

SECTION 02800

DRIP IRRIGATION SYSTEM

PART 1 – GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install complete drip irrigation system in the locations as shown on the Drawings and as specified herein.
- B. The Contractor's attention is called to the fact that all PVC piping drip tubing and accessories are not shown on the Drawings. Some piping is simply shown in schematic form. The Contractor shall furnish and install all piping indicated or required for the proper operation of the drip irrigation system.

1.2 RELATED WORK

- A. Drawings and General Provisions of Contract, including General Supplemental Conditions or General Provisions and other DIVISION 1 specifications as may apply.
- B. The following sections contain requirements that relate to this section:
 - 1. Section 02840: Trees, Shrubs, and Ground Cover.

1.3 DESCRIPTION OF SYSTEM

- A. The drip irrigation system shall utilize reclaimed storm water runoff, filtered and stored in below ground and above ground storage tanks that will provide a pressurized 4-inch PVC distribution system ranging from 10-45 psi.
- B. The drip irrigation system shall consist of:
 - 1. 4-inch PVC main distribution pipe extending from Market to Broad Street as shown on the drawings.
 - 2. Zone type irrigation of each block (total of four zones) for both turf, trees, and ground cover along both sides of 17th Street.
 - 3. Control panel for the automatic and timed control of irrigation for each of the four zones.
 - 4. Drip tubing and solid tubing for the uniform distribution of reclaimed water to the areas to be irrigated.
 - 5. Motorized automatic diverter valves, filters, flushing valves, and air-vacuum relief valves for each irrigation zone.

1.4 QUALIFICATIONS

- A. The drip irrigation system layout and design shall be performed by an individual or firm regularly engaged in the design and installation of drip irrigation system. A representative list of past projects shall be submitted to the Engineer for review with system submittal data.
- B. All plastic pipe shall be furnished by a single manufacturer who is fully experienced, reputable, and qualified in the manufacture of the items to be furnished. The piping shall be designed, manufactured, and installed in accordance with ASTM and AWWA methods and shall comply with these Specifications.

1.5 SUBMITTAL

- A. Shop Drawings shall be submitted to the Engineer for approval in accordance with these Specifications and shall include dimensioning and technical specification for all piping to be furnished.
- B. Submit samples of all drip tubing materials specified herein to the Engineer for approval when requested.

1.6 PIPE MARKING

- A. All PVC pipe shall be marked with the following information:
 - 1. Manufacturer's name or trademark.
 - 2. Nominal pipe size and OD base.
 - 3. AWWA or ASTM material code designation.
 - 4. Dimension ratio.
 - 5. AWWA pressure class.
 - 6. AWWA or ASTM specification designation (AWAA C900, ASTM D2241, ASTM D1785, Schedule 80).
 - 7. Product record code.
 - 8. Certification seal(s), if required.

1.7 RECEIVING, HANDLING, AND STORAGE

- A. Receiving, handling, and storage of PVC pipe shall be in accordance with AWWA Manual No. M23, "PVC Pipe Design and Installation," except that all PVC pipe which is stored longer than one week shall be covered with an opaque material.
- B. All drip tubing and irrigation control valves shall be suitably stored and protected until installed and placed in operation.

PART 2 – PRODUCTS

2.1 PVC RECLAIMED WATER PIPING

- A. The 4-inch main distribution piping shall be “purple save” reclaimed PVC water pipe as manufactured by J-M Manufacturing Company, Inc. or approved equal.
- B. Pipe shall be purple in color and meet the requirements of AWWA C900, “Polyvinyl Chloride (PVC) Pressure Pipe”. All Class 100 pipe shall meet the requirements of DR25. Class 150 pipe shall meet the requirements of DR18.
- C. Pipe shall have C-900 markings and shall also be stenciled “Reclaimed Water – Do Not Drink”.
- D. Pipe shall come in standard 20-foot lengths with Ring-Tite push joints with flexible elastomeric ring gasket. Ends shall be compatible for direct connection to cast or ductile iron fittings without adaptors.

2.2 FOUR INCH GATE VALVES

- A. Gate valves shall be of ductile iron body, resilient seated type, manufactured in conformance with AWWA C509. Gate shall be of ductile iron with bonded resilient seat and integral flush drain. Minimum working pressure shall be 200 psi when unbalanced pressure is applied to either side of the gate. Gate valves shall have a minimum of two O-ring stem seals; one above and one below the integral stem collar. The area between the O-rings shall be filled with permanent lubricant.. Valve shall have no metal fasteners or screws exposed in the wetted portion of the valve. All ferrous surfaces shall be shot-blasted to a white finish. All interior and exterior valve surfaces, including the interior of the gate and all bolt holes shall be coated with an epoxy coating in accordance with AWWA C550. The minimum thickness of the coating shall be 8 mils. Valve ends shall be of the type required for the installation as specified herein or shown on the Drawings.

2.3 GEOWFLOW DRIP IRRIGATION SYSTEM COMPONENTS

- A. General – The following specification details the geoflow wasteflow drip emitter tubing, air relief valve, control panel, and automatic diversion valve. These components shall be considered a minimum for the project, but this specification shall in no way be construed to be complete in every detail. The system shall include a GEO Siemens Logo PLC Panel capable of automatically controlling a four-zone system. The tubing and emitters shall be spaced on an average of 18” for irrigation purposes.

- B. Dripline (Wasteflow PC 18" / ½ gph) – The dripline shall consist of nominal sized one-half inch linear low density polyethylene tubing, with turbulent flow, drip emitters bonded to the inside wall. The tubing shall have an outside diameter (O.D.) of approximately .63-inches and an inside diameter (I.D.) of approximately .54-inches. The tubing shall consist of three layers; the inside layer shall be a bactericide protection, the middle layer shall be black and the outside layer shall be purple striped for easy identification. The dripline shall have emitters regularly spaced 18" apart. The pressure compensating emitters shall be molded from virgin polyethylene resin with a silicone rubber diaphragm. The pressure compensating emitters shall have nominal discharge rates of ½ gallon per hour. The emitters shall be impregnated with Treflan® to inhibit root intrusion for a minimum period of ten years and shall be guaranteed by the manufacturer to inhibit root intrusion for this period. Wasteflow PC pressure compensating dripline shall be Geoflow model number WFPC 16-2-18.
- C. Filter – The Y filter body shall be molded from glass reinforced black plastic with a 1.0-inch male pipe thread (MIPT) inlet and outlet. The two piece body shall be capable of being serviced by unscrewing and shall include an O-ring seal. An additional ¾" MHT outlet shall be capable of periodic flushing. The 150 mesh filter screen is all stainless, providing a 28.4 square inch filtration area. The outer support shall be woven stainless steel wire, and the inner screen shall be made of stainless steel cloth. The inner and outer screens shall be soldered together. The screen collar shall be molded from vinyl. The 1" filter shall be Geoflow model number AP4E-100.
- D. Air Vacuum Relief Valve – The air vacuum relief valve provides instant and continuous vacuum relief and non-continuous air relief. Both the body and the removable dirt cover shall be constructed of molded plastic. The body and the dirt cover shall be connected with a ¾ inch hose thread. The ball shall be constructed of low density plastic and the internal seat shall be constructed of vinyl. The air vacuum relief valve shall seal at 5 psi. Inlet size shall be 1-inch male pipe thread. The air vent shall be Geoflow item number APVBK-1. Note: Maximum flow of 50 gpm per 1" air vacuum relief. Valve shall be supplied with 12" meter box.
- E. GEO MVP Control Panel – The Geo controller shall be housed in a NEMA 3R enclosure and shall contain the Siemens Logo PLC, HOA switches, step down transformer for the motorized diversion valves, and all relays and all other necessary components to insure a complete operational system.. The system shall operate in the following fashion: The Logo PLC shall automatically open/close the motorized diversion valve for each zone based upon a 24/7 time clock and duration timer settings. System shall be capable of automatic operation for seven days a week with independent settings for each day of the week as well as lock out time settings for disabling irrigation during early or late day hours. Time settings for each field shall be identical, i.e. in minutes or hours, and shall be adjustable from 0-60 minutes with corresponding off time adjustable from 0-60 minutes. PLC shall open diverter valve and allow each zone to be irrigated for timer duration. PLC shall allow for independent zones to be disabled or manually irrigated. HOA switches shall be accessible without opening enclosure door. Enclosure dimensions shall be 16" x 16".

- F. Motorized Diverter Valve (Flow Control Valve) – The automatic flow control valve shall be a OSI Jandy Maximum Torque Model 2440/2400 Series Irrigation Valve, operating off a 24 VAC voltage. Valve shall be two position with integral cam adjustments and local HOA switch. Valve shall be supplied with 18” minimum depth meter box and lockable green covered lid marked irrigation and sized to contain the filter and flow control valve as shown on the drawings.
- G. Miscellaneous – Provide all miscellaneous fittings, valves, meter boxes control wiring and accessories necessary for a complete operating system.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Alignment and Layout. All pipe valves, meter boxes, control wiring and drip tubing, etc. shall be installed in accordance with approved layout drawings submitted with shop drawings.
- B. Trench Construction for Four Inch PVC Reclaimed Water Piping
1. Stockpiling Excavated Material. All excavated material shall be stockpiled in a manner that will not endanger the work or obstruct sidewalks and driveways. Hydrants under pressure, valve-pit covers, valve boxes, curb-stop boxes, fire and police call boxes, and other utility controls shall be kept accessible.
 2. Trench Depth. Provide minimum of 36 inches of cover in both traffic and non-traffic areas.
 3. Trench Width. Trench width at the ground surface may vary depending on depth, type of soil, and position of surface structures.
 - a. For construction with a backhoe, the minimum clear width of the trench, sheeted or unsheeted, measured at the springline of the pipe shall be 1 foot greater than the outside diameter of the pipe. The maximum recommended clear width of the trench at the top of the pipe is equal to the pipe outside diameter plus 2 feet. If the maximum recommended trench width must be exceeded or if the pipe is installed in a compacted embankment, then pipe embedment shall be compacted to a point of at least 2-1/2 pipe diameters from the pipe on both sides of the pipe or to the trench walls, whichever is less.
 - b. For construction with a trencher:
 - 1) Provide at least 2 inches of clear space on each side of pipe to allow for pipe placement and embedment.
 - 2) For 1 ½ and 2-inch pipe, a trench width of 6 inches is recommended.
 - 3) For 3-, 4-, and 6-inch, pipe a trench width of 12 inches is recommended.
 - c. Quantities of crushed stone embedment in rock trenches shall be based upon the actual width of trench, not to exceed 2 feet plus the pipe outside diameter, unless authorized by the Engineer.

4. Dewatering. Where conditions are such that running or standing water occurs in the trench bottom or the soil in the trench bottom displays a “quick” tendency, the water shall be removed by pumps and other suitable means (such as well points or pervious underdrain bedding) until the pipe has been installed and the backfill has been placed to a sufficient height to prevent flotation of pipe. Generally, a depth of backfill over the top of the pipe equal to 1-1/2 pipe diameters is sufficient to prevent flotation.
5. Preparation of Trench Bottom. The trench bottom shall be constructed to provide a firm, stable, and uniform support for the full length of the pipe. Bell holes shall be provide at each joint to permit proper assembly and pipe support. Any part of the trench bottom excavated below grade shall be backfilled to grade and shall be compacted as required to provide firm pipe support. When an unstable subgrade condition is encountered that could provide inadequate pipe support, additional trench depth shall be excavated and refilled with suitable foundation material. Ledge rock, boulders, and large stones shall be removed to provide 6 inches of cushion on all side of the pipe and accessories.
6. Laying of Pipe. To prevent damage, proper implements, tools, and equipment shall be used for placement of the pipe in the trench. Under no circumstances shall pipe or accessories be dropped into the trench. All foreign matter or dirt shall be removed from the pipe interior. Pipe joints shall be assembled with care. When pipe laying is not in progress, open ends of installed pipe shall be closed to prevent entrance of trench water, dirt, foreign matter, or small animals into the pipeline.
7. Restrained Joints. Restraint devices shall be provided at each hydrant, valve, bend, tee, and at reducers and fittings where changes occur in pipe diameter or direction. Restraining device shall be Uni-Flange No. 1300, concrete thrust blocks or approved equal.
8. Pipe Embedment.
 - a. Native Earth Embedment: PVC pipe shall be installed with native earth embedment and backfill in areas where the native earth materials are suitable for pipe embedment. Suitable material shall be ASTM D2487, Class I (with graded or angular stone less than 3/4-inch in size), Class II, Class III, or Class IV.

- b. Rock Trench Embedment: In areas having rock trenches, PVC pipe shall be installed with crushed stone (less than $\frac{3}{4}$ -inch diameter) or sand bedding providing uniform longitudinal support under the pipe. Backfill material shall be worked under the sides of the pipe to provide satisfactory haunching. Initial backfill material shall be crushed stone and shall be placed to a minimum depth of 12 inches over the top of the pipe as shown on the Drawings. All pipe embedment material shall be selected and placed carefully. Sharp stones and crushed rock (larger than $\frac{3}{4}$ inch) which could cause significant scratching or abrasion of the pipe, shall be excluded from the embedment material. Bedding and initial backfill shall be compacted to a minimum of 90 percent standard proctor.
9. Final Backfill. After placement and compaction of pipe embedment materials and initial backfill, the balance of backfill materials may be machine placed. The material shall contain no large stones or rocks, frozen material or debris. Proper compaction procedures shall be exercised to provide required 90 percent density, standard proctor.
10. Pipe Embedment and Backfill within roadway and sidewalk areas. All PVC pipe shall be bedded with crushed stone (less than $\frac{3}{4}$ - inch diameter) to 12 inches over crown of pipe. Remaining backfill shall be compacted pug mix (33-P) thoroughly compacted by means of mechanical tamp.
- C. Install PVC valves with the flow arrow in the proper direction. Union nuts on PVC valves shall be tightened only hand tight in accordance with manufacturer's instructions. Spare O-ring seals and seats shall be furnished with each PVC valve.
- D. Line taps into 4-inch PVC pipe for 1 $\frac{1}{2}$ " laterals for zone irrigation shall be made using tapping saddles constructed for use on PVC pipe. Saddles shall be constructed of bronze or brass, shall have all stainless steel bolts or screws, and have a resilient rubber gasket to provide a positive, watertight seal.

3.2 TESTING 4" PVC RECLAIMED WATER PIPING

- A. All solid PVC piping shall be hydrostatic tested to 100 psi.
- B. Buried Pipe
 1. To prevent floating of the pipe, sufficient backfill shall be placed prior to filling pipe with water and subsequent field testing. Where local conditions require that the trenches be backfilled immediately after the pipe has been laid, the testing may be carried out after backfilling has been completed, but before placement of the permanent surface.

2. At least seven days shall elapse after the last concrete thrust or reaction blocking, if used, has been cast with normal (Type I) portland cement. The elapsed time may be reduced to three days with the use of a high-early-strength (Type III) portland cement. It is suggested that testing be conducted first on short lengths of installed pipe line, thereby permitting the installer to verify that proper installation and joint assembly techniques have been employed.
 - a. Filling, Drainage, and Air Relief of Mains. Water mains shall be drained through drainage branches or blow-offs. Drainage branches and blow-offs shall be provided with valves and shall be located at low points and dead ends. Drainage branches or blow-offs must not be connected to any sewer, submerged in any stream, or be installed in any other manner that can permit back siphonage into the distribution system. Permanent air vents shall be installed at all high points. If permanent air vents are not required at all high points, the installer shall install corporation cocks at all such points to expel air during initial filling and pressure testing of the lines. Lines shall be filled slowly with maximum velocity of 2 fps, preferably 1fps, while venting all air. After filling, lines shall be flushed at hydrants, blow-offs, and dead ends at minimum velocity of 2.5 fps. Valves shall be closed very slowly to prevent surges.
 - b. Procedure. The following procedure is based on the assumption that the pressure and leakage tests will be performed at the same time. Separate tests may be made if desired, in which case the pressure test shall be performed first. The specified test pressure shall be applied by means of a pump connected to the pipe. The test pressure shall be maintained (by additional pumping if necessary) for the specified time. While the line is under pressure, the system and all exposed pipe, fittings, valves, and hydrants shall be carefully examined for leakage. All defective elements shall be repaired or replaced and the test repeated until all visible leakage has been stopped and the allowable leakage requirements have been met.
 - c. Test Method. The installer may perform simultaneous pressure and leakage tests, or he may perform separate pressure and leakage tests on the installed system at test durations and pressures specified below.

SYSTEM TEST METHODS

Procedure	Pressure	Test Duration (hours)
Simultaneous pressure and leaking tests	100 psi	2
Separate pressure test	100 psi	1
Separate leadage test	100 psi	2

Source: Recommended Standard for the Installation of Polyvinyl Chloride (PVC) Pressure Pipe, UNI-B-3, Uni-Bell Plastic Pipe Association

d. Allowable Leakage

- 1) The duration of each leakage test shall be 2 hours, unless otherwise specified, and during the test the main shall be subjected to the pressure required in the following table.

**ALLOWABLE LEAKAGE
FOR AWWA PVC PIPE**

Average Test Pressure in Line (psi)
(Allowable Leakage Per 1,000 Feet or 50 Joints [gal/hr])

Nominal Pipe Size (inches)	50	100	150	200	250
4	0.19	0.27	0.33	0.38	0.43

- 2) 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 5 psi of the specified leakage test pressure after the pipe has been filled with water and the air in the pipeline has been expelled. No installation shall be accepted if the leakage is greater than that determined by the following formula:

$$L = \frac{ND \cdot P}{7400} \quad \text{add the square root symbol}$$

Where:

- L = allowable leakage, gph
- N = number of joints in the length of pipeline tested
- D = nominal diameter of the pipe, inch
- P = average test pressure during the leakage test, psig

- 3) Leakage values determined by the above formula are to be found in the preceding table.
- C. Take all precautions necessary to protect any equipment that might be damaged by the pressures used in the tests. Delicate equipment shall be valved off, removed, or otherwise protected.
- D. Securely anchor and restrain all piping against movement prior to application of test pressures. All joints, fittings, and valves will be left open where possible. All exposed pipe, fittings, valves, and joints shall be carefully examined during the pressure test.

- E. Expel all air from piping before applying the specified test pressure. If hydrants, blow-offs, or air release valves are not available at the high places, make the necessary taps at points of highest elevation before the test is made and insert plugs after the test has been completed.
- F. Excessive leakage developing during the test shall be corrected at the Contractor's expense. If the defective portion cannot be located, the Contractor, at his expense, shall remove and reconstruct as much as of the original work as necessary to obtain a facility meeting the specified leakage limits.
- G. Contractor shall bear the complete cost of the tests, including set-up, labor, temporary piping, blocking, gauges, bulkheads, water, air, soap solutions, and any other materials required to conduct the tests.

3.3 DRIP IRRIGATION SYSTEM

- A. Coordinate installation of zone piping and placement of dripline tubing with placement of topsoil and installation of trees, shrubs, and ground cover.
- B. Install 1 and 1 ½-inch solid PVC zone piping a minimum of 18-inches below finished grade. Grade and slope shall be uniform from low point to high points with air/vacuum relief valves installed at high points within an irrigation zone.
- C. Install a flush valve and box at the end of each irrigation zone to facilitate manual flushing.
- D. Drip tubing shall be uniformly spaced at a minimum of 18-inch to provide uniform wetting at a depth of 4-6 inches below finish grade.
- E. Place air/vacuum relief valve(s) at the highest point(s) of each zone. Connect the air/vacuum relief valve to all dripline laterals within the elevated area with an air/vacuum relief lateral.
- F. Place dripline no further than four inches from the edge of the areas to be irrigated. Uniformly space drip tubing such that maximum spacing between drip tubing is 18 inches.
- G. Thoroughly flush and pressure test the drip tubing to a minimum of 10 psi prior to covering tubing to identify leaks in fittings, splices, and compression fittings. Repair all leaks.
- H. Exercise extreme care when placing plants so as not to damage or cut any drip tubing or zone piping. Repair or replace cut or damaged sections as may be warranted.
- I. Install properly sized control wiring in minimum ¾-inch PVC conduit to each control valve box for each irrigation zone. Bury conduit a minimum of 12-inches below finish grade.

- J. Mount and install irrigation system control panel in filter building (constructed by others). Wire control panel to electric panel in filter building.
- K. Test irrigation system and control panel operation and demonstrate operation to owner's personnel.

4.0 PAYMENT

- A. Base Bid – Payment shall be by lump sum as shown in the bid schedule for a complete and operating system using the geoflow wasteflow drip emitter tubing and system components specified under paragraph 2.3 of this specification.
- B. Alternate Bid – Alternate drip irrigation systems will be considered provided they meet the intent of the specification in the opinion of the Engineer and meets or exceeds that of the geoflow wasteflow system specified.

END OF SECTION