SECTION 32 84 00

PLANTING IRRIGATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Irrigation materials and equipment.

B. Installation standards.

C. System location and layout.

D. Excavation and backfill.

E. Installation of pipe, equipment, and appurtenances.

F. Water flow meters.

G. Field quality control.

H. Plant establishment period.

I. Training.

1.02 RELATED SECTIONS

A. The landscape irrigation system shall consist of a completely automatic, electrically-controlled bubbler and spray-irrigation system. The system shall be designed to provide complete coverage with minimum maintenance. The irrigation system shall be designed to prevent overspray onto walks and structures.

B. The irrigation system shall avoid conflicts with plant materials, lighting standards, sign posts, architectural features, above and below ground utilities, and drainage system. Irrigation piping layout is schematic, showing location of pipes and fittings close to planter areas. Piping shall be located inside the planter areas.

C. The landscape irrigation system shall be furnished and installed complete, including the following functions and features: connection to irrigation water stub-out; backflow preventer assemblies and backflow preventer assembly enclosures; all pipe, fittings; valves; electric automatic controllers; separate phone jack, line amplifier, and modem for Controller "A"; phone cable in conduit to all other controllers; electrical power to automatic controllers; the electric remote control valves; irrigation heads; valve boxes; electrical pullboxes and all appurtenances, incidentals, and accessories required for a complete and operable irrigation system. Exterior controllers shall furnished and installed complete with enclosures and concrete base.

D. Providing modifications, alterations, and additions to the existing landscape irrigation system.

E. Trenching and backfilling for piping and appurtenances are specified in Section 33 05 28 - Trenching and Backfilling for Utilities.

F. Site water supply system is specified in Section 33 11 00 - Water Utility Distribution Piping.

1.03 MEASUREMENT AND PAYMENT

A. Measurement: Landscape irrigation system, including excavation, backfilling, and compaction, will be measured for payment by the lump sum method, acceptably performed and completed.

B. Payment: Landscape irrigation system, including excavation, backfilling, and compaction, will be paid for at the Contract lump sum price, as indicated in the Bid Schedule of the Bid Form.

1.04 REFERENCES

A. American Society for Testing and Materials (ASTM):

1.	ASTM A53	Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
2.	ASTM D1557	Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2700 kN-m/m^3))
3.	ASTM D1784	Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
4.	ASTM D1785	Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
5.	ASTM D2241	Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR-Series)
6.	ASTM D2464	Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
7.	ASTM D2466	Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
8.	ASTM D2564	Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems

B. California Code of Regulations, Title 24:

1.	Part 3	California Electrical Code
2.	Part 5	California Plumbing Code

C. Underwriters Laboratories Inc. (UL):

UL 651	Schedule 40 and 80 Rigid PVC Conduit

1.05 SUBMITTALS

A. General: Refer to Section 01 33 00 - Submittal Procedures, and Section 01 33 23 - Shop Drawings, Product Data, and Samples, for submittal requirements and procedures.

B. Shop Drawings: Submit detailed drawings and wiring diagrams of all mechanical and electrical equipment.

C. Product Data: Submit manufacturers' product data of the following items: Irrigation controller, flow meter, master control valve, electrical remote-control valves, backflow preventer assembly and backflow preventer assembly enclosure, gate valves, quick coupling valves, valve boxes, irrigation heads, and related equipment.

D. Operation and Maintenance (O&M) Manual: Refer to Section 01 78 23 - Operation and Maintenance Data, for submittal requirements. As a minimum, provide operation and maintenance instructions for the following items:

1. Electric Remote Control Valves (including master control valves);
2. Satellite Irrigation Controllers;
3. Water Flow Meters; and
4. Irrigation Controller Software.

E. Manufacturer's Installation Instructions: Submit installation instructions for control valves, flow meters, master control valves, and irrigation controllers.

1.06 QUALITY ASSURANCE

A. Prior to the start of the irrigation installation, the Contractor shall arrange with the satellite irrigation controller manufacturer to provide pre-installation instructions and training on the proper installation and start-up of the irrigation control system.

1.07 EXISTING IRRIGATION SYSTEM

A. The existing irrigation system and the extent of the work are indicated in the Contract Specifications and Drawings.

B. Location and quantities of the existing irrigation system and its indicated components are approximate. Irrigation drawings show which areas of the existing irrigation systems are to be modified and which areas of the existing landscaping are to be preserved. The staged sequence of installation shall be submitted to the Engineer before site demolition commences.

C. Verify the condition of the existing irrigation system within the boundary of the work site before performing any work. Reference (As-Built) Drawings reflecting the existing irrigation system and utility pipe routing will be provided by the Engineer. Notify the Engineer, in writing, of any discrepancies found, including broken or inoperable main lines, branch lines, irrigation heads, and control valves.

D. Controllers, valves, valve box assembly components, sprinklers, and all other brass parts of the existing irrigation system to be removed or replaced shall remain the property of the District and shall be neatly stored in a locked area on District property, as directed by the Engineer.

E. The shut-off of parts of the existing irrigation system which are to remain in place, to be modified, or relocated, shall conform with the following requirements:

1. The Engineer shall be notified, in writing, 24 hours before shut-off and a written notice shall be submitted to the Engineer specifying the time when the system will be turned back on.

2. When shut-off of the irrigation system is longer than 72 hours, a full irrigation cycle of the system shall be performed before shut-off. Fully irrigate landscaped areas at least once every 16 hours.

3. Replace damaged plants and repair damaged areas that result from construction operations. Include damage resulting from lack of watering.

1.08 SEQUENCING AND SCHEDULING

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

B. Coordinate installation of irrigation system with excavation of planting beds and backfilling of planting beds with topsoil. Refer to Section 32 90 00, Planting, for requirements. Typically, the irrigation system shall be installed after planting beds have been excavated and backfilled with topsoil.

C. The irrigation system shall be installed and tested prior to installation of plant material. Coordinate layout and installation of irrigation system with location and installation of plant material to assure that there will be complete and uniform irrigation coverage of planting as indicated.

D. Tree and shrub locations shall be staked in the field prior to installation of irrigation pipe and heads. Refer to the plant list on the Contract Drawings for plant setbacks and spacing requirements.

1.09 WRENCHES AND KEYS

A. Furnish and deliver to the Engineer two each of the following items upon completion of the work of this Section:

1. Wrench for each type of valve; and

2. Keys for valve box covers, controller panels, pedestal enclosure doors, and backflow preventer assembly enclosures.

B. Furnish and deliver to the Engineer four quick coupling keys with hose swivels and two keys for locking cover, all of same manufacturer as the valve.

C. The District will furnish padlocks and keys for enclosures that can be padlocked.

PART 2 - PRODUCTS

2.01 IRRIGATION MATERIALS AND EQUIPMENT

A. Requirements: Irrigation materials and equipment shall be new, non-corroded, non-defective, that meet specified standards.

B. Piping: Above grade piping shall be galvanized steel. Below grade mains and laterals shall be rigid polyvinyl chloride (PVC), with flexible connectors at the base of each riser.

1. Galvanized Steel Pipe: Galvanized steel pipe shall be Schedule 40, conforming to ASTM A53, Grade B, with 150 pound banded, galvanized malleable iron screwed fittings.

2. Plastic Pipe:

a. Plastic pipe shall be solvent welded polyvinyl chloride (PVC) 1120 or 1220 pressure-rated pipe. Supply lines (those lines from the meter or other irrigation point of connection to each valve, and to quick disconnects) shall be ASTM D1785, Class 12454-B, PVC1120 or PVC1220, Schedule 40.

b. Irrigation laterals (those lines from the valve to end of each run) shall be ASTM D2241, Standard Dimension Ratio (SDR) 13.5 (Class 315), for pipe 1/2 inch and smaller, and ASTM D1785, Class 12454-B, for pipe 3/4 inch and larger.

c. Fittings shall be molded PVC, Schedule 40, conforming to ASTM D2466, Class 1433. Fittings shall be capable of withstanding maximum pressure rating of the pipe with which it is used. Provide Schedule 80 fittings conforming to ASTM D2464 where indicated or required.

d. Pipe thread sealant compound shall comply with requirements of ASTM D1784 or ASTM D2564, as applicable.

C. Conduit: Provide rigid non-metallic conduit conforming to UL Standard No. 651 for rigid non-metallic conduit, such as Schedule 40 PVC conduit, unless otherwise indicated.

D. Telephone Cable: Provide 4-conductor telephone cable (matching irrigation controller specifications) in conduit for phone cable linkage between Controller "A" and all other controllers connected to that Controller "A."

E. Phone Line Hookup: Provide phone jack, line amplifier, and modem, in accordance with the irrigation controller manufacturer's specifications, for Controller "A."

F. Electric Remote Control Valves and Master Control Valves: Remote and master control valves shall be Rainbird EFB-CP series, a District Designated Matching Product. Remote and master control valves shall meet the following requirements:

1. Valves shall have a contamination proof (CP) self-flushing nylon screen located at the valve inlet to filter out grit and prevent clogging of hydraulic control ports and assure reliable operation.

2. Valves shall be normally closed and be of the size indicated.

3. Valves shall be serviceable from the top without removing the valve body from the system.

4. Valves shall be equipped with a device that will regulate and adjust the flow of water, and with a manual shut-off.

5. Automatic closing time shall not be less than 5 seconds.

6. Valves shall be compatible with the electric automatic controllers.

7. Valve solenoid shall be designed for operation at 24-volts, AC, at 0.41 amps maximum in-rush current.

8. Valves shall be made of brass.

G. Unions: Unions shall be a minimum of 150-pound galvanized malleable iron with ground joints for above grade locations, and PVC schedule 80 threaded for below grade locations, and shall be provided on both sides of the wye strainer, control valves, and pressure reducing valve. Valves or strainer having integral union(s) are acceptable substitutes for union(s).

H. Satellite Irrigation Controllers:

1. Satellite irrigation controllers shall provide local control of the irrigation system and transmit data to and receive remote control communication from a BART central computer via telephone link or, where indicated, via digital radio.

   a. The lead controller shall be designated Controller "A" and shall have a line amplifier, modem, and telephone communication link to the central computer.

   b. Subsequent controllers (if needed) shall be designated Controller "B," Controller "C," etc. Subsequent controllers shall have wireless link to Controller "A."

2. Irrigation Controller. Controllers shall be Calsense ET2000e series, a District Designated Matching Product. They shall be furnished complete, and shall have the following features:

   a. Independent control over each station start and stop time (dwell time), and number of cycles per day.

b. 24-hour timer; 14-day minimum calendar period; dwell times adjustable in one minute increments for 1 to 360 minutes and cycles of minimum 4 starts in 24 hours.

c. 24-volt, 1.5-amp minimum output capacity with circuit breaker and with automatic reset and controller and valve surge protection.

d. Number of stations as indicated.

e. Six repeat watering program (cycles, windows) per day capability.

f. Two-minute dwell time for each station in event of power interruption.

g. Simple "user friendly" keyboard programming with messages flashed on display screen to prompt entries by user.

h. Retention of volatile program memory setting, time and date for up to 18 hours in event of power failure with rechargeable battery and trickle charger provided. Non-volatile, entry erasable programmable memory (EEPROM) is preferred.

i. Shutdown and bypass of station in event of excess flow, sensed by flow meter, or excess current sensed by controller. Controller shall shut master control valve in the event excessive flow is sensed on three or more stations in succession. Default values shall be capable of being overridden by the Central Computer or manually at the controller.

j. Suitable connection for District-owned receiver, prewired to allow complete automatic override of controller and remote operation of each valve by the District transmitter with 24-volt fuse protection and power supply connection for receiver.

k. Computer Interface with modem, connected to the controller and flow meter through a dedicated telephone line serial link to a central computer, shall display statistics on each station operation. Statistics shall include: total flow, start and stop times for each cycle of operation of each station on a daily basis; valve failures, system failures or faults; power interruption occurrences and duration of outage; and total daily water consumption. In addition, computer interface linked through modem to Central Computer shall provide for adjustment, from remote computer, of each station start, and stop (dwell) times number of cycles. Interface shall be compatible with the District computer and related software.

l. Manual actuation of each valve locally at the controller. This is in addition to the capability requirements for valve control by transceiver and remote control, statistical reporting to, and random access and reprogramming from the central computer.

m. Keyboard with all control functions. Terminal strip for input/output connections easily accessible. Single 120-volt, single phase power connection and telephone line modem connection.

n. Scanning of station zone moisture condition and replenishment with multiple repeats during each daily watering program.

o. Simulation test board.

p. Default to last program preferred; default to preprogram required.

3. Controller Enclosure and Pedestal: Irrigation controllers, complete with all necessary inter-controller interface connections, shall be housed in a Calsense Model SSE enclosure, a District Designated Matching Product. Enclosure shall provide built in surge and lighting protection, Calsense Model TP-110 and Model TP-1 respectively. Enclosure shall feature a GFI receptacle and power disconnect switch. Enclosure shall be mounted on a heavy gage, stainless steel pedestal, Calsense Model SSE-PED, with concrete base, furnished with, and exactly matching the cabinet. Cabinet and pedestal shall be of all welded construction with locks and shall provide security and protection of field wiring. Two keys for each cabinet door shall be furnished to the District. Locks shall be keyed alike.

I. Control, Common, and Spare Wires:

1. Low voltage control wire shall be Type UF, 600-V size as recommended by the manufacturer of the controller furnished for this project, but not smaller than No. 14 AWG. Common wire shall not be smaller than No. 12 AWG. Insulation shall be of a type approved by the California Electrical Code for underground direct burial, Class 2 wiring, 24-volt, 60 cycle, A.C. service.

2. Controller valve main wire insulation shall be black or red. Furnish different color control wire for each controller. Each common line shall be white with a color strip to match the color of control wires it serves. Spare wire shall be a color different from control and common wires.

3. Control wire identification tags shall be 2-1/4 inches by 2-3/4 inches insize.

4. Splices shall consist of waterproof wire connectors with copper crimp-type sleeves over barred wire ends. Splices shall be capable of satisfactory operations under continuous submersion in water.

J. Shut Off Valves: Valves shall be for underground service. Valves shall be 150-pound gate valves with square head operators (valve wheels are unacceptable). Stem shall be non-rising. Valves shall be furnished with a cast iron box with bolted cover, installed flush with grade, and having the embossed letters “IRR. WATER”.

1. Valves sized 2-1/2 inches and smaller shall have a screwed bronze body with solid bronze wedge gate and a stem with NPT threaded ends.

2. Valves sized 3 inches and larger shall have a flanged cast iron body with bronze trim.

J. Valve Boxes and Electrical Pull Boxes: Commercial precast concrete boxes, sized to adequately house the specific irrigation components indicated, including the electric remote control valve, master control valve, lateral isolation valve, gate valves, flow meter, wye strainer, pressure gage, and line flush assembly, furnished complete with a one-piece lockable cast-iron or galvanized checker plate steel cover with lift handle. Provide covers with vandal-resistant locking bolt. Provide identification letter and number on rim of valve box stenciled in letters and numbers 2

inches high with epoxy-resin base paint of a contrasting color. Coordinate with Section 33 05 16 - Utility Structures.

L. Backflow Assembly Enclosure:

1. A vandal-resistant solid aluminum cover shall enclose the backflow preventer, filter unit, and pressure-reducing valve. The filter shall be mounted upstream of the backflow preventer and provide 9-inches clearance between the filter drain valve and pad surface. The pressure reducing valve shall be provided downstream of the filter. Unions shall be provided on both sides of each component.

2. The cover shall be equipped with all stainless steel hardware and flush-mounted lockable hatch assembly designed for ease in handling. The cover shall be 3 inches clear of valve operating handles and appurtenances and shall be of stainless steel solid sheeting, with rigid, reinforced construction having a minimum corner angle, mid-section reinforcement and pre-punched viewing ports with rolled or relieved edges. The cover shall be bolted to a 4-inch thick reinforced poured-in-place concrete pad that shall extend a minimum of 3 inches beyond the cover. The cover shall be anchored to the pad at each corner using minimum 1/4 x 2-1/2 inch anchor bolts of galvanized steel.

3. The padlock will be furnished by the District.

4. Bollards shall be provided at each corner of the protective enclosure.

M. Filters: The filter unit shall have a removable cylinder and integral resilient seat ball type drain valve. The free flow principle shall be intrinsic in the unit design, causing the water flowing along the cylinder to seep through the cylinder perforations, allowing particles to drop to the bottom for accumulation. The filter shall be suitable for 175 psig operating pressure and equipped with 155 mesh media. The unit shall have a factory-applied label affixed to the housing indicating media size and a flow arrow cast on the housing. The filter inlet and outlet for 2-inch and smaller units shall be male pipe thread and for 3-inch and larger units shall be 150 psi flanged. The unit shall have the following material of construction, capacities and filter area:

Size (inch)	Material Of Construction Housing Cylinder	Maximum Flow (gpm)	Clean Pressure Drop @ Max. Flow (psi)	Filter Area (sq. in.)
3/4	Glass-filled Polyester Delrin or equal	8	1.4	11
1	Glass-filled Polyester Delrin or equal	30	1.5	20
1-1/2	Glass-filled Polyester Delrin or equal	80	2.0	40
2	Glass-filled Polyester Delrin or equal	110	1.9	132
3	Epoxy-coated stainless steel	180	1.5	240
4	Epoxy-coated stainless steel	350	2.0	365
6	Epoxy-coated stainless steel	700	2.0	730

N. Sleeves for Conduit and Water Lines: For pipe 3/4 inch through 4 inches in diameter, provide PVC Schedule 40 pipe, two pipe sizes larger than the water line and two pipe sizes larger than

conduit. For pipe 6 inches in diameter and larger, provide corrugated metal pipe (galvanized) a minimum of one pipe size larger than the sleeved pipe.

O. Irrigation Heads: The sprinkler body, stem, nozzle and screen shall be constructed of heavy-duty, ultraviolet resistant plastic.

1. Sprinkler Heads and Bodies: Sprinklers shall be Rainbird 1812-SAM series, a District Designated Matching Product. Sprinkler shall have a 12-inch popup height, an integral check valve that holds up to 8 feet of head (3.50 psi), a heavy-duty stainless steel retraction spring, a pressure regulation capability, a soft elastomer pressure-activated wiper seal, and a ratcheting system for easy alignment of the pattern. Riser nipples for all sprinkler heads shall be the same size as the riser opening in the sprinkler body.

2. Sprinkler nozzles: Sprinkler nozzles shall be 5-degree-angle trajectory, of plastic construction, with matched precipitation rates for spray nozzles, flow and radius adjustment by use of a stainless steel adjustment screw, filter screen and arc adjustment where specified.

3. Tree bubblers: Tree bubblers shall be a pressure compensating type, Rainbird 1400 series, a District Designated Matching Product. Tree bubblers shall have a plastic inlet filter screen to protect the nozzle against clogging. Tree bubblers shall be of a permanently assembled design constructed of durable plastic with an integral rubber flow washer. Bubbler nozzles shall be attached to 18-inch long flexible connectors.

4. Flexible Connectors: Flexible connectors shall be of premium grade styrene butadiene rubber-reinforced rayon braid hose with threaded adapter end fittings of high density polyethylene, or of polyethylene corrugated sheath with polyethylene lines and threaded adapter end fittings of high density polyethylene. The connectors shall be a minimum of 6 inches long, or of longer length suitable for the application.

P. Backflow Preventer: Refer to Section 33 11 00 - Water Utility Distribution Piping, for requirements.

Q. Pressure Reducing Valve:

1. The main pressure-reducing valve shall be designed for 150-psig inlet pressure, and shall be furnished with an integral strainer. Pressure reducing valves 2 inches and smaller shall have a brass body with a reinforced, removable plastic diaphragm, stainless steel parts and a labeled outlet.

2. Pressure reducing valves 3 inches and larger shall be the self-contained diaphragm type with epoxy-coated cast iron bodies and 150 pound flanged inlets and outlets, replaceable seats with resilient discs, stainless steel or brass trim and integral pilots suitable for outdoor installation, 150 psig inlet pressure, and factory preset for 30- psig outlet.

R. Water Flow Meters: The water flow meter shall be Calsense Type FM series, a District Designated Matching Product. The water flow meter shall be a line-mounted, impeller type of corrosion-resistant construction, designed to signal rate of flow to the Satellite Irrigation Controller.

PART 3 - EXECUTION

3.01 INSTALLATION STANDARDS

A. The landscape irrigation system shall be installed in accordance with applicable requirements of the California Plumbing Code and California Electrical Code, and the requirements of the jurisdictional water company or utility district.

B. Manufactured materials and equipment shall be installed in accordance with the respective manufacturer's instructions for the location and conditions.

C. Electric automatic controller, electric remote control valves, electrical wiring, and the installation thereof shall conform with applicable provisions of Caltrans Standard Specifications Section 86, Signals, Lighting, and Electrical Systems, and the California Electrical Code.

3.02 SYSTEM LOCATION AND LAYOUT

A. It shall be the Contractor's responsibility to lay out the irrigation system. Location of facilities indicated on Contract Drawings are approximate and diagrammatic and may require adjustment. Work shall be laid out as accurately as possible to conform with the Contract Drawings. Provide additional offsets, fittings, sleeves, and other devices that are required to complete the installation.

B. Irrigation system shall avoid conflicts with plant materials, lighting standards, signposts, architectural features, above and below ground utilities, and drainage system. Irrigation piping layout is schematic, showing location of pipes and fittings approximately. For example, where pipe is shown parallel or close to planting bed areas, it is intended that pipe be located inside the planting bed area.

C. Minimum flow through any valve shall be eight gallons per minute with 30 psi at the downstream side of the backflow preventer and pressure-reducing valve.

1. Minimum flow through any drip circuit valve shall be 3 gallons a minute with 25 psi at the downstream side of the remote control valve and the pressure-reducing valve.

D. Sprinkler spacing shall be in accordance with manufacturer’s recommendations for overlapping coverage. Maximum distance between any adjacent sprinklers shall be eight feet.

E. Laterals shall be installed not less than 12 inches from fences, curbs, sidewalks, and pavement, unless otherwise indicated.

F. Modifications: Provide modifications to the irrigation system to avoid blockage of sprinkler irrigation patterns, to prevent overspray and excessive runoff onto walkway and parking areas, and to provide full irrigation coverage to the planted areas. Such modifications also include trimming and adding heads as required to spray around trees, light poles, sign posts, other

objects that obstruct spray pattern, and adjustments required as a result of trees being relocated or removed due to underground utility or drainage problems.

3.03 EXCAVATION AND BACKFILL

A. Provide excavating, bedding, and backfilling as specified in Section 33 05 28 - Trenching and Backfilling for Utilities.

B. Trenches shall be only wide enough to provide sufficient working space on each side of the pipe for making joint and compacting bedding materials and backfill. Trenches for lateral piping shall be 12 inches deep; trenches for mains and conduits shall be 18 inches deep. Trenches under paving shall be 24 inches deep. The bottom of trench shall be graded and prepared to provide a firm and uniform bearing throughout the length of the pipe, sleeve, or conduit. Pipe, sleeve, or conduit shall be laid on 3-inch thick layer of sand bedding material as specified in Section 33 05 28 - Trenching and Backfilling for Utilities.

1. Trenches for subsurface drip lines shall be 4 inches deep, or as recommended by the subsurface drip line manufacturer.

C. After trenches have been excavated, pipe shall be installed, tested, and inspected, and the trench shall be backfilled without undue delay.

D. Before pipeline trenches are backfilled, the irrigation system shall be pressure tested and the location of irrigation heads modified as required to obtain complete and uniform coverage of each plant's root ball. Refer to field quality control requirements specified herein.

E. Graded sand backfill shall be provided for a minimum thickness of 6 inches on each side and above PVC pipe. Above sand backfill, backfill material in areas other than planting areas shall consist of material as specified in Section 33 05 28 - Trenching and Backfilling for Utilities. Above the sand backfill, backfill in planting areas shall be topsoil from site excavations.

F. Compaction of backfill in landscaped areas shall be not less than that of surrounding ground as determined by ASTM D1557. Backfill materials shall be compacted in layers not exceeding 8 inches in loose depth. Backfill material shall be placed and compacted in accordance with applicable requirements of Section 33 05 28 - Trenching and Backfilling for Utilities, and Section 31 00 00 - Earthwork.

3.04 INSTALLATION OF PIPE, EQUIPMENT, AND APPURTENANCES

A. Installation Requirements:

1. Piping installation shall be as indicated and in accordance with the respective manufacturer's instructions. No lines shall be installed directly over another line. Underground metallic pipes, valves, or fittings of dissimilar metals shall be connected through dielectric coupling or bushing and physically separated from other metal objects. Non-conducting spacers that will ensure physical separation of metallic pipe from foreign objects shall be provided as required.

2. Pipe, fittings, valves and irrigation heads shall be free from sand and dirt before installation. Foreign material shall be prevented from entering the irrigation system during installation. Immediately prior to assembly, all pipes, valves, and fittings shall be cleaned. Unattached ends of pipe, fittings, and valves shall be plugged or capped pending attachment of additional pipe or fittings. All lines shall be thoroughly flushed before attachment of irrigation heads.

3. Pipe shall be laid in the trench to the lines and grades indicated. During backfilling operations, pipe shall be supported so that no damage to pipe or joints will result.

B. Rigid Plastic Pipe and Fittings:

1. Install as indicated and in conformance with the manufacturer's instructions. Rigid plastic pipe 1-1/2 inches in diameter and smaller shall be cut with a PVC cutter.

2. Bushings may be used only to reduce the pipe size between laterals and branches supplying water to irrigation heads.

3. Threaded fittings shall be used for all connections between PVC pipe and metal valves or pipe with threaded fittings using female adapter and Schedule 80 nipple. Use approved pipe joint compound on threaded PVC fittings. Assemble threaded PVC fittings finger-tight plus one to two 360-degree turns, but no more.

C. Valve Boxes and Extensions: Provide boxes at electric remote control valves, master control valve, wye strainers, pressure gages, lateral isolation valves, and flow meter locations. Each valve box shall be installed on a foundation of brick and coarse aggregate as specified in Section 33 05 16 - Utility Structures, and as indicated.

1. In dirt and planted areas: Valve boxes shall be installed so that top of box is two inches above finish grade of soil. Set boxes square to adjacent paving edge or curb. Do not install boxes in paved areas.

D. Control Wiring:

1. Install in conduit laid in trenches with main pipe lines. At valves, conduit shall terminate and both wires shall be brought into the valve box and an excess loop of 24 inches shall be provided before being spliced to solenoid pigtails. Splices will be permitted only in electrical pull boxes or valve boxes housing electric control valves. Wrap the 24-inch excess around a 1-inch diameter pipe and coil neatly.

2. At least two feet of slack shall be left in each conductor at each splice.

3. Expansion loops of 18 inches shall be installed in continuous runs at 100 foot maximum spacing.

4. Attach identification tag to direct line wire at each valve, indicating identification number of valve (controller and station number).

5. Three spare wires shall be installed from the controller and stubbed into each valve box served by the controller in series. The spare wires shall not be connected to any equipment at the time of installation.

6. Do not tie wires together when located in sleeves and conduits.

E. Sleeves:

1. Install sleeves for control wiring conduit and sleeves for piping that pass through foundations, footings, or walls. Wiring, conduit, pipe, or piping sleeves shall not be placed below footing, foundation, or wall. Where necessary, footing shall be lowered to 6 inches minimum below such conduit or sleeve.

2. Wiring conduit and piping sleeves shall be of adequate size, a minimum of two pipe sizes larger than pipe lines and two sizes larger than required in California Electrical Code, Chapter 9, Table 1, to accommodate retrieval for repair of wiring or piping. Sleeve shall extend into planting areas a minimum of 12 inches beyond edges of footings, foundations walls, walks, and paving.

3. Sleeves shall be installed straight and level.

4. Sleeves shall have removable PVC slip-on caps installed on both ends of sleeve to prevent entrance of soil or debris. Do not glue caps in place.

5. Sleeves under paving shall have 24 inches of cover, measured from top of sleeve to the bottom of paving aggregate base material.

6. Provide spare pull wire in each electrical sleeve for future use. Label spare pull wire at each end with identification tag.

7. Provide concrete pull boxes on wire runs longer than 200 feet. Provide a 24-inch excess loop of wire in each pull box.

F. Pressure Gage: Maintain pressures within design tolerances. Check pressure of irrigation system upon installation of the system, immediately prior to acceptance of the system, and regularly in between these times as necessary to maintain pressure within design tolerances.

G. Irrigation Controller:

1. Install as indicated and in accordance with manufacturer's instructions. Install telephone lines, power lines, and grounding rods as indicated and required.

2. Connect remote control valves to controller in sequence according to plan. Attach identification tag to each control wire indicating station number of valve controlled.

3. Affix controller name (for example, "Controller A") on inside of controller cabinet door with letters minimum 1 inch high. Affix a non-fading copy of irrigation diagram to cabinet door below controller name. Irrigation diagram shall be sealed between two sheets of 20 mil (min.) plastic. Irrigation diagram shall be a reduced copy of the "as-built" drawings, and shall show all valves operated by the controller, station number, valve size, and type of plants being irrigated.

4. Install multiple pedestal controller cabinets side by side with 18 inches separation. Door opening shall face adjacent paving. Cabinets shall be adjacent to and square with paving edge.

5. Provide phone jack connection, line amplifier, and modem for Controller "A." Provide in accordance with the manufacturer's specifications.

6. Provide phone line connections from Controller "A" to Controllers "B" and "C" in conduit in accordance with the manufacturer's specifications.

H. Phone cable: Bring phone cable lines in conduit from point of connection up through controller pedestal concrete bases and into each controller cabinet. Connect phone cable lines to controller in accordance with the manufacturer's specifications. Trench, install conduit, and backfill in accordance with PABX installation requirements.

I Water Flow Meters

1. The flow meter is installed after the water meter or backflow device and before the master control valve. The mainline pipe is usually sized down during the installation to accommodate the fitting of the flow meter. Note the intended direction of the flow as indicated by an arrow on top of the flow meter. There must be free, unrestricted pipe of the same size as the flow meter, with a length of at least 10 times the flow meter size upstream or 30 inches, whichever is longer; and 5 times the flow meter size downstream or 20 inches, whichever is longer; and 5 times the flow meter size downstream or 20 inches long, whichever is longer. This applies to the distance from any valve, fitting, meter, or backflow device.

2. Provide and adjust in accordance with the manufacturer’s instructions, and with unions at either side to facilitate removal. Adjustment shall be made with the assistance of the manufacturer’s representative at time of installation.

3. The flow meter shall be easily accessible, housed in a rectangular valve box, and marked ‘FM’. There shall be 6” minimum of pea gravel beneath the flow meter in the valve box.

4. The length of #14 AWG wire connecting the flow meter to the irrigation controller shall not exceed 2,000 feet.

3.05 FIELD QUALITY CONTROL

A. Testing Requirements:

1. Each system shall be tested and approved before backfilling trenches. Electrical circuits shall be tested and operative prior to backfilling of trenches. Leaks in the irrigation system shall be repaired, defective materials replaced, and the test shall be performed again.

2. Prior to testing, sufficient backfill materials may be placed on pipes between fittings, couplings, and connections to ensure stability of the line. Fittings, couplings, and connections shall remain visible for the full period of the test. Before pressure testing, the system shall be flushed with control valves open. Pipe shall be plugged or capped where irrigation heads are to be installed, while testing the system.

3. The entire system shall be checked for uniform and complete coverage after installing and testing.

4. Mains, laterals, valves, fittings, and automatic electrical control valves shall be pressure tested. After assembly and installation, and after joints have cured for 24 hours, test main first, then capped laterals (before installation of heads). For mains, pump to 100 psi static pressure, then disconnect pump. Pressure gages shall be located at two points in the system and shall show no loss after a period of six hours. Laterals shall be tested at line pressure.

5. Pipes, where pavement will be installed above, shall be retested, after subbase and base course material have been installed, in same manner as Article 3.07 A.4. above.

B. Irrigation System Function Tests: Function tests shall be performed for each electric automatic controller and associated automatic irrigation system. The function test shall consist of not less than five consecutive working days during which time each controller shall have completed at least ten complete cycles automatically for each station controlled by said controller. If unsatisfactory performance of the system develops, the condition shall be corrected, and the test repeated until continuous satisfactory operation for five consecutive working days is obtained.

C. Manufacturer's Field Services:

1. The Contractor shall provide a representative of the irrigation controller manufacturer who shall be responsible for site observations, training, and final inspection and approval of all connections. The representative shall also coordinate with the Engineer's initial programming of the controller.

2. The irrigation controller manufacturer's representative shall provide adequate training of District maintenance personnel pertaining to central control programming.

3. The irrigation controller manufacturer's representative shall be responsible for monitoring and down loading controllers for a period of 60 days after the project is operational. Moisture adjustments and system monitoring shall be performed in conjunction with District personnel.

D. Back Flow Preventers Test:

1. Testing of back flow preventers shall be conducted by a certified back flow preventer tester. The tester shall hold a valid certification as a back flow preventer tester from the county or other jurisdictional authority in which the device to be tested is located.

2. Test for back flow preventers shall be satisfactorily completed after installation of the back flow preventer assemblies and before operation of the irrigation system. Back flow preventers that fail the required tests shall be repaired or replaced and retested.

E. Final Inspection: Prior to Acceptance of the Work, clean and adjust all systems. Operate all systems under the observation of the Engineer. Irrigation heads shall be visually inspected for coverage. Remote control valves shall be properly balanced. Attach a revised typewritten legend inside the existing controller door, indicating areas covered by each remote control valve.

3.06 PLANT ESTABLISHMENT PERIOD

A. The plant establishment period shall be as specified in Section 32 90 00 - Planting.

B. Timing of irrigation controllers shall be adjusted for optimum performance and, to prevent flooding, on a cycle to end not later than 6:30 a.m.

C. Upon completion of landscape planting and clean-up operations, the Contractor shall request a final inspection by the Engineer. The Contractor will not be permitted to begin the plant establishment period until after the Engineer has approved the landscape irrigation system installation in writing.

D. The Contractor shall maintain electrical and irrigation systems throughout the plant establishment period. Defective equipment shall be replaced.

3.07 TRAINING

A. Thirty days prior to completion of the plant establishment period, the Contractor shall provide a course on the use, adjustment, and maintenance of the automatic controllers, and irrigation heads. The instructions shall be given in one course of three, eight-hour days at a District Oakland Office or on site as arranged for by the District.

B. Approximately ten BART maintenance persons will attend the course. The Contractor shall schedule the course through the Engineer at a time convenient to the District. The Contractor shall notify the Engineer of the proposed course dates at least six weeks prior to those scheduled dates.

END OF SECTION 32 84 00