

SECTION 32 84 23

UNDERGROUND IRRIGATION SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Underground irrigation systems complete with heads, valves, controls, and accessories.
- B. Related sections:
 - 1. Section 32 94 23 Planting

1.02 REFERENCE STANDARDS

- A. NFPA 70: National Electric Code.
- B. ASTM: American Society for Testing and Materials
- C. IA: The Irrigation Association: Main BMP Document, Landscape Irrigation Scheduling and Water Management Document.
- D. ASIC: American Society of Irrigation Consultants: ASIC Grounding Guideline
- E. City Codes/Ordinances relating to Landscape and Irrigation

1.03 DEFINITIONS

- A. Water Supply: Culinary and/or secondary pumping, piping, and components provided and installed by others to provide irrigation water to this project. Includes but is not limited to: storage ponds, pump stations, saddles, nipples, spools, shut-off valves, corporation stop valves, water meters, pressure regulation valves, and piping or components upstream of (or prior to) the Point-of-Connection.
- B. Point-of-Connection: Location where the Contractor shall tie into the water supply for landscape irrigation needs and use. Tie to existing piping.
- C. Main Line Piping: Pressurized piping downstream of the point-of-connection to provide water to remote control valves and quick coupling valves. Normally piping is under constant pressure.
- D. Lateral Line Piping: Circuit piping downstream of the remote-control valves to provide water to sprinkler heads, drip system, or bubblers. Normally piping is under pressure only when control valve is in operation.

1.04 PERFORMANCE REQUIREMENTS

- A. The work to be performed under this Section shall consist of furnishing all labor and materials necessary to construct a complete working and tested underground sprinkler irrigation system per all drawings and specifications, providing one hundred (100) percent head-to-head coverage on all lawn and planting areas on the site without overspray onto hardscape, buildings, or other site features. Included also will be system maintenance and warranties.
- B. The efficiency of the completed irrigation system shall meet the following minimum standards:

1. Circuits using spray sprinklers shall perform at a minimum 60% efficiency.
 2. Circuits using rotor sprinklers shall perform at a minimum 70% efficiency.
 3. Efficiency shall be determined by an independent water audit performed by a certified irrigation auditor selected by the Owner. The Contractor shall include in his bid price the cost of this audit. The audit shall be conducted after substantial completion and before final acceptance of the irrigation system.
- C. The Contractor shall perform, but not be limited to, all of the following functions: paying all connection fees, deposits, and all other charges related to the connection to the water source; obtain all permits; complete all excavation and backfill; provide backflow device, tapping saddle, yoke, stop and waste, corp. cock, concrete vaults and miscellaneous pipe fittings; make necessary road repairs; provide safety barrier; make connection to water source; install all electric valves, valve control devices, isolation gate valves, quick coupling valves, drain valves, meter base, conduit, junction boxes, controller, backflow prevention devices and enclosures, filters and enclosures, and all necessary wiring. All work shall comply with applicable codes and requirements of the utility companies involved.
 - D. If any or all of the above-mentioned fees or charges are not listed on the bidding schedule or on plan, they shall be included in the bid lump sum price of the irrigation sprinkling system item.
 - E. Contractor shall verify with the appropriate water district the location of the water service main line and water pressure and complete all requirements necessary to bring water service to the site. Total cost to be included in the irrigation sprinkling system bid item.
 - F. The above specification statement supersedes the graphic representation location of the contract limit line. This pertains to the water line location on either side of the street adjacent to the project site.
 - G. All work shall be done in accordance with the drawings and specifications, as well as all applicable water and electrical codes.
 - H. The Contractor shall operate, maintain until acceptance, and guarantee the new system as specified herein until all lawn and plants installed on this project have become established and have been accepted by the Owner.

1.05 **SUBMITTALS**

- A. Product Data: Complete set of manufacturer's technical data and installation instructions for all equipment to be installed on the project. Submittal shall be made prior to commencement of any irrigation work.
- B. Main line and lateral line pressure test results: Submitted at the time of occurrence.
- C. Operation and Maintenance (O&M) Manual:
 1. O&M manual shall contain the following information:
 - a. Manufacturer cut sheets and current printed specifications for each element or component of the irrigation system.
 - b. Parts list for each operating element of the system.
 - c. Manufacturer's printed literature on operation and maintenance of operating elements of the system.
 - d. Section listing instructions for overall system operation and maintenance. Include directions for spring start-up and winterization.

2. Manual shall be submitted at least thirty (30) days prior to final inspection and acceptance of the project.
- D. Complete As-Built Drawings:
1. Drawings shall conform to the following criteria:
 - a. One (1) 22" x 34" and one (1) 11" x 17" drawing shall be submitted.
 - b. All submitted drawings shall be made on Mylar or Tyvek original.
 - c. Show detail and dimension changes made during installation.
 - d. Include field dimension locations of sleeving, points of connection, main line piping, wiring runs not contained in main line pipe trenches, valves and valve boxes, quick coupling valves.
 - e. Dimensions shall be taken from permanent constructed surfaces, features, or finished edges located at or above finished grade.
 2. A complete set of as-built drawings shall also be submitted in electronic digital format (.pdf).
 3. As-Built drawings shall be submitted prior to final inspection and acceptance.
- E. Controller Map: Each controller shall be equipped with a color-coded copy of the area that the controller services. Include valve zone number, type of plant material irrigated, and zone location on the project. Laminate map with heat shrink clear plastic and mount inside controller.

1.06 **QUALITY ASSURANCE**

- A. Acceptance: Do not install work of this section prior to acceptance of the area by the Owner as being properly prepared to receive said work (i.e. at proper grade, properly compacted, permanent fixtures in place, etc.).
- B. Adequate Water Supply: Contractor shall verify that proper connection is available to supply lines, and is of adequate size and volume. Perform static water pressure test prior to commencement of work. Notify Owner of problems encountered prior to proceeding.
- C. Workmanship: It is the intent of this specification that all materials herein specified with the best standards of practice relating to the trade.
- D. The Contractor shall provide to the City a document or resume which includes the following information:
 1. The Contractor has been installing sprinkler systems on commercial projects for at least ten (10) previous consecutive years.
 2. The Contractor is currently licensed to perform landscape construction in the State of Utah.
 3. The Contractor is bondable and insurable for the work to be performed.
 4. References of at least five (5) projects of similar size and scope completed within the last five (5) years. Three (3) of the projects listed must be located in the general region of the project site.
 5. List of suppliers from whom materials will be obtained for use on this project.

1.07 **PROJECT CONDITIONS**

- A. Any discrepancies between existing site conditions and those indicated on the plans shall be called to the attention of the Landscape Architect or Owner's Representative prior to continuance of the project.
- B. The Contractor shall use only the equipment and products specified in the

construction drawings. No substitution of materials will be allowed on the irrigation system without prior authorization from the Landscape Architect and the Owner's Representative.

- C. During delivery, installation, and storage of materials for the project, all materials shall be protected from contamination, damage, vandalism, and prolonged exposure to sunlight. All material stored at the project site shall be neatly organized in a compact arrangement and storage shall not disrupt the project Owner or other trades on the project site. All material to be installed shall be handled by the Contractor with care to avoid breakage or damage. Materials damaged by the Contractor shall not be used but shall be replaced with new materials at the Contractor's expense.
- D. The Contractor shall familiarize himself and his workmen with all hazards and existing utilities prior to commencing work. This shall require local Blue Staking to be completed before any construction activity can begin.

PART 2 PRODUCTS

2.01 GENERAL

- A. The Contractor shall provide all materials to be used on this project. The Contractor shall not remove any material purchased for this project from the project site, nor mix these project materials with other contractor-owned materials. The Owner retains the right to purchase and provide project materials.
- B. Handling and unloading of all equipment, pipe, and fittings shall be in such a manner as to insure delivery to the job site in a sound, undamaged condition. Any installed equipment or pipe found to be damaged or defective in workmanship or materials shall be rejected and removed and replaced at Contractor's expense.

2.02 PIPE

- A. All PVC pipe used on this project for the irrigation system shall meet or exceed the requirements of ASTM D-1784, cell classification 12454B, Type 1, Grade 1. Pressure pipe must conform to the requirements of ASTM D-1784 (Schedule 40 and Schedule 80) or ASTM D-2241 (SDR-26 or SDR-41) and be listed by the National Sanitation Foundations (NSF) for use with potable water. It shall be free of cracks, holes, foreign material, blisters, inside bubbles, wrinkles, and dents.
- B. All main line pipe, three (3) inches inside diameter and smaller shall be Schedule 40 PVC solvent weld bell end unless otherwise specified.
- C. All main line pipe, four (4) inches inside diameter and larger, shall be PVC Class 200 gasketed bell end (except as required for conversion to metal fittings).
- D. All lateral line pipe shall be Schedule 40 PVC solvent weld.
- E. Maximum flows allowed through main line and lateral line pipe shall be determined by water speed in the pipe. The maximum water speed allowed in both main lines and lateral lines is five (5) feet per second. The resulting maximum gallons per minute (gpm) allowed to flow through PVC pipes are as follows:

<u>PIPE SIZE</u>	<u>GPM</u>
3/4"	8
1"	12
1 1/4"	22
1 1/2"	30
2"	50
2 1/2"	75
3"	110
4"	190
6"	425

For sizes larger than 6", consult manufacturer's recommendations.

- F. No bends in pipe shall be permitted. The Contractor shall use elbow fittings of ninety (90), forty-five (45), twenty-two and one half (22-1/2), and eleven and one quarter (11-1/4) degrees as individual situations demand.
- G. All pipe used from the main line to the control valves shall be solvent weld Sch. 80 PVC pipe unless otherwise noted or shown on the construction drawings.

2.03 FITTINGS

- A. All PVC fittings used on this project for the irrigation system shall meet or exceed the requirements of ASTM D-1784, cell classification 12454B, Type 1, Grade 1. Fittings must conform to the requirements of ASTM D-1784, ASTM D-2466 and ASTM D-2467.
- B. Main Line Fittings:
 - 1. All main line fittings four (4) inches inside diameter and larger shall be either M.J. or deep bell push-on, gasketed, ductile iron.
 - 2. All main line fittings three (3) inches and smaller inside diameter shall be solvent weld Schedule 80 PVC.
 - 3. All main line fittings four (4) inches and larger, whether ductile iron or solvent weld, shall be thrust blocked per details.
 - 4. All main lines three (3) inches and larger having a horizontal change of direction shall have proper concrete thrust blocks installed. Vertical changes in direction shall require the use of M.J or ductile iron fittings with thrust restraining devices (Mega Lug, Harco Knuckle Joint Restraints, or approved equal) in addition to appropriate concrete thrust blocking. The size and type of thrust block depends on pressure, pipe size, type of soil, and type of fitting. As a general rule, one (1) cubic foot minimum of class AA (AE) Type II concrete is required for each thrust block. Follow thrust blocking details for calculating thrust block size.
 - 5. M.J. tees, Schedule 80 tees with SxT Schedule 80 bushings, or Harco ductile iron service tees are approved on PVC main lines for automatic control valve installation. M.J. fittings shall be greased and wrapped.
- C. Lateral Line Fittings:
 - 1. All lateral line fittings shall be solvent weld Schedule 40 PVC.
 - 2. All risers and exposed fittings shall be solvent weld Schedule 80 PVC, including conversions to metal pipe and fixtures, unless otherwise noted on the plans.
- D. PVC Cement: Solvent weld or glued joints shall use the following materials:

1. Primer: IPS Weld-On P-70 Primer (purple), ASTM F-656.
2. Cement: IPS Weld-On 711 Heavy Bodied PVC Cement (gray), ASTM D-2564.

2.04 **VALVES**

- A. Master Valve: All master valves shall be as specified in the Irrigation Equipment Schedule. Master valve assembly shall be installed according to detail in drawings. Use a two-wire decoder to connect the master valve to the controller. All decoders shall be compatible with the controller specified in the Irrigation Equipment Schedule.
- B. Isolation Gate Valve:
 1. Isolation gate valves shall only be used on the main line.
 2. Isolation gate valves shall be as specified in the Irrigation Equipment Schedule. Valves shall be hydrostatically pressure tested for 400 P.S.I. and shall be designated for a working pressure of 200 P.S.I. Each valve shall contain a resilient wedge urethane rubber seat. Unless otherwise shown or specified, valves three (3) inches and larger shall have flanged end connections.
 3. Buried valves shall have two (2) inch square operating nuts. No handles or wheels will be permitted. Valves inside structures (vaults or valve boxes) may have wheel handles if the valve is two (2) inches or less in size.
 4. Action unions shall be installed on each side of all valves except flanged valves.
 5. The Contractor shall provide adequate material for the connection of valves to the system, i.e., adapters, flanges, nuts, bolts, gaskets, etc.
 6. All buried main line isolation valves with a (2) inch square operating nut shall be fitted with a four (4) inch minimum diameter pipe sleeve place over the top of the valve vertically and extended to grade. Cover with a ten (10) inch round plastic valve box with bolt down lid and set at finished grade.
- C. Remote Control Valve Assembly:
 1. Remote control valves shall be as specified in the Irrigation Equipment Schedule.
 2. Remote control valves shall be globe configuration, electrically activated, normally closed, forward flow design.
 3. All pipe on the control valve assembly shall be Schedule 80 PVC pipe. See detailed drawings.
 4. Action unions shall be installed on each side of the control valve assembly, allowing valve to be removed from the box for maintenance without cutting pipe.
 5. Each control valve shall have a brass gate or ball valve installed immediately upstream of the valve and located within the same valve box.
 6. Flows through each remote-control valve shall not exceed the following limits:

<u>VALVE SIZE</u>	<u>GPM RANGE</u>
1"	1 - 30
1 ½"	31 - 75
2"	76 - 150
 7. Each drip remote control valve assembly shall contain the following components:
 - a. PVC ball valve.
 - b. Inline disc or screen filter with 100 micron/150 mesh filter element.

- c. Remote control valve capable of operating at very low flow levels.
 - d. Inline pressure regulator.
- All components shall be installed according to manufacturer's recommendations, and located within a single valve box, one valve per box (no multi-valve assemblies permitted).
- 8. Use a two-wire decoder to connect the remote-control valves to the controller. All decoders shall be compatible with the controller specified in the Irrigation Equipment Schedule.
- D. Quick Coupling Valve Assembly:
- 1. Quick coupling valves shall be as specified in the Irrigation Equipment Schedule.
 - 2. Quick coupling valves shall be heavy duty brass, two-piece, single lug locking cap.
 - 3. The Contractor shall provide to the Owner at least 1 cap lock key and 1 quick coupling key with a swivel hose bib attached. These keys shall be delivered prior to final acceptance of the project.
- E. Manual Drain Valve Assembly:
- 1. All manual drains shall be three quarter (3/4) inch heavy duty brass ball valve.
 - 2. Manual drain valves shall be required at all low points in the main lines. See plans, notes, and details.
 - 3. The location of each manual drain shall be shown on the "as built" drawing with dimensions from the nearest permanent fixture, such as a building corner, etc.
 - 4. Each manual drain valve will be accessed by a vertical two (2) inch PVC Schedule 40 pipe sleeve, capped by a locking valve cap with a key, enclosed within a ten (10) inch round green valve box with bolt down lid. The top of the drain sleeve shall be three to six (3 - 6) inches below the lid of the valve box.
 - 5. Each manual drain shall empty into a gravel sump, a minimum of twenty four (24) inches by twenty four (24) inches by eighteen (18) inches deep, (or six (6) cubic feet total capacity). The gravel shall be washed three quarter (3/4) inch rock.
- F. Automatic Drain Valves: Automatic drain valves shall not be used.

2.05 VALVE BOXES

- A. All valve boxes shall be green HDPE plastic with locking lid, or approved equal.
- B. Valve box size shall be listed in the installation details for each irrigation system component.

2.06 BACKFLOW PREVENTION ASSEMBLY

- A. Backflow prevention devices shall be a reduced pressure principle backflow preventer consisting of a pressure differential relief valve located between two independently operated spring-loaded "Y" type center guided check valves. Assembly shall also have two full port resilient seated ball valves for shut-off and four resilient seated ball valve test cocks and bronze body construction. Larger

sizes (2 ½" and up) may have two non-rising stem resilient wedge gate valves in lieu of ball valves.

- B. Backflow preventer shall be as specified in the Irrigation Equipment Schedule.

2.07 **FILTER AND ENCLOSURE**

- A. Filters and their enclosures shall be required on all systems using secondary water. Systems using reclaimed water (from a wastewater treatment plant) may not require a filter.
- B. Filters shall be as specified in the Irrigation Equipment Schedule. Filters may be either plastic or steel construction, with screen (perforated or weavewire stainless steel) or plastic disc filter elements.
- C. Filter enclosures shall be either commercially or custom fabricated. They shall be constructed of solid sheet marine grade aluminum, with one hundred (100) percent stainless steel hardware and locking mechanism. They shall exhibit vandal- and weather-resistance and offer easy access.
- D. Enclosures shall be mounted on either a pre-manufactured mounting pad with support base or minimum four (4) inch concrete pads. See detail.

2.08 **AUTOMATIC CONTROL SYSTEM**

- A. Furnish a low voltage automatic control system manufactured expressly for the operation of automatic control valves used in an underground irrigation system.
- B. Automatic controller devices shall be as specified in the Irrigation Equipment Schedule. No substitutions shall be allowed. Unless specified otherwise, install as follows:
 - 1. Install in stainless steel enclosure, model as specified in the Irrigation Equipment Schedule.
 - 2. Whenever a single site has 2 or more controllers, the 2nd and subsequent controllers shall also be mounted in a separate stainless-steel enclosure as specified in the Irrigation Equipment Schedule.
 - 3. Metered enclosures, if required, shall be mounted on a 4" thick concrete pad. Regular enclosures may use a pre-manufactured mounting system as specified in the Irrigation Equipment Schedule.
- C. Provide adequate capacity to accommodate each valve on the system separately. Do not double valves to circuits.
- D. The Contractor shall provide 120-volt electrical service to the controller. Where required, install meter inside meter socket of the enclosure. Coordinate this work with the Owner and other trades involved in the project.
- E. Every controller shall be installed to control a single point of connection (P.O.C.). That point of connection shall be exclusively associated with that controller. Each P.O.C. assembly shall consist of the main line tap, reverse pressure backflow prevention device (if potable water source), filter (if required), master control valve (if specified), flow sensing device (if specified), manual drain valve, and quick coupling valve. No controller shall be wired to control valves which are connected to another P.O.C.

2.09 CONTROL VALVE WIRE

- A. All irrigation control wire from the controller to the decoders must be Polyethylene double-jacketed or UF-B UL PVC double-jacketed two-conductor solid core designed for direct burial systems. The following is recommended:
- B. All controller wire shall be soft drawn, annealed, solid copper conforming to ASTM B33. Conductor insulation must be 4/64-inch thick PVC, conforming to UL Standard #493 for thermoplastic-insulated style UF (Underground Feeder), rated at 60 degrees C.
- C. The two insulated conductors are laid in parallel and encased in a single outer jacket of 3/64-inch thick, high density, sunlight resistant polyethylene conforming to ICEA S-61-402 and NEMA WC5, having a minimum wall thickness of 0.045-inch.
- D. The two conductors must be color-coded: normally one conductor red and one black. Both conductors shall be the same size: 14 AWG.
- E. All wire crossing water, attached to bridges, going under paving, or where conditions require protection, shall be housed in conduit or sleeves. All out-of-ground conduits shall be rigid metal. All buried conduit may be PVC.
- F. All splices shall be water-tight. All connections made inside the box to connect the controller to the valve shall be made using a dry-splice connector DBR/Y. Each connector shall be completely sealed and water-proof.
- G. All other wire splices shall be housed in a separate round valve box and use DBR/Y connectors.
- H. Lightning arrestors and eight (8) foot long by 5/8-inch diameter copper ground rods shall be used as recommended by the manufacturer and be installed per manufacturer recommendations and installation details of this project. Attach bare copper wire to ground rods using Cadweld™ type connection and install in eight (8) inch round valve box.
- I. No aluminum wire shall be used on this project.

2.10 SPRINKLER HEADS

- A. General:
 - 1. All heads used on this project shall be as specified in the Irrigation Equipment Schedule shown on the plans.
 - 2. All sprinkler heads and nozzles shall be as specified in the Irrigation Equipment Schedule.
- B. Spray/Rotary Sprinklers:
 - 1. Spray/Rotary sprinklers shall have either four (4), six (6), or twelve (12) inch pop-up height and built-in check valve. In areas where water pressures are high or fluctuating, pressure regulating series sprinklers shall be used.
 - 2. Spray/Rotary sprinkler nozzles shall be plastic matching precipitation rate nozzles. Variable arc nozzles may be used to meet irregular-shaped areas.
 - 3. Attachment options shall be as specified in the installation details.
- C. Rotor Sprinklers:
 - 1. Rotor sprinklers shall be equipped with stainless steel rotor sleeve and check valve.
 - 2. Rotor sprinkler nozzles shall be as manufactured for each individual model.
 - 3. Small rotor sprinklers (1/2" bottom inlet) may be installed using swing pipe per installation details. Medium (3/4" bottom inlet) and large (1" or greater bottom

inlet) rotor sprinklers shall be installed using swing joints as shown in the installation details. Swing joint size shall match sprinkler inlet size.

- D. Bubblers, Tree Well, and Root Watering Systems: Installed per manufacturer's recommendations. Use only where and when specified.

2.11 DRIP IRRIGATION

- A. Drip irrigation materials shall be as specified in the Irrigation Equipment Schedule.
- B. Emitters shall be of the individual, self-cleaning, pressure-compensating type.
- C. Dripline tubing shall be constructed of high quality linear, low density, UV-resistant, polyethylene resin materials with internal, integral emitters at specified intervals.
- D. All insert barbed fittings shall be constructed of molded, UV-resistant plastic. Each fitting shall have a minimum of two (2) ridges or barbs per outlet. All fittings shall be from the same manufacturer and shall be available in one of the following end configurations:
 - 1. Barbed insert fittings.
 - 2. Male pipe threads (MPT) with barbed insert fittings
 - 3. Female pipe threads (FPT) with barbed insert fittings.
- E. Each drip remote control valve assembly shall contain the following components (in required sequence):
 - 1. PVC ball valve.
 - 2. Inline disc or screen filter with 100 micron/150 mesh filter element.
 - 3. Remote control valve.
 - 4. Inline pressure regulator.
- F. Provide the following equipment to each drip valve circuit, located and installed per manufacturer's recommendations:
 - 1. Line flushing valve(s) - minimum of one (1) on each exhaust header, and one (1) on each supply header.
 - 2. Air/Vacuum relief valve(s) at all high points in the system if required by the manufacturer.

2.12 FLOW SENSING EQUIPMENT

- A. Where specified, each controller shall be installed with its own corresponding flow sensor on a single point of connection to the water source.
- B. The flow sensor shall be compatible with the specified controller.
- C. Size the flow sensor so that it is able to read the high and low flows of the valves used on that particular controller. Install per manufacturer's specifications.

PART 3 EXECUTION

3.01 GENERAL

- A. The irrigation plan is diagrammatic in nature, and some drafting liberties have been taken to maintain the graphic clarity of the drawings. All irrigation equipment shall be located in planting areas only, unless noted otherwise. The Contractor shall install piping to minimize changes in direction, avoid placement under trees or large shrubs, and avoid placement under hardscape features. Refer to the irrigation legend, details, and specifications for equipment and proper installation.

- B. Site Visit: The Contractor shall visit and inspect the project site. He shall take into consideration known and reasonably inferable conditions affecting the proposed work. Failure to visit the site shall not relieve the Contractor of furnishing materials and performing the work required. Any discrepancies between existing site conditions and those indicated on the plans shall be called to the attention of the Owner, by the Contractor, prior to continuance of the project.
- C. The Contractor shall keep the premises clean and free of excess equipment, materials, and rubbish incidental to work of this project. Work areas shall be swept clean and trash and debris picked up daily. Open trenches or hazards shall be protected with yellow caution tape. The Contractor is responsible for removal and legal disposal (off site) of trash and debris generated by his work on this project.
- D. Existing Landscapes:
 - 1. Where existing landscape areas are a part of the project, the Contractor shall repair or replace work damaged by his irrigation system installation at his own expense. If the damaged work is new, the Contractor or the original installer of that work shall perform repairs at the Contractor's expense. The existing irrigation system and landscape shall remain in place, protected, undisturbed, and functional.
 - 2. The Contractor shall protect in place and work around all existing plant materials designated to remain.
 - 3. Coordination of trench and valve locations shall be laid out prior to any excavation work. Plant material deemed by the Landscape Architect or Owner's Representative to be damaged by the Contractor shall be replaced with new plant material at the Contractor's expense. The Contractor shall not cut existing tree roots larger than two (2) inches in diameter. Route pipe, wire, and irrigation components around tree canopy drip lines where possible to minimize damage to tree roots.
 - 4. The Contractor shall leave no part of the existing landscape without water for more than forty-eight (48) hours at a time.
- E. Pre-Construction Meeting: A pre-construction meeting shall be held prior to beginning any work on a project. The Owner and/or Owner's Representative, the project designer, and the Contractor and his Sub Contractors shall all be in attendance.
 - 1. The purpose of this meeting is to review project goals and expectations, the project schedule, and all procedures relative to inspections, permits, and changes that may arise.
 - 2. In the pre-construction meeting, it shall be made clear that the construction documents (plans, details, specifications, and contract) shall be binding upon the Contractor and upon all of his work. Any work not in accordance with the plans and specifications shall be rejected, and the Contractor shall bring the project into compliance at his own expense.

3.02 CONSTRUCTION STAKING

- A. The Contractor shall provide the necessary staking to obtain the layout shown on the plans. The points of reference shall be as indicated in the drawings and shall include such features as the walks, buildings, curbs, etc. Any changes in the system which appear necessary due to field conditions must be called to the attention of the Owner/Owner's Representative and Landscape Architect and approved by the Owner at the time they are discovered and prior to making any changes.

3.03 EXCAVATION AND BACKFILLING

- A. Excavation:
1. Excavation work shall only be as deep and as wide as will be required to safely perform the work, such as making mainline connections or forming vaults.
 2. Trenches shall be deep and wide enough to provide working space for placing two (2) inches of bedding underneath all new mainline pipe and fittings where the soil is rocky or gravelly. Place twenty (20) to thirty (30) inches of cover over the top of all pipe and fittings on main lines. All trench bottoms shall be sloped so the pipes will gravity-drain back to the main connection point or the nearest manual drain. If the existing main line is deeper than thirty (30) inches, the Contractor shall install a riser to a depth of eighteen (18) to thirty (30) inches and then install the new line at the required depth. At no time will the mainline be installed with less than eighteen (18) inches or greater than thirty (30) inches of cover unless prior approval is given by the Landscape Architect or Owner's Representative.
 3. Trenches shall be deep enough to maintain twelve (12) to fourteen (14) inches of cover over the top of all lateral line pipe and fittings. They shall be deep enough to guarantee that all swing joints drain back to the lateral lines. Trenches shall be a minimum of twelve (12) inches away from any walks and/or curbs, buildings, or other hardscape improvements. They shall be of sufficient width to accommodate tees and other fittings that come out sideways (horizontally) from the lateral lines. Lateral lines may be pulled by a mechanical puller provided all other applicable specifications are met.
 4. Any rocks or other debris over one (1) inch in diameter uncovered during excavation or trenching shall be removed from the area.
 5. If more than one (1) pipe line is required in a single trench, that trench shall be deep and wide enough to allow for at least six (6) inches of horizontal separation (if both are lateral lines), or six (6) inches of both horizontal and vertical separation (if one line is a main line) between pipes.
 6. Any existing utility lines damaged during excavating or trenching shall be reported immediately to the Landscape Architect, the utility Owner, and the project Owner. After proper notification to the Landscape Architect, the utility Owner, and project Owner, repairs to the damaged utility shall be made immediately. Repair materials and methods shall meet industry standards and the utility Owner's satisfaction. Should utility lines be encountered which are not indicated on the plans, the Owner shall be notified. The repair of any damage shall be done as soon as possible by the Contractor or the utility Owner, and proper compensation to the Contractor shall be negotiated with the Owner. Such utility locations shall subsequently be noted on the "As-Built" drawings

required before final payment of the irrigation system contract.

7. Where trenching is done in established lawn, care shall be taken to keep the trenches only as wide as is necessary to accomplish the work. The trenches shall be backfilled as specified and then four (4) inches of approved topsoil placed to bring the trench up to existing grade so that sod can be laid. Only new sod shall be used as trench cover. It shall be established new sod, of standard width, and shall be laid along the trenches so as to match the existing sod. No small pieces of sod shall be used, and only standard lengths shall be accepted. No sod from the construction site shall be used unless otherwise specified. In the event of any backfill settlement prior to the end of the guarantee period, the Contractor shall perform the required repairs at his own expense.

B. Backfilling:

1. No backfilling of trenches shall be done until the system has been inspected and approved by the Landscape Architect or Owner's Representative for proper trench depths, installation of equipment, control wire, and location of heads.
2. Before trenches are backfilled, the Contractor must show the Landscape Architect or Owner's Representative the redlined "As-Built" drawing he has been keeping on the site, indicating that changes and corresponding dimensions have been recorded where such changes have been made.
3. Prior to backfilling, the system shall be tested under pressure for leaks and general operation of the equipment. The main line shall be tested for a period of four (4) hours at a pressure of 120 PSI. Any failures detected during the testing period shall be repaired by the Contractor and the testing shall be repeated. The Landscape Architect shall certify the testing to ensure that it has been completed and that the system has met all testing requirements. All defects discovered by the pressurization and operation test shall be corrected by the Contractor at his own expense before proceeding with further work.
4. Trench bedding and backfill material shall be existing site soil free of rocks larger than one (1) inch in diameter and any other debris. Wasted pipe and other excess project materials or rubbish (tape, wire, trash, wrappers, boxes, bottles, etc.) shall not be backfilled into the trenches. All trenches shall be backfilled, and then watered sufficiently to insure no settling of the surface. In the event of any backfill settlement prior to the end of the guarantee period, the Contractor shall perform all required repairs at his own expense.
5. Backfill under and around the lines to the center line of the pipe shall be placed in maximum layers of six (6) inches and thoroughly compacted. Compaction shall be ninety-five (95) percent relative density (modified proctor) under walks and roads, and eighty-five (85) percent in planting areas.
6. Special care shall be taken to assure complete compaction under the haunches of the pipe. Backfill compaction under the haunches of the pipe shall be compacted to the original density. Compaction requirements above the pipe shall be the same as for surrounding areas.

3.04 POINT-OF-CONNECTION

- A. The Contractor shall verify the location of the irrigation point-of-connection (P.O.C.) and the static water pressure at that location prior to beginning any irrigation work. Verify water pressure during the time of day that the irrigation system is intended to operate.
- B. If the P.O.C. location or water pressure is different than that expressed by the irrigation designer, or if the pressure appears to be unusually high or low, the Contractor shall notify the Landscape Architect or Owner's Representative immediately prior to beginning any irrigation work.

3.05 ELECTRICAL POWER SUPPLY AND AUTOMATIC CONTROLLER

- A. If 120 volt ac electrical service is not already in place, the Contractor shall be required to make all necessary arrangements with the appropriate power company and provide all necessary materials and labor to provide said power, including but not limited to: paying fees, making power connections, providing poles, weatherhead and meter, etc., as specified on the plans or as required by the power company and the Owner. The automatic controller shall be of the type and manufacturer specified and located as shown on the drawings.

3.06 PIPE AND FITTINGS

- A. Install pipe to allow for expansion and contraction as recommended by pipe manufacturer. Where the main line sits uncovered for any length of time in the trench prior to testing, the main line shall be shaded with a thin covering of backfill soil to minimize weather-related expansion or contraction of the pipe. Do not cover up valves or other installed equipment prior to inspection and acceptance.
- B. The ends of all pipe shall be cut squarely and remain free of all inside scale or burrs. Spigot ends of pipes three (3) inches and larger shall be beveled. Threads shall be cut clean and sharp, and to a length equal to one and one eighth (1-1/8) times the length of the female thread receiving the pipe. The threaded pipe shall be screwed into a full length of the female thread.
- C. All threaded pipe joints shall be properly sealed using Teflon tape that is properly applied to the areas to be joined.
- D. Solvent weld joints shall not be glued unless ambient temperatures are at least forty (40) degrees F. Pipe shall not be glued in rainy conditions unless properly tented. Use only the brand and type of primer and glue specified. Glued main line pipe shall cure a minimum of four (4) hours prior to being energized. Lateral lines shall cure a minimum of two (2) hours prior to being energized and shall not remain under constant pressure unless cured for twenty-four (24) hours.
- E. Every care shall be taken during installation to prevent dirt and debris (especially rocks and pipe shavings) from getting into the pipes.
- F. All tees coming out of main lines for valves and other fixtures shall be vertical and constructed with Sch. 80 PVC pipe.
- G. All tees coming out of the lateral lines for heads and other fixtures shall be horizontal so that no direct weight or pressure may be exerted through the head to the top or bottom of the lateral line pipe. Tees on lateral lines shall also be SxSxT to the head swing joints.

3.07 **THRUST BLOCKS**

- A. Thrust blocks are needed wherever the main pipe line:
 1. Changes any direction at tees, angles, and crosses vertical and horizontal.
 2. Changes size at reducers.
 3. Stops at a dead-end.
 4. Valves at which thrust develops when closed.

The size and type of thrust block depends on pressure, pipe size, type of soil, and type of fitting. As a general rule, one cubic foot (minimum) of class AA (AE) Type II concrete (2,000 psi minimum) is required for each thrust block. Follow thrust blocking details for calculating thrust block size.

- B. Thrust blocks shall rest against undisturbed original earth in the direction of thrust.
- C. Where a fitting is used to make a vertical bend, use a three-eighths (3/8) inch bar to anchor the fitting to a thrust block braced against undisturbed soil. The thrust block should have enough resistance to withstand upward and outward thrusts at the fitting.
- D. Where concrete thrust blocking shall come in contact with PVC pipe, wrap the PVC pipe with a layer of plastic to protect the pipe from any caustic effects that may be caused by the concrete mix.
- E. Thrust restraining devices may be used in lieu of thrust blocking, but they must be installed strictly according to manufacturer's recommendations. Use of these devices in lieu of thrust blocking shall be approved by the Owner or Owner's Authorized Representative prior to use.

3.08 **PIPE SLEEVES**

- A. Pipe sleeves shall be required for all piping under all new concrete or other new paving. The size of the sleeve shall be at least twice the size of the pipe or wires to be sleeved. Wires shall be sleeved separately within their own sleeve. All pipe sleeves four (4) inches and smaller in diameter shall be PVC Schedule 40 pipe; sleeves greater than four (4) inches in diameter shall be Class 200 PVC, unless otherwise specified on the drawings.

3.09 **VALVES**

- A. General:
 1. Isolation valves, remote control valves, and quick coupling valves shall be installed according to manufacturer's recommendations and these drawings and specifications.
 2. Valve boxes shall be set over valves so that all parts of the respective valve assembly can be reached for service. Valve box and lid shall be set to be flush with the proposed finished grade.
 3. No valve box shall rest directly upon the valve or any fixture associated with it, including main line and lateral lines. Each valve box shall be centered on the valve assembly it covers. Each valve box shall have four (4) inches of three quarter (3/4) inch gravel placed in the bottom underneath the valve and lines to reduce the potential of mud and standing water therein.

- B. Remote Control Valve:
 1. Each control valve shall have its own gate or ball valve (as specified), and only one (1) control valve and gate/ball valve per valve box. No valve manifolds shall be allowed. Also included in the remote-control valve assembly is the two-wire decoder.
 2. The bottom of the remote-control valve shall be a minimum of four (4) inches above the gravel.
 3. All control valves shall be located within shrub areas where possible and installed per the details on the plans. No large grouping of valves (greater than 3) in any one spot shall be allowed, unless approved by the Landscape Architect or Owner's Representative.
 4. Control valve assemblies shall be installed no closer to one another than two (2) feet.
 5. No control valve shall be installed more than twelve (12) inches below finished grade.
 6. Tag each control valve with a permanent and non-smearing label indicating its proper controller and valve number as shown on the irrigation plans.
- C. Quick Coupling Valve:
 1. Quick coupling valves shall be installed within a ten (10) inch round green plastic valve box, with the top of the valve box at finished grade.

3.10 VALVE BOX

- A. Where indicated in the installation details, valve boxes shall rest on concrete pavers only, thus eliminating any weight or pressure from being exerted on the main line or valve inside the valve box. There shall be a minimum of three (3) inches of clear space between the bottom of the valve box lid and the topmost part of the valve (including solenoid).
- B. Valve box extensions shall be used where necessary to prevent soil around the valve from collapsing into the space inside the valve box.

3.11 BACKFLOW PREVENTION ASSEMBLY

- A. The Contractor shall install backflow prevention equipment behind (downstream from) the point-of-connection to the supplying main and lateral lines. Installation shall comply with local, state, and national codes and regulations, and per manufacturer's recommendations (whichever is most restrictive). See plans and details for more information. Install a quick coupling valve just down stream of the backflow prevention assembly for system blowout purposes.
- B. The Contractor shall have the backflow prevention assembly operation tested within ten (10) days of the time of installation by a certified backflow preventer assembly tester. Testing shall be conducted per state requirements to insure proper and safe operation. Subsequent annual testing at spring start-up shall be the responsibility of the Owner.

3.12 **FILTER & ENCLOSURE**

- A. The Contractor shall install the filter and its enclosure just downstream from the point-of-connection and upstream from the backflow prevention assembly (if present).
- B. The filter shall be equipped with a ten (10) foot length of hose that can be attached to the exhaust port of the filter to direct water and debris away from the enclosure during flushing operations. Auto-flush filter models shall be provided with a permanent method of capturing and directing exhaust water away from the filter assembly without creating puddles, ponding, or any other nuisance drainage problems.

3.13 **WIRE & CABLES**

- A. Where wires pass under paved areas, they shall be installed in a 2" Schedule 40 PVC sleeves, separate from lateral or main lines. These sleeves shall be installed prior to installation of the paving, if possible, and prior to installation of the wires.
- B. Run a single 14-gauge wire along the top of the main line to be used for tracking the location of the main line. The color of the tracing wire shall be different than any other wire color used.
- C. All wires shall be installed with twenty-four (24) inches of excess wire (coiled) at the end of each wire run, wire splice, and at each controller.
- D. Isolation valves, quick coupling valves, manual drain valves, and wire splices not specifically associated with the control valve shall be located in separate valve boxes.

3.14 **SPRINKLERS**

- A. General:
 - 1. All sprinkler heads shall be installed above grade so as to minimize washing of the topsoil and seed during the landscaping establishment period, except those which border paving or flat work of any kind. These heads shall be installed at the finished grade of the adjacent paving or flat work. Prior to final acceptance of the project, all heads shall be raised or lowered to final lawn or planting grade.
 - 2. All sprinkler heads shall be installed using the bottom inlet. No side outlets shall be used. Tape or plug all open ends while installing to prevent debris contamination.
 - 3. Rotor heads located on hillsides shall be adjusted to the downhill side to avoid cutting into the hill by the stream of water and causing erosion.
 - 4. Heads installed in existing sod shall be set at the grade of the soil.
 - 5. All rotor pop-up heads shall be installed at final grade using Lasco unitized swing joint or Spears swing joint riser assemblies. All swing joints must drain by gravity back to the supply lines.
 - 6. All pop-up, shrub spray/rotary, turf spray/rotary, bubbler and strip spray/rotary heads shall be installed as shown in the details.
 - 7. All pipes, lines, and risers shall be flushed thoroughly with water before installation of any heads. All debris and rocks found at that time shall be removed from the area as soon as possible.
 - 8. All spray sprinklers shall be flushed thoroughly with clean water a second time

before installation of nozzles.

9. The Contractor shall adjust all heads to provide a uniform coverage and to keep spray off buildings, walkways, walls, parking areas, and drives.
10. Check valves shall be used where indicated and where necessary to prevent water flow from lower elevation heads when system is turned off. Install per manufacturer's recommendations.

B. Inline Drippers

1. Inline drip tubing shall be spaced approximately equal to the inline emitter spacing. Inline drip tubing spacing may be adjusted to be slightly less than the emitter spacing in order to achieve uniform spacing. For slope applications, place drip tubing laterals parallel to the slope contour. When slopes exceed thirty (30) percent, increase the recommended lateral spacing by twenty-five (25) percent on the lower one third (1/3) of the slope.
2. Inline dripper tubing shall be installed at finished grade with soil staples and covered with three (3) inches of specified mulch. Supply and exhaust headers shall be installed at normal lateral line depths.
3. All drip tubing shall be held in place by soil staples and shall conform to the following:
 - a. Sandy Soil - One staple per every three (3) feet and two (2) staples on each change of direction (tee, elbow, or cross)
 - b. Loam Soil - One staple every four (4) feet and two (2) staples on each change of direction (tee, elbow, or cross)
 - c. Clay Soil - One staple every five (5) feet and two (2) staples on each change of direction (tee, elbow, or cross)
4. Installation of inline drip circuits shall generally conform to the following steps:
 - a. Assemble and install ball valve, filter, remote control valve and pressure regulating valve assembly in accordance with installation details.
 - b. Assemble and install supply header(s) in accordance with installation details. Tape or plug all open connections to prevent debris contamination.
 - c. Install lateral drip lines in accordance with details and relevant specifications and manufacturer's recommendations. Tape or plug all open ends while installing to prevent debris contamination.
 - d. Assemble and install exhaust header(s) in accordance with installation details. Tape or plug all open connections to prevent debris contamination.
 - e. Install air/vacuum relief valve(s) at the zone's highest point(s) in accordance with installation details.
 - f. Thoroughly flush supply header(s) and connect drip lateral lines while flushing.
 - g. Thoroughly flush drip lateral lines and connect to exhaust header(s) and any interconnecting lateral lines while flushing.
 - h. Thoroughly flush exhaust header(s) and install line flushing valves in accordance with details.

3.15 AS-BUILT DOCUMENTS

- A. The Contractor shall keep a current and accurate record of exact dimensioned locations, grades, elevations, and size of all exterior and interior underground piping, valves, and drains. Dimensions shall indicate distances from columns, buildings, curbs, and similar permanent features on the site. This information shall be recorded on a print as the work progresses and shall be permanently recorded electronically via AutoCAD or similar Autodesk program. The AutoCAD as-builts will then be provided to the Owner, which will include a PDF of all as-builts and any electronic files. At the conclusion of the work, the Contractor shall present to the Owner fresh, clean drawings of all the changes made and recorded previously and they shall become part of the permanent record of the project.
- B. Final payment for the contract will not be processed until "As-Built" drawings or plans are received by the Owner.

3.16 OPERATIONAL TEST AND MAJOR INSPECTIONS

- A. Substantial Completion:
 - 1. At substantial completion of the irrigation system, the Contractor shall call for an operational and coverage test. Substantial completion shall be defined as the complete installation of all irrigation equipment and completion of all backfilling and grading operations in their entirety. Substantial completion shall not be given for designated portions of the project.
 - 2. Notice by the Contractor shall be given, in writing, at least three (3) days in advance to the Owner so that proper scheduling can be made for those who are to attend.
 - 3. At the appointed time, an inspection of all irrigation equipment, including control valve assemblies, controllers, isolation valves, quick coupling valves, drain valves, and sprinklers shall be made. The entire system will be tested for operation, coverage, and head adjustment. Please note that the pressure testing of the main lines shall already have been completed prior to this time.
 - 4. A list of uncompleted items or repairs (punch list) shall be generated by the Owner and distributed to the Contractor and other involved parties within three (3) days of the operational testing. Each item on the punch list shall be corrected before the system will be approved and accepted by the Owner. The Contractor will be back charged for time spent by the Owner and any consultants who have been brought to the site for a final inspection when the project is not ready for said inspection.
- B. Maintenance/Establishment Period:
 - 1. The duration of the irrigation maintenance period shall be equal to the plant maintenance/establishment period. It shall begin one (1) day after the substantial completion inspection. The Contractor shall complete all punch list items during the maintenance period, as well as maintain and operate the entire irrigation system.
 - 2. The irrigation Contractor (if different than the landscaping Contractor) shall coordinate with the landscaping Contractor during the entire plant and lawn establishment period on the use, scheduling, and maintenance of the sprinkler system.
 - 3. The maintenance period shall not end until Final Acceptance of the project.

- C. Final Acceptance:
1. A second inspection shall be held at the end of the maintenance period to ensure that all punch list items have been completed and the entire system is ready for acceptance by the Owner.
 2. Upon satisfaction that the Contractor has completed all punch list items, the irrigation system is fully and completely functional, and the required As-Built drawings and maintenance manuals have been submitted, the Owner shall accept the project.
 3. An official letter of final acceptance shall be prepared and issued by the Owner to the Contractor and Landscape Architect. Upon acceptance of the system by the Owner, the Owner shall assume full responsibility for the system, and the guarantee period shall begin.

3.17 **GUARANTEE AND MAINTENANCE**

- A. Guarantee:
1. Upon final acceptance of the irrigation system as being operational and properly installed, the Contractor shall guarantee the workmanship, materials, fixtures, and equipment to be free from defects for a period of one (1) year after that date.
 2. The Contractor shall insure and guarantee complete drainage of the system. In working with or connecting to an existing system, the Contractor shall guarantee compatibility in operation and drainage between the two systems.
- B. Maintenance Required During Guarantee Period:
1. In the fall of the year during the installation and guarantee period, the CONTRACTOR shall meet with the Owner's maintenance personnel on the site. The Contractor shall winterize the system by draining all of the water and doing everything necessary to insure protection of the system until spring. Blowing out the lines by compressor shall be permitted during the one (1) year guarantee. Maximum compressor pressure shall be 30 psi on spray circuits, 50 psi on rotor circuits, and 20 psi on all drip circuits. The individuals involved from both parties shall exchange all information necessary for the eventual take-over of the system by the Owner.
 2. The Contractor, with the Owner's maintenance personnel and Owner in attendance, shall energize the sprinkler irrigation system again the following spring and shall repair all defects found as a result of winter damage, improper installation, improper maintenance, defective materials or inadequate sprinkler drainage.
 3. At the end of the guarantee period, when the lawn and landscaping have been accepted, the Contractor shall call for a final inspection of the sprinkler irrigation system. There shall be at least five (5) days prior notice given in writing to the Owner so the appropriate people have opportunity to attend.
 4. Prior to that time, the Owner shall adjust all heads to their proper pattern, radii, and height. The system shall have been flushed out, checked for operation, and any defects covered by the guarantee shall be repaired. The entire system shall be inspected and checked to determine if everything is in working order. A final list of warranty items found in need of correction (if any) shall be made and the

Contractor shall correct them. The Contractor shall notify the Owner when he has verified that every item is corrected.

5. After all warranty items have been corrected, the Owner shall, in writing, officially release the Contractor from all warranty claims pertaining to the irrigation system and assume full and complete responsibility for said system.

END OF SECTION