SECTION 32 84 00

IRRIGATION SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

A. Provide all materials, labor, equipment and services necessary to furnish, install and maintain the Irrigation System, accessories and other related items necessary to complete the Project as indicated by the Contract Documents unless specifically excluded.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Drawings and Special Provisions of the Contract.

B. Standard Specifications

1.03 CODES AND REGULATIONS

A. All work and materials shall be in full accordance with the following codes adopted and amended by the authority having jurisdiction. Nothing in these drawings or specifications is to be construed to permit work not conforming to these codes. The work described in these specifications shall govern in the event that the drawings or specifications call for material or methods of construction of higher quality or standard than required by these codes.
   1. California Plumbing Code
   2. California Administrative Codes:
      a. Title 8, Industrial Relations
      b. Title 19, Public Safety
   3. California Electrical Code
   4. Standards and Regulations of other agencies, water utility provider, or organizations as listed in this specification relating to products or procedures, e.g. American Society for Testing and Materials.

1.04 DEFINITIONS

A. Piping: All pipe fittings, valves, and accessories as required for a complete piping system.

B. PVC: Polyvinyl Chloride.

C. Agencies and Organizations:
   1. ASTM- American Society for Testing and Materials
   2. AWWA- American Water Works Association
   3. IAPMO- International Association of Plumbing and Mechanical Officials
   4. NEC - National Electrical Code.
   5. UL - Underwriter's Laboratories
   6. SSPWC – Standard Specifications for Public Works Construction, by the American Public Works Assoc./Associated General Contractors of California.

1.05 QUALITY ASSURANCE

A. The work of this section shall be performed by a single firm experienced in irrigation work and holding a current California Contractor’s A or C27 License.

B. Qualifications of Workers

1. The Contractor shall employ skilled workers who are thoroughly trained and experienced in irrigation system installation and who are completely familiar with the specified requirements and methods needed for proper performance of this work.
2. The Contractor shall provide adequate supervision by a qualified foreman fluent in English that will be continuously onsite during the performance of this work.

1.06 SUBMITTALS

A. The Contractor shall submit complete lists of proposed materials and equipment per the Special Provisions, including manufacturer's name and model numbers. Only provide additional product data and/or catalog cut sheets if a substitute material or equipment is proposed. No substitution will be allowed without prior written approval by the Engineer.

B. Shop drawings shall follow for all equipment, including dimensions, capacities, and other characteristics as listed in product specifications. Materials and equipment shall not be ordered until given written approval by the Project Inspector. Equipment or materials installed or furnished without prior approval of the Project Inspector may be rejected and the Contractor required to remove such materials from the site at his own expense.

C. When specific name brands of equipment and materials are used, they are intended as preferred standards only. This does not imply any right upon the part of the Contractor to furnish other materials unless specifically approved in writing as equal in quality and performance by the Engineer. Decisions by the Engineer shall govern as to what name brands of equipment and materials are equal to those specified on the plans and his decisions shall be final. It shall be the responsibility of the Contractor to furnish proof as to equality of any proposed equipment or material.

D. Approval of any item, alternate or substitute indicates only that the products apparently meet the requirements of the drawings and specifications on the basis of the information or samples submitted. Manufacturer's warranties shall not relieve the Contractor of his liability under the guarantee. Such warranties shall only supplement the guarantee.

E. Acceptance of any submittals, deliverables, or other work product of the Contractor shall not be construed as assent that the Contractor has complied with, nor in any way relieved the Contractor of compliance with (i) the applicable standard of care of (ii) applicable statutes, regulations, rules, guidelines, and contract requirements.

F. Irrigation Equipment: When the Contractor desires to transfer irrigation equipment and/or parts to the Project Inspector, he must submit along with the equipment an itemized list. The Contractor is solely responsible to obtain a written confirmation by the Project Inspector that all materials received by the Project Inspector matches his material list. The transfer of materials will not be considered executed without written confirmation of same.

1.07 EXPLANATION OF DRAWINGS

A. The intent of the drawings and specifications is to indicate and specify a complete and efficient sprinkler irrigation system ready for use in accordance with the manufacturer's recommendations, and all applicable local codes and ordinances. Interpretation of irrigation plans and specifications shall be the responsibility of the Landscape Architect or Engineer.

B. All existing systems and improvements are shown in their approximate locations. Before proceeding with any work, the Contractor shall carefully check and verify all dimensions and shall report any variations to the Project Inspector.

C. Due to the scale of the drawings, it is not possible to indicate all offsets, fittings, etc., which may be required. The Contractor shall carefully investigate the structural and finished conditions affecting all his work, and plan his work accordingly, furnishing such fittings, etc., as may be required to meet such conditions. Drawings are generally diagrammatic and indicative of the work to be installed in the most direct and workmanlike manner, so that conflicts between sprinkler systems, planting, utilities, and architectural features will be avoided. Locate pipe, valves and other equipment in planting areas unless specifically noted otherwise.

D. All work called for on the drawings by notes shall be furnished and installed whether or not specifically mentioned in the specifications.

1.08 EXISTING CONDITIONS

A. The Contractor shall not install the irrigation system as indicated on the Drawings when it is obvious in the field that obstructions or differences in existing conditions and/or systems are present. Such obstructions or differences should be immediately brought to the attention of the Project Inspector and Engineer. Failure to provide notification prior to the start of this work shall make the Contractor liable for any and all repairs and/or corrections necessary for proper functioning and coverage of the system without any additional cost to the Owner.

B. The Contractor shall examine carefully the site of work contemplated and the proposal, plans, specifications, and all other contract documents. It will be assumed that the Contractor has investigated and is satisfied as to the conditions to be encountered, as to the character, quality, and quantity of work to be performed and materials to be furnished, and as to the requirements of the specifications. The Contractor shall take necessary precautions to protect existing site conditions that are to remain. Should damage be incurred, the Contractor shall make the necessary repair or replacement to bring it back to its original condition at his own expense.

C. Prior to cutting into the soil, the Contractor shall coordinate with the Project Inspector locate all cables, conduits, sewers, septic tanks, and other such underground utilities as are commonly encountered and he shall take proper precaution not to damage or disturb such improvements. If a conflict exists between such obstacles, notify the Project Inspector who will consider realignment of the proposed work. The Contractor will proceed in the same manner if a rock layer or any other condition encountered underground makes change advisable. Should utilities not shown on the plans be found during excavations, Contractor shall promptly notify the Project Inspector for instructions as to further action. Failure to do so will make Contractor liable for any and all damage thereto arising from his operations subsequent to discovery of such utilities not shown in plans.

D. The Contractor shall verify the correctness of all finish grades within the work area in order to insure the proper soil coverage (as specified) of the sprinkler system pipes. The Contractor shall verify and be familiar with location and size of the proposed water supply (P.O.C.). He shall make approved type connection and install new work.

E. The Contractor shall be responsible for notifying the Project Inspector prior to installation that equipment or methods indicated on the drawings or in the specifications conflict with local codes, are incompatible or an error is apparent. It the event the Contractor neglects to do this, he will accept full responsibility for any revisions necessary.

F. If the project includes an existing irrigation system, the Contractor and the Project Inspector shall verify the operational condition of that portion of the existing irrigation system pertaining to the proposed planting areas prior to the start of the proposed work. The Contractor shall notify the Owner and Project Inspector of any repairs and/or corrections necessary for proper functioning and coverage in the area of work. The repairs and/or corrections shall be completed before any plant material is planted. Failure to verify the existing system's operational status and to provide notification prior to the start of this work shall make the Contractor liable for any and all repairs

and/or corrections necessary for proper functioning and coverage of the system, as well as any required plant replacement, without any additional cost to the Owner.

G. If the project includes an existing irrigation system, the Contractor shall ensure that the irrigation system outside the area of work shall remain continuously operational except for brief periods where the Contractor is making connections or modification to the existing system. Notify the Project Inspector at least 48 hours in advance of any scheduled shut off.

1.09 PERMITS

A. The Contractor shall obtain and pay required fees to any governmental or public agency. Any permits for the installation or construction of any of the work included under this contract, which are required by any of the legally constituted authorities having jurisdiction, shall be obtained and paid for by the Contractor, each at the proper time. He shall also arrange for and pay all costs in connection with any inspections and examination required by these authorities.

B. In all cases, where inspection of the irrigation system work is required and/or where portions of the work are specified to be performed under the direction and/or inspection of the Project Inspector, the Contractor shall notify the Project Inspector, at least 48 hours in advance of the time when such inspection and/or direction is required. Any necessary re-excavation or alterations to the system needed because of failure of the Contractor to have the required inspection shall be performed at the Contractor's own expense.

1.10 TESTING

A. General: Unless otherwise directed, tests shall be witnessed by the Project Inspector. Work to be concealed shall not be covered until prescribed tests are made. Should any work be covered before such tests, the Contractor shall, at his expense, uncover, test and repair his work and that of other contractors to original conditions. Leaks and defects shown by tests shall be repaired and entire work re-tested. Tests may be made in sections, however, all connections between sections previously tested and new section must be included in the test.

B. Main Line Piping: Hydrostatically test main line pipe segments after a minimum of twenty-four (24) hours after any solvent connections. Purge any free air in the test pipe sections. Partially backfill pipe but keep all joints exposed. Maintain 125 psi water pressure in new main line piping for a minimum duration of tow (2) hours. There can be a maximum +/- 5psi change in pressure during the test.

C. After being installed at the project site, the Backflow Prevention unit must be tested and approved as functioning properly per the local water agency requirements. Approval of the backflow prevention unit must precede any final inspection of the irrigation system. All costs for the test to be the responsibility of the Contractor.

1.11 OBSERVATION

A. General:
   1. Installation and operations must be approved by the Project Inspector.
   2. In no event shall the Contractor cover up or otherwise remove from view any work under this contract without prior approval of the Project Inspector. Any work covered prior to inspection shall be opened to view by the Contractor at his expense.
   3. In all cases, where inspection of the irrigation system work is required and/or where portions of the work are specified to be performed under the direction and/or inspection of the Project Inspector the Contractor shall notify the Project Inspector, at least 48 hours in advance of the time when such inspection and/or direction is required. Any necessary re-

excavation or alterations to the system needed because of failure of the Contractor to have the required inspection, shall be performed at the Contractor's own expense.

B. Periodic observations shall be required for basic operations and installations during progression of the project. Such observations will include but not necessarily be limited to the following items:
   1. Demolition of existing system components.
   2. Layout and flagging of sprinkler heads and system.
   3. Trenching.
   4. Wire placement.
   5. Partial fill compaction of trenches.
   6. Control valve installation.
   7. Irrigation controller installation and operation.
   8. Backflow Prevention Assembly installation.
   9. Main line installation.
   10. Main line sustained pressure check.

C. Coverage & Operations Review

   1. When the irrigation system is operational and prior to soil conditioning operations, the Contractor in the presence of the Project Inspector shall perform a coverage test of the irrigation system. The Contractor shall furnish all materials and labor required to perform the coverage test and to correct any minor inadequacies of coverage disclosed. The Contractor shall inform the Project Inspector and Engineer of any deviation from the plan required due to wind, planting, soil, or site conditions that bear on proper coverage. If such notification of necessary corrections or additions to the irrigation system is not provided prior to or during the coverage test, the Contractor shall make all subsequent adjustments and corrections needed for proper coverage without any extra cost to the Owner.

   2. Prior to the start of the maintenance period, the irrigation system shall be reviewed by the Owner for proper operations, and a review of and training on equipment and associated controls performed. Any corrections and/or adjustment shall be made as a condition for the start of the maintenance period and subsequent Final Acceptance.

D. Final Acceptance: The work will be accepted in writing when the entire project improvements have been completed to the satisfaction of the Owner and Engineer. In judging the work, no allowance for deviation from the original plans and specifications will be made unless already approved in writing at proper time. Should it become necessary for the Owner to occupy any portion of the work area before the contract is fully completed, such occupancy shall not constitute acceptance. The Contractor will not be responsible for any damage caused by the Owner's separate work forces.

1.12 REJECTION OF NON-CONFORMING MATERIAL OR WORK

A. The Owner reserves the right to reject any material or work which does not conform to the contract documents. The rejected material or work shall be removed or corrected by the Contractor at no additional cost to the Owner.

1.13 OPERATIONS AND MAINTENANCE INSTRUCTIONS & RECORD DOCUMENTS

A. The Contractor shall prepare and deliver to the Owner Representative within ten (10) calendar days prior to completion of the construction, all required and necessary descriptive material in complete detail and sufficient quantity, properly prepared in two individually bound sets of Operating and Maintenance Manuals. These manuals shall describe the material installed and shall be in sufficient depth to permit operating personnel to understand, operate and maintain all

equipment. Spare part lists and related manufacturer identification shall be included for each installed equipment item. Each complete, bound manual shall contain the following information:

1. Index sheet stating Contractor's address and telephone number, duration of guarantee period, and list of equipment, with names and addresses of local manufacturer representatives.
2. The Contractor to issue a "CERTIFICATE OF CONSTRUCTION COMPLIANCE" which indicates that all work done, materials and equipment used and installed are in compliance with the approved plans, specifications and all authorized revisions.
3. Complete operating and maintenance instruction on all major equipment.
4. Complete set of manufacturer's literature and specifications of material installed, including parts list.
5. A list of the controller station number for each control valve if different than the control valve number shown on the drawings.
6. Initial electrical data on each control valve:
    a. Ohms reading for each valve taken at the controller (circuit is OFF).
    b. Voltage reading for each valve taken both at the controller and at the valve (circuit is ON).

B. The contractor shall furnish one set of As-Built full-scale drawings on bond, and one set of Autocad 2004 drawing files on compact disk after all As-Built record information has been included in the CAD files.
    1. Label first page of each document, or set of documents, "PROJECT RECORD" in neat large printed letters on lower right hand corner. Record information concurrently with construction progress. Prints for this purpose may be obtained from the Project Inspector. This set of drawings shall be kept on the site and shall be used only as a record set. Do not conceal any work until required information is recorded. These drawings shall also serve as work in progress sheets, and the Contractor shall make **neat and legible** annotations thereon daily as the work progresses, showing the work as actually installed. These drawings shall be available at all times for inspection and shall be kept in a location designated by the Project Inspector.
    2. Drawings: Legibly mark to record actual construction:
        a. Horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements. Give sufficient horizontal and vertical dimensions to accurately trace route and depth of each concealed line or item. Accurately locate each capped, plugged or stubbed line.
        b. Field changes of dimension and detail.
        c. Changes made by Field Order, by Addenda, or by Change Order.
        d. Details not on original Contract Drawings.
        e. Show the controller station number for each control valve if different than the control valve number shown on the drawings.
    3. Deliver all Record Documents (As-Builts) to the Project Inspector. Accompany submittal with transmittal letter in duplicate, containing:
        a. Date.
        b. Project title.
        c. Contractor's name and address.
        d. Title and number of each Record Document (As-Built).
        e. Signature of Contractor or his authorized representative.

C. The Contractor shall provide controller chart(s) as follows:
    1. The Contractor shall provide two controller charts for each controller installed.
    2. The chart shall show the area controlled by the automatic controller and shall be the maximum size that the controller door will allow.
    3. Show the controller station number for each control valve if different than the control valve number shown on the drawings.
    4. The chart may be a reduced drawing of the actual as-built system. However, in the event the valve numbering is not legible when the drawing is reduced, it shall be enlarged to a size that will be readable when reduced.
    5. The chart shall be colored with a different permanent color for each station.

6. The chart shall be enclosed in a waterproof envelope or laminated.

1.14 SPARE PARTS AND EQUIPMENT

A. Prior to the conclusion of the maintenance period, furnish the Owner with the following spare parts and equipment:
   1. One quick coupler key with attached hose swivel for each set of four quick coupler valves installed.
   2. Ten spare nozzles for each different sprinkler head arc and/or radius nozzle installed.
   3. One gate valve key that fits the handle on gate valves.

1.15 WORK AREA AND SAFETY

A. The Contractor shall furnish, erect, and maintain all temporary facilities; perform all temporary work during the period of construction, including those herein specified. All facilities shall be maintained in proper and safe operating and sanitary conditions at all times.

B. The Contractor shall comply with the provisions of the Construction Safety Orders, and General Safety Orders issued by the State Division of Industrial Safety, as well as all other applicable laws, ordinances and regulations.

C. The project site shall be maintained in a neat and safe condition at all times. Cleanup shall be accomplished as the work progresses and upon completion of the work. The Contractor shall provide adequate safety measures to protect workers and the public from injury.

1.16 GUARANTEE

A. Irrigation system consisting of materials, equipment and workmanship shall be guaranteed for proper operation one year from date of Final Acceptance of the Work or the Notice of Substantial Completion of the Project, whichever is later.

B. The Contractor shall be held responsible for repair and/or replacement of damages to new or existing improvements resulting from the defects of materials, equipment or workmanship one year from the date of Final Acceptance of the Work or the Notice of Substantial Completion of the Project, whichever is later.

C. The Owner reserves the right to make temporary repairs as necessary to keep the irrigation system equipment in operating condition. The exercise of this right by the Owner shall not relieve the Contractor of his responsibilities under the terms of the Guarantee as herein specified.

PART 2 - PRODUCTS

2.01 PIPE AND FITTINGS

A. Schedule rated white rigid PVC Pipe shall be made from NSF approved Type 1, Grade I, PVC compound conforming to ASTM D-1785.

B. Class rated (Standard Dimension Ratio) white rigid PVC Pipe shall be made from NSF approved Type 1, Grade I, PVC compound conforming to ASTM D-1784.

C. PVC pipe shall be of the Class or Schedule as designated on the Drawings.
   1. PVC pipe shall meet ASTM D-2241 for solvent weld, plain end, ASTM D-2672 for solvent weld, bell end, and ASTM D-3139 for gasketed bell end.
   2. Pipe sleeves under paving shall be PVC Schedule 40 for 3-inch and smaller or SDR 35 for 4-inch and larger pipes.

D. All pipes shall be continuously and permanently marked and conform with the following information: manufacturer's name or trademark, nominal pipe size, Schedule or Class of pipe, pressure rating in PSI, ASTM designation and (NSF) seal of approval.

E. White rigid polyvinyl chloride (PVC) Fittings:
   1. Schedule 40 type I and II grade 1, solvent weld socket fittings ASTM D-2466 for all lateral lines.
   2. Grey Schedule 80 type I and II grade 1 solvent weld socket fittings ASTM D-2464 for all mainline less than 2 inches diameter, and lateral lines 3 inches and larger.
   3. All fittings shall bear the manufacturer's name or trademark, material designation, size, applicable (IPS) schedule, and (NSF) seal of approval.
   4. All plastic fittings and connectors shall be injection molded of an improved polyvinyl chloride compound featuring high tensile strength, high chemical resistance and high impact strength in terms of current ASTM standards for such fittings. Where threads are required in plastic fittings, these shall be injection molded also.
   5. For 3 inch and smaller main lines, electric control/quick coupler valve service connections shall use Schedule 80 PVC ASTM D2464.
   6. For 4 inch or greater main lines, electric control/quick coupler valve service connections shall use painted ductile iron service saddles with stainless steel double straps, Roman Industries 202S or equal.

F. PVC Solvent Weld Adhesive: All socket and bell type connections shall be joined with primer and PVC solvent cement which shall meet the requirements of ASTM F656 for primer and ASTM D2564, "Standard Specification for Solvent Cements for Polyvinyl Chloride (PVC) Plastic Pipe and Fittings." Solvent cement joints for plastic pipe and fittings will be made as prescribed by manufacturer. The high chemical resistance of the pipe and fitting compounds specified in the foregoing sections makes it mandatory that an aggressive colored primer, which is a true solvent for (PVC) be used in conjunction with a solvent cement designed for the fit of pipe and fittings of each size range specified. A medium bodied solvent cement to be used on pipe joints with interference fits only and not with Schedule 80 fittings. A heavy bodied solvent cement can be used for all classes and schedules of pipe and fittings.

G. PVC Pipe Thread Sealant: A non-hardening all purpose sealant and lubricant similar to Permatex #51 or Lasco blue pipe thread sealant which is certified by the manufacturer to be harmless to PVC pipe and fittings. Apply sealant to clean male threads, brushing into grooves and to the first three threads of the female threads. A good quality grade of teflon tape recommended by the manufacturer for use with plastics may also be used. Minimum width of tape to be used is 3/4". A minimum of two wraps and a maximum of three wraps to be used.

H. PVC Swing Joints: Connections to sprinkler heads from lateral lines shall be made with swing joints as detailed. Pre-assembled swing joints from Hunter, King Brothers or Spears are acceptable.
   1. Use 6” length nipples for 1/2 inch inlet heads.
   2. Use 12” length nipples for 3/4 or 1 inch inlet heads.

I. Galvanized pipe and fittings:
   1. Galvanized Pipe shall be hot dip galvanized continuous welded, seamless steel SCH 40 pipe conforming to current ASTM A53 standards.
   2. Galvanized Fittings shall be galvanized, threaded malleable iron SCH 40 conforming to current ASTM A865 standards.

2.02 BACKFLOW PREVENTION ASSEMBLY

A. Backflow prevention assembly shall be a reduced pressure principle type with resilient seated shut off valves as shown on plans. The backflow preventer shall be approved by the University of Southern California Foundation for Cross-Connection Control and Hydraulic Research.

B. Provide a commercial anti-freeze insulated blanket around the backflow assembly, FrostGuard by BPDI or equivalent. Wrap with minimum half-laps all above grade pipe with insulated tape rated for exterior use.

C. Provide a metal enclosure per City of Madera Standards around the backflow preventer assembly. Provide a concrete base of minimum 6 inch thickness per the manufacturer's recommended size for the enclosure.

2.03 VALVES

A. Electric Control Valves: Globe valves operated by low-power solenoid, normally closed, manual flow adjustment. Sizes and types as shown on drawings.

B. Control Valve Marking: Christy's valve identification tag (or equal), yellow color with text designating controller and valve station number, e.g. "A12", or equivalent.

C. Isolation Valves:
   1. Cast bronze gate valve with resilient wedge, non-rising stem and operating nut. Match size of mainline.

D. Quick Coupling Valve: Two piece quick coupling valve as shown on the Drawings.

2.04 VALVE BOXES

A. Control Valve boxes:
   1. Shrub/Ground Cover areas: Carson 1419 with lockable green plastic cover, or equivalent.
   2. Turfgrass areas: Christy B16 concrete box (11.75" x 22.25") with Fibrelyte FL16D lid, or equivalent.

B. Quick Coupler Valve boxes:
   1. Shrub/Ground Cover areas: Carson 910 with lockable green plastic cover, or equivalent.

C. Isolation Valve boxes:
   1. Gate Valve box in vehicular pavement: Christy G05 round concrete valve box (10.375" ID) with cast iron G05C lid, or equivalent.
   2. Gate Valve box in pedestrian areas: Christy F08 round concrete valve box (8" ID) with Fibrelyte FL08D lid, or equivalent. Use F14 ADS adapter and extension for sizes 2.5 inches and larger.
   3. Ball Valve box: Christy B16 concrete valve box (11.75" x 22.25") with Fibrelyte FL16D lid, or equivalent.

D. Control Valve box marking: Plastic and concrete lids shall have an embossed, exterior grade plastic label permanently attached to the top of lid with 2" high letters showing controller letter and station number.

2.05 CONTROLLER

A. Solid state microcomputer controller, completely automatic in operation, which shall electrically start the sprinkler cycle and program and time the individual stations. Controller shall have attached instruction booklet, integral 24V transformer, clock indicating time of day and day of week, 24V master valve circuit and terminal connection strip. Controller shall be universal remote ready with pre-installed connectors. See Drawings for manufacturer and model.

B. Controller enclosure shall be stainless steel of a size and type as specified on the Drawings.

C. Sensors, flow meters and other accessories shall be a model type compatible with the controller and as specified on the Drawings.

2.06 UNIVERSAL HANDHELD REMOTE

A. Remote unit shall be able to have complete control over any solid state or electro/mechanical controllers. Unit shall have a minimum range of 1,000 feet from transmitter to the receiver.

B. Remote unit shall be capable of coded FM transmissions which eliminate unwanted interference and works amid buildings or hilly terrain.

C. Receiver board shall be integral to the controller unit. The receiver antenna shall be integrated into the controller enclosure.

2.07 CONTROL AND TRACER WIRE

A. Connections between the automatic controllers and the electric control valves, and tracer wire shall be made with direct burial #14 AWG - UF 600 volt copper wire manufactured for irrigation system use.

B. Hot control wires shall be red. Common ground wire shall be white, with a different color stripe when multiple controllers are installed. Spare control wires shall be black and spare common wire blue. Tracer wire shall be green.

C. Install in accordance with valve manufacturer's specifications and wire chart. In no case shall wire size be less than #14. Common wire serving multiple valves scheduled for simultaneous operation shall be a minimum #12 size.

D. All control wire splices shall be made with waterproof wire connectors, Spears Model No. DS-500 Dri-Splice, King Safety Products King 6 Blue, or approved equal. Use one splice per connector sealing pack.

2.08 IRRIGATION HEADS

A. Spray Head: Molded plastic body with plastic nozzles. Refer to schedule on drawings. Manufacturer's numbers are listed with description.

2.09 OTHER MATERIALS

A. Materials not specifically indicated but necessary for the proper execution of this work shall be of first quality as selected by the Contractor subject to the acceptance of the Engineer.

B. All materials appearing in the legend and details of the irrigation drawings are to be furnished and installed by the Contractor unless specifically noted to the contrary. Contractor is responsible for installation according to plans and details. The system shall efficiently and uniformly irrigate all areas and perform as required by these plans and specifications.

C. Granular bedding material shall be clean natural occurring sand, free from clay, salt, sea shells or organic material, suitable for the purpose intended, and shall be of such size that 90 percent to 100 percent will pass a No. 4 sieve and not more than 5 percent will pass a No. 200 sieve.

PART 3 - EXECUTION

3.01 SYSTEM DESIGN AND VERIFICATION

A. Contractor shall verify existing pressure and equipment as shown on the Drawings and inform the Engineer of discrepancies in writing prior to the start of irrigation system installation. Failure to inform the Engineer of any discrepancy within seven working days prior to beginning of system installation will place the responsibility of corrective action on the Contractor at no expense to the Owner.

3.02 PIPING INSTALLATION

A. General:
   1. Any equipment installed by the Contractor and deemed to be for the use of the Owner in various situations (i.e., control valves, control panels, etc.) shall be so installed to be readily accessible and quickly operable. Equipment deemed by the Owner to be inoperable for its intended purpose shall be reinstalled by the Contractor in an operable position before approval will be given. Any changes made by the Contractor shall be done without any additional cost to the Owner.
   2. The Contractor shall be responsible for layout of proposed facilities and any minor adjustments required due to differences between existing conditions and the Drawings. Any such deviations in layout shall be within the intent of the original drawings, and without additional costs to the Owner. The Owner will indicate the proposed precise location of the control panels. Head spacing on drawings is diagrammatic. Head spacing and patterns shall be adjusted to provide complete and adequate coverage with a minimum spray on non-planted areas. Where head spacing is not specifically noted, Contractor shall install sprinkler heads evenly along the irrigation area's perimeter. Flush all lines prior to installation of heads.
   3. Support piping without strain on joints or fittings and allow for piping expansion and contraction. "Snake" pipe into trench in accordance to manufacturer's recommendations to allow for expansion. Lay on solid sub-base, at uniform depth.

B. The Contractor shall examine all other portions of working drawings and plan trenching and pipe layout so that no conflict will arise between irrigation and any other work. Any corrective action will be the Contractors responsibility at no further expense to the Owner.

C. Excavations:
   1. Excavations shall be open vertical construction, sufficiently wide to provide clear working space around the work installed and to provide ample space for backfilling and tamping.
   2. The use of a vibratory plow or methods other than open vertical trenching will not be allowed without the written approval of the Engineer. To obtain such approval, a field test must be performed, at the proposed site, with the equipment to be used in the presence of the Engineer and Project Inspector. The field test is to indicate if the proposed site is favorable to the plowing method. Approval for plowing at one location does not allow the use of plowing at another location. Approval for plowing must be obtained for each location where the use of plowing is proposed. If, at previously approved plowing locations, conditions for plowing become unfavorable as determined by the Project Inspector, plowing shall be terminated.
   3. Trenches for pipe and equipment shall be cut to required grade lines, and compacted to provide an accurate grade and uniform bearing for the full length of the line.
   4. Unless written approval for using native soils as bedding material is given by the Engineer, main line pipe shall be placed on a minimum 4 inch depth of granular bedding material.
   5. When two pipes are to be placed in the same trench, it is required to maintain a minimum six inch (6") horizontal separation between pipes.
   6. Depth of trenches shall be sufficient to provide a minimum cover above the top of the pipe as follows:
      a. 24-inch minimum over main lines.
      b. 18-inch minimum over non-pressure (rotary pop-up) lateral lines.
      c. 12-inch minimum over non-pressure (pop-up spray head) lateral lines.
      d. 24-inch minimum over any lines located out in road surface area of paved streets.
      e. Maximum cover above the top of the pipe shall not exceed twelve inches (12") greater than the required minimum cover.

f. 4-inch cover over drip-line lateral lines.

D. Assemblies:
1. Routing of pressure supply lines as indicated on drawings is diagrammatic. Install lines (and various assemblies) in such a manner as to conform with details on plans.
2. Install all assemblies specified herein according to the respective detail drawings or specifications pertaining to specific items required to complete the work. Perform work according to best standard practice.
3. Install no multiple assemblies on plastic lines. Provide each assembly with its own outlet.
4. All threaded pipe and fittings shall be assembled using an approved teflon tape, or equivalent, applied to the male threads only. A minimum of two (2) wraps and a maximum of three (3) wraps of an approved teflon tape will be required.
5. No main line elbows, branch tees or isolation valves are to be located closer than five (5) feet to each other without prior approval of the Engineer.

E. Line Clearance: All lines shall have a minimum clearance of four inches (4") from each other, and six inches (6") from lines of other trades. Parallel lines shall not be installed directly over one another.

F. Plastic to Steel Connections:
1. At all plastic (PVC) pipe connections, the Contractor shall work the steel connections first. Connections shall always be plastic into steel, never steel into plastic. An approved teflon tape shall be used on all threaded (PVC) to steel, never steel into plastic. An approved teflon tape shall be used on all thread (PVC) to steel pipe joints applied to the male threads only, and light wrench pressure is to be applied. A minimum of two (2) wraps and a maximum of three (3) wraps of an approved 3/4" wide teflon tape will be required.
2. A non-hardening sealant and lubricant similar to Permatex #51 or LASCO blue pipe sealant may be used in lieu of teflon tape. Apply sealant to clean male threads brushing into grooves and to the first three threads of the female threads.

G. Plastic Pipe:
1. The Contractor shall exercise care in handling, loading, unloading, and storing plastic pipe and fittings. All plastic pipe and fittings shall be stored under a weatherproof roofed structure before using and shall be transported in a vehicle with a bed long enough to allow the length of pipe to lie flat so as not to be subject to undue bending or concentrated external load at any point.
   a. All lumber, rubbish, rubble, concrete and rocks shall be removed from the trenches by the Contractor. Pipe shall have a firm uniform bearing for the entire length of each pipe line to prevent uneven settlement. Wedging or blocking under riser tees shall be done only if specified on the plans. Pad trenches with soil as necessary to provide uniform bearing surfaces.
   b. Where extensive lengths of pipe are installed, snake pipe in trench from side to side to allow for expansion and contraction. One additional foot per one hundred (100) feet of pipe is the minimum allowance for snaking. Never lay pipe when there is water in the trench or when the temperature is 32 degrees F or below.
   c. All changes in direction of pipe shall be made with fittings, not by bending. No main line fittings for changes in direction shall be greater than 45 degrees. Provide a minimum five (5) feet between changes in direction elbows.
   d. Safely handle primers and cements per ASTM F-402. Make solvent weld joints per ASTM D-2855 with a non-synthetic bristle brush in the following sequence:
      1) Make sure pipe is cut square and all rough edges and burrs are removed. All connecting surfaces are properly cleaned and dry prior to application of pipe primer.
      2) Apply an even coat of colored primer to pipe and fitting prior to application of solvent.
      3) Apply an even coat of solvent to the outside of the pipe, making sure that the coated area is equal to the depth of the fitting socket.
      4) Apply an even light coat of solvent to the inside of the fitting.

5) Apply a second coat of solvent to the pipe.
6) Insert the pipe quickly into the fitting and turn pipe approximately one-eighth to one-quarter turn to distribute the solvent and remove air bubbles. Hold the joint for approximately fifteen seconds so the fittings do not push off the pipe.
7) Using a clean rag, make sure to wipe off all excess solvent to prevent weakening at joint.
8) Exercise care in going to the next joint so that pipe is not twisted, thereby disturbing the last completed joint.
9) Allow at least fifteen minutes setup time for each welded joint before moving.
10) Repairing plastic pipe when damaged shall be done by replacing the damaged portion of pipe.

H. Concrete Thrust Blocks: Concrete anchors or thrust blocks shall be provided on pressure main pipelines greater than 2” in diameter at abrupt changes in pipeline grade, changes in horizontal alignment (elbows, tees and crosses), reduction in pipe size (reducers, reducing tees or crosses), end-line caps or plugs, and in-line valve to absorb any axial thrust of the pipeline. The pipe manufacturer's recommendation for thrust control shall be followed. Thrust blocks must be formed against solid unexcavated earth (undisturbed). Do not enclose entire joint in concrete. Provide a minimum of two cubic feet of 2,000 PSI concrete for each concrete thrust block.

3.03 PIPE DEPTH AND BACKFILL

A. Backfill shall not be placed until the installed system has been inspected, pressure tested and approved by the Project Inspector.

B. Backfill material shall be approved soil. Unsuitable martial, such as pipe remnants and wire including clods and rocks over two inches (2") in size, shall be removed from the premises and disposed of legally at no cost to the Owner. Backfill for first 4 inches around and above main line pipe and control wires shall be granular bedding material, unless the Engineer approves in writing that native soil may be used for initial backfill in lieu of granular bedding material.

C. Backfilling for all pipe shall be carried out in two basic stages.
1. Stage One Backfilling:
a. This shall be accomplished as soon as possible after the pipe is laid. A bedding of uniform depth with no voids must be provided along the entire length of the pipe. The bedding material should be placed in the trench and tamped into the areas under the pipe, using a suitable tool. Joints should be left exposed until hydrostatic tests are completed. Cover only those portions of the pipe necessary to prevent movement or damage.
2. Stage Two Backfilling:
a. This shall be completed after all hydrostatic tests are completed and the piping system has been thoroughly checked for leaks or other defects. Continue to add backfill material in four inch (4") layers and hand tamp to achieve density similar to adjacent soil. After twelve inches (12") in main line trenches and eight inches (8") in lateral line trenches of hand tamped soil is in place over the pipe and fittings, backfilling can be continued, using light machinery to place dirt in the trenches in six inch (6") layers and to compact the dirt to conform to adjacent soil. Extreme care should be taken to avoid damage to the pipe from machinery that is too heavy. All trenches shall then be water jetted to assure uniform settling and compaction. Backfilling operations will not be considered complete until the top surface has been graded to conform to the adjacent soil. All rocks uncovered and not used as backfill must be collected and removed from the site.

D. All backfilling shall be done carefully and shall be properly tamped. All soil shall be tamped and puddled to eliminate any voids.

E. Surplus earth remaining after backfilling shall be disposed of as directed by the Owner.

F. PVC piping and fittings shall not be backfilled during periods of extreme heat or when a sudden lowering of temperature of the pipe may cause separation of joints or fittings.

G. Contractor shall fill with properly amended topsoil any irrigation trench that subsides during the warranty period. Contractor shall assume all cost associated with the trench repair, including but not limited to plant replacement of a size of plant disturbed at the time of the repair.

3.04 BACKFLOW PREVENTION ASSEMBLY

A. Install the backflow prevention assembly per the Contract Documents, manufacturers installation instructions, and agency requirements.

B. Construct the concrete base, and install the enclosure and the freeze blanket per the Contract Documents and the enclosure manufacturer's instructions.

C. Operational testing of any new backflow prevention assembly shall be performed by a Certified testing firm. Provide a Certificate of Operation satisfactory to the local agency.

3.05 CONTROL AND TRACER WIRE

A. Protect wire by running alongside of mainline piping. Bundle wires together and tape at intervals of ten (10) feet. Do not tape wire together when encased in sleeve. Minimum cover shall be 24 inches. Crimp wires together at valve manifold with Scotchlok connector. Seal splice with 3M DBY splice kit. Tag all control wire splices and at control valve and controller with approved control wire markers.

B. Wire size shall be determined by the number of valves operating on a given wire and the distance from the controller to the farthest valve, as specified by the charts furnished by the remote control valve manufacturer. Splices are not encouraged but allowed. All splice connections must be provided in a valve box.

C. Install tracer wire along the top of pipe at the following locations:
   1. All pipe sleeves.
   2. Main line pipe without adjacent control wire.

3.06 VALVES

A. The Contractor shall make all necessary connections for operation, and shall be connected and aligned to provide the most efficient flow of water to the irrigation heads. Where pressure regulating electric control valves are specified, the Contractor shall adjust the valve so a uniform distribution of water is applied by the heads, and that the most remote heads operate at the pressure recommended by the head manufacturer.

B. Each valve is to be enclosed in a separate valve box. The valve box shall be secured on firm soil clear of valves and wiring connections. Valve boxes and lids shall be set to finished grade or as indicated on the Drawings. Use valve box extensions of the same material as the box to the proper depth below the pipeline. Backfill carefully and properly compact in order to prevent settlement and subsequent damage.

C. Locate valve boxes in ground cover/shrub planting areas instead of turfgrass areas whenever possible. Locate valve boxes 18" from and perpendicular to adjacent paving. When grouped together, provide equal spacing of at least 36" between boxes.

D. Permanently attach the plastic valve identification tag to the remote control valve body and locate so it's clearly visible in an open valve box.

E. Permanently secure the control valve identification label to the top of the valve box lid with non-corrosive connectors.

3.07 AUTOMATIC CONTROLLER

A. Install controller, enclosure, sensors and accessories per manufacturer's approved details and installation instructions, and the Drawings.

B. Provide the Owner with one fully charged handheld remote controller unit.

C. Install automatic controller chart in laminated or watertight plastic envelope inside controller cover showing which valves are connected to which stations on controller.

3.08 ELECTRICAL SERVICE

A. Electrical service shall be provided to the controller location by others. Contractor shall make the electrical power connection to the controller per code requirements.

B. Install grounding rods, plates, etc. as shown on the Drawings and/or per manufacturer's and code requirements.

3.09 SPRINKLER HEAD INSTALLATION

A. Head spacing on drawings is diagrammatic. Head spacing and patterns shall be adjusted to provide complete and adequate coverage with a minimum spray on non-planted areas. Flush all lines prior to installation of heads.

B. Sprinkler heads shall be installed as detailed, set adjacent to the edge of hardscape elements (6 inches for spray heads, 12 inches for rotary heads) and perpendicular to the finish grade.

C. Upon completion of the installation, the Contractor shall adjust or change sprinkler head nozzles to properly distribute water flow without overspray and shall place entire irrigation system in first-class operating condition.

D. Sprinkler heads shall be adjusted in order by fully opening the sprinkler furthest from the control valve and working back toward the control valve. Adjust sprinkler heads which spray toward buildings or adjacent hardscape so that water spray does not contact the side of buildings or significantly over-spray onto hardscape .

3.10 COMPLETION AND MAINTENANCE

A. Irrigation system shall be maintained and adjusted as required to provide proper coverage throughout the maintenance period or until Final Acceptance of the project, whichever is greater. Irrigation system maintenance shall commence upon a general review following the completion of irrigation installation, planting operations and general clean-up.

B. After the system has been completed, the Contractor shall instruct an authorized representative of the Owner in the operations and maintenance of the system and controls, and shall set the desired controller irrigation time for each station.

3.11 REPAIR AND CLEAN-UP

A. All areas shall be maintained in a neat and orderly condition at all times. All reasonable precautions shall be taken to avoid damage to existing planting and structures. Disturbed areas shall be restored to their original condition.

B. After the planting operations are completed, the Contractor shall remove all trash, excess materials, empty containers or any other debris accumulated by the work from the site. All damage caused by the work shall be repaired at the Contractor's expense and the site shall be left in a neat and orderly condition to the satisfaction of the Project Inspector and Owner.

END OF SECTION