This master should be used by designers working on Port of Portland construction projects and by designers working for PDX tenants (“Tenants”). Usage notes highlight a few specific editing choices, however the entire section should be evaluated and edited to fit specific project needs.

SECTION 328400 – PLANTING IRRIGATION

1. GENERAL
	* + 1. DESCRIPTION
				1. This section describes construction of an automated irrigation system including underground piping, valves, sprinkler heads, and control wiring and devices.
			2. RELATED WORK SPECIFIED ELSEWHERE
				1. Section 260500, Common Work Results for Electrical
				2. Section 312300, Trenching, Backfilling, and Compacting
				3. Section 329000, Landscape Maintenance
				4. Section 329113, Soil Preparation
			3. REFERENCES
				1. AASHTO: American Association of State Highway and Transportation Officials

AASHTO T180: Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop

* + - * 1. ANSI: American National Standards Institute

ANSI B2.1: USAS Pipe Threads (Except Dryseal)

* + - * 1. ASTM: American Society for Testing and Materials

ASTM A120: Specification for Pipe, Steel, Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless for Ordinary Uses

ASTM D1785: Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

ASTM D2241: Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)

ASTM D2466: Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40

* + - * 1. National Arborist Association Standard No. 3
			1. EXISTING CONDITIONS AND UTILITY LOCATIONS
				1. See Section 015000, Temporary Facilities and Controls.
			2. SUBMITTALS
				1. As-Constructed Drawings:

See Section 013300, Submittal Procedures.

Maintain a current record drawing of all pipe and equipment placement and record variations. Submit to the Port upon completion of the irrigation system.

Pipe not installed in accordance with the drawings as originally contracted shall be dimensioned to a permanent structure, curbline, or station point sufficient for location after burial.

* + - * 1. Operation and Maintenance Manuals: See Section 013300, Submittal Procedures.
				2. Training Manuals: Submit written instructions to guide Port staff in system operation, maintenance, and winterization.
				3. Equipment:

List other spare parts required.

Submit information for the following equipment in accordance with Section 013300, Submittal Procedures: Valves, controllers (manual and automatic), sprinkler heads, flow elements, backflow preventers and gauges.

Upon acceptance of the system by the Port, submit the necessary keys and/or other tools necessary to operate, drain, and activate the system, including:

Two valve operating keys and valve box keys.

Two lock cap keys.

Two keys for locking automatic controller doors.

Two quick‑coupling valve couplers with hose swivels.

Two sets of wrenches for removal and adjustment of each type of sprinkler head and valve.

* + - 1. DELIVERY, STORAGE, AND HANDLING
				1. Exercise care in handling, loading, unloading, and storing to avoid damage.
				2. Store and transport the pipe in a vehicle with bed long enough to allow the length of pipe to lay flat, so as not to be subject to undue bending or concentrated external load at any point.
				3. Do not store PVC pipe and fittings in direct sunlight for longer than 30 days.
			2. WARRANTY PERIOD
				1. See the General Conditions and/or the Supplementary Conditions.
				2. Repair any settling of backfilled trenches occurring during the warranty period at no added cost to the Port. Include complete restoration of damaged planting, paving, or other improvements of any kind.
			3. SYSTEM COVERAGE
				1. The system is designed to provide full coverage on lawn areas and full coverage, less plant interference, on planting areas.
				2. The Contractor shall exercise professional judgment in location, height, and slope of sprinkler heads without measurably changing the system design. Make no changes in the system design without the prior written approval of the Port.

Delete if not part of the contract. Use one-year landscape maintenance only at specific request of Project Manager and only for PDX projects. Do not use for RGID, SIIP, or Marine Terminals.

* + - 1. ONE‑YEAR LANDSCAPE MAINTENANCE
				1. See Section 329000 for description of maintenance requirements during the one‑year maintenance period.

Most Rainbird products throughout this section are specified as “no substitution,” except as otherwise noted. The brand name exemption for Rainbird expires April 30, 2020.

1. PRODUCTS
	* + 1. GENERAL
				1. Provide new materials and equipment.
				2. Whenever reference is made to a product by number and/or manufacturer, such reference shall be understood to be made for the purpose of facilitating the description, performance, and representative quality of the product intended for use.
				3. Each type of material or model of equipment shall be of one manufacturer, except as noted. Pipe and fittings shall be from the same manufacturer.
			2. PVC PIPE
				1. Pipe shall be polyvinyl chloride, Class 200, bell-end solvent weld pipe, conforming to ASTM D2241, except main line pipe 4 inches or less in diameter shall be Schedule 40.
				2. Fittings shall be Schedule 40, conforming to ASTM D2466.
				3. Nipples shall be Schedule 80, conforming to ASTM D1785.
				4. Use cement, solvents, and primers recommended by the manufacturer.
			3. GALVANIZED PIPE
				1. Galvanized nipples and fittings shall be hot dip galvanized iron or steel, Schedule 40, conforming to ASTM A120.
			4. SWING JOINTS

The Port’s Rainbird product exemption will not be applied to flexible swing joints; therefore retain “or equal.”

* + - * 1. Flexible swing pipe assembly shall be minimum 18-inch length polyethylene piping with spiral barb fittings as manufactured by Rainbird, or equal. Use rigid pipe swing joint for higher flows in excess of 12 GPM.

Use for PDX.

* + - * 1. Rigid pipe swing joint assembly shall be Lasco or Spears 360‑degree O-ring swing joint riser assemblies, for use on high‑flow heads, for constant pressure locations, and at quick couplers. Size swing joint to match head inlet.
			1. SPRINKLER HEADS
				1. Pop‑up sprinkler head, and matched precipitation rate plastic nozzles, Rainbird 1800 Series, no substitution. Match nozzle patterns and jets to provide even coverage from any nozzle combination.
				2. Rotor pop‑up sprinkler, part/full circle patterns, Rainbird, no substitution. Provide with “no-tool” arc adjustment. Rotor shall be adjustable from 25 degrees to 350 degrees as a part circle and 360 degrees full circle with the same rotor. Nozzles shall be plastic with fully adjustable flow. Rotary sprinklers shall have a vandal-resistant drive with a memory arc feature.
			2. AUTOMATIC CONTROL VALVES

Choose 1 or 2, as appropriate. Choose 2 for work at PDX.

* + - * 1. Remote control scrubber valves:

For Potable Water: Rainbird PEB Series, no substitution.

For Non-Potable Water: Rainbird 100‑PESB/150‑PESB/200‑PESB, no substitution.

Install with threaded unions.

Install isolation valve ahead of the scrubber valve.

* + - * 1. Diaphragm type using the normally closed principle.
				2. 24‑volt electric solenoid actuated.
				3. Manually operated adjusting stem with cross‑handle enabling valve to be partially or fully closed with operating key.
				4. Same manufacturer as automatic controller.
				5. Pressure regulating module shall be installed with the scrubber valve, capable of pressure regulations of 15 to 100 psi with flows from 15 to 200 gpm. Field retrofit to existing PE valves. Rainbird PRS-Dial model level or higher, no substitution.
				6. Valves shall be rated at 200 psi working pressure. Valves shall include manual internal bleed.
				7. A master valve shall be installed at all controllers. Bermad Master Valve IR-410-x-2, or equal, with pressure reducing and flow control hydrometer. IR-4-GI-AI-PG-4RO-PP-X or equal.
			1. VALVE BOXES
				1. Fog‑Tite No.1 meter box, Ametek, Pentek, or equal plastic irrigation valve boxes (12‑inch box with locking lid for remote control valves and 20‑inch jumbo box with bolt‑down cover for backflow preventer and quick coupling valve/remote control valve locations).
			2. ISOLATION VLAVES
				1. Manual gate valve, bronze, brass, or stainless designed so that the gate rises completely out of the water flow line.
			3. QUICK COUPLING VALVES
				1. 3/4‑inch heavy duty brass or bronze; watertight before and after the coupler is inserted.
				2. Keys shall be brass, bronze, or stainless steel designed expressly for use with quick‑coupling valves.
				3. Double‑lugged valve with double‑lugged key.

The Port’s Rainbird product exemption will not be applied to quick coupling valves; therefore retain “or equal.”

* + - * 1. Rainbird 33DNP valve, or equal, with Rainbird key. Label cap “non‑potable water.”
			1. DRAIN VALVES
				1. Manual globe valve, bronze, brass, or stainless steel designed so that valve seat rises completely out of the water flow line.
				2. Submit two keys to fit standard star handle or notched round handle.
			2. CONTROLLER

Choose A for PDX properties, or B for Marine properties. Verify specified controller represents latest desired technology.

* + - * 1. Independent station control, Rainbird ESP SAT-Link controller, (8-, 12-, 16-, 24, 28, or 32-station models, or other Maxicom-compatible Rainbird controller, no substitution. This includes one radio and one receiver card with antennas. The frequency shall be determined by the location of the controller being west or east of Northeast 82nd Avenue.
				2. Rainbird ESP LXME controller or similar Rainbird smart controller with LIMR remote and ET manager card cartridge, no substitution.

Choose 1 or 2 and edit as appropriate. Verify with Port landscape lead.

* + - * 1. Controller Housing Mount:

Pedestal-Mount: Weatherproof, heavy‑duty stainless steel, 16-gauge, lockable housing. Color: [dark green] [standard brush finish].

Wall-Mount (not to exceed 12-station application): Weatherproof, stand-alone, non-radio application.

* + - * 1. Provide electric automatic controller used in conjunction with electric zone control valves of the normally closed type, designed to operate on 24 to 26 1/2‑volt, 60‑Hz. Controller shall have the UL approval marked on it. The number and kind of station controls required shall be as shown on the drawings.
				2. Provide a minimum of 10 inches of slack control wiring in the base of the controller pedestal.
				3. Provide capability in controller to control each of its station operations on a fully automatic and manual basis. Provide the controller with a master switch which will cut off the entire operations of the system controlled without disturbance of the timing sequences.
				4. Provide controller able to automatically perform the following:

Control operation of the system by time of day and number of days per week within a 7-or 14‑day cycle.

Provide variable time cycles through each station within an adjustable range of 1 to 99 minutes per station, with separate adjustment for each station.

Be upgradable to a satellite controller capable of operating as part of a Rainbird Maxicom central control system, no substitution.

Allow each station to have its own start days and start times programmable completely independent of any other station.

* + - 1. WATER PRESSURE REGULATOR
				1. Bronze pressure regulator, Wilkins, Watts, or equal.
				2. Installed on system side of manual master valve.
				3. Size: 2‑inch.
			2. BACKFLOW PREVENTER
				1. Conbraco Double‑Check Assembly, or pre-bid approved equal.
			3. MISCELLANEOUS ITEMS
				1. Control Wire: Copper type UF, UL approved for direct underground burial, AWG size No. 14 with No. 12 common. All control conductors shall be red, except for the common, which shall be white.

The Port’s Rainbird product exemption will not be applied to electrical splicing; therefore retain “or pre‑bid approved equal”.

* + - * 1. Electrical Splicing: Waterproof PVC socket and plug, and sealer for PVC insulated copper wire, designed for underground burial, DBY by 3M splice kit, or pre-bid approved equal.
				2. Backfill Material: Excavated material from site free of roots, stones, organic matter, and debris.
				3. Sump Gravel: 1/2 inch to 3/4 inch clean, washed, round gravel.

Choose one of the following two paragraphs. Use Bore Sleeves if under road traffic or runways.

* + - * 1. Pipe Sleeves: PVC, Schedule 80, a minimum of 2 inches in diameter larger than the pipe to be sleeved.
				2. Bore Sleeves: Steel casings compatible with bore operation, as approved by the Port.
				3. Utility Locate Wire: Copper Type XHHW stranded, UL-approved for direct underground burial, minimum AWG size, No. 10. Color blue.
			1. LOW-VOLUME DRIP IRRIGATION SYSTEM
				1. Low-flow control zone kits (valve, filter, pressure-regulator), landscape dripline with in-line emitters, compression or in-line fittings, 1/4 inch distribution tubing, 1/4 inch barb transfer fittings, and emitters for use with 3/4‑inch or 1-inch lateral line system.
				2. Manufactured by Rainbird, no substitution.
1. EXECUTION
	* + 1. CONSTRUCTION
				1. Install materials and equipment in strict accordance with manufacturer’s written specifications and recommendations and all applicable codes.
				2. Layout shall follow as close as is practicable the schematic design shown on the drawings. Verify exact locations of proposed system. Make necessary measurements to ensure precise fit of items in accordance with the design shown. Make no substantial alterations without prior approval.
				3. Provide protection at all times ample to keep rock, dirt, gravel, debris, and other foreign materials from entering piping, valves, and other irrigation equipment.
			2. EXCAVATION OF TRENCHES
				1. Excavate material required for construction of the irrigation system facilities as shown on the drawings.
				2. Trench for main line and laterals after grading has been completed but prior to the addition of soil amendments described in Section 329113.
				3. Excavate around existing trees as follows:

Route trenches as far from existing trees as is practicable.

When trenching near trees, tunnel over or under roots. Do not cut main lateral roots or tap roots; however, smaller roots less than 1 inch in diameter which interfere with the work may be cut. Cut roots with sharp pruning instruments. Roots shall not be broken or chopped.

Hand excavate root systems to minimize damage. Use a narrow-tine spading fork to comb soil to expose roots. If large, main lateral roots are encountered, roots shall be exposed beyond excavation limits as required to bend and shall be relocated without breaking.

If roots are encountered immediately adjacent to the location of new work and relocation is not practical, cut roots at maximum distance of three inches back from the new work.

Do not allow exposed roots to dry out before permanent backfill is placed. Temporary earth cover shall be provided or roots shall be packed with peat moss and wrapped with burlap. Roots shall be watered and maintained in moist condition and shall be temporarily supported and protected from damage until they are permanently relocated and covered with backfill.

Prune branches in accordance with National Arborist Association Standard No. 3 to balance loss to root system caused by damage or cutting of roots.

* + - * 1. Provide trench of sufficient width to allow for proper tamping around pipe.
				2. Slope piping at 1 percent minimum grade (1/2 percent minimum where greater slope is not practicable), to facilitate operation of manual drain valves.
				3. Bottom of trenches shall be smooth and free of sharp rocks and other objects that may damage pipe.
				4. Backfill any overdepth excavation with suitable material free of rocks or other materials that may damage pipe, and thoroughly compact to give full support to pipe.
				5. Trench depth shall be sufficient to allow at least 18 inches cover to top of pipe for zone lines, at least 24 inches for main lines, and at least 36 inches for main lines located within City of Portland right‑of‑way.
			1. EXCESS FILL FROM TRENCHING
				1. Classify excess and unsuitable excavated material as disposal excavation and dispose of where shown on the drawings.
			2. CONFLICTS WITH OTHER UTILITIES
				1. Underground lines shall have a minimum horizontal clearance of 12 inches from other utility lines. This requirement does not apply to other lines crossing at angles from 45 degrees to 90 degrees with each other. Maintain minimum 2‑inch vertical clearance between lines which cross between these angles. Do not install a line parallel to and directly over another utility line.
			3. PVC PIPE AND FITTINGS
				1. Exercise care in handling, so as to avoid damage.
				2. Discard pipe that has been dented or damaged until such damage has been cut out and the pipe is rejoined with coupling.
				3. Lay pipe in accordance with standard practice, substantially supported at all points and “snaked” slightly to allow for expansion and contraction. Pipes installed in a common trench shall be separated by a minimum of one inch, but not less than required to achieve the specified compaction.
				4. Solvent weld PVC pipe joints except where indicated otherwise. Cut pipe square, deburr, and wipe from the surface saw chips, dust, dirt, moisture, and foreign matter which may contaminate the cemented joint. Apply cleaner/primer and solvent cement. Make joints in accordance with manufacturer’s recommendation, using appropriately sized applicator for applying cements.
				5. Do not solvent weld PVC pipe when the temperature is below 40°F. In rainy weather, do solvent welding of PVC pipe only under cover.
				6. Use manufacturer’s set up time/temperature chart to give solvent welded joints proper set‑up time before moving or handling. Pipe shall be partially center loaded to prevent arching and slipping.
				7. Thread joints shall not be solvent cemented, but wrapped with three wraps of Teflon tape. Sealing joints with liquid Teflon thread sealant is acceptable.
				8. Provide a leak resistant joint with freedom of movement at flexible pipe swing joints to irrigation heads, and rigid pipe swing joints at quick couplers or any location having continuous pressure.
				9. Allow solvent weld joints at least 24 hours curing time before pressure testing.
				10. Do not thread or connect PVC pipe to a threaded fitting without an adapter.
				11. Ensure that the inside of the pipe remains absolutely clean. Pipe ends, in trench, not being worked on shall be protected and not left open.
			4. GALVANIZED PIPE
				1. Ream pipe to be threaded and thread in accordance with ANSI B2.1.
				2. Clean threads prior to making connections.
				3. Leave no more than two threads showing at joints.
				4. Exposed conduit or 90-degree vertical bends shall be GRSC.
			5. AUTOMATIC CONTROLLER
				1. Install the electric controller on a new concrete pad where shown on the drawings.
				2. Post an as-constructed diagram of zone coverage and flow rate by area in the controller, within a waterproof packet, to facilitate system operation.
				3. See Section 260500 for installation of conduit and conductors for 120‑volt power to location of new pad for automatic controller and for connection of electrical power to controller.
			6. CONTROL WIRE
				1. Lay in trenches under main lines when practical for maximum protection.
				2. Install conduit and pipe sleeves where indicated.
				3. Install single wires (red) to each solenoid from controller and a common neutral wire (white) to solenoids from the controller.
				4. For wire sizes, use wire sizing chart published by manufacturers of automatic control valves installed. Minimum size wire shall be AWG 14.
				5. Tape control wires together at 5‑foot intervals. Tuck wires under haunch of pipe after pipe installation. Do not tape wires to pipe.
				6. Splice only at the valves and never between valves or between valve and controller.
				7. Make splices mechanically and electrically secure using approved electrical connectors.
				8. Make splices moisture proof by encapsulating each splice in a separate PVC socket. Mix and install epoxy resin per manufacturer’s instructions. Do not group splices.
				9. Identify each red conductor at every point of access with a stainless steel or brass tag indicating the zone number. Attach with a nylon tie.
				10. Terminate each stranded conductor at the controller with an insulated forked or ring connector crimped with an approved tool and identified by zone with a T&B or Brady wrap‑on label.
				11. Where both wires are being spliced, stagger the splices.
				12. Provide an expansion curl (10 inches minimum) within 3 feet of each wire connection to a solenoid and for at least every 100 feet of wire length. Curl wire by wrapping around one-inch pipe.
				13. Provide two spare red conductors to the farthest valve with a 12‑inch loop at all others.
			7. AUTOMATIC CONTROL VALVES
				1. Thoroughly flush the main line prior to installation of automatic valves. Install per manufacturer’s recommendations and as detailed on the drawings.
			8. GATE VALVES
				1. Install per manufacturer’s recommendations and as detailed on the drawings.
			9. BACKFLOW PREVENTER
				1. Install per manufacturer’s recommendations and local code. See detail on the drawings.
			10. SPRINKLER HEADS
				1. Thoroughly flush entire system prior to installation of sprinkler heads.
				2. Install sprinkler heads of types, sizes, and coverage called for in the Irrigation Legend at locations shown and as indicated on the drawings.
				3. Install heads on flexible pipe swing joint risers, unless otherwise noted.
				4. Set top of head flush with finish grade. Allow for mulch depth where specified.
			11. QUICK COUPLERS
				1. Install quick coupler valves at a ratio of one quick coupler per three valves installed, to provide water access.
			12. MANUAL DRAIN VALVES
				1. Install as detailed with valve cover flush with finish grade, one manual drain valve at low point of each main line and each lateral line.
			13. VALVE BOXES
				1. Install valve boxes with cover flush with finish grade.
			14. SLEEVES
				1. Install sleeves for new pipes shown under new and existing sidewalks, driveways, streets, and other concrete or asphalt concrete obstructions.
				2. Jack or bore sleeves under existing obstructions. Breaking or cutting of existing concrete or asphalt concrete will not be allowed except as approved by the Port.
				3. Extend sleeves a minimum of 12 inches and a maximum of 18 inches past the edge of obstructions.
				4. After installation, stuff ends of sleeve with treated burlap or filter fabric and seal ends.
			15. BACKFILLING
				1. Do not place final backfill material in the trenches until installation and testing of pipes has been performed as specified and approved by the Port.
				2. Separate pipes in a common trench a minimum of 1 inch, but not less than required to achieve the specified compaction.
				3. Backfill excavations by carefully placing trench excavated suitable material, free of sticks, trash, and stones around and over piping.
				4. Place backfill in successive layers of not more than 6 inches in depth. Compact each layer as follows: Traffic areas, 92 percent of maximum density; landscaped areas, 85 percent of maximum density, as measured by AASHTO T‑180.

Include Section 312300, Trenching, Backfilling, and Compacting, in specifications for utility warning tape and locate wire products and installation.

* + - * 1. Utility warning tape and utility locate wire: See Section 312300,.
				2. Fill piping with water at approximately 15 psi during backfilling operation of main line.
				3. Perform backfilling for plastic pipe in accordance with the manufacturer’s instructions.
			1. TESTING
				1. Test all lines prior to complete backfilling of trenches. Backfill the trench sufficiently to ensure stability of the pipe line, leaving the joints exposed. Complete pressure testing prior to completion of backfill.
				2. Allow plastic pipe joints to set at least 24 hours before testing with air temperature in excess of 40°F. Should the temperature drop below 40°F, extend the curing time to 36 hours before testing.

Pressure for testing varies depending on where the line is installed.

* + - * 1. Thoroughly flush the line and subject to 150 psi minimum water pressure. Check joints for leaks. Maximum loss in a two‑hour test shall be 4 psi.
				2. Correct leakage immediately and repeat the test until the system is airtight.
				3. In plastic pipe lines, cut out leaking joints. Insert new sleeves or fittings and a section of pipe. Make connections to the satisfaction of the Port. Heat welding will not be permitted to seal leaks.
				4. Testing shall be witnessed by the Port. Give 24 hours’ notice to the Port prior to the anticipated date of inspection.
				5. Have the backflow device tested and certified, prior to final inspection, and again at the end of the warranty period.

Choose one of the following two paragraphs. Use the first if Section 260500 is included in the manual, use the second if it is not.

* + - * 1. After installation and prior to termination at circuit breaker, controller, or valves, test conductors for insulation resistance to ground with a magohmmeter in the presence of the Port. Provide the test instrument, rated 500 volts d.c., and record and maintain the results. Submit copies to the Port.
				2. After installation and prior to termination at circuit breaker, controller, or valves, test each conductor as specified in Section 260500.
				3. With all heads operational, install fittings necessary to show operating pressure of longest lawn and planting bed zone. Perform in the presence of the Port and record readings.
			1. ADJUSTMENTS
				1. Completely balance heads in each zone for required gallonage and throw, through adjustment of sprinkler nozzles and automatic control valves.
				2. Adjust heads for proper direction and optimum coverage without excessive overthrow on walks, roads, and buildings.
			2. DEMONSTRATION
				1. Conduct a final walkthrough with the Port to demonstrate proper activation and function of each irrigation zone.
			3. TRAINING
				1. Train Port maintenance personnel and provide written instructions to ensure that the system operation, maintenance, and winterizing may continue after conclusion of the contract. Coordinate training through the Port. The Contractor shall be liable for damages or losses resulting from failure to comply with the provisions of this paragraph.

END OF SECTION 328400