

SECTION 32 84 00
IRRIGATION
Construction Specification

PART 1 GENERAL

1.1 DESCRIPTION

- A. The work in this section consists of furnishing, layout and installing an irrigation system complete, including certification of irrigation system installation as required by the State of California Model Water Ordinance described herein.
- B. The Contractor shall also install purple mainline and lateral pipe adjacent to and in parallel with the system piping design in preparation for future integration to reclaimed water. Refer to Drawings.
- C. Related Documents:
 - 1. Section 32 90 00 PLANTING.
 - 2. Section 26 00 00 ELECTRICAL stub-out(s) for controller(s).
- D. California Model Water Efficient Landscape Ordinance Requirements:
 - 1. Contractor shall be familiar with and follow the State of California Model Water Ordinance, California Code of Regulations, Title 23 Waters, Division 2, Department of Water Resources, Chapter 2.7. Also, the Contractor is responsible to follow all local water ordinances.
 - 2. Pursuant to the requirements of the California Model Water Efficient Landscape Ordinance, the Contractor shall submit a Certification of Installation to the Local Jurisdiction /water purveyor as described in the construction documents and these specifications. Certification shall at a minimum include the following documents:
 - a. Project Information Sheet
 - b. Certification of Installation according to the landscape documentation package.
 - c. Irrigation Scheduling and Controller Programming
 - d. Schedule of Landscape and Irrigation
 - e. Landscape Irrigation Audit Report
 - f. Soil Management/Analysis Report with verifying implementation, see
 - g. Planting Specification for analysis requirements.

1.2 QUALITY ASSURANCE

- A. Manufacturer's Specifications: Follow manufacturer's current printed specifications and drawings in all cases where the manufacturers of articles used in the Contract furnish directions covering points not specified or shown in the drawings.
- B. Ordinances and Regulations: All local, municipal and state laws, codes and regulations governing or relating to all portions of this work are hereby incorporated into and made a part of these Specifications. Anything contained in these Specifications shall not be construed to conflict with any of the above codes, regulations or requirements of the same. However,

when these Specifications and Drawings call for or describe materials, workmanship or construction of a better quality, higher standard, or larger size than is required by the above codes and regulations, the provisions of these Specifications and Drawings shall take precedence. Furnish without extra charge additional materials and labor required to comply with above rules and regulations.

C. References, Codes and Standards:

1. AB 325 and 1881 State of California Model Water Efficient Landscape Ordinance, California Code of Regulations Title 23.
2. California Environmental Quality Act (CEQA)
3. Water Use Classification of Landscape Species (WUCOLS).
4. American Society of Irrigation Consultants (ASIC) Design Guidelines.
5. California Landscape Standards, California Landscape Contractors Association, (CLCA) Sacramento, California.
6. CAL-OSHA, title 8, Subchapter 4-Construction Safety Orders and Subchapter 7-General Industry Safety Orders.
7. California Electric Code.
8. California Plumbing Code (UPC) published by the Association of Western Plumbing Officials.
9. NFPA 24, Section 10.4, Depth of Cover.
10. Underwriters Laboratories (UL): Electrical wiring, controls, motors and devices, UL listed and so labeled.
11. American Society of Testing Materials (ASTM).

D. Furnish without extra charge any additional material and labor when required by the compliance with all above mentioned codes and regulations, though the work be not mentioned in these specifications or shown on the drawings.

E. Note: Reclaimed water is not currently available on SMCCCD campuses as of July 2019, but is anticipated in the future. Appropriate steps to prepare for future use of reclaimed water shall be taken.

1. If using Reclaimed Water: Contact water company supplying reclaimed water prior to the commencement of installing the irrigation system to coordinate inspection of the work and to verify all codes and regulations regarding use of reclaimed water. Provide all required signage and other warnings.

F. Experience: Assign a full-time employee to the job as supervisor for the duration of the Contract with a certified landscape technician, irrigation certification through CLCA or minimum of four (4) years' experience in landscape irrigation installation.

G. Labor Force: Provide a landscape installation and maintenance force thoroughly familiar with, and trained in, the work to be accomplished to perform the task in a competent, efficient manner acceptable to the Owner's Representative.

H. Explanation of Drawings:

1. Due to the scale of the Drawings, it is not possible to indicate all piping offsets, fittings, sleeves, etc., which may be required. Carefully investigate the conditions affected all of the work and plan accordingly, and furnish all required fittings. Install system in such a manner to avoid conflicts with planting, utilities and architectural features.
 2. Do not install the irrigation system as shown on the Drawings when it is obvious in the field that obstructions, grade differences or discrepancies in arc dimensions exist that might not have been considered in engineering. Bring such obstruction or differences to the attention of the Owner's Representative. Notify and coordinate irrigation Work with applicable contractors for location and installation of piping and sleeves through or under walls, pavement and structures. In the event this notification is not given, the Contractor shall assume full responsibility for any revision necessary. All deviations from the original design shall be recorded and submitted in the as-built drawing set.
- I. Coordinate plant locations with emitter locations.
1. Adjust plant locations in relation to the subsurface emitters as required to ensure that the plant roots receive the proper amount of water in order for it to thrive.
 2. Coordinate planting and irrigation and provide hand watering of emitter irrigated and drip irrigated areas as required to maintain moist root zones until end of plant establishment period.
- J. Coordination of Landscape Irrigation with Mechanical for building systems.
1. Refer to Drawings for copper stub-ups by mechanical into landscape areas. Coordinate with the work of other sections and provide installation of landscape remote control valves, wire and controllers in garage areas with mechanical's copper feeder lines. Coordinate locations and work of other sections with Rain Shut Off and Controller Antenna. Install required equipment, wiring, etc. See electrical and mechanical for conduits, etc.
- K. Protection of Existing Structures and Utilities:
1. The Drawings show, if applicable, existing above and below grade structures and utilities that are known to the Owner. Locate known existing installations before proceeding with construction operations that may cause damage to such installations. Existing installations shall be kept in service where possible and damage to them shall be repaired with no adjustment of Contract Sum. Verify with Owner if As Built drawings are available.
 2. If other structures or utilities are encountered, request Owner's Representative to provide direction on how to proceed with the Work. If a structure or utility is damaged, take appropriate action to ensure the safety of persons and property.
 3. Verify location of existing irrigation systems to be removed and/or replaced. Maintain any existing systems as required by the Drawings and Specifications, including temporary retention of systems necessary to maintain existing on site and adjacent planting.
- 1.3 SUBMITTALS, IN ACCORDANCE WITH SECTION [01 33 00]
- A. Materials List:
1. Submit required copies of the cut sheets and a complete list of materials proposed for installation, along with any proposed substitutions clearly identified and obtain the Owner Representative's written approval thereof before proceeding. Use only accepted materials and items of equipment.

2. List all materials by manufacturer's name and model number.
 3. Submit to Local Water Purveyor with copy to the Owner Certification of Installation as required by the State of California Model Water Ordinance.
 - a. Submit all materials related to this Section in one Submittal.
- B. Substitutions:
1. If the Contractor desires to substitute a product, he shall list each item and note it as a "substitution" and provide descriptive information describing its similarities to the specified product.
 2. If the product is approved and, in the opinion of the Owner's Representative, the substituted product does not perform as well as the specified product, the Contractor shall replace it with the specified product at no additional cost to the Owner.
- C. Operations and Maintenance Manuals:
1. Prior to the final acceptance of the irrigation system, furnish three (3) individually bound Operation and Maintenance Manuals to the Owner's Representative for use by the Owner. The manuals shall contain complete enlarged drawings, diagrams and spare parts lists of all equipment installed showing manufacturer's name and address. In addition, each Service Manual shall contain the following:
 - a. Index sheet indicating the Contractor's name, address and phone number.
 - b. Copy of the Landscape Irrigation Audit
 - c. Copy of the 12-month irrigation schedule and estimate of annual water consumption
 - d. Copies of equipment warranties and certificates.
 - e. List of equipment with names, addresses and telephone numbers of all local manufacturer representatives.
 - f. Complete operating and maintenance instructions in sufficient detail to permit operating personnel to understand, operate and maintain all equipment.
 - g. Parts list of all equipment such as controllers, valves, solenoids and heads.
- D. Record Drawings:
1. Dimension the location of the following items from two (2) permanent points of reference such as building corners, sidewalks, road intersections, etc.:
 - a. Connection to existing water lines/meter.
 - b. Connection to electrical power.
 - c. Gate valves.
 - d. Routing of sprinkler pressure lines (a dimension at least every 100 feet and as required to identify all changes in direction and location).
 - e. Routing of reclaimed system purple pipe where installed for future.

- f. Remote control valves.
 - g. Routing of control valves.
 - h. Quick coupling valves.
 - i. All sleeve locations.
 - j. Routing of all control wiring.
 - k. Include all invert elevations below 12".
2. Deliver a reproducible record drawing to the Architect within seven (7) working days before the date of final review. Delivery of the record drawings shall not relieve the Contractor of the responsibility of furnishing required information in the future.
- E. Controller Plan:
1. Provide one Irrigation Diagram plan in each controller housing. The plan shall show the area controlled by each valve in different colors and for orientation, any major permanent structure such as buildings and roads.
 2. Charts to be waterproof and hermetically sealed between two pieces of transparent 10 mil thick plastic and installed in each controller on the door as accepted by the Owner's Representative no later than the time of the coverage test of the irrigation system.
- F. Maintenance Material - supply the following tools to the Owner:
1. Three (3) sets of specialized tools required for removing, disassembling and adjusting each type of sprinkler, valve or other equipment supplied on this project.
 2. Two (2) keys for each type of equipment enclosure.
 3. Two (2) keys for each type of automatic controller.
 4. Two (2) keys for each type of valve (including square type key for valves larger than 2")
 5. Two (2) quick-coupler keys and matching hose swivels for each type of quick-coupling valve installed.
 6. All lock keys shall be keyed alike.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Furnish and deliver materials in manufacturer's packaging, bearing original legible labeling.
- B. The Contractor is cautioned to exercise care in handling, loading, unloading, and storing pipe and fittings. All pipe shall be transported in a vehicle which allows the length of the pipe to lie flat so as not to subject it to undue bending or concentrated external load at any point. Any section of pipe that has been dented, cracked, or otherwise damaged shall be discarded and, if installed, shall be replaced with new piping.

1.5 TRENCH INTERFERENCE WITH EXISTING TREE ROOT SYSTEMS

- A. Where Irrigation is shown within the drip line of existing trees, Contractor shall determine in the field where irrigation can be installed without impacting or damaging existing roots.

Contractor shall layout exact proposed trench locations or equipment and review locations with the Arborist and Resident Engineer. Adjust the system as required to avoid damage to tree roots and as directed by the Arborist and Owner.

- B. Excavation within the drip line shall be done by hand only, with no exceptions unless approved or directed by the Arborist.
- C. The Contractor is responsible for securing the services of a Certified Arborist at no cost to the Owner.
- D. Excavation in areas where 2 inch (50 mm) or larger roots occur shall be done by hand. All roots 2 inch (50mm) and larger in diameter, except directly in the path of pipe or conduit, shall be tunneled under and shall be heavily wrapped with burlap, to prevent scarring or excessive drying.
- E. Where a ditching machine is run close to trees having roots smaller than 2 inch (50 mm) in diameter, the wall of the trench adjacent to the tree shall be hand trimmed, making clean cuts through.

1.6 SEQUENCING AND SCHEDULING

- A. Acceptance: Do not install main line trenching prior to acceptance by Owner's Representative of rough grades completed under another Section.
- B. Coordination: Coordinate with the work of other sections to insure the following sequence of events:
 - 1. Sleeves and Conduits: Installation of all sleeves and conduits to be located under paving and through walls prior to placement of those materials.
 - 2. Bubbler Heads: Install after placement of tree, but prior to backfill with planter soil mix.
 - 3. On-Structure Equipment: Install piping and risers after waterproofing is accepted.
 - 4. Sprinkler Head in Pots: Install riser and seal the penetration of the pot prior to backfill of pot with drainage materials and planter soil mix.
 - 5. Coordinate work schedule with Owner to avoid disruption of landscape maintenance of existing landscaping.
 - 6. Install piping prior to soil preparation (planting soil amendment installation).

1.7 WARRANTY, PER SECTION [01 78 36]

- A. In addition to manufacturer's guarantees and warranties, work shall be warranted for one (1) year from date of final acceptance against defects in material, equipment and workmanship. Warranty shall also cover repair of damage to any part of the premises resulting from leaks or other defects in materials, equipment and workmanship to the satisfaction of the Owner.
- B. Include a copy of the warranty form in the Operation and Maintenance Manual.

1.8 OPERATION

- A. Routine: Inspect and adjust all spray heads and control valves including raising or lowering of spray head heights to accommodate plant growth and weather conditions.

- B. Controller: Inspect regularly for power interruption and reset clock as required. Adjust station timing to accommodate changes in plant growth and weather conditions.
- C. System Failure: Perform all repairs within one (1) operating period. Replacements to match removed products and materials in all respects. Report promptly all damage not resulting from Contractor's operations. Repair all damage caused by Contractor at no expense to Owner.
- D. Climate Change: Set and program automatic controllers in response to seasonal requirements and requirements of newly planted materials.

PART 2 PRODUCTS

2.1 DESIGN STANDARD

For the following sections PVC piping should be avoided if and wherever possible due to its toxicity to both human and environmental health. For any PVC listed products below, a HDPE or other alternative product should be used. In cases where this is not possible approval from the District Project Manager should be obtained to utilize PVC.

- A. Pipe:
 - 1. Pressure Main Line Pipe and Fittings: All fittings shall bear the manufacturer's trademark name, material designation, size, applicable I.P.S. schedule and NSF seal of approval.
 - 2. Main line pipe:
 - a. 3 inches and smaller: Schedule 40.
 - b. 4 inches and larger: Class 200.
 - c. PVC Pressure Rated Pipe: ASTM D2241 NSF approved Type I, Grade I, solvent welded PVC with an appropriate standard dimension ratio (S.D.R.).
 - d. PVC Scheduled Pipe: ASTM D1785 NSF approved, Type I,
 - e. Grade I, solvent welded PVC.
 - f. PVC Solvent-weld Fittings: ASTM D2466 Schedule 40, 1-2, II-I NSF approved.
 - g. Solvent Cement and Primer for PVC solvent-weld pipe and fittings: Type and installation methods prescribed by the manufacturer.
 - h. Connections between Main Lines and RCVs: Schedule 80 PVC (threaded both ends) nipples and fittings unless required otherwise by local jurisdiction.
 - i. Valves 2-inch and larger shall be flanged only.
 - j. Copper pipe shall be Type K or Red Brass where threaded joints are required and Type L otherwise.
 - k. Main line pipe for reclaimed systems shall be purple-colored PVC material and shall be printed on two sides with the wording "CAUTION-RECLAIMED WATER" every 24 inches along the pipe.
 - 3. Lateral line pipe:

- a. All lateral line pipe shall be solvent welded and shall be schedule 40 unless shown otherwise on the Drawings.
 - b. Lateral line pipe for reclaimed systems shall be purple-colored PVC material and shall be printed on two sides with the wording "CAUTION-RECLAIMED WATER" every 24 inches along the pipe.
- B. Controller Enclosures:
1. Type: Use one of the following (unless noted otherwise on the Drawings):
 - a. Stainless steel, NEMA Type 3 rated, with back panel, padlocking hasp and padlock Rain Bird, Le Meur, "Strong Box" or approved equal. See Detail for pedestal construction.
 - b. Rain Bird, "Non-Central" Controller Assemblies
 - 1) LXMM – ESP – LXM Cabinet, Powder Coated Steel
 - 2) LXMPED – ESP-LXM Pedestal, Powder Coated Steel
 - c. Verify correct equipment to fit the specified equipment from Rain Bird Services Corporations "Package Systems" for "Central Control" projects. Available from Rain Bird Services Corporation (RBSC) (888) 444-5756.
 - d. Le Meur, (714) 822-5100.
 - e. "Strong Box" available from John Deere, (800) 347-4272.
- C. Remote Control Valve: As shown on Drawings and with the following minimum requirements:
1. Remote control valves shall be those normally manufactured for irrigation systems and shall have a slow, consistent speed of closure through entire closing operation, including last portion. To ensure this, the effective diaphragm working area/valve seating opening ratio must be a minimum 3 to 1.
 2. Shall be mechanically self-cleaning to help prevent diaphragm or solenoid port plugging. To ensure this, the flush rod should be tapered to vary the size of the port opening as the diaphragm raises and lowers, thus allowing trapped material to escape. Rod is to be finished with a serrated surface to help scrub trapped material out. Screens not acceptable.
 3. Shall have removable valve seat so valve can be repaired without removal from irrigation line.
 4. Shall have ability to operate manually without the use of wrenches or special keys.
 5. Shall have one-piece solenoid that attaches directly to valve without shunts or clips that can be lost.
 6. Shall have cross top handle to adjust maximum travel of diaphragm to allow "tuning" of valve and closure.
- D. Box For Remote Control Valve :
1. Rectangular black plastic valve box by Ametek, Carson, Christy, Rain Bird or approved equal, with non-hinged bolt down black colored lid marked "irrigation". Box

body shall have knock outs. Do not saw cut body. The minimum size box is as shown on Drawings. Increase box size as required to fit. Valve box lids are to indicate the controller letter and station number of valve as accepted by Owner's Representative. Also refer herein to required polyurethane tag at valve solenoid control wire under Control Wires. Locate the identification in center of the lid. Provide separate box for each valve. Provide H/20 Loading concrete boxes with bolt-down concrete lids for all valves that occur in paved areas.

- E. Controller(S): [Editor's Note: This controller specification is for Cañada College only.]
1. Shall be user-friendly. The controller must have a minimum 20-character readout display describing actions or options, or a full visible panel of buttons, dials, or switches that control all different functions separately.
 2. Shall have the ability to start a programmed sequence of valves a minimum of 5 times a day per program.
 3. Shall have ability to easily and quickly change watering schedules due to change in weather.
 4. Flow Sensors: Compatible with Controller and as recommended by Controller manufacturer.
 5. Hand Held Remote Control: Portable device as manufactured by Controller manufacturer capable of operating all control valves.
 6. Master Control Valve: Compatible with Controller and with the following requirements:
 - a. Master Control Valve shall be a 24 VAC, industrial type, solenoid control valve, Griswold 2000 series or equal. Valve shall be equipped with spring loaded packless diaphragm, cast iron body and bronze trim. The valve shall be of the normally closed type and shall be equipped with four-prong (cross) flow control. Valve shall be slow closing without chatter settings or adjustment. Valve shall have a mechanical self-purging internal control system with tapered, serrated, scrubbing rod through diaphragm for positive, variable port opening and cleaning. No solenoid port screens. Valve solenoid shall be corrosion-proof, molded in epoxy to form one integral unit with no connection shunts and shall be 24 VAC, 3 watt maximum.
- F. Satellite Controller(S): [Editor's Note: This controller specification is for Skyline and CSM only.]
1. General: Satellite controllers capable of communicating and operating with existing Campus Central Control System.
 2. ET based monitoring
 3. Capable of field change programming uploads.
 4. Alarm reporting for system component failure.
 5. Report generation: run time, water usage, alarms, logged system changes.
 6. Water use, rain, and ET accumulation.
 7. Flow Sensors: Compatible with Central Control System and as recommended by Control System manufacturer.

8. Flow Monitors: Compatible with Central Control System and as recommended by manufacturer.
 9. Hand Held Remote Control: Portable device as manufactured by Central Control System manufacturer capable of operating all control valves.
- G. Master Control Valve: Compatible with Central Control System and with the following requirements
1. Master control valve shall be a 24 VAC, industrial type, solenoid control valve, Griswold 2000 series or equal. Valve shall be equipped with spring loaded packless diaphragm, cast iron body and bronze trim. The valve shall be of the normally closed type and shall be equipped with four-prong (cross) flow control. Valve shall be slow closing without chatter settings or adjustment. Valve shall have a mechanical self-purging internal control system with tapered, serrated, scrubbing rod through diaphragm for positive, variable port opening and cleaning. No solenoid port screens. Valve solenoid shall be corrosion-proof, molded in epoxy to form one integral unit with no connection shunts and shall be 24 VAC, 3 watt maximum.
- H. Controller Ground:
1. Provide each pedestal controller with its own ground rod set remote from controller as recommended by controller manufacturer. Separate the ground rod by a minimum of eight feet. The ground rod shall be an eight foot long by 5/8" diameter U.L. approved copper clad rod or as recommended by controller manufacturer. Install no more than 6" of the ground rod above finish grade. Connect #8 gauge wire with a U.L. approved ground rod clamp to rod and back to ground screw at base of controller with appropriate connector. Make this wire as short as possible, avoiding any kinks or bending. Install within pedestal housing base unless otherwise noted.
 - a. Provide each irrigation controller with its own independent low voltage common ground wire.
- I. Control Wires:
1. Connections between automatic controllers and the solenoid-operated electric control valves shall be made with direct burial copper wire 14- AWG-UF 600 volt (minimum size). Pilot wires shall be a color other than white, and shall be a different color for each automatic controller with wires sharing a common trench. Common wires shall be white in color, with a different color stripe for each controller with wiring sharing the same common trench. No stripe is required if multiple controller wiring is not present.
 2. Size of wire shall conform to the remote control valve manufacturer's specification for control wire sizes, but in no case shall the control wire be smaller than #14. Runs over 2,000 lineal feet shall be #12- AWG-UF 600 volt copper wire.
 3. All wire splices are to be made within a valve box, with a copper crimp-type connector, and a "3-M" #DBY splice kit or Rain Bird "DBTWC25".
 4. Use continuous control wiring between controllers and remote control valves (no splices).
 5. Provide polyurethane tag at valve solenoid control wire that shows the controller number and station number. Also refer to valve box lid identification.
 6. Provide a spare control wire in each RCV box for future expansion.
- J. Spray Heads:

1. Pop-up as shown on drawings and with the following minimum requirements:
 - a. Shall have approximately 30 psi water pressure coming out of nozzle to prevent "fogging" or misting. Shall have pressure-compensating devices.
 - b. Shall have ability to prevent low head drainage. Use heads with integral check valves.
 - c. Shall not have spray blocked by turf or shrubbery; use minimum 4" pop-ups in turf areas.

- K. Rotor Heads:
 1. As shown on drawings and with the following minimum requirements:
 - a. Heads shall have exact matched precipitation rates. Radius and precipitation rates must be the same.
 - b. Rotors should be pressure regulated

- L. Bubbler Heads:
 1. As shown on drawings

- M. Quick Coupler Valves:
 1. Quick coupler valves shall be 3/4" minimum. List on the Drawings with 10" diameter black box and black lid similar to isolation valve box described below.

- N. Isolation Valve:
 1. Valves 3 inches and smaller: 125 lb. WSP bronze gate valve with screw-in bonnet, non-rising stem and solid wedge disc, NIBCO T-113 K, or approved equal. Valves shall be line size.
 2. Valves larger than 2": shall have square nut stem and o-ring connections for key operation.

- O. Drip Irrigation (On Surface):
 1. Drip Manifold:
 - a. Pressure Regulator: Preset at 30 psi outlet pressure, 3/4" female threaded inlet and outlet, by RainBird, Toro or equal.
 - b. Emitters: Xeri-Bug (XB Series) by RainBird, Toro EZ Drip Series, or equal.
 - c. Flexible PVC: ASTM D2287 algae-resistant flexible PVC as recommended by manufacturer of Drip Emitters.
 - d. Drip tubing: Conform to A. S. A. E. standards for minimum inside diameter and wall thickness, Minimum 2% carbon black, Salco 3/4" AR Drip PVC flexible drip hose, or equal.
 - e. 3/4" Y-filter, 200 mesh.
 - f. Toro DL 2000 Air/Vacuum Relief Valves and In-line Spring Check Valves.
 - g. 3/4" manual PVC ball valve with extra 3' of hose coiled in valve box.

- h. Drip system in accordance with "RainBird Xerigation Low-Volume Landscape Irrigation Design Manual" and as shown on the drawings as required for a complete working system.
 - i. Contractor shall add additional system check valves as necessary to prevent low emission drainage due to slope conditions.
 - j. Contractor shall include operational indicators as recommended by the manufacturer.
- P. Subsurface Drip Irrigation:
- 1. As specified herein and as shown on the drawings and in accordance with manufacturer's recommendations. Provide all miscellaneous valves, filters fittings etc. required for a complete, operable system including the following:
 - a. Emitters shall be Rain Bird XF-SDI with "Copper Shield" technology. Drip system in accordance with "RainBird Xerigation Low-Volume Landscape Irrigation Design Manual" and as shown on the drawings as required for a complete working system.
 - b. Or Toro DL 2000 Techline, in-line Treflon impregnated emitter with Netafim Automatic Flush Valves, Toro DL 2000 Air/Vacuum Relief Valves in accordance with "Toro DL-2000 Low-Volume Irrigation Bidding Specifications and Design Details" and as shown on the drawings as required for a complete working system.
 - c. Contractor shall add additional system check valves as necessary to prevent low emission drainage due to slope conditions.
 - d. Contractor shall include operational indicators as recommended by the manufacturer.
 - 2. Drip Valve Assembly: Size valve box large enough and deep enough to contain assembly and allow convenient access and easy removal of filter screen. Position filter pointed down, approximately 45 degrees.
 - 3. Pressure regulator: Size regulator in accordance with flow rate. Do not over size. Use factory pre-set regulator at 30 PSI.
- Q. Box for Isolation Valve:
- 1. 10" diameter black plastic - Ametek, Brooks, Christy, Rain Bird, or approved equal - with bolt down black lid marked "irrigation," or accepted equal. Avoid locating valve in paved areas. Provide H/20 Loading concrete box with bolt-down concrete lid if valve is located in paved area. Obtain location approval by Owner's Representative.
- R. Swing Joints:
- 1. Sprinklers and Bubblers: Use Dura, Lasco, Rain Bird or equal pre-assembled swing joints with O-rings.
 - 2. Quick Coupling Valve: Dura 1-inch 1-A2-1-11-18 pre-assembled swing joint with O-rings and Dura quick lock to receive stabilizing rod.
- S. Backflow Prevention Device:

1. As required by Code and as shown on Drawings. Verify with Owner if Anti-freeze Jacket is required and provide as required.
 2. Riser assemblies from main line burial depth to backflow preventers shall be Schedule 40 brass pipe.
 3. All metallic pipe and fittings installed below grade shall be painted with two coats of Koppers #50 Bitumastic, or approved equal. Pipes may be wrapped with an approved asphaltic tape in lieu of the liquid-applied coating.
 4. Backflow preventer shall receive a minimum 6 inch thick concrete coordinated to fit backflow preventer enclosure as shown and as accepted by the Landscape Architect.
- T. Backflow Prevention Device Enclosure:
1. Marine-grade Aluminum Backflow Enclosure available from V.I.T., Escondido, CA (800) 729-1314 or equal. Coordinate size of enclosure with plumbing for minimum clearance and size. Enclosure to include concrete footing with hasp and staple to receive padlock. Padlock N.I.C.
- U. Conduit/Sleeves:
1. Sleeving shall be Schedule 40 PVC pipe sleeves and a minimum of two times the aggregate diameter of all pipes contained within the sleeve. Provide vertical sweep for all electrical conduit on each side of hardscape and terminate ends at 12" minimum depth and 12" from hardscape surface.
- V. Y-Strainer:
1. "Y"-Strainer upstream of remote control valves, Brass, 100 mesh.
- W. RCV IDENTIFICATION TAGS: Plastic or brass tags with valve number, approximately 2" by 2" with number imprinted, as accepted by Owner.
- X. Miscellaneous Installation Materials:
1. Solvent Cement and Primers for Solvent-weld Joints: Make and type approved by manufacturer(s) of pipe and fittings. Maintain cement proper consistency throughout use.
 2. Pipe and Joint Compound: Permatex: Do not use on sprinkler inlet port.
- Y. Miscellaneous Equipment/Accessories:
1. Concrete for equipment pads: Poured-in-place Class A concrete per Section 90 of the Caltrans Standard Specifications.
 2. Sleeves and Conduits: See Drawings.
 3. Key(s) for Quick-Coupling Valves:
 - 1) Type: Same manufacturer as Quick-Coupling Valve.
- Z. Other Equipment: As shown on Drawings and required for a fully functional irrigation system.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Sleeves and Conduits: Verify that all installed sleeving and conduits are undisturbed and are free of defects or errors introduced by the work of other sections.
 - B. Water Meter/Water Pressure: Test and verify that existing water pressure is the minimum pressure at maximum system g.p.m. to operate the irrigation system as indicated on the drawings.
 - C. Stub-outs: Verify that all stub-outs to be provided under another contract are correctly sized, located and installed as noted on Drawings.
 - D. Notification: Submit written notification to Owner's Representative within ten (10) working days of above inspections describing all acceptable and non-acceptable site conditions.
- 3.2 Trench Layout/Interference with Tree Root Systems:
- A. Prior to trenching, layout main and lateral line locations within Drip Line of trees and review locations with Owner's Representative. Relocate any lines that may interfere with existing root systems to avoid or reduce damage to root systems as accepted by Owner's Representative.
- 3.3 Connections To Services:
- A. Provide and coordinate connection to water meter.
 - B. Provide and coordinate connection of irrigation controller to electrical power source.
- 3.4 Installation:
- A. Install irrigation system components in accordance with this Section, with the Drawings, with the manufacturer's recommendations, and with established industry standards. The Contractor shall do nothing that may jeopardize any manufacturer warranty.
 - 1. Conduits and Sleeves:
 - a. Coordination: Provide conduits and sleeves and coordinate installation with other trades.
 - b. Extent: Install conduits and sleeves where control wires and pipes pass under paving or through walls as shown on Drawings. Extend twelve inches (12") beyond edges of paving and walls and cap ends until ready for use.
 - 2. Excavating and Trenching:
 - a. Pipe Layout: Layout pipe lines within Spread of Tree Branches as described above in Part I, TRENCH INTERFERENCE WITH TREE ROOT SYSTEMS.
 - b. Dig trenches wide enough to allow a minimum of three inches (3") between parallel pipe lines. Provide a minimum cover from finish grade as follows:
 - 3. Pipeline Assembly:
 - a. Install pipe and fittings in accordance with manufacturer's current printed Specifications.
 - b. Clean all pipes and fittings of dirt, scale and moisture before assembly.
 - c. Solvent-welded Joints for PVC Pipes:
 - 1) Solvents: Use solvents and methods specified by pipe manufacturer.

- 2) Curing Period: Minimum of one (1) hour before applying any external stress on the piping and at least 24 hours before placing the joint under water pressure.
- d. Threaded Joints for Plastic Pipes:
 - 1) Use Permatex on all threaded PVC fittings except sprinkler heads and quick coupler valve ACME threads.
 - 2) Joining: Use strap-type friction wrench only. Do not use metal-jawed wrench. Assemble finger tight plus one or two turns.
- e. Laying of Pipe:
 - 1) Bedding On-grade: Remove from trench all rocks or clods. Bed pipe in at least 2 inches of soil excavated from trench. Backfill on all sides of piping to provide a uniform bearing.
 - 2) Snaking: Snake pipe from side to side of trench bottom to allow for expansion and contraction. Minimum allowance for snaking is one (1) additional foot per 100 ft. of pipe.
 - 3) Moisture Restrictions: Do not lay PVC pipe when there is water in the trench. Do not assemble PVC pipe unless the pipe is dry.
- f. Laying of Purple Pipe for future:
 - 1) Contractor shall install long pipe runs as feasible in parallel with the operational system.
 - 2) Cap purple pipe at both ends to avoid contamination.
4. Control Valves:
 - a. Install in valve boxes where shown on Drawings and group together where practical. Install box flush with finish grade, not necessarily level. If valve occurs in drainage swale, relocate out of drainage swale as approved by Owner's Representative.
 - b. Where two or more valves are installed adjacent to each other, provide at least six inches (6") separation. Align boxes in a row, perpendicular with pavement edge.
 - c. Permanently mark valve box lid with 2" black valve number and controller letter or with numbered metal tag inside box as approved by Owner's Representative.
 - d. Refer to control wiring for required spare wire in each valve box.
5. Install "Y"-Strainer upstream of remote control valves at backflow preventer with two pressure gauges, one upstream and one downstream of each strainer/filter.
6. Sprinkler Head Installation:
 - a. Pop-up Heads:
 - 1) Place all sprinkler heads in planting areas with top of heads set to finish grade or top of mulch as required.

- 2) Place part-circle pop-up sprinkler heads two inches (2") from edge of and flush with top of adjacent walks, header boards, curbs and mowing bands or paved areas and 12 inches (12") from building foundations at time of installation.
 - 3) Set all sprinkler heads in turf to allow for settlement. Adjust as required after settlement. Hold heads two inches (2") clear of pavement edge.
- b. Bubblers:
- 1) Coordinate installation with planting contractor to insure timely and proper placement of heads at new planting.
7. Subsurface Irrigation:
- a. Coordinate plant locations with emitter locations. Refer to QUALITY ASSURANCE herein.
 - b. Coordinate hand watering of emitter irrigated and drip irrigated areas. Refer to QUALITY ASSURANCE herein.
 - c. Coordinate emitter spacing with planting types and plant spacing as accepted by Landscape Architect. Install emitters at uniform 18 inches on center maximum and 2 to 4 inches deep, except where emitter spacing and depth is shown otherwise.
 - d. In Turf in raised (podium) planters and similar sandy soil planting areas, install emitters at uniform 12 inches on center maximum and 3 inches deep, except where emitter spacing and depth is shown otherwise.
 - e. Adjust spacing on slopes to prevent over watering at base of slopes. Install system in accordance with "Toro DL-2000 Low-Volume Irrigation Bidding Specifications and Design Details" and as shown on the Drawings as required for a complete working system.
 - f. Provide air/vacuum relief valves at all high points on systems.
 - g. Provide filter as shown and as recommended by emitter's manufacturer.
 - h. Tape pipe ends during installation and do not allow dirt or debris to enter pipe.
 - i. Use emitter line with the specified emitter flow rate and emitter spacing. Assemble dripper line to allow water to flow continuously and directly, with no dead ends or dead end loops between control valve and flush valve.
 - j. Use fittings at sharp bends and do not allow dripper line to kink.
 - k. Install emitter line around perimeter of planter not more than 3 inches off edge for ground cover and turf, 18 inches maximum for shrub planting.
 - l. Adjust alternate rows so emitters are spaced in a triangular pattern.
 - m. Collect water from multiple dripper lines and convey the water to automatic line flush valve.
 - n. Install flush valve at end(s) of collector laterals so that entire system will flush and be free of dirt and debris.

- o. Flush valves shall be open when water is turned on for the first time and after a break in the main or lateral lines. Extend collector lateral as required and locate flush valve at convenient accessible location.
 - p. Flush the systems weekly through the first month of the maintenance period.
 - q. Thoroughly saturate soil prior to planting. Provide additional surface watering as required to keep plant root systems moist during planting establishment period.
8. Drip Irrigation (On surface):
- a. Install system in accordance with "RainBird Landscape Irrigation Design and Specifications Xerigation Products and Details" or equal and as shown on the Drawings as required for a complete working system.
 - b. Install Toro DL 2000 Air/Vacuum Relief Valves at high points in system.
 - c. Install manual PVC ball valve with extra 3' of hose coiled in valve box at end(s) of collector laterals so that entire system will flush and be free of dirt and debris.
9. Automatic Controller:
- a. General: Install with lock box cutoff switch per local code and manufacturer's current printed specifications. Provide each controller with its own independent low voltage common ground wire.
 - b. Connection to Valves: Connect remote control valves to controller in clockwise sequence to correspond with station setting beginning with Stations 1, 2, 3, etc.
 - c. Labeling: Affix controller letter (i.e., "A") on inside of controller cabinet door with minimum of one-inch (1") high permanent letter.
 - d. Irrigation Diagram: Affix a non-fading, waterproof copy of irrigation diagram to cabinet door below controller name. Irrigation diagram to be sealed between two plastic sheets, 20 mil. minimum thickness. Use a legible reduced copy of the Record Drawing for the irrigation diagram clearly showing all valves operated by the controller, station, number, valve size, and type of planting irrigated. Color code area operated by each valve.
10. Control Wiring:
- a. General: Install control wires in common trenches with sprinkler mains and laterals wherever possible. Lay to the bottom side of pipe line. Provide looped slack at valves. Snake wires in trench to allow for contraction of wires. Tie wires in bundles at 10 ft. intervals.
 - b. Extra Length: Provide 30 inches (30") extra control wire at each remote control valve splice to facilitate the removal of the remote control bonnet to finish grade without cutting wires.
 - c. Spare: Install one unconnected spare control wire running from the controller through each intermediate control valve box.
 - d. Size: Minimum size of wire is to be determined strictly by the manufacturer's current printed specifications for remote control valves, but not smaller than #14.

- e. Detection Wire: Install a bare #12 copper wire or greater on top of the PVC supply line for the purpose of possible future mine detection search. Install the control wires on the bottom of the PVC supply line with electrical tape every ten feet (10').
 - f. Splicing: Crimp control wire splices at remote control valves. Seal with specified splicing materials. In-line splices will be allowed only on runs exceeding 2500 feet and only in junction boxes.
11. Closing of Pipe and Flushing of Lines:
- a. Capping: Cap or plug all openings as soon as lines have been installed to prevent entrance of materials that would obstruct the pipe. Leave in place until removal is necessary for completion of installation.
12. Rain Shutoff Switch:
- a. Install switch in area not affected by irrigation or rain shadow. Provide wires in rigid conduit as accepted by Owner's Representative.
13. Detection Wire and Warning Tape:
- a. Install a bare # 12 copper wire or greater on top of the PVC supply line for the purpose of possible future mine detection search.
 - b. Install a continuous PVC irrigation mainline warning tape 12" above the supply line.
14. RCV Identification Tags: Install in remote control valve box as recommended by manufacturer and as accepted by Owner's Representative.

3.5 MISCELLANEOUS EQUIPMENT

- A. Install miscellaneous equipment with concrete footings, brackets, etc., as required and as recommended by manufacturer.
- B. Field Quality Control:
 - 1. Testing of Irrigation System:
 - a. Sub surface drip: The Contractor must perform the following tests and demonstrate the operation of the system to the District Representative as well as the Manufacturer's Representative, prior to final soil lift and planting. Consistent coverage must be achieved for approval to proceed.
 - b. Make hydrostatic tests with risers capped when welded PVC joints have cured at least 24 hours. Center load piping with backfill to prevent pipe from moving under pressure. Keep all couplings and fittings exposed.
 - c. Install two (2) pressure gauges at opposite ends of main line system. Pump system up to a minimum of 125 psi the day preceding the scheduled test and verify that pressure is holding. Inspect system early following day and immediately notify Owner's Representative if the test confirmation must be postponed.
 - d. Apply continuous static water pressure of 125 psi in accordance with Caltrans Standard Specifications Section 20-5.03H, except after a drop in pressure (5

psi maximum), then the pressure must stabilize and remain stable for a one (1) hour minimum period before acceptance of the test.

- e. Leaks detected during tests shall be repaired and test repeated until system passes tests at no additional cost to Owner.

2. Irrigation Audit Report with Certificate of Completion:

- a. Per the requirements of the California Model Water Efficient Landscape Ordinance, the Contractor shall perform an irrigation audit and provide a report with certificate of completion to the local agency that may include, but is not limited to: inspection, system tune-up, system test with distribution uniformity, reporting overspray or run off that causes overland flow, and preparation of an irrigation schedule. Irrigation audits shall be conducted by a CLIA Certified landscape Irrigation Auditor by the Irrigation Association. Operation of the irrigation system outside the normal watering window is allowed for auditing and system maintenance.

3. Adjustment of the System:

- a. Flush and adjust all sprinkler heads for optimum performance and to prevent overspray onto walks, roadways and buildings. Adjust the arc and radius as applicable.
- b. Include as a part of the work any nozzle changes or arc adjustments necessary due to daytime windy conditions during grass establishment period. After grass has been established and watering can be performed during calm early morning or evening hours, make any required adjustments to nozzles and arcs.
- c. Set all sprinkler heads perpendicular to finished grades unless otherwise noted on the drawings.
- d. When the landscape sprinkler system is completed and before planting, perform a coverage test in the presence of the Owner's Representative to determine if the water coverage for planting areas is adequate.
- e. Test controllers individually in the presence of the Owner's Representative and the Landscape Architect. Demonstrate that all control valves operate electronically. Provide vehicles and radio equipment as necessary to expedite this process.
- f. Demonstrate to Owner's Representative that irrigation scheduling programmed into controller is adequate for plant requirements without causing runoff, and that scheduling capacities of controller are utilized.

C. Irrigation Scheduling and Controller Programming:

- 1. Per the requirements of the California Model Water Efficient Landscape Ordinance All irrigation schedules and programs shall be developed, managed and evaluated to utilize the minimum amount of water required to maintain plant health.
- 2. Irrigation controller Scheduling and Programming Parameters to be conducted by a CLCA Certified Irrigation manager and submitted to the local agency as part of the Certificate of Completion.
- 3. Parameters used to set the automatic controller shall be developed for each of the following:

- a. Plant establishment period
 - b. Established landscape period
 - c. Temporary irrigated area (if applicable)
4. Each irrigation schedule shall consider for each station all of the following that apply:
- a. Irrigation interval (days between irrigation)
 - b. Irrigation run times (hours or minutes per irrigation event to avoid runoff)
 - c. Number of cycle starts required for each irrigation event to avoid runoff
 - d. Amount of applied water scheduled to be applied on a monthly basis
 - e. Application rate setting
 - f. Root depth setting
 - g. Plant type setting
 - h. Soil type
 - i. Slope factor setting
 - j. Shade factor setting
 - k. Irrigation uniformity or efficiency setting
5. Total annual applied water shall be less than or equal to Maximum Applied Water Allowance (MAWA). Actual irrigation schedules shall be regulated by automatic irrigation controllers using current reference evapotranspiration data (CIMIS or soil moisture sensor data).
- D. Backfill and Compacting:
1. General: After system is operating and required tests and reviews have been made, backfill excavations and trenches with clean soil, free of debris.
 2. Backfill for All Trenches: Regardless of the type of pipe covered, compact to minimum 95% density under pavements and 85% under planted areas.
 3. Finishing: Dress off areas to finish grades. Re-dress any areas which subsequently settle.
 4. Owner's testing agency will test backfill compaction in areas under paving.
- E. Maintenance:
1. The entire sprinkler irrigation system shall be under full automatic operation for a period of 2 days prior to any planting.
 2. The Owner's Representative reserves the right to waive or shorten the operation period.
 3. Maintain/repair system for full duration of plant maintenance period.
- F. Reviews Prior to Acceptance:

1. Notify the Owner's Representative in advance for the following reviews, according to the time indicated:
 - a. Supply line pressure test and control wire installation - 72 hours.
 - b. Coverage and controller test - 72 hours.
 - c. Final review - 7 days.
 2. No reviews will commence without record drawings, without completing previously noted corrections, or without preparing the system for review.
- G. Final Review and Cleanup, Per Section [01 77 00]:
1. Operate each system in its entirety for the Owner's Representative at time of final review. Any items deemed not acceptable by the Owner's Representative shall be reworked to the complete satisfaction of the Owner's Representative.
 2. Provide evidence to the Owner's Representative that the Owner has received all accessories and equipment as required before final review can occur.
 3. Final acceptance and start of warranty period will occur no earlier than the end of the plant maintenance period.
 4. For time of final review, Contractor shall arrange a meeting with the Owner's maintenance personnel to demonstrate the operation of the irrigation systems automatically in order to verify acceptance and to familiarize the maintenance personnel with the system and recommended programming.

3.6 WATER EFFICIENCY

- A. NOTE: A Water Efficient Landscape worksheet is to be completed by the landscape architect and included in the Specifications or on the Drawings. Following is an example.

Water Efficient Landscape Worksheet
 San Mateo Community College District
 [Project Name, Campus]

Hydrozone*	Zone or Valve	Irrigation Method**	Area (Sq. Ft.)	% of Landscape Area
1 - MW	1,2,3	B	26,100	15
2 - MW	11,16	B	23,070	13
3 - MW	16	B	1,390	01
4 - LW	17,18,19	S	2,874	02
5 - MW	20,21,25,26,27,38,39,40,43,44	S+B	28,870	17
6 - HW	12,13,14,15,22,23,24	R	17,750	11
7 - HW	28,29,30	R	3,246	02
8 - HW	36,37	R	5,780	03
9 - HW	4,5,6,7,8,9,32,33,34,35,41,42	R	62,370	36
	TOTAL:		171,450	100%

*Hydrozone

HW = High Water Use Plants
 MW = Moderate Water Use Plants
 LW = Low Water Use Plants

**Irrigation Method

S = Spray
 R = Rotor
 B = Bubler

Maximum Applied Water Allowance:

MAWA = (ET_o) (0.62) [(0.7 x LA) + (0.3 x SLA)]
 MAWA = (50.7) (0.62) [(0.7 x 171,450) + (0.3 x 89,146)]
 MAWA = 4,612,6703 gallons per year or 6,166 cubic-feet per year

Hydrozone*	Plant Water Use Type	Plant Factor (PF)	Area (Sq. Ft.)	PF X HA (Square Feet)
1	MEDIUM	.4	26,100	10,440
2	MEDIUM	.4	23,070	9,228
3	MEDIUM	.4	1,390	556
4	LOW	.3	2,874	862
5	MEDIUM	.4	28,870	11548
	SUB TOTAL:		82,304	32,634
6	SLA	.6	17,750	10,650
7	SLA	.6	3,246	1,947
8	SLA	.6	5,780	3,468
9	SLA	.6	62,370	37,422
	SUB TOTAL:		89,146	53,487

*See Construction documents for hydrozone plan.

Estimated Total Water Use:

ETWU = (ET_o) (0.62) (PF x HA / IE + SLA)
 ETWU = (50.7) (0.62) (32,634 / 0.71 + 53,487)
 ETWU = 3,126,122 gallons per year or 4,179 cubic-feet per year

END OF SECTION