

## 32 8400 Irrigation

### DISCLAIMER AND RESPONSIBILITY OF THE USER

**Use of this document:** The following specification has been prepared by the Urban Tree Foundation and is copyright 2014. Permission for use this material is granted for individual use to prepare specifications. It may not be reproduced in part or in its entirety for sale or profit. This document, when used as the basis of a specification, has significant legal and financial ramifications on the outcome of a construction project. By adopting this specification, in part or in its entirety, the user accepts all liability related to its use.

### INSTRUCTIONS TO THE SPECIFICATION WRITER:

*The following document is intended as a general specification to guide the writing of a project-specific specification. Each project is unique and it is required that the specification be developed accordingly. DO NOT USE THE FOLLOWING SPECIFICATION WITHOUT MAKING IMPORTANT ADJUSTMENTS to reflect local conditions, regulations, market standards, project schedules and local and regional practices. The following are specific items that need to be addressed.*

**1. General instructions to use this specification:** *These instructions are intended to guide the specification writer (the specifier) through the process of editing this document into an Irrigation specification. Be sure to delete these instructions before issuing the specifications. Note that there is a watermark on each page identifying this as a draft specification. Be sure to delete this watermark before issuing this document. The watermark is found under the "Insert" pull down in the tool bar.*

**2. General Requirements - Division 01 (Construction Specification Institute) specifications and other contract elements:** *This specification is designed to be used in conjunction with standard Division 01 specifications, which cover project general conditions and project wide contract elements. THIS IS NOT A STAND-ALONE SPECIFICATION and should not be used as a contract for the purchase of and installation of an irrigation system. Important issue of project ownership, liability, insurance, contract language, project controls, Instructions to bidders, change orders and review and approval of the work are normally in the Division 01 specifications.*

**3. The construction team:** *A construction project is a team effort where the owner, in effect, creates a partnership with all the Contractors to build a project. As with any good contract there are protections for both sides; that the Owner will get the quality of project that they desire within the time limits and budget available; and the Contractor will be paid for the work satisfactorily completed. In between the initial bidding and the final completion there will be many places where parts of the construction do not work out as originally intended. This is normal and a good contract should allow for these changes in a manner that is equitable to both the Owner and the Contractor. To get there, a team approach and spirit must prevail. Both sides must assume that each is operating in the best interest of the project goals. The clearer the goals and description of the project, the smoother the flow of a successful project. **The more each of the team members can trust the other members, the better the project.** This should be a critical principle in approaching the interpretation of the specification.*

**4. Other project documents:** *This specification is intended to be used in conjunction with other project documents including the bid forms, the construction contract, Division 1 specifications, other specifications directly related to this section; other specifications that are not directly related to this work, and most critically the Project construction drawings. It is very critical that all these documents be prepared with consistent terminology and that they be coordinated. The terms used for the parts of trees and other plants, different soil types, drainage features, irrigation features and structures such as paving, walls and planters must be consistent across disciplines. A very common mistake is the use of different terms and details for soil and the extent of soil work. The terms and details for Planting Soil, subsoil and other materials must be well coordinated.*

**5. Relate specification sections:** *This specification requires additional specification sections to describe several important related parts of the planting process.*

**Tree Protection:** *This specification assumes that there is a separate specification section and construction drawings and details for tree protection; remove this section if there are no existing trees to be protected on the project.*

**Planting:** This specification assumes that there is a separate specification section and separate plans and details for installation of Planting.

**Planting Soil:** This specification assumes that there may be a separate specification section for Planting Soil associated with the project planting.

**6. Reviewing and approval authority:** Each specification identifies a certain entity as responsible for the review and approval of the work, project submittals, changes to the work and final acceptance of the work. The entity is normally identified in Division 1. For the purposes of this specification, the term the “Owner’s Representative” has been used as a placeholder for this entity. Once the proper term is defined, for example another term such as; Contracting Officer, The Architect, The Landscape Architect, The Engineer etc.; this term should replace the words “Owner’s Representative” wherever it appears in this specification.

**7. Header and footer requirements:** Change the header/footer language to meet the project requirements.

**8. Notes to specifiers:** Before issuing the document, be sure to remove all “Notes to specifiers” incorporated into this document after you have read them and responded to the recommendations.

**9. Submittals:** Submittals are a critical part of any construction contract. This is where all products and materials are reviewed and approved in advance of the work. Including very specific requirements for approval of submittals, while a good practice, assumes that the reviewing authority has the skills needed to make these reviews and interpret the results. A common practice is to make very specific requirements but not have the time or expertise to enforce them. Lack of review of submittals does not automatically transfer quality control to the Contractor. In fact, lack of review or inappropriate review can make the reviewing authority responsible for having accepted the submittal even if it was not acceptable. **Do not put into the specification submittal requirements that you do not have the time, resources or knowledge, which you knew or should have known, to enforce.**

**10. Specification modifications:** There are locations in this specification where additional information is required to reflect project region or contract conditions. Please insert the requested information.

#### **11. SPECIAL REQUIREMENTS OF THIS SPECIFICATION:**

**Product specification:** This specification offers three approaches to product quality. The first is a generic quality non-proprietary product specification. The second option is to peg the generic product quality to a specific manufacture or several or equal manufactures product lines (inserted by the specifier) without specifying specific products. The third option is to allow the specifier to specify specific products where that product exactly fits the design premise of the system design and quality. If the specifier desires to specify specific products a schedule including the product descriptions and model numbers needs to be added either to the drawings or to the specification. **DO NOT** add a schedule to both documents.

**Irrigation system design assumptions:** This specification assumes that the specifier and the system designer understand the system design assumptions such as the supply pipe size and water pressure. This information must be incorporated onto the drawing. Other design features on the plan such as head type and spacing are a function of water pressure, requirements of completeness of water cover, topography and wind factors. This makes substitutions of head type, for example, have impact on the layout and spacing of heads and even the number of heads on a specific zone. Given the integration of design considerations, drawings and specifications, it is critical for the specifier to work closely with the system design team during the preparation of this document and the resulting construction observation and submittal process.

## SECTION 32 8400

### IRRIGATION

#### PART 1 – GENERAL

##### 1.1 SUMMARY

**Note to specifier:** *Remove any parts of this work description that does not apply.*

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

**Note to specifier:** *Confirm if the installing Contractor or the general Contractor or the owner is paying for water and electric use fees and hook up charges. Amend the above paragraph if the installing Contractor is required to pay any of these fees.*

1. Locate, purchase, deliver and install piping, conduit, sleeves, 120 volt and low voltage electrical and water connections, valves, backflow preventer devices, controllers, rain sensors, spray and bubbler heads, drip irrigation lines, and associated accessories for a fully operational automatic irrigation system.
  2. Trenching and water settling of backfill material.
  3. Testing and startup of the irrigation system.
  4. Prepare an as built record set of drawings.
  5. Training of the Owner's maintenance personnel in the operational requirements of the Irrigation system.
  6. Clean up and disposal of all excess and surplus material.
  7. Maintenance of the irrigation system during the proscribed maintenance period.
- B. The system shall efficiently and evenly irrigate all areas and be complete in every respect and shall be left ready for operation to the satisfaction of the Owner's Representative.
- C. Coordinate with other trades, as needed to complete work, including but not limited to Water Meter, Point of Connection (POC) and Backflow Preventer Device (BFPD) location and electrical hookups.

##### 1.2 CONTRACT DOCUMENTS

- A. Shall consist of specifications and its general conditions and the drawings. The intent of these documents is to include all labor, materials, and services necessary for the proper execution of the work. The documents are to be considered as one. Whatever is called for by any part shall be as binding as if called for in all parts.

##### 1.3 RELATED DOCUMENTS AND REFERENCES

- A. Related Documents:

**Note to specifier:** *Coordinate this list with the other related specification sections. Add or delete sections as appropriate.*

1. Drawings and general provisions of contract, including general and supplementary conditions and Division I specifications, apply to work of this section.
2. Related Specification Sections
  - a. Section - Planting
  - b. Section - Planting Soil
  - c. Section – Lawn
  - d. Sections - Mechanical/Plumbing
  - e. Section – Tree and Plant Protection

f. Sections - Electrical

B. References:

1. American Society of Testing Materials (ASTM): cited section numbers.
2. National Sanitation Foundation (NSF): rating system.
3. Irrigation Association: Turf & Landscape Irrigation Best Management Practices

1.4 VERIFICATION

- A. Irrigation piping and related equipment are drawn diagrammatically. Scaled dimensions are approximate only. Before proceeding with work, carefully check and verify dimensions and immediately notify the Owner's Representative of discrepancies between the drawings or specifications and the actual conditions. Although sizes and locations of plants and or irrigation equipment are drawn to scale wherever possible, it is not within the scope of the drawings to show all necessary offsets, obstructions, or site conditions. The Contractor shall be responsible to install the work in such a manner that it will be in conformance to site conditions, complete, and in good working order.
- B. Piping and equipment is to be located within the designated planting areas wherever possible unless specifically defined or dimensioned otherwise.

1.5 PERMITS AND REGULATIONS

- A. The Contractor shall obtain and pay for all permits related to this section of the work unless previously excluded under provision of the contract or general conditions. The Contractor shall comply with all laws and ordinances bearing on the operation or conduct of the work as drawn and specified. If the Contractor observes that a conflict exists between permit requirements and the work outlined in the contract documents, the Contractor shall promptly notify the Owner's Representative in writing including a description of any necessary changes and changes to the contract price resulting from changes in the work.
- B. Wherever references are made to standards or codes in accordance with which work is to be performed or tested, the edition or revision of the standards and codes current on the effective date of this contract shall apply, unless otherwise expressly set forth.
- C. In case of conflict among any referenced standards or codes or between any referenced standards and codes and the specifications, the more restrictive standard shall apply or Owner's Representative shall determine which shall govern.

1.6 PROTECTION OF WORK, PROPERTY AND PERSON

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

1.7 CHANGES IN THE WORK

- A. The Owner's Representative may order changes in the work, and the contract sum being adjusted accordingly. All such orders and adjustments plus claims by the Contractor for extra compensation must be made and approved in writing before executing the work involved.
- B. All changes in the work, notifications and Contractor's request for information (RFI) shall conform to the contract general condition requirements.

1.8 CORRECTION OF WORK

- A. The Contractor shall re-execute any work that fails to conform to the requirements of the contract and shall remedy defects due to faulty materials or workmanship upon written notice from the Owner's Representative, at the soonest as possible time that can be coordinated with other work, and seasonal weather demands, but not more than 90 (ninety) days after notification.

1.9 DEFINITIONS

- A. Owner's Representative: The person appointed by the Owner to represent their interest in the review

and approval of the work and to serve as the contracting authority with the Contractor. The Owner's Representative may appoint other persons to review and approve any aspects of the work.

- B. Substantial Completion Acceptance: The date at the end of the Planting, Planting Soil, and Irrigation installation where the Owner's Representative accepts that all work in these sections is complete and the Warranty period has begun. This date may be different that the date of substantial completion for the other sections of the project.
- C. Final Acceptance: The date when the Owner's Representative accepts that the plants and work in this section meet all the requirements of specification. It is intended that the materials and workmanship warranty for Planting, Planting Soil, and Irrigation work run concurrently.

#### 1.10 SUBMITTALS

- A. See the contract General Conditions for policy and procedures related to submittals.
- B. Product data
  - 1. Submit a minimum of (3) complete lists of all irrigation equipment to be used, manufacturer's brochures, maintenance manuals, warranties and operating instructions, within 15 days after the notice to proceed.
    - a. This submission may be done digitally and all documents shall be submitted in one PDF document.
  - 2. The submittals shall be packaged and presented in an organized manner, in the quantity described in Division 1 of the specifications. Provide a table of contents of all submitted items.
  - 3. Clearly identify on each submitted sheet by underlining or highlighting (on each copy) the specific product being submitted for approval. Failure to clearly identify the specific product being submitted will result in a rejection for the entire submittal. No substitutions of material or procedures shall be made concerning these documents without the written consent of an accepted equivalent by the Owner's Representative.
  - 4. Equipment or materials installed or furnished without prior approval of the Owner's Representative, may be rejected by the Owner's Representative and the Contractor shall be required to remove such materials from the site at their own expense.
  - 5. Approval of substitution of material and/or products, other than those specified shall not relieve the Contractor from complying with the requirements of the contract documents and specifications. The Contractor shall be responsible, at their own expense, for all changes that may result from the approved substitutions, which affect the installation or operations other items of their own work and/or the work of other Contractors.
- C. Samples: Samples of the equipment may be required at the request of the Owner's Representative if the equipment is other than that specified.
- D. Other Submittals: Submit for approval:
  - 1. Documentation of the installer's qualifications.
  - 2. As built record set of drawings.
  - 3. Testing data from all required pressure testing.
  - 4. Backflow prevention device certification: Certification from the manufacturer or their representative that the back flow prevention device has been installed correctly according to the manufactures requirements.
  - 5. Booster pump certification: Certification from the manufacturer or their representative that the booster pump has been installed correctly according to the manufacturer's requirements.
  - 6. Irrigation controller certification: Certification from the manufacturer or an authorized distributor that the Controller has been installed correctly according to the manufactures requirements.

#### 1.11 OBSERVATION OF THE WORK

- A. The Owner's Representative may inspect the work at any time. They may remove samples of materials for conformity to specifications. Rejected materials shall be immediately removed from the site and replaced at the Contractor's expense. The cost of testing materials not meeting specifications shall be paid by the Contractor.
- B. The Owner's Representative shall be informed of the progress of the work so the work may be observed at the following key times in the construction process. The Owner's Representative shall be afforded sufficient time to schedule visit to the site. Failure of the Owner's Representative to make field observations shall not relieve the Contractor from meeting all the requirements of this specification.
  - 1. Trenching, directional boring, and sleeving review.
  - 2. Hydrostatic pressure testing.
  - 3. Adjustment and coverage test.
  - 4. Pre-maintenance observation.
  - 5. Final acceptance / system malfunction corrections.

#### 1.12 PRE-CONSTRUCTION CONFERENCE

- A. Schedule a pre-construction meeting with the Owner's Representative at least seven (7) days before beginning work to review any questions the Contractor may have regarding the work, administrative procedures during construction and project work schedule.

#### 1.13 QUALITY ASSURANCE

- A. It is the intention of this specification to accomplish the work of installing an automatic irrigation system, which will operate in an efficient and satisfactory manner. The irrigation system shall be installed and made operational according to the workmanlike standards established for landscape installation and sprinkler irrigation operation as set forth by the most recent Best Management Practices (BMP) of the Irrigation Association.
- B. The specification can only indicate the intent of the work to be performed rather than a detailed description of the performance of the work. It shall be the responsibility of the Contractor to install said materials and equipment in such a manner that they shall operate efficiently and evenly and support optimum plant growth and health.
- C. The Owner's Representative shall be the sole judge of the true intent of the drawings and specifications and of the quality of all materials furnished in performance of the contract.
- D. The Contractor shall keep one copy of all drawings and specifications on the work site, in good order. The Contractor shall make these documents available to the Owner's Representative when requested.
- E. In the event of any discrepancies between the drawings and the specification, the final decision as to which shall be followed, shall be made by the Owner's Representative.
- F. In the event the installation is contradictory to the direction of the Owner's Representative, the installation shall be rectified by the Contractor at no additional cost to the Owner. The Contractor shall immediately bring any such discrepancies to the attention of the Owner's Representative.
- G. It shall be distinctly understood that no oral statement of any person shall be allowed in any manner to modify any of the contract provisions. Changes shall be made only on written authorization of the Owner's Representative.
- H. Installer Qualifications: The installer shall be a firm having at least 5 years of successful experience of a scope similar to that required for the work.
  - a. Installer Field Supervision: The installer shall maintain on site an experienced full-time supervisor who can communicate in English with the Owner's Representative.
  - b. Submit the installer's qualifications for approval.

#### 1.14 IRRIGATION SYSTEM WARRANTY:

- A. The Contractor shall Warrantee all workmanship and materials for a period of X year (s) following the acceptance of the work.

**Note to specifier:** *Insert above the length of time for the system warrantee period. It is advised to make the irrigation system and the plants have the same length of warrantee.*

- 1. Any parts of the irrigation work that fails or is defective shall be replaced or reconstructed at no expense to the Owner including but not limited to: restoring grades that have settled in trenches and excavations related to the work. Reconstruction shall include any plantings, soil, mulch or other parts of the constructed landscape that may be damaged during the repair or that results from soil settlement.
- B. The date of acceptance of the work and start of the Guarantee period shall be determined by the Owner's Representative, upon the finding that the entire irrigation system is installed as designed and specified, and found to be operating correctly, supplying water evenly to all planting and/or lawn areas.
- C. The system controller shall be warranted by the equipment manufacturer against equipment malfunction and defects for a period of X years, following the acceptance of the work.

**Note to specifier:** *Insert the length of time that the selected controller is warrantied. Verify material warranty with the controller manufacturer. If a specific controller is not specified, delete the above paragraph.*

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

#### 1.15 SITE CONDITIONS

- A. It is the responsibility of the Contractor to be aware of all surface and sub-surface conditions, and to notify the Owner's Representative, in writing, of any circumstances that would negatively impact the installation of the work. Do not proceed with work until unsatisfactory conditions have been corrected.

#### 1.16 DELIVERY, STORAGE, AND HANDLING

- A. All materials and equipment shall be stored properly and protected as required by the Contractor. The Contractor shall be entirely responsible for damages or loss by weather or other cause to work under the contract. Materials shall be furnished in ample quantities and at such times as to ensure uninterrupted progress of the work.
- B. Deliver the products to the job site in their original unopened container with labels intact and legible at time of use.
- C. Store in accordance with the manufacturers' recommendations.

#### 1.17 PROTECTION

- A. The Contractor shall continuously maintain adequate protection of all their work from damage, destruction, or loss, and shall protect the owner's property from damage arising in connection with this contract. Contractor shall make good any such damage, destruction, loss or injury. Contractor shall adequately protect adjacent property as provided by law and the contract documents.
- B. The Contractor shall maintain sufficient safeguards, such as railings, temporary walks, lights, etc., against the occurrence of accidents, injuries or damage to any person or property resulting from their work, and shall alone be responsible for the same if such occurs.
- C. All existing paving, structures, equipment or plant material shall be protected at all times, including the irrigation system related to plants, from damage by workers and equipment. The Contractor shall follow all protection requirements including plant protection provision of the general contract documents. All damages shall be repaired or replaced at the Contractor's expense. Repairs and or

replacement shall be to the satisfaction of the Owner's Representative, including the selection of a Contractor to undertake the repair or maintenance. Repairs shall be at no cost to the owner.

1. For trees damaged to the point where they will not be expected to survive or which are severely disfigured and that are too large to replace, the cost of damages shall be as determined by the Owner's arborist using accepted tree value evaluation methods.
- D. The Contractor shall refrain from trenching within the drip line of any existing tree to remain. The Owner's Representative may require the Contractor to relocate proposed irrigation work, bore lines beneath roots or use air spade technology to dig trenches through and under the root system to avoid damage to existing tree root areas.

#### 1.18 EXCAVATING AROUND UTILITIES

- A. Contractor shall carefully examine the civil, record, and survey drawings to become familiar with the existing underground conditions before digging.

1. Do not begin any excavation until all underground utilities have been located and marked.

Determine location of underground utilities and perform work in a manner that will avoid possible damage. Hand excavate, as required. Maintain stakes and or markings set by others until parties concerned mutually agree to their removal.

**Note to specifier:** *Insert the telephone number and correct name of the Local Utility Locator Service if available to the paragraph below.*

- B. Notification of *Local Utility Locator Service, Insert PHONE NUMBER*, is required for all excavation around utilities. The Contractor is responsible for knowing the location and avoiding utilities that are not covered by the *Local Utility Locator Service*.

**Note to specifier:** *If the project is not in California remove the following paragraph.*

- C. Section 4216/4217 of the government code requires a dig-alert identification number be issued before a "permit to excavate" will be valid. For your dig-alert identification number call underground service alert toll free 1-800-422-4133 two working days before beginning construction.

#### 1.19 POINT OF CONNECTION

**Note to specifier:** *Confirm exactly where the irrigation Contractor is to connect to the water and high voltage electrical supply. Often the General Contractor and their plumber and electrician are to provide the connections, including the electrical junction box or plug receptacle, back flow preventer, main shutoff valve and other items. Where non-potable water is used another Contractor may provide some of the required equipment and connections. This specification provides two options, which may also need further modification by the specifier. The specifier must confirm assumptions and pick one of the following options.*

##### **Point of connection option 1 - Irrigation Contractor provided**

- A. The point of connection of the irrigation system to its electrical power sources shall be provided by the irrigation installer. All connections shall be made by a licensed electrical Contractor per governing codes at the location shown on the drawings.
- B. The point of connection of the irrigation system to its potable and or non-potable water sources, including the main shutoff valve and backflow preventer shall be provided by the irrigation installer. All connections shall be made by a licensed Contractor per governing codes, at the location shown on the drawings.

##### **Point of connection option 2 – General Contractor provided**

- A. The point of connection of the irrigation system to its electrical power sources shall be provided by the General Contractor's licensed electrical Contractor per governing codes at the location shown on the drawings. The irrigation Contractor will connect the power to provided junction box or grounded plug receptacle.



- B. The point of connection of the irrigation system to its potable and or non-potable water sources, including the main shutoff valve and backflow preventer shall be provided by the General Contractor's licensed plumbing Contractor per governing codes at the location shown on the drawings. The minimum size and water pressure of the pressurized line will be as noted on the irrigation drawing.

#### 1.20 TEMPORARY UTILITIES

- A. All temporary piping, wiring, meters, panels and other related appurtenances required between source of supply and point of use shall be provided by the Contractor and coordinated with the Owner's Representative. Existing utilities may be used with the written permission of the owner.

#### 1.21 CUTTING, PATCHING, TRENCHING AND DIGGING

- A. The Contractor shall do all cutting, fitting, trenching or patching of their work that may be required to make its several parts come together as shown upon, or implied by, the drawings and specifications for the completed project.
- B. Digging and trenching operations shall be suspended when the soil moisture is above field capacity.

#### 1.22 USE OF PREMISES

- A. The Contractor shall confine their apparatus; the storage of materials, and the operations of their workers to limits indicated by the law, ordinances, or permits and shall not unreasonably encumber the premises with their materials.
- B. Contractor parking, and material and equipment storage shall in areas approved by the Owner's Representative.

#### 1.23 AS BUILT RECORD SET OF DRAWINGS

- A. Immediately upon the installation of any buried pipe or equipment, the Contractor shall indicate on the progress record drawings the locations of said pipe or equipment. The progress record drawings shall be made available at any time for review by the Owner's Representative.
- B. Before final acceptance of work, the Contractor shall provide an as built record set of drawings showing the irrigation system work as built. The drawings shall be transmitted to the Owner's Representative in paper format and as a pdf file of each document on compact disk or flash drive. The drawings shall include all information shown on the original contract document and revised to reflect all changes in the work. The drawings shall include the following additional information
  1. All valves shall be numbered by station and corresponding numbers shall be shown on the as built record set of drawings.
  2. All main line pipe or irrigation equipment including sleeves, valves, controllers, irrigation wire runs which deviate from the mainline location, backflow preventers, remote control valves, grounding rods, shut-off valves, rain sensors, wire splice locations, and quick coupling valves shall be located by two (2) measured dimensions, to the nearest one-half foot. Dimensions shall be given from permanent objects such as buildings, sidewalks, curbs, walls, structures and driveways. All changes in direction and depth of main line pipe shall be noted exactly as installed. Dimensions for pipes shall be shown at no greater than a 50 ft. maximum interval.
  3. As built record set of drawings shall be signed and dated by the Contractor attesting to and certifying the accuracy of the as built record set of drawings. As built record set of drawings shall have "As Built Record Set of Drawings", company name, address, phone number and the name of the person who created the drawing and the contact name (if different).
- C. The Owner shall make the original contract drawing files available to the Contractor.

#### 1.24 CONTROLLER CHARTS:

- A. Provide one controller chart for each automatic controller installed.

1. On the inside surface of the cover of each automatic controller, prepare and mount a color-coded chart showing the valves, main line, and systems serviced by that particular controller. All valves shall be numbered to match the operation schedule and the drawings. Only those areas controlled by that controller shall be shown. This chart shall be a plot plan, entire or partial, showing building, walks, roads and walls. The plan, reduced as necessary and legible in all details, shall be made to a size that will fit into the controller cover. This print shall be approved by the Owner's Representative and shall be protected in laminated in a plastic cover and be secured to the inside back of the controller cabinet door.
2. The controller chart shall be completed and approved prior to acceptance of the work.

#### 1.25 TESTING

- A. Provide all required system testing with written reports as described in part 3.

#### 1.26 OPERATION AND MAINTENANCE MANUALS AND GUARANTEES

- A. Prepare and deliver to the Owner's Representative within ten calendar days prior to completion of construction, two 3-ring hard cover binders containing the following information:
  1. Index sheet stating Contractor's address and telephone number, list of equipment with name and addresses of local manufacturers' representatives.
  2. Catalog and parts sheets on all material and equipment.
  3. Guarantee statement. The start of the guarantee period shall be the date the irrigation system is accepted by the Owner.
  4. Complete operating and maintenance instruction for all major equipment.
  5. Irrigation product manufacturers warranties.
- B. In addition to the above-mentioned maintenance manuals, provide the Owner's maintenance personnel with instructions for maintaining major equipment and show evidence in writing to the Owner's Representative at the conclusion of the project that this has been rendered.

### PART 2 – PRODUCTS

#### 2.1 MATERIALS GENERAL

- A. All materials shall be of standard, approved and first grade quality and shall be new and in perfect condition when installed and accepted.

*Note to specifier: The following are three options for the use of specific manufacturer's product to set quality and capability of the installation. Confirm the desired approach and select only one of the following options. Modify the text as needed.*

*Option 1 – Use of a manufacturer's name on the drawing only as a general guide.*

- B. The use of a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and configuration desired only. Other manufacturer's equipment may be submitted for approval with written approval by the Owner's Representative. Substituted equipment shall not substantially alter the operations of the system.

*Option 2 – Use of a manufacturer's name or names in the specification as a specific requirement to use their products but where no specific products are required.*

- B. All controllers, valves, and heads *(add other product categories if needed)* shall be manufactured by the following manufacturer(s) *(or approved equal)*.
  1. *Insert manufacturer's name(s) and contact information.*

**Option 3 - Use of a specific manufacturer's name and product model for critical products. If this option is selected modify the product specific specifications that follow so that the text is consistent with the product required.**

- B. See the parts schedule on the drawings (or below) for specific components and manufacturers.  
*1. Insert schedule of required parts with manufactures name(s) and contact information or add to the various product specifications below.*
- C. Approval of any items or substitutions indicates only that the product(s) apparently meet the requirements of the drawings and specifications on the basis of the information or samples submitted. The Contractor shall be responsible for the performance of substituted items. If the substitution proves to be unsatisfactory or not compatible with other parts of the system, the Contractor shall replace said items with the originally specified items, including all necessary work and modifications to replace the items, at no cost to the owner.

**Note to specifier:** *Some of the following product specifications have a clause that say that further product descriptions are on the drawings. Confirm that this is the case. If this is the desired option for the specification, select Option 3 above. If this is not the case remove reference to the product being described on the drawings. Add additional specifications as needed to strengthen the product requirements as needed by the project goals and tolerance for tightening industry product options.*

*Delete all products in the following paragraphs not applicable to this specific project.*

## 2.2 RECLAIMED WATER SYSTEM DESIGNATION

- A. Where irrigation systems use reclaimed water, all products including valve boxes, lateral and main line pipe, etc. where applicable and/or required by local code shall have the reclaimed water purple color designation.

## 2.3 PIPING MATERIAL

- A. Individual types of pipe and fittings supplied are to be of compatible manufacturer unless otherwise approved. Pipe sizes shown are nominal inside diameter unless otherwise noted.
- B. Plastic pipe:
  - 1. All pipe shall be free of blisters, internal striations, cracks, or any other defects or imperfections. The pipe shall be continuously and permanently marked with the following information: manufacturer's name or trade mark, size, class and type of pipe pressure rating, quality control identifications, date of extrusion, and National Sanitation Foundation (NSF) rating.
  - 2. Pressure main line for piping upstream of remote control valves and quick coupling valves:
    - a. Pipe smaller than 2 inch diameter shall be plastic pipe for use with solvent weld or threaded fittings. Shall be manufactured rigid virgin polyvinyl chloride (PVC) 1220, Type 1, Grade 2 conforming to ASTM D 1785, designated as Schedule 40.
    - b. Pipe 2 - 3 inch diameter shall be manufactured rigid virgin polyvinyl chloride (PVC), Type 1, Grade 2 conforming to ASTM D 1785, designated as bell gasket Class 315.
    - c. Pipe larger than 3 inch diameter shall be manufactured rigid virgin polyvinyl chloride (PVC), Type 1, Grade 2 conforming to ASTM D 1785, designated as bell gasket Class 200 PVC.
  - 3. Non-pressure lateral line for piping downstream of remote control valves: plastic pipe for use with solvent weld or threaded fittings. Shall be manufactured rigid virgin polyvinyl chloride PVC 1220 (type 1, grade 2) conforming to ASTM d 1785, designated as Class 200, 3/4" minimum size.
- C. Galvanized pipe shall be used for above ground connections to, backflow prevention device assemblies, hose bibs, and booster pumps and as shown on the plans and details.
  - 1. Pipe shall be hot dip galvanized continuous welded, seamless, Schedule 40 conforming to applicable current ASTM standards.

## 2.4 FITTINGS AND CONNECTIONS:

- A. Polyvinyl chloride pipe fittings and connections: Type II, Grade 1, Schedule 40, high impact molded fittings, manufactured from virgin compounds as specified for piping tapered socket or molded thread type, suitable for either solvent weld or screwed connections. Machine threaded fittings and plastic saddle and flange fittings are not acceptable. Furnish fittings permanently marked with following information: nominal pipe size, type and schedule of material, and National Sanitation Foundation (NSF) seal of approval. PVC fittings shall conform to ASTM D2464 and D2466.
- B. Brass pipe fittings, unions and connections: standard 125 pound class 85% red brass fittings and connections, IPS threaded.
- C. PVC Schedule 80 threaded risers and nipples: Type I, grade 1, Schedule 80, high impact molded, manufactured from virgin compounds as specified for piping and conforming to ASTM D-2464. Threaded ends shall be molded threads only. Machined threads are not acceptable.
- D. Galvanized pipe fittings shall be galvanized malleable iron ground joint Schedule 40 conforming to applicable current ASTM standards.

## 2.5 SOLVENT CEMENTS AND THREAD LUBRICANT

- A. Solvent cements shall comply with ASTM D2564. Socket joints shall be made per recommended procedures for joining PVC plastic pipe and fittings with PVC solvent cement and primer by the pipe and fitting manufacturer and procedures outlined in the appendix of ASTM D2564.
- B. Thread lubricant shall be Teflon ribbon-type, or approved equal, suitable for threaded installations as per manufacturer's recommendations.
- C. Pipe Joint Compound (Pipe dope) shall be used on all galvanized threaded connections. Pipe Joint Compound is a white colored, non-separating thread sealant compound designed to seal threaded connections against leakage due to internal pressure. It shall contain PTFE (Polytetrafluoroethylene) to permit a tighter assembly with lower torque, secure permanent sealing of all threaded connections and allow for easy disassembly without stripping or damaging threads.

## 2.6 BACKFLOW PREVENTION DEVICES

- A. The backflow prevention device shall be certified to NSF/ANSI 372 shall be ASSE Listed 1013, rated to 180 degree F, and supplied with full port ball valves.
- B. The main body and access covers shall be low lead bronze (ASTM B 584)
- C. The seat ring and all internal polymers shall be NSF Listed Noryl and the seat disc elastomers shall be silicone.
- D. Backflow Preventer shall be as indicated on the drawings.

## 2.7 PRESSURE REGULATOR

- A. Pressure regulator shall certified to NSF/ANSI 372, consisting of low lead bronze body bell housing, a separate access cap shall be threaded to the body and shall not require the use of ferrous screws.
- B. The main valve body shall be cast bronze (ASTM B 584).
- C. The access covers shall be bronze (ASTM B 584 or Brass ASTM B 16)
- D. The assembly shall be of the balanced piston design and shall reduce the pressure in both flow and no flow conditions.
- E. Pressure regulator shall be as indicated on the drawings.

## 2.7. Wye Strainer

- A. Strainer shall conform to MIL -S-16293, and be ANSI 3<sup>rd</sup> party certified to comply with the states lead plumbing law 0.25% maximum weighted average lead content.
- B. The main body shall be low lead bronze (ASTM B 584)

- C. The access covers shall be yellow brass or cast bronze (ASTM B 16 or ASTM B 584)
- D. Strainer screen shall be 300 series stainless steel available in 20, 40, 60, 80, or 100 mesh.
- F. Wye strainer shall be as indicated on the plans.

## 2.8 BACKFLOW PREVENTER CAGE

- A. A heavy-duty steel mesh cage with rust proof finish. The caging shall be sized to allow space for the entire piping assembly associated with the Backflow Preventer unit, and all associated equipment.
- B. The cage shall include the manufacturers' standard tamper proof locking mechanism.
- C. Provide a concrete base as detailed on the drawings.
- D. Backflow Preventer Cage type, manufacturer and color shall be as indicated on the plans.

## 2.9 BOOSTER PUMP

*Note to specifier: Booster pumps are used when available static pressure is too low for the system to operate, demand is high requiring multiple stations to operate at once, future expansion of the system of the water window is very small due to maintenance practices or site use (such as in the case of parks, sports fields, or schools). It is the responsibility of the specifier to consider all such factors in determining whether or not a booster pump is required. IN many cases booster pumps are specified when they are not needed due to all of the variables not being taken into consideration.*

- A. Booster pump shall be housed in a sturdy, locking, weather-resistant case, furnished for maximum exterior protection.
- B. Booster pump shall be as indicated on the drawings.

## 2.10 BALL VALVES

- A. Ball valves for 3/4 inch through 2-1/2 inch shall be of PVC, block, tru-union design with EDPDM seals and o-ring.
- B. Ball valves for 3 inch and larger shall be gate design and shall be iron body, brass or bronze mounted AWWA gate valves, and shall have a clear waterway equal to the full nominal diameter of the valve, and shall be rubber gasket, flanged or mechanical joint only, and shall be able to withstand a continuous working pressure of 150 PSI. Valve shall be equipped with a square-operating nut.
- C. All ball valves located in a valve manifold shall be the same size as the main line (1-1/2 inch size minimum). Provide pipe-reducing adapters down stream of valves, as required. All ball valves in line shall be the same size as the pipe.
- D. Ball valves shall be as indicated on the drawings.

## 2.11 CHECK VALVES

- A. Swing check valves 2 inch and smaller shall be 200 lbs., W.O.G., bronze construction with replaceable composition, neoprene or rubber disc and shall meet or exceed federal specification WW-V- 5ld, class a, type iv.
- B. Anti-drain valves shall be of heavy-duty virgin PVC construction with female iron pipe thread inlet and outlet. Internal parts shall be stainless steel and neoprene. Anti-drain valves shall be field adjustable against draw out from 5 to 40 feet of head.
- C. Check valves shall be as indicated on the drawings.

## 2.12 REMOTE CONTROL VALVES

- A. Remote control valves shall be electrically operated, single seat, normally closed configuration, equipped with flow control adjustment and capability for manual operation.

- B. Valves shall be actuated by a normally closed low wattage solenoid using 24 volts, 50/60 cycle solenoid power requirement. Solenoid shall be epoxy encased. A union shall be installed on the discharge end.
  - C. Remote control valves shall be wired to controller in same numerical sequence as indicated on drawings.
  - D. Remote control valves shall be as indicated on the drawings.
- 2.13 MASTER CONTROL VALVES
- Note to specifier:** *The master valve and flow sensor specifications must meet the requirements or recommendations of the controller manufacturer. Additional specifications are required for this product.*
- A. Master Control Valve shall be compatible with the irrigation controller.
  - B. Master control valves shall be as indicated on the drawings.
- 2.14 FLOW SENSOR
- A. Flow sensor shall be compatible with the irrigation controller.
  - B. Flow sensor shall be as indicated on the drawings.
- 2.15 HYDROMETER
- Note to specifier:** *The hydrometer specifications must meet the requirements or recommendations of the controller manufacture. The Hydrometer can be either Reed Switch or Photo Diode Register, specifier needs to verify with the controller manufacturer. Additional specifications are required for this product.*
- A. Hydrometer shall be compatible with the irrigation controller.
  - B. Hydrometer shall be as indicated on the drawings.
- 2.16 QUICK COUPLER VALVES
- A. Quick coupler valves shall be a one or two piece, heavy-duty brass construction with a working pressure of 150 PSI with a built in flow control and a self-closing valve.
  - B. Quick coupler shall be equipped with locking red brass cap covered with durable yellow thermo-plastic rubber cover. Key size shall be compatible with quick coupler and of same manufacturer.
  - C. Quick coupler valves shall be as indicated on the drawings.
- 2.17 SPRINKLER HEADS
- Note to specifier:** *The selection of irrigation heads is a complex decision and needs far stronger specifications than are listed here. Confirm the approach to selecting heads and revise the text.*
- A. All sprinkler heads shall have check valves installed.
  - B. All sprinkler heads shall be as indicated on the drawings.
  - C. Riser nipples for all sprinkler heads shall be the same size as the riser opening in the sprinkler body and fabricated as shown on the drawings.
- 2.18 AUTOMATIC CONTROLLER
- Note to specifier:** *Irrigation controllers vary upon the designer's preferences, users needs, and education of the owner/maintenance personal. The specifier shall develop these specifications based upon those factors.*
- A. Controller shall be housed in a sturdy, locking, weather-resistant case, furnished for maximum exterior protection.
  - B. Controller shall be equipped with evapo-transpiration (ET) sensor, which adjusts the controller programming based on local climatic conditions. The sensor shall also have a rain sensing shut-off switch, wind sensing shut off switch, and freeze sensing shut-off of switch.

1. If a moisture sensor is used in lieu of an evapo-transpiration sensor an additional sensor, which has a rain-sensing shut-off switch, wind sensing shut-off switch, and freeze sensing shut-off switch shall be provided.
  - C. Automatic controller shall be as indicated on the drawings.
- 2.19 CONTROLLER DECODERS
- Note to specifier:** *Controller decoders for 2-wire systems are specific to each controller manufacturer. In addition the installation warranty can be connected to the purchase of the 2-wire controller and decoders from the same distributor. The specifier shall develop these specifications based upon those factors.*
- A. All decoders shall be per the controller manufacturer's specifications.
  - B. Decoder model number shall be as shown on the drawings.
- 2.20 ELECTRICAL CONTROL WIRING
- A. Low voltage
    1. The electrical control wire shall be direct burial type UF, no. 14 AWG, solid, single conductor, copper wire UL approved or larger, if required to operate system as designed.
    2. For 2-Wire controllers all irrigation wire for the controller, flow sensor, master valve, hydrometer, remote control valves and moisture sensors shall be per the controller manufacturer's specifications and recommendations.
    3. Color code wires to each valve. Common wire shall be white.
    4. If multiple controllers are being utilized, and wire paths of different controllers cross each other, both common and control wires from each controller to be of different colors.
    5. Control wire splices: Splices are when required shall be placed in splice boxes.
    6. Wire connections shall be per the controller manufacturer's specifications and recommendations.
  - B. High voltage
    1. Shall be of type as required by local codes and ordinances.
    2. Shall be of proper size to accommodate needs of equipment it is to serve.
- 2.21 VALVE BOXES AND MATERIALS
- Note to specifier:** *Valve box color shall differentiate depending on the specifier's preference or the irrigation system is using non potable water.*
- A. Valve boxes: valve boxes shall be constructed of ABS (acrylonitrile butadiene styrene) plastic, **green** in color, with rigid base and sides and shall be supplied with bolt lock cover secured with stainless steel bolts. Cover shall be identified as shown on drawings. Provide box extensions as required.
    1. Master valves, flow sensors, remote control irrigation valves, gate valves, and ball valves 3 inch or less in size shall use a 14 inch x 19 inch x 12 inch rectangular box.
    2. Quick coupler valves, wire splices, and grounding rods shall use a 10 inch circular box.
- 2.22 CONCRETE THRUST BLOCKS
- A. Concrete thrust blocks shall be sized per the pipe manufactures requirement or as indicated on the drawings.
- 2.23 VALVE IDENTIFICATION TAGS
- A. Valve Identification Tags shall be 2.25 inch x 2.65 inch polyurethane. Color: potable water; yellow / Non-potable water; purple. Tags shall be permanently attached to each remote control valve with

tamper proof seals as indicated on the drawings.

2.24 EQUIPMENT TO BE FURNISHED TO OWNER

- A. Two (2) sets of keys for each automatic controller.
- B. Two (2) 48 inch tee wrenches for operating the gate valves.
- C. Three (3) sets of special tools required for removing, disassembling and adjusting each type of sprinkler and valve supplied on this project.
- D. Five (5) Extra sprinkler heads, nozzles, shrub adapters, nozzle filter screens, for each type used on the project.
- E. Two (2) quick coupler keys to match manufacturer type of quick coupler.

2.25 INCIDENTAL MATERIALS AND EQUIPMENT

- A. Furnish all materials and equipment not specified above, but which are necessary for completion of the work as intended.

2.26 MAIN LINE LOCATOR TAPE

- A. 3 - inch wide plastic detectable locator tape.

2.27 MAIN LINE AND LATERAL LINE BEDDING SAND

- A. Sand shall consist of natural or manufactured granular material, free of organic material, mica, loam, clay or other substances not suitable for the intended purpose.
- B. Sand shall be masonry sand ASTM C 144 or coarse concrete sand, ASTM C 33.

**PART 3 – EXECUTION**

3.1 GENERAL REQUIREMENTS

- A. Code requirements shall be those of state and municipal codes and regulations locally governing this work, providing that any requirements of the drawings and specifications, not conflicting therewith, but exceeding the code requirements, shall govern unless written permission to the contrary is granted by the Owner's Representative.
- B. Extreme care shall be exercised at all times by the Contractor in excavating and working in the project area due to existing utilities and irrigation systems to remain. Contractor shall be fully responsible for expenses incurred in the repair of damages caused by their operation.
  - 1. The Contractor is responsible for identifying and maintaining existing irrigation main lines that supply water to areas on the site as noted on the drawings and outside of the proposed limit of work. The Contractor shall relocate or replace existing irrigation main line piping as required to provide a continuous supply of water to all areas of existing irrigation on site.
    - a. Providing continuous water supply shall include hand watering and or the use of watering trucks to provide adequate water.
- C. Plan locations of backflow preventers, valves, controllers, irrigation lines, sleeves, spray heads and other equipment are diagrammatic and indicate the spacing and relative locations of all installations. Final site conditions and existing and proposed plantings shall determine final locations and adjusted as necessary and as directed to meet existing and proposed conditions and obtain complete water coverage. Minor changes in locations of the above from locations shown shall be made as necessary to avoid existing and proposed trees, piping, utilities, structures, etc. at the Contractor's expense or when directed by the Owner's Representative.
  - 1. The Contractor shall be held responsible for relocation of any items without first obtaining the Owner's Representative's approval. The Contractor shall remove and relocate such items at their expense if so directed by the Owner's Representative.



- D. Prior to any work the Contractor shall stake out locations of all pipe, valves, equipment and irrigation heads and emitters using an approved staking method and maintain the staking of the approved layout in accordance with the drawings and any required modifications. Verify all horizontal and vertical site dimensions prior to staking of heads. Do not exceed spacing shown on drawings for any given area. If such modified spacing demand additional or less material than shown on the drawings, notify the Owner's Representative before beginning any work in the adjacent area.
- E. Stub out main line at all end runs and as shown on drawings. Stub out wires for future connection where indicated on plan and as directed.
- F. Point of connection shall be approximately as shown on drawings. Connect new underground piping and valves and provide all flanges, adapters or other necessary fittings for connection.
- G. Permission to shut off any existing in-use water line must be obtained 48 hours in advance, in writing from the Owner. The Contractor shall receive instructions from the Owner's Representative as to the exact length of time of each shut-off.
- H. No fittings shall be installed on pipe underneath pavement or walls.
- I. Prior to starting any work, Contractor shall obtain a reading of existing static water pressure (no flow condition) at the designated point of connection and immediately submit written verification of pressure with date and time of recording to Owner's Representative.

### 3.2 TRENCHING, DIRECTIONAL BORING AND SLEEVING

- A. Perform all trenching, directional boring, sleeving and excavations as required for the installation of the work included under this section, including shoring of earth banks to prevent cave-ins.
- B. The Contractor may directional bore lines where it is practical or where required on the plans.
  - 1. Extend the bore 1' past the edge of pavement unless noted differently on the plans
  - 2. Cap ends of each bore and locate ends at finished grade using metal stakes.
  - 3. All boring and sleeving shall have detectable locator tape placed at the ends of the pipe.
- C. Make trenches for mains, laterals and control wiring straight and true to grade and free of protruding stones, roots or other material that would prevent proper bedding of pipe or wire.
- D. Excavate trenches wide enough to allow a minimum of 4 - inch between parallel pipelines and 8 inch from lines of other trades. Maintain 3 - inch vertical clearance between irrigation lines. Minimum transverse angle is 45 degrees. All pipes shall be able to be serviced or replaced without disturbing the other pipes.
- E. Trenches for pipelines shall be made of sufficient depth to provide the minimum cover from finished grade as follows:
 

**Note to specifier:** *Mainline depths shall vary based on geography and climate conditions. For colder climates mainline depths shall be deeper. Specifier shall verify local and or state requirements.*

  - 1. Pressure main line: 18 inches below finish grade and 24-30 inches below paved areas in Schedule 40 PVC sleeves.
  - 2. Reclaimed water constant pressure main lines shall cross at least twelve (12) inches below potable water lines.
    - a. If a constant pressure reclaimed water main line must be installed above a potable water line or less than twelve (12) inches below a potable water line, then reclaimed water line shall be installed within an approved protective sleeve. The sleeve shall extend ten (10) feet from each side of the center of the potable line, for a total of twenty (20) feet. The sleeve shall be color-coded (purple) for use with reclaimed water.
  - 3. Lateral lines: 12 inches below finish grade and 18 inches below paved areas in Schedule 40 PVC sleeves.

4. Control wiring: to the side of pressure main line and 24 inches below paved areas in Schedule 40 PVC sleeves.
- F. On new on-site systems (post-meter), the required horizontal separation between potable water lines, reclaimed water constant pressure main lines and sewer lines shall be a minimum of four (4) feet apart as directed by the project engineer and/ or regulatory agency. Measurements shall be between facing surfaces, not pipe centerlines.
- G. When trenching through areas of imported or modified soil, deposit imported or modified soils on one side of trench and subsoil on opposite side.
- H. Backfill the trench per the requirements in paragraphs "Backfilling and Compacting" below.

### 3.3 PIPE INSTALLATION

#### A. General Pipe Installation

1. Exercise caution in handling, loading and storing, of plastic pipe and fittings to avoid damage.
  - a. The pipe and fittings shall be stored under cover until using, and shall be transported in a vehicle with a bed long enough to allow the length of pipe to lay flat so as not to be subjected to undue bending or concentrated external load at any point.
  - b. All pipe that has been dented or damaged shall be discarded unless such dent or damaged section is cut out and pipe rejoined with a coupling.
2. Trench depth shall be as specified above from the finish grade to the top of the pipe.
3. Install a detectable pipe locator tape 6 to 8 inches above all main line pipes.

#### B. Polyvinyl Chloride Pipe (PVC) Installation

1. Under no circumstance is pipe to rest on concrete, rock, wood blocks, construction debris or similar items.
2. No water shall be permitted in the pipe until a period of at least 24 hours has elapsed for solvent weld setting and curing.
3. Install assemblies and pipe to conform to respective details and where shown diagrammatically on drawings, using first class workmanship and best standard practices as approved. All fittings that are necessary for proper connections such as swing joints, offsets, and reducing bushings that are not shown on details shall be installed as necessary and directed as part of the work.
4. Dielectric bushings shall be used in any connections of dissimilar metals.
5. Gasketed plastic pipe: pipe-to-pipe joints or pipe to fittings shall be made in accordance with manufacturer's specifications.
6. Solvent weld or threaded plastic pipe:
  - a. Installation of all pipe and fittings shall be in strict accordance with manufacturer's specifications.
  - b. Pipe shall be cut using approved PVC pipe cutters only. Sawed joints are disallowed. All field cuts shall be beveled to remove burrs and excess before gluing.
  - c. Welded joints shall be given a minimum of 15 minutes to set before moving or handling. Excess solvent on the exterior of the joint shall be wiped clean immediately after assembly.
  - d. Plastic to metal connections shall be made with plastic adapters and if necessary, short (not close) brass threaded-nipples. Connection shall be made with two (2) wraps of Teflon tape and hand tightened plus one turn with a strap wrench.
  - e. Snake pipe horizontally in trench to allow one (1) foot of expansion and contraction per 100 feet of straight run.
  - f. Threaded pipe joints shall be made using Teflon tape. Solvent shall not be used with threaded joints. Pipe shall be protected from tool damage during assembly. All damaged pipe shall be removed and replaced. Take up threaded joints with light wrench pressure.
  - g. No close nipples or risers are allowed. Cross connections in piping is disallowed.

- h. Center load pipe at 10 feet on center intervals with small amount of backfill to prevent arching and slipping under pressure. Other than this preliminary backfill all pipe joints, fittings and connections are to remain uncovered until successful completion of hydrostatic testing and written approval of the testing report.
- i. Concrete thrust blocks shall be constructed behind all pipe fittings 1-1/2 inch diameter and larger at all changes of direction of 45 degrees or more.

C. Galvanized Pipe Installation

- 1. All joints shall be threaded with pipe joint compound used on all threads.
- 2. Dielectric bushings shall be used in any connections of dissimilar metals.

3.4 TRENCHING, DIRECTIONAL BORING, AND SLEEVING REVIEW:

- A. Upon completion and installation of all trenching, directional boring, and sleeving, all installed irrigation control wiring, lines and fittings shall be visually observed by the Owner's Representative unless otherwise authorized. Do not cover any wires, lines or fittings until they have been tested and observed by the Owner's Representative.

3.5 FLUSHING

- A. Openings in piping system during installation are to be capped or plugged to prevent dirt and debris from entering pipe and equipment. Remove plugs when necessary to flush or complete system.
- B. After completion and prior to the installation of any terminal fittings, the entire pipeline system shall be thoroughly flushed to remove dirt, debris or other material.

3.6 HYDROSTATIC PRESSURE TESTING

- A. After flushing, and the installation of valves the following tests shall be conducted in the sequence listed below. The Contractor shall furnish all equipment; materials and labor necessary to perform the tests and all tests shall be conducted in the presence of the Owner's Representative.
- B. Water pressure tests shall be performed on all pressure main lines before any couplings, fittings, valves and the like are concealed.
- C. Immediately prior to testing, all irrigation lines shall be purged of all entrapped air or debris by adjusting control valves and installing temporary caps forcing water and debris to be discharged from a single outlet.
- D. Test all pressure main line at 150 PSI. For a minimum of four (4) hours with an allowable loss of 5 PSI. Pressure and gauges shall be read in PSI, and calibrated such that accurate determination of potential pressure loss can be ascertained.
- E. Re-test as required until the system meets the requirements. Any leaks, which occur during test period, will be repaired immediately following the test. All pipe shall be re-tested until final written acceptance.
- F. The Contractor is responsible for proving documentation stating the weather conditions, date, the start time and initial water pressure readings, the finish time and final water pressure readings and the type of equipment used to perform the test. The documentation must be signed by a witness acceptable to the Owner, verifying all of the above-mentioned conditions.
- G. Submit a written report of the pressure testing results with the other above required information to the Owner's Representative for approval.

3.7 BACKFLOW PREVENTER TESTING

- A. The backflow preventer shall be tested according to procedures and results per the requirements of the Foundation for Cross-Connection Control and Hydraulic Research, University of Southern California or American Water Works Association whichever is more stringent.
- B. Testing shall be performed by a Backflow Prevention Assembly Tester with a current certification

from the American Backflow Preventer Association.

### 3.8 CONTROLLER AND BOOSTER PUMP TESTING AND CERTIFICATION

**Note to specifier:** *Testing and certification of the installation of the controller and the booster pump (if installed) is sometimes preferred by the specifier for a third party verification that the equipment was installed and working in accordance with the manufacturer's specifications. The specifier's knowledge of the manufacturer's installation requirements, along with their level of construction observation and administration on the project, should be taken into consideration on whether or not to proceed with certification. Not having the installation certified does not relieve the Contractor of any responsibility for installation but does provide the specifier with an additional mechanism so that the equipment is installed correct and technical support, if a non-manufacturing issue were to arise with the equipment, is available. Remove this section if certification is not required.*

- A. Controller and booster Pump shall be certified by xxxxx of (name the company). Contact xxxxxxxx at xxx.xxx.xxxx.

### 3.9 BACKFILLING AND COMPACTING

- A. Irrigation trenches shall be carefully backfilled with material approved for backfilling and free of rocks and debris one (1) inch in diameter and larger. When back filling trenches in areas of imported or modified planting soil, replace any excavated subsoil at the bottom and the imported soil or modified planting soil at the top of the trench.
- B. Backfill shall be compacted with approved equipment to the following densities
  - 1. Backfill under pavement and within 2 feet of the edge of pavement: Compact to 95% or greater of maximum dry density standard proctor.
  - 2. Backfill of subsoil under imported planting mixes or modified existing planting soil: Between 85 and 90% of maximum dry density standard proctor.
  - 3. Backfill of imported planting mixes or modified existing planting soil: Compact to the requirements of the adjacent planting mix or planting soil as specified in section "Planting Soil".
- C. Finish grade of all trenches shall conform to adjacent grades without dips or other irregularities. Dispose of excess soil or debris off site at Contractor's expense.
- D. Any settling of backfill material during the maintenance or warranty period shall be repaired at the Contractor's expense, including any replacement or repair of soil, lawn, and plant material or paving surface.

### 3.10 RESURFACING PAVING OVER TRENCHES

**Note to specifier:** *In some projects paving restoration may be the responsibility of the General Contractor. Coordinate with other specification sections and amend this paragraph as needed.*

- A. Restore all surfaces and repair existing underground installations damaged or cut as a result of the excavation to their original condition, satisfactory to the Owner's Representative.
- B. Trenches through paved areas shall be resurfaced with same materials quality and thickness as existing material. Paving restoration shall be performed by the project paving Sub-contractor or an approved Contractor skilled in paving work.
- C. The cost of all paving restoration work shall be the responsibility of the irrigation Contractor unless the trenching thru the paving was, by previous agreement, part of the general project related construction.

### 3.11 INSTALLATION OF EQUIPMENT

- A. General:
  - 1. All equipment shall be installed to meet all installation requirements of the product manufacturer. In the event that the manufacturer's requirements cannot be implemented due to particular condition at the site or with other parts of the design, obtain the Owner's Representative's written authorization and approval for any modifications.

2. Install all equipment at the approximately at the location(s) and as designated and detailed on the drawings. Verify all locations with the Owner's Representative.
  3. Install all valves within a valve box of sufficient size to accommodate the installation and servicing of the equipment. Group valves together where practical and locate in shrub planting areas.
  4. All sprinkler irrigation systems that are using water from potable water systems shall require backflow prevention. All backflow prevention devices shall meet and be installed in accordance with requirements set forth by local codes and the health department.
- B. Pressure regulator:
1. Set regulator for required PSI per manufacturer's specifications.
- C. Check Valve:
1. Install check valves approximately at the locations necessary to prevent low head run off.
- D. Remote control valves:
1. Install one remote control valve per valve box.
  2. Remote control valve manifolds and quick coupler valves shall be separate allowing use of a quick coupler with all remote control valves shut off.
  3. Install boxes no farther than 12 inches from edge of paving and perpendicular to edge of paving and parallel to each other. Allow 12 inches clearance between adjacent valve boxes.
- E. Quick coupler valve:
1. Install each quick coupler valve in its own valve box.
  2. Install thrust blocks on quick couplers.
  3. Place no closer than 12 inches to adjacent paving.
  4. Install 18 inches off set from main line.
- F. Sprinkler heads:
1. All main lines and lateral lines, including risers, shall be flushed and pressure tested before installing sprinkler heads.
  2. Install specified sprinkler heads as shown in details at locations shown on the drawings. Adjust layout for full coverage, spacing of heads shall not exceed the maximum spacing recommended by the manufacturer.
  3. All sprinkler heads shall be set perpendicular to finish grade unless otherwise designated on the drawings or details.
- G. Irrigation controllers:
1. Remote control valves shall be connected to controller in numerical sequence as shown on the drawings.
  2. Controller shall be tested with complete electrical connections. The Contractor shall be responsible for temporary power to the controller for operation and testing purposes.
  3. Connections to control wiring shall be made within the pedestal of the controller. All wire shall follow the pressure main insofar as possible.
  4. Electrical wiring shall be in a rigid gray PVC plastic conduit from controller to electrical outlet. The electrical Contractor shall be responsible for installing all wiring to the controller, in order to complete this installation. A disconnect switch shall be included.
- H. Wiring:
1. Low Voltage
    - a. Control wiring between controller and electrical valves shall be installed in the same trench as

the main line where practical. The wire shall be bundled and secured to the lower quadrant of the trench at 10 foot intervals with plastic electrical tape.

- b. When the control wiring cannot be installed in the same main line trench it shall be installed a minimum of 18 inches below finish grade and a bright colored plastic ribbon with suitable markings shall be installed in the trench 6 inches below grade directly over the wire.
- c. An expansion loop shall be provided every 500 feet in a box and inside each valve box. Expansion loop shall be formed by wrapping wire at least eight (8) times around a  $\frac{3}{4}$  inch pipe and withdrawing pipe.
- d. Provide one control wire to service each valve in system.

**Note to specifier:** *A majority of the newer irrigation controllers have more than one port for common wire allowing for multiple directional runs. Depending on the controller location within the irrigation system it might be more efficient to have more than one common wire in the system. The specifier must confirm the number of common wires and fill in below.*

- e. Provide **XX** common wire(s) per controller.
- f. Run two (2) spare #14-1 wires from controller along entire main line to last electric remote control valve on each and every leg of main line. Label spare wires at controller and wire stub to be located in a box.
- g. All control wire splices not occurring at control valve shall be installed in a separate splice valve box.
- h. Wire markers (sealed, 1 inch to 3 inch square) are to identify control wires at valves and at terminal strips of controller. At the terminal strip mark each wire clearly indicating valve circuit number.

## 2. High Voltage

- a. All electrical work shall conform to local codes, ordinances and any authorities having jurisdiction. All high voltage electrical work to be performed by licensed electrician.
- b. The Contractor shall provide 120-volt power connection to the automatic controller unless noted otherwise on drawings.

## I. Valve boxes:

1. Install one valve box for each type of valve installed as per the details.
2. Gravel sump shall be installed after compaction of all trenches. Final portion of gravel shall be placed inside valve box after valve is backfilled and compacted.
3. Permanently label valve number and or controller letter on top of valve box lid using a method approved by the Owners Representative.

## J. Tracer wire:

1. Tracer wire shall be installed with non-metallic plastic irrigation main lines where controller wires are not buried in the same trench as the main line.
2. The tracer wire shall be placed on the bottom of the trench under the vertical projection of the pipe with spliced joints soldered and covered with insulation type tape.
3. Tracer wire shall be of a color not used for valve wiring. Terminate wire in a valve box. Provide enough length of wire to make a loop and attach wire marker with the designation "tracer wire".

## K. Drip Installation:

1. Clamp fittings with Oetiker clamps or approved equal when operating pressure exceeds specific drip tubing fitting requirements.
2. When installing drip tubing, install soil staples as listed below:
  - a. Sandy Soil - One staple every three (3') feet and two (2) staples on each change of direction (tee, elbow, or cross).
  - b. Loam Soil - One staple every four (4') feet and two (2) staples on each change of direction (tee, elbow, or cross).
  - c. Clay Soil - One staple every five (5') feet and two (2) staples on each change of direction (tee, elbow, or cross).

3. Cap or plug all openings as soon as lines have been installed to prevent the intrusion of materials that would obstruct the pipe. Leave in place until removal is necessary for completion of installation.
4. Thoroughly flush all water lines before installing valves and other hydrants.

### 3.12 ADJUSTMENT AND COVERAGE TEST

#### A. Adjustment:

1. The Contractor shall flush and adjust all sprinkler heads, valves and all other equipment to ascertain that they function according to the manufacturer's data.
2. Adjust all sprinkler heads not to overspray onto walks, roadways and buildings when under maximum operating pressure and during times of normal prevailing winds.

#### B. Coverage test:

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

### 3.13 REPAIR OF PLANTING SOIL

- A. Any areas of planting soil including imported or existing soils or modified planting soil which become compacted or disturbed or degraded as a result of the installation of the irrigation system shall be restored to the specified quality and compaction prior to beginning planting operations at no additional expense to the Owner. Restoration methods and depth of compaction remediation shall be approved by the Owner's Representative.

### 3.14 CLEAN-UP

- A. During installation, keep the site free of trash, pavements reasonably clean and work area in an orderly condition at the end of each day. Remove trash and debris in containers from the site no less than once a week.
  - a. Immediately clean up any spilled or tracked soil, fuel, oil, trash or debris deposited by the Contractor from all surfaces within the project or on public right of ways and neighboring property.
- B. Once installation is complete, wash all soil from pavements and other structures.
  1. Make all repairs to grades ruts, and damage to the work or other work at the site.
  2. Remove and dispose of all excess soil, packaging, and other material brought to the site by the Contractor.

### 3.15 PROTECTION

- A. The Contractor shall protect installed irrigation work from damage due to operations by other Contractors or trespassers.
  1. Maintain protection during installation until Acceptance. Treat, repair or replace damaged work immediately. The Owner's Representative shall determine when such treatment, replacement or repair is satisfactory.

3.16 PRE-MAINTENANCE OBSERVATION:

- A. Once the entire system shall be completely installed and operational and all planting is installed, the Owner's Representative shall observe the system and prepare a written punch list indicating all items to be corrected and the beginning date of the maintenance period.
- B. This is not final acceptance and does not relieve the Contractor from any of the responsibilities in the contract documents.

3.17 GENERAL MAINTENANCE AND THE MAINTENANCE PERIOD

- A. General maintenance shall begin immediately after installation of irrigation system. The general maintenance and the maintenance period shall include the following:
  - 1. On a weekly basis the Contractor shall keep the irrigation system in good running order and make observations on the entire system for proper operation and coverage. Repair and cleaning shall be done to keep the system in full operation.
  - 2. Records of all timing changes to control valves from initial installation to time of final acceptance shall be kept and turned over to the Owner's Representative at the time of final acceptance.
  - 3. During the last week of the maintenance period, provide equipment familiarization and instruction on the total operations of the system to the personnel who will assume responsibility for running the irrigation system.
  - 4. At the end of the maintenance period, turn over all operations logs, manuals, instructions, schedules, keys and any other equipment necessary for operation of the irrigation system to the Owner's Representative who will assume responsibility for the operations and maintenance of the irrigation system.
- B. The maintenance period for the irrigation system shall coincide with the maintenance period for the Planting. (See specification section "Planting")

3.18 SUBSTANTIAL COMPLETION ACCEPTANCE

- A. Upon written notice from the Contractor, the Owners Representative shall review the work and make a determination if the work is substantially complete.
- B. The date of substantial completion of the irrigation shall be the date when the Owner's Representative accepts that all work in Planting, Planting Soil, and Irrigation installation sections is complete.

3.19 FINAL ACCEPTANCE / SYSTEM MALFUNCTION CORRECTIONS

- A. At the end of the Plant Warrantee and Maintenance period, (See specification section "Planting") the Owner's Representative shall inspect the irrigation work and establish that all provisions of the irrigation system are complete and the system is working correctly.
  - 1. Restore any soil settlement over trenches and other parts of the irrigation system.
  - 2. Replace, repair or reset any malfunctioning parts of the irrigation system.
- B. The Contractor shall show all corrections made from punch list. Any items deemed not acceptable shall be reworked and the maintenance period will be extended.
- C. The Contractor shall show evidence that the Owner's Representative has received all charts, records, drawings, and extra equipment as required before final acceptance.
- D. Failure to pass review: If the work fails to pass final review, any subsequent observations must be rescheduled as per above. The cost to the Owner for additional observations will be charged to the Contractor at the prevailing hourly rate of the reviewer.

END OF SECTION 32 8400