FITTINGS** - Fittings for ductile iron or PVC Pipe shall be American Manufactured ductile iron, shall conform to ANSI/AWWA C110/A21.10 or ANSI/AWWA C153/A21.53 and shall be coated of mechanical joint or push-on joint type. Fittings for PE Pipe are as listed in this specification section 2.4. Provide required standard and tapped mechanical joint plugs and caps to accommodate appurtenances to the main for testing and sterilization.

Mechanical joints and push-on joints shall be in accordance with ANSI/AWWA C111/A21.11, incorporating rubber gaskets. With push-on joints, the surfaces to be in contact with the rubber gasket shall be wiped clean and dry just prior to making the joint and, when making the joint, a lubricant shall be used in accordance with the manufacturer's recommendations. With mechanical joints, the surfaces to be in contact with the rubber gasket shall be brushed with soapy water to remove all sand and grit just prior to making the joint.

All costs required for furnishing and installing fittings, plugs, caps, and appurtenances shall be included in the price bid per lineal foot for the force mains.

Whenever it is necessary to cut the pipe at fittings, valves, specials or elsewhere, the remaining portions may be used where possible to minimize the number of scrap pieces when the project is complete. Scrap pieces less than five feet in length shall not be used.

11.8 **INSPECTION AND REJECTION** - All pipes, fittings, etc. shall be appropriately marked for the purpose of identification.

The materials and methods of manufacture shall be subject to inspection at all times, and the complete pipes, fittings, etc. shall be subject to inspection and rejection at the factory, trench or other point of delivery.

Further, all are subject to rejection when defects are discovered until the final completion and adjustment of Contract.

11.9 **MANUFACTURER'S AFFIDAVIT** - Pipe sections shall be strung along the route of the mains so as to interfere least with pedestrians and vehicular traffic and to protect the pipe as fully as possible. Care shall be taken at all times in handling the pipe so as not to injure it in any way and at no time shall other pipes or material be placed in the pipes.

11.10 **INSTALLATION** - The mains shall be laid in the locations and at the grades shown on the Drawings, except as specifically permitted or ordered otherwise by the ENGINEER in order to avoid existing or proposed utility lines or any other obstructions encountered in the progress of the work, to secure a more readily accessible position for trenching, or to facilitate the location of various appurtenances of the mains. CONTRACTOR is cautioned to pay particular attention to proposed utilities to estimate possible future conflicts.

Existing utilities or other obstructions along the route of the mains shall be located and the elevation determined at least 200 feet in advance of pipe laying. All utilities, when encountered shall be adequately supported, shored up or otherwise protected whenever exposed in the excavation as approved by the ENGINEER. Timber supports shall be minimum of 4-inches square. While the Drawings indicate the location of existing utilities in accordance with the best information presently available, neither the OWNER nor the ENGINEER assumes any responsibility for the accuracy of their location or that all utilities are shown.

When abrupt changes in the grade of the main are necessary to avoid existing utilities or other obstructions, suitable fittings, usually 1/16 bends, shall be used unless otherwise specified, so as to secure an easy flow of liquid and to provide sufficient cover below same. Pipe shall be so located with respect to other utilities so as to allow for taps to be inserted. A minimum clearance of one foot in all directions shall be maintained.

Forcemains may be installed using horizontal directional drilling or free bore methods. The installation of pipe by these methods shall be as proposed by the Contractor and approved by the Engineer. All methods of horizontal directional drilling or free bore shall be completed without damage to any other utilities or surface features. Unless specifically called for on the plans, a casing pipe shall not be required but may be provided at the Contractor's cost. The Contractor shall fill any voids in the boring with an approved material. The Contractor shall submit an affidavit or manufacturer's certification showing all proposed pipe materials are suitable for horizontal directional drilling or free bore installation.

11.11 **TRENCHES** - Except where otherwise specifically required or permitted by the ENGINEER, the mains shall be laid in open trench excavated to a depth sufficient to provide not less than 4 feet of vertical cover, unless otherwise noted. However, pipes shall be installed at a greater depth when shown on Drawings; when necessary to pass under other utilities or obstructions; or where necessary to prevent high points in the main.

Sufficient space shall be provided in the trench for properly making the joints without raising the length of pipe above the solid bottom of the trench. Care shall be taken to detect and remove any large stones or other debris that might be encountered in the bottom of the trench which would damage the pipe or be detrimental to the proper bedding of the pipe.

Trenches in rock shall be excavated to a depth of at least 6 inches below the outside bottom of the pipe barrel and joint when the pipe is laid on its final grade. The pipe shall then be laid on a cushioning layer of granular material as approved by the ENGINEER and at the expense of the CONTRACTOR. The width of the trench shall not be more than 24 inches greater than the inside diameter of the pipe, except at joints, where sufficient space shall be provided for properly making the joint.

Trench excavation shall include the removal of existing pavements, curbs, and sidewalks.

11.12 **MECHANICAL JOINT RESTRAINT** - Pipe shall be anchored at dead ends, bends, tees, valves and other fittings requiring restraint by means of mechanical joint restraints. Mechanical joint restraint shall be incorporated in the design of the follower gland and shall include a restraining mechanism which, when actuated, imparts multiple wedging action against the pipe, increasing its resistance as the pressure increases. Flexibility of the joint shall be maintained after burial. Glands shall be manufactured of ductile iron conforming to ASTM A 536-80. Restraining devices shall be of ductile iron heat treated to a minimum hardness of 370 FHN. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell and tee-head bolts conforming to

ANSI/AWWA A21.11 and ANSI/AWWA C153/A21.53 of latest revision. Twist-off nuts shall be used to insure proper actuating of the restraining devices. The mechanical joint restraint device shall have a working pressure of at least 250 psi with a minimum safety factor of 2:1.

The cost of all mechanical joint restraints shall be included in the price bid per lineal foot for the force mains.

11.13 **PIPE EMBEDMENT** - After the pipe has been laid and the joints made, the full length of each ductile iron pipe shall be thoroughly bedded by tamping sand as approved by the ENGINEER, around and over the pipe for a distance of 6 inches above the top of the pipe barrel and shall be provided at the expense of the CONTRACTOR.

The full length of each PVC pipe shall be thoroughly bedded by tamping crushed stone, as approved by the ENGINEER, around and over the pipe as shown on the waterline trench detail and shall be provided at the expense of the CONTRACTOR.

The material shall be placed in layers not exceed 6 inches in thickness, loose measurement, and securely compacted by hand or mechanical tamping to secure a good compaction while taking care not to displace or damage the pipe or joints.

11.14 **BACKFILLING** - Backfilling shall include the material placed above a plane 6 inches above the top of the pipe barrel for Ductile Iron.

Trenches coming within paved or stone streets, alleys, driveways, and parking areas or proposed pavements shall be backfilled with granular material conforming to Item 411 as shown on the Drawings.

11.15 **PROGRESS** - The CONTRACTOR shall be required to complete backfilling operations and general cleanup within a reasonable distance of trenching and pipe laying operations, and other excavations. The specific limitations of this paragraph shall be at the discretion of the ENGINEER, but the general intent is to require the CONTRACTOR to minimize the inconvenience to nearby residences or businesses where the mains are constructed in streets and alleys or in other locations where the construction produces an inconvenience. The ENGINEER shall be permitted to require the CONTRACTOR to cease trenching and pipe laying operations at such time he feels that backfilling and cleanup have not progressed satisfactorily.

11.16 **REPLACEMENT** - With the exception of replacement items subsequently specified; the CONTRACTOR shall be liable for all damage to public and private property caused by movement of equipment or by other construction operations. All damaged or disturbed property shall be repaired or replaced with new materials, to the satisfaction of the ENGINEER, at the CONTRACTOR'S expense.

11.17 **PRESSURE AND LEAKAGE TESTS** -All new force mains shall be pressure and leakage tested in accordance with procedures outlined in AWWA C600-05 and AWWA C605-05. The forcemain shall be isolated from adjacent mains while the pressure test is applied by pumping water through a 1 inch corporation stop installed in the ends of the main, with the CONTRACTOR to provide the initial pressure test.

The pressure test shall be started in an afternoon and the pressure shall remain on for 18 hours. The pressure shall then be maintained for an additional 6 hours by pumping water from the container. At the end of the 6 hour period, the water pumped to maintain the test pressure shall be measured and the loss by leakage shall not exceed that as determined by the formula:

$$L = \frac{SD (P)^{1/2}}{148,000}$$

in which L is the allowable leakage, in gallons

per hour; S is the length in feet of main line being tested; D is the nominal diameter of the pipe in inches; P is the average test pressure during the leakage test in pounds per square inch gage or 2 times the discharge head of the pump station.

Pressure testing of each side of the intermediate valves shall be done at this time by shutting each valve and exhausting the pressure on one side and then applying the test pressure of 150 psi or more to the main on the opposite side of the valve. This procedure shall be repeated for each intermediate valve.

If the main valves do not pass the leakage test, the leak or leaks shall be located and repaired and the test procedure repeated.

11.18 **MINOR DETAILS** - Minor details not specifically mentioned in these Specifications nor shown on the Drawings, but necessary to secure a workmanlike job and proper operation, shall be provided by the CONTRACTOR without extra cost.

11.19 **PRICE BID** - The price bid for Force Mains shall include all necessary excavation, embedment, backfill, materials, labor, fittings, joints, the testing of force mains, replacement of existing facilities, maintenance of the backfilled trenches, and the construction of the mains, all in accordance with the foregoing Specifications and accompanying Drawings, and shall be the price per lineal foot, installed complete, for the size of the force main included in the bid items.

<u>ITEM</u>	<u>ODOT</u>	<u>DESCRIPTION</u>	<u>UNIT</u>
11a	SP	4" Diameter C-900 Sanitary Forcemain	LF