Division 328400
Planting Irrigation
DESIGN GUIDE

328400 - Planting Irrigation

PART 1 - GENERAL

1.1 Summary

A. This section includes but is not limited to the furnishing of all labor, tools, materials, appliances, tests, permits, taxes, etc., necessary for the installation of a landscape irrigation system as herein specified and shown on the drawings, and the removal of all debris from the site.

1. Locate, purchase, deliver and install piping, conduit, sleeves, 120 volt and low voltage electrical and water connections, valves, backflow preventer devices, controllers, rain sensors, flow meters, rotors, spray and bubbler heads, drip irrigation lines, and associated accessories for a fully operational automatic irrigation system.
2. Trenching and water settling of backfill material.
3. Testing and startup of the irrigation system.
4. Winterization of the system.
5. Prepare an as built record set of drawings.
6. Training of the Owner's maintenance personnel in the operational requirements of the Irrigation system.
7. Clean up and disposal of all excess and surplus material.
8. Maintenance of the irrigation system during the proscribed maintenance period.

B. The system shall provide efficient and uniform irrigation all planting areas and be complete in every respect and shall be left ready for operation to the satisfaction of the Owner's Representative.

C. Irrigation shall be hydro zoned according to plant type and location in respect to sun, shade, soil type, and wind.

D. Coordinate with other trades, as needed to complete work, including but not

limited to Water Meter, Point of Connection (POC) and Backflow Preventer Device (BFPD) location and electrical hookups, sleeving under concrete and hard surfaces.

E. Some of the University's existing irrigation systems are connected to a non-potable water system. This system is the preferred irrigation water supply.

1.2 Related Documents and References

A. Related Documents:

1. Drawings and general provisions of contract including general and supplementary conditions and Division I specifications apply to work of this section.
   a. Section - Earthwork
   b. Section - Planting Soil
   c. Section - Irrigation
   d. Section - Plantings
   e. Section - Turf Grasses
   f. Section - Storm Drainage
   g. Section - Sustainable Design Requirements
   h. Section – Electrical
   i. Section Mechanical/Plumbing

B. References:

1. American Society of Testing Materials (ASTM): cited section numbers.
2. National Sanitation Foundation (NSF): rating system.
3. Irrigation Association: Turf & Landscape Irrigation Best Management Practices
4. American Water Works Association (AWWA).
5. National Electrical Manufactures Association (NEMA)

1.3 Definitions

A. Owner’s Representative: The person appointed by the Owner to represent their interest in the review and approval of the work and to serve as the contracting authority with the Contractor. The Owner’s Representative may appoint other persons to review and approve any aspects of the work.

B. Substantial Completion Acceptance: The date at the end of the Planting, Planting Soil, and Irrigation installation where the Owner’s Representative accepts that all work in these sections is complete and the Warranty period has begun. This date may be different that the date of substantial completion for the other sections of the project.

C. Final Acceptance: The date when the Owner’s Representative accepts that the plants and work in this section meet all the requirements of specification. It is

intended that the materials and workmanship warranty for Planting, Planting Soil, and Irrigation work run concurrently.

1.4 Quality Assurance

A. Landscape Irrigation Contractor Qualifications: Installer shall be licensed in the state of Washington with at least 5 years of documented experience of performing work of comparable size, scope, and quality, be a specialist in installing and planting landscape products, and experienced in landscape work of the highest professional quality. Firm shall have equipment and personnel adequate to perform the work specified.

B. In the event of any discrepancies between the drawings and the specification, the final decision as to which shall be followed, shall be made by the Owner's Representative.

C. In the event the installation is contradictory to the direction of the Owner's Representative, the installation shall be rectified by the Contractor at no additional cost to the Owner. The Contractor shall immediately bring any such discrepancies to the attention of the Owner's Representative.

1.5 Submittals

A. Landscape Irrigation Contractors Qualifications: Submit experience of Landscape Contractor meeting requirements as stated herein.

B. Product data

1. Submit a minimum of two (2) complete lists of all irrigation equipment to be used. Include materials showing manufactures name, catalog numbers, catalog cute, technical data, installation, operation, maintenance instructions, and warrantees within 15 days after the notice to proceed.

    a. This submission may be done digitally, and all documents shall be submitted in one PDF document.

2. Equipment or materials installed or furnished without prior approval of the Owner's Representative, may be rejected by the Owner's Representative and the Contractor shall be required to remove such materials from the site at their own expense.

C. Point of Connection Water Pressure Test: Test water pressure at each irrigation point of connection. Submit written results of the test to the Owner's Representative.

D. Certification Letter for date and activities for irrigation system winterization and reactivation.

E. Record Drawings: in accordance with requirements stated herein:

1. Record accurately in red ink on one set of black-line prints all changes in the Work constituting departures from the Contract Drawings.

2. Record the changes and dimensions in a legible manner to the satisfaction of the
Owner's Representative. Before Final Inspection of the Work, submit Record Drawings to the Owner's Representative for review.
3. Dimension from two permanent points of reference (buildings, monuments, sidewalks, curbs, and pavements). Record data on Record Drawings daily as the Work is being installed.
4. Show locations, depths, size, and information as applicable, of the following items:

    a. Point of connection and available static water pressure.

    b. Routing of mainlines and lateral pipes.

    c. Dripline, air/vacuum relief valves, and flush valves.

    d. Gate valves.

    e. Irrigation control valves.

    f. Quick coupling valves.

    g. Routing of control wires.

    h. Other irrigation system component locations necessary to accurately represent authorized changes to the irrigation system.
5. Backflow prevention device certification: Certification from the manufacturer or their representative that the back flow prevention device has been installed correctly according to the manufacture's requirements.
6. Backflow prevention device Test Report: Backflow device shall be tested and certified as having passed the Backflow and Cross Connection Test Report for the City of Ellensburg.
7. Backflow Assembly Tester (BAT): The person performing the backflow Test Report shall have a valid Backflow Assembly Tester (BAT) license in the state of Washington.
8. Maintain Record Drawings on site during construction.

F. Submit Operation and Maintenance Manuals in accordance with requirements stated
herein and Section 017800, Closeout Submittals.

G. Submit controller charts in accordance with requirements stated herein.

H. Submit special tools and spare parts in accordance with requirements stated herein.

1.6 Sequencing and Scheduling

A. Coordinate installation of irrigation as shown on the Contract Drawings with all other work.

B. Coordinate layout and installation of irrigation sleeves, conduits, and piping under paved areas and other features prior to their construction.

C. Coordinate installation of irrigation system with excavation of planting beds and backfilling of planting beds with topsoil.

D. Install and test the irrigation system before installation of plant material except as noted herein. Coordinate layout and installation of irrigation system with location and installation of plant material to ensure that there will be complete and full irrigation coverage of planting.

1.7 Protection of Work, Property and Person

A. The Contractor shall adequately protect the work, adjacent property, and the public, and shall be responsible for any damages or injury due to the Contractor's actions.

1.8 Changes in the Work

A. The Owner's Representative may order changes in the work, and the contract sum being adjusted accordingly. All such orders and adjustments plus claims by the Contractor for extra compensation must be made and approved in writing before executing the work involved.

B. All changes in the work, notifications, and Contractor's request for information (RFI) shall conform to the contract general condition requirements.

1.9 Correction of Work

A. The Contractor, at their own cost, shall re-execute any work that fails to conform to the requirements of the contract and shall remedy defects due to faulty materials or workmanship upon written notice from the Owner's Representative, at the soonest as possible time that can be coordinated with other work, and seasonal weather demands.

1.10 Observation of the Work

A. The Owner's Representative may inspect the work at any time. They may remove samples of materials for conformity to specifications. Rejected materials shall be immediately removed from the site and replaced at the Contractor's expense. The cost of testing materials not meeting specifications shall be paid by the Contractor.

B. The Owner's Representative shall be informed of the progress of the work so the work may be observed at the following key times in the construction process. The Owner's Representative shall be afforded sufficient time to schedule visit to the site. Failure of the Owner's Representative to make field observations shall not relieve the Contractor from meeting all the requirements of this specification.

1. SITE CONDITIONS PRIOR TO THE START OF INSTALLATION: review the soil and drainage conditions.
2. COMPLETION OF THE IRRIGATION LAYOUT STAKING: Review of the layout.
3. MATERIAL INSPECTION: review and confirm the irrigation materials used conform to the requested materials, prior to backfill.
4. COMPLETION OF THE INSTALLATION: Review the completed layout.

1.11 Turnover Items

A. Controller Charts:

1. Provide one (1) irrigation zone location chart, sized to fit inside the controller door for each irrigation controller. Chart shall be clearly marked and legible.
2. This chart shall be a reduced version of the Record Drawing.
3. The chart shall be color coded with different colors for each irrigation zone indicating coverage area.
4. When completed and accepted, hermetically seal chart between 2 pieces of transparent plastic. Install chart in controller enclosure using Velcro fasteners.
5. Complete irrigation zone location charts prior to Final Acceptance.

B. As Built Record Set of Drawings

1. Immediately upon the installation of any buried pipe or equipment, the Contractor shall indicate on the progress record drawings the locations of said pipe or equipment. The progress record drawings shall be made available at any time for review by the Owner's Representative.
2. Before final acceptance of work, the Contractor shall provide an as built record set of drawings showing the irrigation system work as built. The drawings shall be transmitted to the Owner's Representative in paper format and as a pdf file of each document on compact disk or flash drive. The drawings shall include all information shown on the original contract document and revised to reflect all changes in the work. The drawings shall include the following additional information:

    a. All valves shall be numbered by station and corresponding numbers shall be shown on the as built record set of drawings.

    b. All main line pipe or irrigation equipment including sleeves, valves,

controllers, irrigation wire runs which deviate from the mainline location, backflow preventers, remote control valves, grounding rods, shut-off valves, rain sensors, wire splice locations, and quick coupling valves shall be located by two (2) measured dimensions, to the nearest one-half foot. Dimensions shall be given from permanent objects such as buildings, sidewalks, curbs, walls, structures and driveways. All changes in direction and depth of main line pipe shall be noted exactly as installed. Dimensions for pipes shall be shown at no greater than a 50 ft. maximum interval.

c. As built record set of drawings shall be signed and dated by the Contractor attesting to and certifying the accuracy of the as built record set of drawings. As built record set of drawings shall have "As Built Record Set of Drawings", company name, address, phone number and the name of the person who created the drawing and the contact name (if different).

C. Operation and Maintenance Manuals: Prior to Final Acceptance, prepare and deliver to the Owner's Representative the required descriptive materials, properly prepared in 2 individually bound copies of the operation and maintenance manual. Describe the material installed in sufficient detail to permit operating personnel to understand, operate, and maintain equipment. Include spare parts lists and related manufacturer's information for each equipment item installed. Include following information in manual:

1. Index sheet listing Contractor's address and telephone number, including names
   and addresses of local manufacturer's representatives.
2. Complete operating and maintenance instructions on major equipment.
3. Manuals: As specified in Closeout Submittals.

D. Special Tools and Spare Parts:

1. Supply the following items as part of Contract:

   a. 2 keys for each irrigation controller.

   b. 1 coupler with 3/4-inch bronze hose bib, bent nose type with hand wheel, and 1 coupler key for each 5 quick couplers installed.

   c. 1 valve box cover key for each 10 valve boxes.

   d. Backflow device valve handles.

2. Deliver tools and spare parts to the Owner's Representative at conclusion of Final Acceptance.

1.12 Irrigation System Warranty

A. The Contractor shall Warrantee all workmanship and materials for a period of 1 year following the Acceptance of the Work.

   1. Any parts of the irrigation work that fails or is defective shall be replaced or reconstructed at no expense to the Owner including but not limited to: restoring grades that have settled in trenches and excavations related to the work. Reconstruction shall include any plantings, soil, mulch, or other parts of the constructed landscape that may be damaged during the repair or that results from soil settlement.

B. The date of Acceptance of the Work and start of the Guarantee period shall be determined by the Owner's Representative, upon the finding that the entire irrigation system is installed as designed and specified, and found to be operating correctly, supplying water evenly to all plantings and/or lawn areas.

C. The system controller shall be warranted by the equipment manufacturer against equipment malfunction and defects for a period of 1 year, following the acceptance of the work.

D. Neither the final acceptance nor any provision in the contract documents shall relieve the Contractor of responsibility for faulty materials or workmanship. The Contractor shall remedy any defects within a period of 7 days (s) from the date of notification of a defect.

E. Provide a written statement to the Owner's Representative stating that the Contractor shall:

   1. Warrant the satisfactory operation of the entire irrigation system including performance, parts, assemblies, and workmanship.

   2. Return to the job site at the beginning of the first winter season to perform a general inspection of the system, test valves and dripline, repair leaks and faulty work, check operation of the system, drain system, show grounds staff location of blow out points, restore areas where trenches have settled, and adjust irrigation controller scheduling if necessary.

   3. Return in spring after the first winter season for a system check and if necessary restore system for spring and summer operation. Adjust irrigation controller scheduling if necessary.

1.13 Protection

A. The Contractor shall continuously maintain adequate protection of all their work from damage, destruction, or loss, and shall protect the owner's property from damage arising in connection with this contract. Contractor shall make good any such damage, destruction, loss, or injury. Contractor shall adequately protect adjacent property as provided by law and the contract documents.

B. All existing paving, structures, equipment, or plant material shall be protected at all times, including the irrigation system related to plants, from damage by workers and equipment. The Contractor shall follow all protection requirements

including plant protection provision of the general contract documents. All damages shall be repaired or replaced at the Contractor's expense. Repairs and or replacement shall be to the satisfaction of the Owner's Representative, including the selection of a Contractor to undertake the repair or maintenance. Repairs shall be at no cost to the owner.

1. For trees damaged to the point where they will not be expected to survive or which are severely disfigured and that are too large to replace, the cost of damages shall be as determined by the Owner's arborist using accepted tree value evaluation methods.

C. The Contractor shall refrain from trenching within the drip line of any existing tree to remain. The Owner’s Representative may require the Contractor to relocate proposed irrigation work, bore lines beneath roots or use air spade technology to dig trenches through and under the root system to avoid damage to existing tree root areas.

PART 2 - PRODUCTS

2.1 Materials General

A. All materials and equipment shall be new and the best grade of its kind. All items of
equipment or material shall be as indicated or specified by patent or proprietary name or names of manufacturer or accepted equal.

B. Approval of any items or substitutions indicates only that the product(s) apparently meet the requirements of the drawings and specifications on the basis of the information or samples submitted. The Contractor shall be responsible for the performance of substituted items. If the substitution proves to be unsatisfactory or not compatible with other parts of the system, the Contractor shall replace said items with the originally specified items, including all necessary work and modifications to replace the items, at no cost to the owner.

C. Subsurface drip irrigation is not approved for use on CWU campus without the approval of the Owner’s Representative.

D. Lateral irrigation lines shall remain the same diameter for entire run when possible.

2.2 Piping and Fittings Material

A. Pipe for buried irrigation systems shall be PVC except where noted otherwise.

B. PVC Pipe:

1. Schedule 40 for mainline and lateral pipes: ASTM D 1785, PVC 1120

compound.
a. 1 ¼ inch lateral piping shall not be used on Project Irrigation.

2. Schedule 80 female adapters for transition between PE and PVC Pipe.

C. PVC Threaded Nipples: 6 inches long, 1/2-inch diameter, Schedule 80, complying with ASTM D1785.

D. Swing joints shall be fitted with Marlex Street Elbows at all connections. Risers shall be Rain Bird Cut-Off riser

E. Sleeves: PVC pipe, Schedule 80. Minimum twice the diameter as the pipe it contains.

F. PVC Pipe Fittings: Schedule 80, socket type - ASTM D2467. Schedule 80 threaded type - ASTM D2464.

G. PE Pipe fittings: Fused polyethylene or Irritec Perma-Loc for all 5/8 inch pipe. For pipe diameter greater than 5/8 inch, use 2 stainless hose clamps and schedule 80 PVC barbed fittings.

2.3 Solvent Cements and Thread Lubricant

A. Solvent cement for PVC pipe solvent-weld pipe and fittings shall be Heavy Duty Gray Cement as manufactured by Oatey, or approved alternate. Solvent primer for PVC solvent-weld pipes and fittings shall be "all Purpose Primer" (purple) for PVC and CPVC pipes and fittings.

B. Thread lubricant shall be Teflon ribbon-type, or approved equal, suitable for threaded installations as per manufacturer's recommendations.

2.4 Backflow Prevention Devices

A. FEBCO Model 805Y or approved equal

2.5 Manual Shut Off Valves

A. Ball valves for 3/4 inch through 2-1/2 inch shall brass, block, tru-union design with EDPDM seals and o-ring.

B. Manual valves for 3 inch and larger shall be gate design and shall be resilient-seated non-rising stem, enclosed in a box with extensions as required. Contractor is required to supply valve key to shut-off valves. Large valves, four inches (4") or larger, must have square operating nuts.

C. All ball valves located in a valve manifold shall be the same size as the main line (1-1/2 inch size minimum). Provide pipe-reducing adapters down stream of valves, as required. All ball valves in line shall be the same size as the pipe.

D. Manufacturer: Wilkins, Nibco, Watts, or accepted equal.

2.6 Remote Control Valves

A. Remote control valves shall be electrically operated shall have a flow control handle adjustable by valve key. Approved manufacturer: Irritrol Model No. 700 Series installed with Schedule 80 union both upstream and downstream.

2.7 Flow Sensor

A. Flow sensor shall be Calsense PVC tee style sized appropriately for irrigation mainline.

2.8 Quick Coupler Valves

A. Quick coupler valves shall be a one or two piece, heavy-duty brass construction with a working pressure of 150 PSI with a built in flow control and a self-closing valve.

B. Quick coupler shall be equipped with locking cap covered with durable yellow thermo-plastic rubber cover. Key size shall be compatible with quick coupler and of same manufacturer.

C. Manufacturer: Rain Bird DLRC

2.9 Irrigation Controller

A. Irrigation Controller, accessories, and mounting panel:

1. The specified irrigation controller is a required CWU standard product capable of
remote control remotely through Calsense propriety software by CWU campus
staff.
2. Type: Calsense CS3000-WM, conventional multi-strand wire.
3. Size to meet zone capacity shown on Drawings with a minimum of 6 zones available for expansion.
4. Controller shall include ethernet connectivity to the Calsense Central Control cloud base system via Calsense CS3-EN.
5. Controller shall be grounded as indicated in the Manufacturer's installation instructions.
6. Factory preassembly controller and accessories on mounting panel.

B. Provide a UL listed 24-V ac transformer with controller. Color-code station wiring with irrigation zone indicator key visibly imprinted. Include master valve control with controller and circuit overload protection to prevent damage due to voltage surges.

C. Controller Housing: Heavy-gauge steel coated with rust inhibitor; finish with industrial gray enamel. Weatherproof cabinet, NEMA Type 4. Gasket controller door and provide covered, heavy-duty lock for protection against theft and vandalism. Mount controller components on face panel for easy removal. Print operating instructions on face of controller for easy access when programming.

2.10 Irrigation Control Wire

A. Provide thermoplastic insulated, solid copper conductor conforming to ASTM B3, suitable for continuous operation at 24 V ac.

B. Direct burial control wires to irrigation control valves: NEC Type UF or G.E. Co. No. SI-58-51 or accepted equal. Size wire to each irrigation control valve to not exceed 5 percent voltage drop from impressed voltage, not less than No. 14 AWG.

C. Common wire: white insulation. Control wire: 1 color other than white or green. Use a different color control wire for each irrigation control valve.

D. Waterproof wire splice connections: 3M DBY, 3M Scotchcast 3570G-N or accepted equal.

2.11 Sprinkler Heads

A. Popup

1. Bodies: Rain Bird 1800-PRS-SAM with PSI rating of 30
   a. All Sprinkler bodies shall be bottom inlet only.
      1.) Turf sprays shall be 4” po-up.
      2.) Shrub Bed sprays shall be 12” pop-up.
2. Nozzles: Hunter MP rotator, Rain Bird
   a. Nozzles installed within an irrigation zone shall match precipitation rates

B. Rotors

1. Approved Models: Hunter I-20 SS, I-25 SS, I-40 SS, I-40 SS-ON
   a. Nozzles installed within an irrigation zone shall match precipitation rates

C. Riser nipples for all sprinkler heads shall be the same size as the riser opening in the sprinkler body and fabricated as shown on the drawings.

2.12 Swing Joints

A. All sprinkler head risers shall by swing joint style. Approved materials include:
   a. Marlex Street Elbow
   b. Schedule 80 nipples
   c. Rain Bird 6 inch cutoff riser

2.13 Valve Boxes and Materials

A. Valve boxes: valve boxes shall be constructed of ABS (acrylonitrile butadiene styrene) plastic, green in color, with rigid base and sides. Cover shall be identified as shown on drawings. Provide box extensions as required.

1. Master valves, flow sensors, remote control irrigation valves, gate valves, and ball valves 3 inch or less in size shall use a 14 inch x 19 inch x 12 inch rectangular box.
2. Quick coupler valves, wire splices, and grounding rods shall use a 10 inch circular box.
3. Drain Rock: Washed, round river pea gravel, no fines.

2.14 Concrete Thrust Blocks

A. Concrete thrust blocks shall be sized per the pipe manufactures requirement or as indicated on the drawings. Thrust blocks are a requirement for all mainline piping 3” and larger. Thrust blocks are required at directional changes such as tees, ells, 45s, pipe size changes, reducers, dead ends and valves.

1. Thrust Blocking: Portland Cement concrete, 3000 psi.

2.15 Valve Identification Tags

A. Valve Identification Tags shall be 2.25 inch x 2.65 inch polyurethane. Tags shall be permanently attached to each remote control valve with tamper proof seals as indicated on the drawings.

2.16 Equipment to be Furnished to Owner

A. Two (2) sets of keys for each automatic controller.

B. One (1) 48 inch tee wrenches for operating the gate valves.

C. Two (2) quick coupler keys to match manufacturer type of quick coupler.

2.17 Main Line Locator Tape

A. 3 - inch wide plastic detectable locator tape.

2.18 Main Line and Lateral Line Bedding Sand

A. Sand shall consist of natural or manufactured granular material, free of organic material, mica, loam, clay or other substances not suitable for the intended purpose.

B. Sand shall be masonry sand ASTM C 144 or coarse concrete sand, ASTM C 33.

PART 3 – EXECUTION

3.1 General Requirements

A. Verify the static pressure at each point of connection before installing the irrigation systems. Report any discrepancies to Owner's Representative.

B. Unless otherwise indicated, irrigation systems shown on Contract Documents are schematic. With acceptance of the Owner's Representative, make adjustments where necessary to conform to actual field conditions. Irrigation systems must be operational, with uniform and adequate coverage of areas to be irrigated prior to planting.

C. Service connections: As indicated or designated by utility company. Notify the Owner's Representative before electrical and water services are required. Furnish labor and materials to connect to service connections.

D. Water Supply: Connect to water supply at locations indicated. Make minor changes caused by actual site conditions.

E. Code Requirements: Before Work of this Section, carefully inspect installed Work of other trades and verify that the Work is complete to the point where irrigation system installation may commence properly. Verify irrigation system can be installed in accordance with pertinent codes and regulations, original design, referenced standards and manufacturer's recommendations.

1. Immediately notify the Owner's Representative of conflicts between equipment and methods indicated or specified with local codes, prior to start of installation. If Contractor fails to give notification, Contractor shall assume responsibility for cost of revisions necessary to comply with code.

F. Grades: Before starting Work, carefully review grades to determine if irrigation Work may proceed. Keep within specified material depths with respect to finish grade.

G. Conduct all irrigation Work within Tree Protection Zones in accordance with the Tree and Plant Protection Plan.

H. Provide Stub outs to main lines at all end runs. Stub out wires for future connection.

I. Point of connection shall be approximately as shown on drawings. Connect new underground piping and valves and provide all flanges, adapters, or other necessary fittings for connection.

J. No fittings shall be installed on pipe underneath pavement or walls.

K. Prior to starting any work, Contractor shall obtain a reading of existing static water pressure (no flow condition) at the designated point of connection and immediately submit written verification of pressure with date and time of

recording to Owner's Representative.

3.2 Trenching and Backfilling

A. Perform excavation and backfilling as specified in Section, Earth Moving. Restore existing surfaces to original condition.

B. Excavate trenches wide enough to allow a minimum of 2 inches between parallel pipelines and 8 inches from lines of other trades. Maintain 2 inch vertical clearance between irrigation lines. Minimum transverse angle is 45 degrees. All pipes shall be able to be serviced or replaced without disturbing the other pipes.

C. Trenches for pipelines shall be free of rock, debris or sharp objects and made of sufficient depth to provide the minimum cover from finished grade as follows:

1. All main lines shall be buried at a minimum of eighteen inches (18") and shall be surrounded with at least three inches (3") of sand on the bottom and sides, and six inches (6") on top (or for large pipes, backfill equaling half the pipe diameter minimum).
2. Laterals shall be buried a minimum of twelve inches (12") surrounded by a three inch (3") sand bed.
3. Provide locator tape with metallic strip over main lines 4" diameter and larger. The end of the wire shall terminate in a valve box.

3.3 Installation

A. PVC Pipe Assembly:

1. Handle plastic materials carefully, store under cover and prevent damage to pipe. Provide support beds for full lengths of pipe when transporting and storing pipe. Do not install damaged or dented pipe.
2. Cut PVC pipe square and remove burrs. Clean pipe and fittings using primer and cleaner recommended by PVC pipe manufacturer. Use tinted primer to aid in visual inspection.
3. Apply a thin, even flow coat of slow drying, heavy duty PVC solvent cement to outside of male fittings. Cure joints as recommended by manufacturer and keep pipe and fitting out of service during curing period. Construct watertight joints equal to or greater in strength than pipe. Do not tap pipe and fittings.
4. Wipe off excess solvent cement with a clean rag. Let welded joints cure at least 15 minutes before moving them and at least 24 hours before water is permitted into pipe.
5. Install pipe fittings for sprinkler and quick coupler valve outlets horizontally and facing the exterior of the planting area.
6. Thoroughly flush all water pipes before installing valves and other accessories.

7. All pipe is to be schedule 40 PVC. Acceptable pipe sizes for lateral lines are as follows: 2", 1.5", 1" and 0.75". 0.75" pipe is to be used only on the last segment (between the last two heads) of a zone.
   a. 1 1/4'" PVC shall not be used on Project Irrigation.

B. Thrust Blocking

1. For all 4" mainline piping 2 cubic feet of concrete will be required for the above mentioned conditions.
2. It is the responsibility of the Contractor to install all mainline piping and thrust blocking in an acceptable manner so as to make the system fully operation and maintainable.
3. Visual inspection of thrust blocks is required prior to backfilling.

C. Sleeves for Irrigation Pipe and Control Wires:

1. Place pipe to be installed under pavement and through site walls in a pipe sleeve that has an inside diameter not less than 2 inches larger than outside diameter of the pipe or the combined outside diameter of pipes installed.
2. Sleeves through building walls shall have watertight seals.
3. Extend sleeves 1 foot minimum beyond edge of curbs and pavement.
4. Keep sleeves free of soil or debris during construction and after construction.
5. Sleeves shall be marked into concrete at each end of the sleeve with 2" by 2" (+).

D. Sprinkler Control Valves:

1. Thoroughly flush mainline pipe prior to installation of remote control valves.
2. Use valve box extensions by same manufacturer to ensure that box extends completely below the bottom of the valve and lids are flush to finished grade.
3. Valve boxes shall be installed perpendicular to walks and curbs. Placed a minimum of 3 feet from curbs, walks, and pathways.
4. Stake location of valve boxes for review by Owner's Representative prior to installation.
5. Valves should be clustered whenever possible.
6. Label each valve and associate wiring with an identification tag as specified herein, indicating the number of the valve according to the control station number.

E. Sprinkler Heads:

1. Heads and nozzle choice shall be spaced to provide at a minimum 100% head to head coverage. Open lawn areas or locations that are exposed to direct winds should be spaced with 25% overlap in coverage.
2. Install sprinkler heads flush to finish grade and perpendicular to level unless specified for slope according to Contract Drawings

3. Install sprinkler heads 2” from any hard surface unless approved by Owner’s Representative.
4. All sprinkler head risers shall by swing joint style. Approved materials include:
   a. Marlex Street Elbow
   b. Schedule 80 nipples
   c. Rain Bird 6 inch cutoff riser
5. Head Spacing for I-20 should not exceed 30 feet and spacing for I-25 and I-40 should not exceed 35 feet head to head - triangular spacing.
6. Full circle and partial circle rotors are to be placed on separate zones.

F. Quick Coupler

1. Install each quick coupler valve in its own valve box.
2. Install thrust blocks on quick couplers.
3. Install couplers with swing joint style riser.

G. Control Wires:

1. Tape control wires together at 10-foot intervals with electrical tape. Tape this bundle to the bottom of the mainline at 10-foot intervals with at least 1 full wrap of duct tape. Tie a loose 24-inch loop in all wiring runs at changes of direction greater than 30 degrees. Untie all loops after all connections have been made.
2. All wiring under hardscaped areas must be sleeved. All sleeves must be marked for identification in the hard surface with a 2 inch by 2 inch cross (+) on both ends of the sleeve location.
3. Each wire shall have an excess of two feet (2') coiled in the valve box.
4. One spare wire shall be laid so that it enters and leaves every valve box. The spare shall be yellow.
5. All splices shall be waterproofed.
6. All splices must be contained in plastic valve box where a valve is installed. Allow expansion coils long enough so valve bonnet may be removed and placed outside the box for maintenance purposes. Provide separate hot lead for each automatic valve. One common wire for each controller.

H. Irrigation Controller:

1. Coordinate electrical service to controller location.
2. Install wall-mounted controller and communication accessories in accordance with the manufacturer’s instructions.
3. Program the irrigation controller to operate after plants have been installed and without conflict with other Work.
4. Test operation of irrigation controller, flow sensor, rain gauge and drip control valves as stated herein.

3.4 Testing

A. Perform tests in the presence of the Owner's Representative. Provide advance notice of tests.

B. Hydrostatically test pipes normally under pressure as follows:

1. Leave all system joints, connections, and other fittings exposed until after completion and acceptance of pressure test. All subsequent breaches of integrity of the mainline shall require re-testing.
2. Mainline: test at 120 psi static pressure for 1 hour. Test will fail if pressure loss occurs during the test. Ensure means of air release at terminations and bleeding of all trapped air.
3. Lateral pipes: 80 psi for 30 minutes. Lateral test shall include all swing joint assemblies with temporary threaded caps on the downstream Marlex fitting. Wrap caps with 3 wraps of Teflon tape. Ensure means of air release at terminations and bleeding of all trapped air. Test will fail if pressure loss is greater than 5 psi during the duration of the test.
4. Test the entire system as a complete unit. Do not test in separate completed segments.
5. Center load uncovered sections of pipe with small amount of backfill to prevent arching and movement under pressure. Leave joints exposed for inspection during pressure test. No water is permitted in pipe for pressure testing until at least 24 hours has elapsed for solvent weld setting and curing.
6. Test by capping each outlet, filling pipe with water, and applying pressure with a pump. Measure pressure with a pressure gauge. Maintain specified pressure for the specified duration and determine if leaks exist. Immediately correct leaks, and subject system to same test. No pipe, fitting or joint showing leakage will be accepted. After piping has been tested to the satisfaction of the Owner's Representative, backfill pipe trenches before adjustment and testing of sprinklers and valves.
7. Do not cover installed Work before the Owner's Representative has inspected installation. Uncover covered Work as directed by the Owner's Representative for testing
8. Furnish necessary force pump and other test equipment
9. The Contractor is responsible for proving documentation stating the weather conditions, date, the start time and initial water pressure readings, the finish time and final water pressure readings and the type of equipment used to perform the test. Submit the written report to the Owner's Representative, verifying all of the above-mentioned conditions.

C. Irrigation Controller:

1. Test the electronic operation of the irrigation system after installation. Test will include operation of drip control valves and master valve via the controller. The test shall also include operation of the flow sensor via the

controller, and communication loop testing via the Owner's Representative irrigation central control system.

2. Test controller for 7 days just before end of Warranty Period. Operate system automatically in manner indicated.

D. Backflow Preventer Testing

1. The backflow preventer shall be tested according to procedures and results per the requirements of the City of Ellensburg Cross-Connection and Backflow Policy and Procedures.
2. Testing shall be performed by a certified Backflow Assembly Tester (BAT) with a valid certification within the state of Washington.

E. Irrigation Coverage Test:

1. The Contractor shall perform the coverage test in the presence of the Owner's Representative after all sprinkler heads have been installed, flushed and adjusted. Each section is tested to demonstrate uniform and adequate coverage of the planting areas serviced.
2. Any systems that require adjustments for full and even coverage shall be done by the Contractor prior to final acceptance at the direction of the Owner's Representative at no additional cost. Adjustments may also include realignment of pipes, addition of extra heads, and changes in nozzle type or size.
3. The Contractor at no additional cost shall immediately correct all unauthorized changes or improper installation practices.
4. The entire irrigation system shall be operating properly with written approval of the installation by the Owner's representative prior to beginning any planting operations.

3.5 System Protection

A. First Winterization:

1. Close the isolation valve in the irrigation main line ahead of the quick coupler at the irrigation stub out.
2. Insert quick coupling quill, connected to the air compressor at this location.
3. Following the start of the air compressor, program the irrigation controls through three complete cycles or until all the water has been forced out of the system.
4. Insert the quick coupling quill into the couplers at dead end runs and run the air compressor to force out any trapped water.
5. Remove quills and close the valve downstream of the stub out quick connector.
6. Notify the Owner that the irrigation system is secured for the winter season.

B. Spring Start-up: Upon notification by the Owner, return to the work site and start up the irrigation system as follows.

1. Visually inspect the system for winter damage and repair/replace any damaged devices, piping, etc.
2. Schedule with the Owner to have the cross-connection backflow assembly device put back into service.
3. Place quick connector quills at the main stub out and dead-end coupler locations, at attach hoses to the quills.
4. Open the valve upstream of the stub out quick connector location and then charge the system and allow the water to flow until the air is removed from the stub out section of piping.
5. Remove the quill from the quick connector at the stub out location and verify that the cross-connection backflow assembly device is functioning correctly.
6. Open the system valve downstream of the stub out quick connector and charge the system to the zone control valves. Allow the water to flow to the dead-end quick connector locations to drive the air out of the system mains.
7. Open each zone valve manually and allow the water to flow until all the air is out of the controlled zone. Verify that each sprinkler head is functioning correctly, if not, adjust or repair/replace as necessary.
8. Put the controls into automatic mode and run the entire system through at least one complete cycle to verify correct operation of all components of the system.

C. When using compressed air to winterize the system, do so in short cycles at no more than 40 psi air pressure. Do not allow pipe close to the compressor to get hot to the touch.

3.6 Clean-Up

A. During installation, keep the site free of trash, pavements reasonably clean and work area in an orderly condition at the end of each day. Remove trash and debris in containers from the site no less than once a week.

   a. Immediately clean up any spilled or tracked soil, fuel, oil, trash or debris deposited by the Contractor from all surfaces within the project or on public right of ways and neighboring property.

B. Once installation is complete, wash all soil from pavements and other structures.

1. Make all repairs to grades ruts, and damage to the work or other work at the site.
2. Remove and dispose of all excess soil, packaging, and other material brought to the site by the Contractor.

3.7 Substantial Completion Acceptance

A. Upon written notice from the Contractor, the Owners Representative shall review the work and make a determination if the work is substantially complete.

B. The date of substantial completion of the irrigation shall be the date when the Owner's Representative accepts that all work in Planting, Planting Soil, and Irrigation installation sections is complete.

3.8 Final Acceptance / System Malfunction Corrections

A. At the end of the Plant Warranty and Maintenance period, (See specification section "Planting") the Owner's Representative shall inspect the irrigation work and establish that all provisions of the irrigation system are complete and the system is working correctly.

   1. Restore any soil settlement over trenches and other parts of the irrigation system.

   2. Replace, repair, or reset any malfunctioning parts of the irrigation system.

B. The Contractor shall show all corrections made from punch list. Any items deemed not acceptable shall be reworked and the maintenance period will be extended.

C. The Contractor shall show evidence that the Owner's Representative has received all charts, records, drawings, and extra equipment as required before final acceptance.

D. Failure to pass review: If the work fails to pass final review, any subsequent observations must be rescheduled as per above. The cost to the Owner for additional observations will be charged to the Contractor at the prevailing hourly rate of the reviewer.

END OF SECTION