

**SECTION 32 84 00
PLANTING IRRIGATION**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies materials and procedures to install a new, automatically-controlled landscape irrigation system, controller and all other appurtenances necessary to serve the specified Phase I landscape and plant bed areas. System infrastructure to accommodate future Phases has been specified and shall be included in this installation. Computer central control and on-site weather station equipment is specified for installation as part of this project and shall include retrofit of the existing landscape irrigation system to be included in computer central control landscape irrigation operation.
- B. The selected irrigaiton installer shall be responsible for furnishing, delivery, installation and programming of a fully automatic system with full and complete coverage within the areas indicated on the drawings. Furnish all labor, materials, supplies, equipment, tools, transportation, and perform all operations in connection with and reasonably incidental to the complete installation of the fully functional landscape irrigation system and warranty as shown on the drawings, the installation details, and as specified. Other items of work specifically included are:
1. Procurement of all applicable licenses, permits, and payment of required fees.
 2. Coordination of Utility Locates ("Call Before You Dig").
 3. Maintenance period services.
 4. Sleeving for irrigation pipes and wires as indicated, and/or beneath all hardscape surfaces.
- C. Manufacturer of primary equipment including but not necessarily limited to sprinklers, controller, control valves and decoders shall be generally the same as existing components at the original cemetery east of Riley Road except where called-out otherwise.

1.2 DEFINITIONS

- A. Lateral Piping: Piping located downstream from control valves to sprinklers, specialties, and drain valves. Piping is under pressure during flow.

- B. Mainline Piping: Located downstream from point of connection to water distribution piping to, and including, control valves. Piping is under system pressure.
- C. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50volts or for remote-control, signaling power-limited circuits.
- D. Hardscape: Site roads, walks, walls, or any other surface improvements for which removal for excavation to perform maintenance or replacement of the irrigation system pipes, or wires will require disturbance of other than landscape materials.
- E. COR: Resident Engineer/Contracting Officer's Technical Representative.

1.3 RELATED WORK

- A. Maintenance of Existing Utilities: Section 01 00 00, GENERAL REQUIREMENTS.
- B. Submittals: SECTION 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES
- C. Concrete: Section 03 30 53, CAST-IN-PLACE CONCRETE (SHORT FORM).
- D. Excavation, Backfill: Section 31 20 00, EARTH MOVING.
- E. Division 26, ELECTRICAL
- F. Section 32 90 00, PLANTING
- G. Section 33 10 00, WATER UTILITIES
- H. 32 84 00A, BOOSTER PUMP STATION AND BACKFLOW

1.4 QUALITY ASSURANCE

- A. Irrigation Contractor/Installer:
 - 1. The selected installing installer shall furnish proof of use of persons directly employed by the Contractor who have successful experience in the construction and programming of not less than five (5) landscape irrigation systems having large diameter gasketed pipe (4-inch and larger), computer centralized control systems with hardwired or radio communication, flow sensing equipment and software, landscape irrigation weather stations, electrically operated remote control valves using digital two-wire control technology, large radius rotary sprinklers (minimum 1-inch inlet with swing joint), bubbler irrigation, irrigation on steep slopes and pre-fabricated pump stations with variable speed controls.
 - 2. The selected irrigation installer shall be an employer of on-site field workers that shall include not less than one Certified Irrigation Contractor in good standing as accredited by The Irrigation Association, Falls Church, VA and who shall be currently

PLANTING IRRIGATION

employed by the selected irrigation installer and who shall personally conduct or oversee the conduct of all work upon this project. The selected irrigation installer shall be licensed in the State of Oregon by its Landscape Contractor Board and whose license as a professional landscape irrigation installer possessing an Irrigation and Backflow license shall be held in good standing.

B. Equipment Manufacturer:

1. Manufacturer regularly and presently manufactures the items submitted as among its principal products.
2. There is a permanent service organization, maintained or trained by the manufacturer, which shall render satisfactory service within 24 hours of receipt of notification that service is requested.
3. Installer or supplier of a service, has technical qualifications, experience, and trained personnel and facilities to perform the specified work.

C. Products Criteria:

1. Multiple Units: When two or more units of the same type or class of materials or equipment are required, these units are products of one manufacturer.
2. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled unit.
 - a. All components of an assembled unit need not be products of the same manufacturer but component parts which are alike shall be the product of a single manufacturer.
 - b. Components shall be compatible and as a total assembled unit for the intended use.
3. Nameplates: Nameplate bearing manufacturer's name or identification trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.

D. System Requirements:

1. Full (head-to-head when broadcast irrigated) and complete coverage of the irrigated areas is required. The actual and spirit of intent of this project outcome is clearly indicated upon the drawing sheets and within the specification documents. The selected irrigation installer shall, at no additional cost to the Government, make

necessary adjustments to component locations as required to achieve full coverage of irrigated areas.

2. Layout work as closely as possible to drawings. Drawings are diagrammatic to the extent that swing joints, offsets and all fittings are not shown. Diagrammatic also refers to the location of the pipelines and valves, which may have been presented for clarity of the drawings. Lines in tight areas shall be common trenched wherever possible. Irrigation emission devices along roadways shall be placed between 3 cm (1 inch) to 8 cm (3 inches) from back of curb, unless otherwise specified.
3. Locations of remote control valves is schematic. Remote control valves shall be grouped wherever possible and aligned at a set dimension back of curb along roads. Where the exact location for the valve(s) has not been set or there are any conflicts, the location shall be coordinated with the COR before installation.
4. Irrigation lines and control wire shall run at boundaries of graves, thru designated utility lanes or beside roadways such that any gravesite may be opened in the future without disruption of the irrigation system.
5. Irrigation lines, communication wire, control wire and power wires shall be run in trenches as indicated on the drawings or as typical for industry standards, if not indicated.
6. Connect new system to a six-inch metered potable water supply stub furnished to the surface by others and at the approximate location shown upon the drawings. Furnish and install all necessary components, elements and labor services to build-out the point-of-connection water supply including but not limited to pre-packaged booster pump station with integrated backflow prevention assembly, concrete slab and enclosure(s), electrical permits connection/termination and labor, plumbing permits connection/termination and labor and all other permits and labor required to furnish and connect the new system to its specified water supply. Stake and gain approval of all points of connection locations from the COR before installation.
7. Unless noted otherwise, all irrigation lines, power wires and control wires shall be run in sleeves or conduit where installed beneath any site hardscape materials. When sleeved, low voltage

PLANTING IRRIGATION

control wires shall be placed in sleeves separate from pressure pipe and separate from high voltage wires.

- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70 by a qualified testing agency, and marked for intended location and application.
- F. Completely furnish, install and program computer central control software and hardware, weather station, server controller, client controllers, flow sensors, mastervlve(s) and any interphase with booster pump station and/or its individual components designated for interphase with or by the completed landscape irrigation system.
- G. Follow manufacturer's instructions for all installation.
- H. Manufacturer of control system shall certify control system is complete, including all related components, and completely operational. Furnish certificate of proof of manufacturer certification to COR as a condition of system acceptance.
- I. Coordinate Final location of central control computer, server controller, client controller(s), flow sensor(s) and weather station with COR at the time of installation.

1.5 SUBMITTALS

- A. Furnish qualification data for:
 - 1. A qualified irrigation Installer(s).
 - 2. A qualified service provider, maintained and/or trained by the manufacturer to render satisfactory service within 24 hours of service request notification.
- B. Make submittals and provide number of copies per Specifications Section 01 33 23. Unless otherwise noted, provide four (4) copies of irrigation information in separate identical 3-ring binders with tables of contents and index sheets. Provide sections that are indexed and labeled for controls, computer central control, flow sensors, low voltage remote control valves, decoders, weather station, emission devices, pipe and fittings, wire and wire connectors, ID tags, shop drawings, full range sample paint colors for the plumbing enclosure and pump control station enclosure, and all other irrigation equipment shown or described on the drawings and within these specifications. Highlight items being supplied on the catalog cut sheets. Submittal package shall be complete prior to being reviewed by the COR. Incomplete submittals will be returned without review. Sequentially number each page of the submittal for ease in referencing during

PLANTING IRRIGATION

submittal review. Pages within a letter or number identified Tab section may be numbered sequentially as long as the process is consistent and provide unique page identification for each page of the submittal.

- C. Materials List: Include all materials and products that are part of the irrigation system including, but not limited to: pipe, fittings, low voltage remote control valves, mainline components, electrical components, weather station components, flow wensing components and control system components. Quantities of materials need not be included.
- D. Manufacturers' Data: Submit manufacturers' catalog cuts and specifications for equipment to be included in the project work. For rotary emission devices include Center for Irrigation Technology Space Pro Single Leg Profile showing the Distribution Uniformity and Scheduling Coefficient for the nozzles being used at the specified spacing.
- E. Shop Drawings: Complete detailed layout shop drawings covering design of system showing pipe sizes and lengths; fittings, locations, types and sizes of emission devices; controls; point of connection including backflow preventer, pump station and related; valves and decoders; location and mounting details of electrical control equipment; complete wiring diagram showing routes and wire sizes; wiring details and source of current and connections to existing services. Do not start work before final shop drawing approval.
- F. Testing: Submit a proof of testing report following completion of each test listed in these specifications. Unless otherwise noted, include name of test, date of test, name of the individual completing the test, name of the company completing the test and a summary of the test results. If system fails test, document any and all retests until system passes test.
- G. Maintenance and Operation Instructions: Submit information listed in these specifications.
- H. Record Drawings: Submit information listed in these specifications.
- I. Include a professionally-prepared and presentable station/zone chart and controller timing schedule showing each irrigation station/zone and its corresponding control valve and corresponding decoder information; and show the time settings, expected flow and relevant computer central control programming information for each automatic controller zone.

PLANTING IRRIGATION

- J. Name and address of a permanent service organization maintained or trained by the manufacturers that shall as a result of determined warranty work, or after warranty period following execution of a service contract for this facility, render satisfactory service within 24 hours of receipt of notification that service is requested.
- K. Reproducible "as-built" drawings. Submit information for approval by the COR indicating the "as-built" conditions for the irrigation system to the COR as electronic DWG files of the original bid drawings posted with all addendum, clarifications, and approved modifications.
- L. After electronic "as-built" drawing(s) have been approved, the selected irrigation installer shall utilize as-built drawings to prepare a professionally-prepared and presentable overall irrigation system drawing proximate to the irrigation central control computer.
- M. Controller Chart:
 - 1. Prepare a map diagram showing location of all valves, lateral lines, and route of the control wires. Identify all valves as to size, station, number and type of irrigation. "As-built" drawings shall be submitted and approved before charts are prepared.
 - 2. Provide one controller chart showing the area covered by controller for placement at or inside each automatic controller at the maximum size controller door will allow. Chart shall be one or more reduced drawing sheets of the actual "as-built" system in sections that result in easy to read or decipher format. If controller sequence is not legible when the drawing is reduced to door size, the drawing shall be enlarged to a size that is readable and placed folded, in a sealed plastic container at or inside the controller door.
 - 3. Chart shall be a print with a different color used to show area of coverage for each station. Charts shall be completed and approved by COR prior to final inspection of the irrigation system.

1.6 SUBSTITUTIONS

- A. Unless otherwise noted, use specified equipment to match existing equipment at the east side of Riley Road. COR shall approve all equipment prior to construction.
- B. No equipment substitutions shall be used unless expressly approved in writing by COR. Any requested substitutions shall be submitted in writing by the requesting party with all required associated data in justification of the requested change, not less than close of business the 21st day prior to the date of bid opening. Any requested

PLANTING IRRIGATION

substitutions shall be furnished in writing with associated product cut sheets and rationale for the requested change including cost changes to the owner for use of such proposed equipment and improvements to irrigation system performance that shall be realized by implementation of any proposed changes. Changes and associated design costs to accommodate alternative equipment are the responsibility of the contractor/submitter. "As-Built" information shall show the sizes, types and models installed. See related sections herein.

- C. Pipe sizes referenced in the construction documents are minimum sizes, and may be increased at selected irrigation installer's option.

1.7 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressures: The landscape irrigation pump station settings shall be programmed by the selected irrigation installer to maintain system pressure of not less than 90 psi dynamic while not less than two stations of similar water use volume are in simultaneous operation including stations at or near the furthest uphill interval from the irrigation system point of connection. In no case shall pump station programming be set to exceed 105 psig. Station-specific pressure regulation shall occur at each control valve and shall be set by the selected irrigation installer to the optimum or manufacturer recommended operating pressure of the associated irrigation emission devices downstream of each control valve. The following are minimum pressure requirements for piping, valves, and appurtenances unless otherwise indicated.

- 1. Irrigation Mainline Piping: 1380 kPa (200 psig).
- 2. Lateral Piping: 1035 kPa (150 psig).

1.8 CODES AND REGULATIONS

- A. Work and materials shall be in accordance with the latest edition of the National Electric Code, the Uniform Plumbing Code, and applicable laws and regulations of governing authorities having jurisdiction.
- B. When the contract documents call for materials or construction of a better quality or larger size than required by the above-mentioned rules and regulations, provide the quality and size required by the contract documents.
- C. If quantities are provided either in these specifications or on the drawings, these quantities are provided for information only. It is the selected irrigation installer's responsibility to determine the actual quantities of all material, equipment, and supplies required by the

PLANTING IRRIGATION

project and to complete an independent estimate of quantities and wastage.

1.9 AVAILABILITY AND USE OF UTILITY SERVICES

- A. The government shall make NO utilities available to the selected selected irrigation installer from existing outlets and supplies except upon completion of the new irrigation system for this project or completion of portions thereof. The selected irrigation installer through the permanent connection of the new irrigation system to the new fully operational irrigation water source/supply constructed as part of this project, shall be provided water at available flow and pressure for use by the selected irrigation installer provided additional facilities and/or equipment as required to perform the required flushing and testing of the new irrigation system are employed. The selected irrigation installer shall coordinate the construction of the new irrigation water source/supply with the irrigation system construction to insure that water is available for irrigation purposes, or shall provide for irrigation water by other means at no cost to the Government. Once the irrigation system and irrigation water source of supply are deemed operable and approved and prior to the final inspection, the selected irrigation installer may use water at no cost through the irrigation system for establishing turf and maintaining plant material. No other expressed or implied uses of Government furnished water exist.
- B. The selected irrigation installer, at installer's expense and in a workmanlike manner satisfactory to the COR, shall install and maintain all necessary temporary connections and distribution lines and meters required by the public utilities for providing temporary irrigation water. Before final acceptance of the work by the Government, the selected irrigation installer shall remove all temporary connections, distribution lines, meters, and associated appurtenances.

1.10 TESTING

- A. Notify the COR not less than three working days in advance of testing.
- B. Newly installed irrigation pipelines jointed with rubber gaskets or threaded connections shall be subject to pressure and leakage testing after partial completion of backfill. Pipelines jointed with solvent-welded PVC joints will be allowed to cure at least 24 hours before testing.

- C. Subsections of mainline pipe may be tested independently, subject to the review of the COR.
- D. Furnish clean, clear water, pumps, labor, fittings, power and equipment necessary to conduct tests or retests.
- E. Volumetric Leakage Test - Gasketed Mainline Pipe:
1. Backfill to prevent pipe from moving under pressure. Expose couplings and fittings.
 2. Purge all air from the pipeline before test.
 3. Provide all necessary pumps, bypass piping, storage tanks, meters, 75 mm (3-inch) test gauge, supply piping, and fittings in order to properly perform testing. Testing pump shall provide a continuous 700 kPa (100 psi) pressure to the mainline pipe. Where main lines are installed with significant elevation change, perform the test at the mid elevation of the segment being tested. Main lines may be tested in segments where the terrain makes it difficult to maintain the test pressure throughout. The test pressure is the minimum pressure on the line at the highest point of the line segment being tested.
 4. Allowable deviation in test pressure is 35 kPa (5 psi) during test period. Average pressure during the test shall be 700 kPa (100 psi) therefore the pressure shall start at 5 psi above and be re-pressurized when the pressure is 5 psi below the test pressure. Restore test pressure to 700 kPa (100 psi) at end of test. Water added to mainline pipe shall be measured volumetrically to nearest 950 ml (0.25 gallons).
 5. Subject mainline pipe to the anticipated operating pressure of 700 kPa (100 psi) for two hours. The amount of additional water pumped in during the test will not exceed the value in the table, or the calculated value using the formula below, based upon differing number of joints, duration or pressure of the test:

Leakage Allowable (Gallons per (100 Joints) / Hour)

PIPE SIZE mm (INCHES)	Test Pressure (PSI)								
	60	70	80	90	100	110	120	130	140

PLANTING IRRIGATION

63mm (2 ½")	0.26	0.28	0.30	0.32	0.34	0.35	0.37	0.39	0.40
75mm (3")	0.31	0.34	0.36	0.38	0.41	0.43	0.44	0.46	0.48
100 mm (4")	0.42	0.45	0.48	0.51	0.54	0.57	0.59	0.62	0.64
150 mm (6")	0.63	0.68	0.73	0.77	0.81	0.85	0.89	0.92	0.96
200 mm (8")	0.84	0.90	0.97	1.03	1.08	1.13	1.18	1.23	1.28
250 mm (10")	1.05	1.13	1.21	1.28	1.35	1.42	1.48	1.54	1.60
300 mm (12")	1.26	1.36	1.45	1.54	1.62	1.70	1.78	1.85	1.92

Note: Allowable Leakage calculated using $L = (ND\sqrt{P})/7400$

Where: L = Allowable Leakage (gph)

N = Number of Joints

D = Nominal Diameter of Pipe (inches)

P = Average Test Pressure (psi)

The following are the values for a 2 hour duration test at 100 psi for pipe length containing 100 joints.

- a. 3.10 l (0.82 gallons) per 100 joints of 75 mm (3-inch) diameter pipe
- b. 4.09 l (1.08 gallons) per 100 joints of 100 mm (4-inch) diameter pipe
- c. 6.13 l (1.62 gallons) per 100 joints of 150 mm (6-inch) diameter pipe
- d. 8.18 l (2.16 gallons) per 100 joints of 200 mm (8-inch) diameter pipe
- e. 10.22 l (2.70 gallons) per 100 joints of 250 mm (10-inch) diameter pipe
- f. 12.26 l (3.24 gallons) per 100 joints of 300 mm (12-inch) diameter pipe

Volumetric leakage exceeding the amounts indicated above, adjusted for system test pressure, number of joints and shall be a failure of the test. Replace defective pipe, fitting, joint, valve, or appurtenance. Repeat the test until the pipe passes test.

6. Cement or caulking to seal leaks is prohibited.

7. The selected irrigation installer may sub-contract testing to pipeline testing company approved in writing by COR and in advance of testing.
- F. Hydrostatic Pressure Test - Solvent Weld Lateral Pipe:
1. Subject lateral pipe to a hydrostatic pressure equal to the anticipated operating pressure of 550 kpa (80 psi) for 30 minutes.
 2. Cap all sprinkler risers.
 3. Backfill to prevent pipe from moving under pressure. Expose couplings and fittings.
 4. Leakage will be detected by visual inspection. Replace any defective pipe, fitting, joint, valve, or appurtenance. Repeat the test until the pipe passes test.
 5. Cement or caulking to seal leaks is prohibited.
 6. After lateral passes test and prior to operational test, install sprinklers and backfill and compact all pipe, fittings, joints, or appurtenance.
- G. Operational Test - Remote Control Valves, Lateral Piping and Sprinklers:
1. Activate each remote control valve in sequence from each new satellite controller manually at the controller, automatically from the Central Computer, and via any handheld units. Manual, non-electric operation of the valves is not an acceptable method of activation for operational testing purposes. The COR will visually observe operation, water application patterns, and leakage.
 2. Replace defective remote control valve, solenoid, wiring, or appurtenance to correct operational deficiencies.
 3. Replace, adjust, add, or move water emission devices to correct operational or coverage deficiencies.
 4. Replace defective pipe, fitting, joint, valve, sprinkler, or appurtenance to correct leakage problems. Cement or caulking to seal leaks is prohibited.
 5. Repeat test(s) until each lateral passes all tests. Repeat tests, replace components, and correct deficiencies at no additional cost to the Owner.
 6. The backflow prevention device shall be tested and documented acceptable according to local code or ordinance by a certified tester authorized to practice in the local jurisdiction prior to system acceptance.

H. Distribution Uniformity (DU):

1. IRRIGATION AUDITS

- a Complete an irrigation audit, to include 10 representative irrigation zones/test areas.
 - b Identify the 10 areas to be tested, based on each individual cemetery site and conditions, in consultation with the cemetery foreman/irrigation personnel, irrigation auditor, NCA National Irrigation Engineer and VA Resident Engineer.
 - c Test Area Selection Criteria:
 - 1) Proximity to water source
 - a) Minimum one audit close to the source
 - b) Minimum one audit near farthest point of irrigation system from source
 - 2) Elevation
 - a) Minimum one audit near the highest point on the site
 - b) Minimum one audit near the lowest point on the site
 - 3) Sprinkler Characteristics
 - a) Minimum one audit for each combination of sprinkler model, nozzle type, spacing, and pressure commonly used for the site
 - b) Minimum of one audit in an area with good sprinkler coverage based on the quality of turf
 - c) Minimum of one audit in an area with poor sprinkler coverage based on the quality of turf
 - d. Final determination of the areas of site to be tested shall be based on the recommendation of the selected irrigation installer and its understanding of the purpose and goals of performing irrigation audits on each site with final approval by the NCA National Irrigation Engineer prior to beginning audits. Submit a map indicating the locations of the zones to be tested.
2. Follow the methodology found in the current edition of the Irrigation Association Landscape Irrigation Auditor Manual and Irrigation Audit Guidelines for performing irrigation audits.
- a. During each audit, a wind anemometer shall be used and wind speed information recorded every 5 minutes, and a graph of this information shall be provided with the summary report and audit information.

PLANTING IRRIGATION

- 1) If at any time during the audit the wind exceeds 5 mph, it shall be noted in the summary report.
 - 2) If at any time the wind exceeds 10 mph, the audit shall be stopped and restarted (cans emptied and started anew) when the wind drops below 5 mph for an extended period of time, at the discretion of the auditor.
 - 3) If a site is being audited that consistently has winds above 10 mph, then the selected irrigation installer and COR shall determine the best course of action to proceed as to the effect of the wind on the audits.
- b. Provide all data called for in the irrigation audit worksheets used in the current edition of the Irrigation Association Landscape Irrigation Auditor Manual.
- 1) Supply all data in a digital (MS Excel format) as well as paper report format to NCA via VA Resident Engineer.
 - 2) Create similar templates/data sheets as those forms represented in MS Excel if none are readily available to the general public from the Irrigation Association.
 - 3) Provide copies of all field notes, drawings, and data collection forms used in the field, to be submitted along with the paper report and digital media versions of the audit information.
- c. Do not complete the Pre-Audit Inspection Corrective Actions included in the Irrigation Association Guidelines, as the existing irrigation system is to be audited in its current condition. However, pressure is to be checked at the Pressure regulating device on each valve tested by using a schrader valve compatible connection and liquid filled pressure gauge. If there are no pressure regulating valves the closest sprinkler to the RCV will be checked using a pitot tube and liquid filled pressure gauge.
- d. Based on the area being audited, the selected irrigation installer shall use a number of catch cans that is divisible by 4, with a minimum of 28 catch cans being used for each audit.
- e. Catch cans shall be laid out in a grid format per the current edition of Irrigation Association Landscape Irrigation Audit Manual, based on:
- 1) Number of catch cans used

PLANTING IRRIGATION

- 2) Size of the area tested
 - 3) Number of sprinklers tested
 - 4) Site conditions
 - 5) Spacing shall be consistent and in a square pattern throughout each testing area.
- f. Catch cans shall be as level as possible prior to beginning the audit. Cal Poly ITRC Catch Cans shall be used or approved equal.
- g. If water gets into the catch cans prior to the audit beginning, then all catch cans shall be emptied out and the sprinklers test shall start over.
- h. Depending on the type of sprinklers being audited, the following general rules shall be followed for determining sprinkler run times:
- 1) Rotor type sprinklers - a minimum of 10 minute run time and a maximum of a 30 minute run time;
 - 2) Spray type sprinklers (pop ups) - a minimum of 5 minute run times and a maximum of 10 minute run times;
 - 3) Rotary/stream type sprinklers - a minimum of 20 minute run time and a maximum of 60 minute run time.
- i. Catch can data collection shall be performed by the same person for all irrigation audits for consistency of data purposes.
- j. All worksheets shall be filled out to the fullest extent possible. As much data as can be reasonably determined on each site for each test shall be provided in the worksheets.
- 1) Any missing worksheet data shall be accounted for with a written explanation as to why the data is not present in the worksheets. An example of this would be:
 - a) No flow meter information provided
 - b) Reason - no flow meter present on site
 - 2) Worksheets shall include all collected catch can data and determination of Low Quarter Distribution Uniformity (DULQ) and Precipitation Rate (PR) along with all of the other pertinent data in the worksheets.
- k. On a copy of the irrigation plan accurately (within 1-foot) show the following:
- a) All sprinklers and associated valves for each test area

- b) Any surrounding hardscape, plants, or physical site surroundings (roads, walkways, headstones, benches, water spigots, trees, shrubs, etc.)
- c) All catch cans (numbered per the worksheets) and associated data collected
- 1. A summary report (maximum of one page per audit) shall be provided along with a map and audit data for each location audited along with associated worksheets filled out as specified above.
- m. If any conclusions can be drawn based on the area tested, Distribution Uniformity, or Precipitation Rate, they shall be explained in the summary page, along with any recommendations for improvements of irrigation uniformity for the audit condition.
- n. Submit Entire audit report to COR within 10 working days of the completed field work.

I. Control System Grounding:

- 1. Test all new satellite controllers for proper grounding of control system with installed grounding equipment that creates grounding resistance readings of 5 ohms or less or higher levels not to exceed 15 ohms, if acceptable by equipment manufacturer without equipment warranty invalidation. Test results shall meet or exceed control system manufacturer's requirements for acceptance, while maintaining equipment warranty.
- 2. Replace defective wire, grounding rod or appurtenances. Repeat the test until the manufacturer's requirements are met. Add grounding equipment as needed, bond all rods together.
- 3. When a grounding test is acceptable, the individual completing the test shall neatly document the results of the grounding test on the inside of each satellite controller pedestal door and via a written report submitted to the COR. Documentation shall include satellite name or number, date of test, name or initials of the individual completing the test, and the ohms resistance to ground. The test results shall be neatly marked on the inside of each satellite controller pedestal door using a permanent marker.
- 4. A written report of the test data listing satellite name or number, date of test, name of the individual completing the test and contact information, name of the company completing the test and the ohms

PLANTING IRRIGATION

resistance to the local ground for each satellite shall be submitted to the COR.

J. Irrigation System Acceptance Test (Burn in) Prior to Final Inspection:

1. Upon completion of construction and prior to Final Inspection, an Acceptance Test (Burn in) shall be passed.
2. Coordinate start of Test with COR.
3. During the Test, the irrigation system shall be fully operational from the central control system. The irrigation system shall operate with no faults for 14 consecutive days. If at any time during the 14 day test period, a system fault occurs, the source of the fault shall be determined and corrected and the 14 day evaluation period shall start again. If a system fault occurs, make repairs within 24 hours of notification from COR. Document any faults in the proof of test report listing date of fault, fault, cause of the fault and the corrective action taken.
4. When the system has operated for 14 days without fault, contact the COR to schedule Final Inspection.
5. The system is designed to detect low, high or non-scheduled flow. Accurate reaction to this condition during Irrigation System Acceptance testing shall be considered a success and testing may continue. If expected system reaction to low high or non-scheduled flow does not occur or is not accurate to the occurrence, repair and/or re-calibration and/or re-programing shall occur and such testing shall begin again.

1.11 WARRANTY AND REPLACEMENT

- A. The purpose of the warranty is to insure that the Government receives irrigation materials of new and prime quality, installed and maintained in a thorough and careful manner.
1. Warranty irrigation materials, equipment, and workmanship against defects for a period of one year from Final Acceptance by COR. Fill and repair depressions. Restore landscape, utilities, structures or site features damaged by the settlement of irrigation trenches or excavations. Repair damage to the premises caused by construction or a defective item. Make repairs within 72 hours of notification from COR.
 2. Replace damaged items with identical materials and methods per contract documents or applicable codes. Make replacements at no additional cost to the contract price.

PLANTING IRRIGATION

3. Warranty applies to originally installed materials and equipment and replacements made during the Warranty period.

1.12 GENERAL CONSTRUCTION REQUIREMENTS

- A. Coordinate construction of irrigation system with COR or in the case of installation of computer central control equipment upon controllers located upon irrigation at the east side of Riley Road, with Cemetery Staff. Coordinate temporary shut-down of existing system with Cemetery Staff prior to construction. Disturbance to cemetery operations shall be minimized. See irrigation plans and installation details and Specifications Sections for required coordination efforts related to the installation of specific irrigation components.
- B. Install irrigation mainline and control and power wiring in sleeves under new roads prior to installation of road base, and under all other concrete or asphalt, either existing or new for this project.
- C. Install irrigation components in landscaped areas unless specifically indicated otherwise. Irrigation components in other than landscaped areas shall not be allowed.
- D. Construction shall not proceed unless staking of irrigation mainline, remote control valve locations, and sprinkler locations are reviewed and accepted by the COR.

1.13 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American National Standard Institute (ANSI):
B40.1-05.....Gauges-Pressure Indicating Dial Type-Elastic
Element
- C. American Society of Sanitary Engineers (ASSE):
1013-2005.....Reduced Pressure Principle Backflow Preventers
- D. American Society for Testing and Materials (ASTM):
A242/A242M-04 (2009)....High Strength Low-Alloy Structural Steel
A536-84 (2009).....Ductile Iron Castings
B61-08.....Steam or Valve Bronze Castings
B62-09.....Composition Bronze or Ounce Metal Castings
D1785-06.....Poly(Vinyl Chloride) (PVC) Plastic Pipe,
Schedule 40, 80, and 120
D1238-04c..... Standard Test Method for Melt Flow Rates of
Thermoplastics by Extrusion Plastometer

PLANTING IRRIGATION

- D1784-08.....Rigid Poly(Vinyl Chloride) (PVC) Compounds and
Chlorinated Poly(Vinyl Chloride) (CPVC)
Compounds
- D1785-06.....Poly(Vinyl Chloride) (PVC) Plastic Pipe,
Schedules 40, 80, 120
- D1894-08.....Standard Test Method for Static and Kinetic
Coefficients of Friction of Plastic Film and
Sheeting
- D2241-05.....Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe
(SDR Series)
- D2464-06.....Threaded Poly (Vinyl Chloride) (PVC) Plastic
Pipe Fittings, Schedule 80
- D2466-06.....Poly(Vinyl Chloride) (PVC) Plastic Pipe
Fittings, Schedule 40
- D2564-04e1.....Solvent Cements for Poly (Vinyl Chloride) (PVC)
Plastic Piping Systems
- D2657-07.....Standard Practice for Heat Fusion Joining of
Polyolefin Pipe and Fittings
- D3139-98 (2005).....Joints for Plastic Pressure Pipes Using
Flexible Elastomeric Seals
- D3350-10Standard Specification for PE Pipe & Fittings
Materials
- F477-08.....Elastomeric Seals (Gaskets) for Joining Plastic
Pipe
- E. American Water Works Association (AWWA):
- C110/A21.10-08.....Ductile-Iron and Gray-Iron Fittings, 3-Inch
Through 48-Inch for Water
- C111/A21.11-06.....Rubber-Gasket Joints for Ductile-Iron Pressure
Pipe and Fittings.
- C115/A21.15-05.....Flanged Ductile-Iron Pipe with Ductile-Iron or
Gray-Iron Threaded Flanges
- C151/A21.51-09.....Ductile-Iron Pipe, Centrifugally Cast, for
Water C153/A21.53-00 Ductile-Iron Compact
Fittings for Water Service
- C504-06.....Rubber Seated Butterfly Valves
- C509-09.....Resilient-Seated Gate Valves for Water Supply
Service

PLANTING IRRIGATION

C901-08.....AWWA Standard for Polyethylene (PE) Pressure
Pipe and Tubing, 13 mm ($\frac{1}{2}$ In.) through 76 mm (3
In.), for Water Service

F. Manufacturers Standardization Society (MSS):

SP70-2006.....Cast Iron gate Valves, Flanged and Thread Ends

G. National Electrical Manufacturers Association (NEMA):

250-2008.....Enclosures for Electrical Equipment (1000 Volts
Maximum)

PART 2 - PRODUCTS

2.1 QUALITY

A. Use new materials without flaws or defects.

2.2 SUBSTITUTIONS

A. Unless noted otherwise, use specified equipment. Equipment used shall match generally or specifically, the equipment installed in previous areas of the property. COR shall approve equipment prior to construction. The Contactor through written request prior to purchase or installation may request substitutions to the approved equals listed herein. Changes and associated design costs to accommodate alternative equipment are the selected irrigation installer's. See also Section 1.6 herein.

B. Pipe sizes referenced in the construction documents are minimum sizes, and may be increased at the selected irrigation installer's option.

2.3 SLEEVING

A. Provide sleeves beneath all hardscape for irrigation pipe and all wiring. Provide separate sleeves beneath hardscape for wiring. Low voltage wire shall be contained in separate sleeves from high voltage wire.

B. Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting the requirements of Cell Classification 12454-A or 12454-B, ASTM Standard D1784, with an integral belled end.

C. Use C905, DR-18 rated at 1615 kPa (235 psi) confirming to dimensional and tolerances established by ASTM Standard D2241 for mainline pipe sleeves larger than 300 mm (12-inch).

D. Use Class 200, SDR-21, rated at 1375 kPa (200 psi), conforming to dimensions and tolerances established by ASTM Standard D2241 or AWWA

PLANTING IRRIGATION

C905, DR-25 rated at 1135 kPa (165 psi) conforming to AWWA Standard C905, or use C-900 PVC pipe, rated at 1375 kPa (200 psi).

- E. Sleeve sizes are to be as shown on the drawings or twice the nominal diameter of pipe if not shown. Wiring shall not exceed more than 40% of the sleeve cross sectional area, per NEC recommendations.
- F. Restrained Casing Spacers:
1. Use restrained casing spacers on gasketed mainline pipe contained in a sleeve. Provide restrained casing spacers for gasketed joints that occur within sleeve and as necessary along pipe length.
 2. Sleeve Size: As shown in the Casing Spacer Installation Detail.
 3. Use casing spacers manufactured from high strength ductile iron, per ASTM A536, Grade 65-45-12. Use restraining rods manufactured from high strength low alloy material meeting the requirements of ASTM A242 and ANSI/AWWA C111/A21.11. Use runners manufactured from ultra high molecular weight polymer with a tensile impact of 175-350 Joules/cm (600-1200 ft-lbs./in.) and a coefficient of friction of 0.14-0.17 per ASTM D-1894.

2.4 PIPE AND FITTINGS

- A. Irrigation Mainline pipe and fittings:
1. Use rigid, un-plasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting the requirements of Cell Classification 12454-A or 12454-B, ASTM Standard D1784, with an integral belled end.
 2. Use Class 200, SDR-21, rated at 200 PSI, conforming to dimensions and tolerances established by ASTM Standard D2241.
Mainline 2.5" and smaller = Schedule 40, Mainline 3" = PVC gasketed, Class 200 SDR-21, Mainline 4" = PVC gasketed, C900 200 PSI.
 3. Use solvent weld pipe for mainline pipe with nominal diameter less than 3-inches. Use Schedule 40, Type 1, PVC solvent weld fittings conforming to ASTM Standards D2466 and D1784. Primer for use with solvent cement to conform to ASTM F656 and purple in color. Solvent cement to conform to ASTM Standard D2564, of type approved by pipe manufacturer.
 4. Mainline pipe within sleeves: Use solvent weld pipe for mainline pipe installed within sleeves or see Section 2.3 for mainline pipe in sleeves sized greater than 2.5".
 5. Use push-on rubber-gasketed pipe equipped with factory installed reinforced gaskets for mainline pipe 3 inch and greater. Gasketed

pipe joints shall conform to the "Laboratory Qualifying Tests" section of ASTM D3139. Gasket material shall conform to ASTM F477. Use push-on rubber-gasketed ductile iron fittings with joint restraints according to 2.4.E.

6. Mainline pipe within sleeves: Provide restrained casing spacers for gasketed joints that occur within sleeve and as necessary along pipe length.

B. Lateral Pipe and Fittings:

1. Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting the requirements of Cell Classification 12454-A or 12454-B, ASTM Standard D1784, with an integral belled end suitable for solvent welding.
2. Use Class 200, SDR-21, rated at 200 PSI, conforming to dimensions and tolerances established by ASTM Standard D2241.
3. Use solvent weld pipe for lateral pipe. Use Schedule 40, Type 1, PVC solvent weld fittings conforming to ASTM Standards D2466 and D1784 for PVC pipe. Use primer approved by pipe manufacturer. Solvent cement to conform to ASTM Standard D2564, of type approved by pipe manufacturer.

C. Pipe Above Grade and in Concrete Structures:

1. AWWA C115, flanged joints and fittings working pressure 1025 kPa (150 psi).

D. Fittings:

1. Irrigation Mains:

a. Ductile Iron Fittings:

Use ductile iron fittings upon all gasketed push-on PVC pressure pipe. Ductile iron fittings shall have fusion-bonded epoxy coating, self restrained fittings 2, 4 and 6 bolt options and blunt serrations. Acceptable manufacturer is LEEMCO or approved equal.

b. Ductile Iron and PVC Pipe:

Use mechanical joints conforming to ANSI A 21.10 (AWWA C110) and ANSI A21.11 (AWWA C111) or flanged fittings conforming to ANSI/AWWA C110 and ANSI B16.1 850 kPa (125#). All fittings shall be installed with retainer glands designed for the pipe material, and shall be manufactured with twist off screws that shear off at the proper force to anchor the retainer gland to the pipe at the

pressure rating for the pipe, or at the test pressure for the pipe, whichever is higher, without causing damage to the pipe.

Acceptible manufacturer is LEEMCO or approved equal.

2. Irrigation Laterals:

PVC, schedule 40, solvent welded socket type, ASTM D2466.

3. Threaded Pipe:

PVC, schedule 80, ASTM D2464.

4. Swing Joints:

Shall be a standard complete assembly by a manufacture, with elastomeric seals that allow 360 degree rotation, and are designed for minimum 1375 kPa (200 psig) working pressure.

E. Jointing Materials:

1. Irrigation Mains: Rubber gaskets, AWWA C111.

2. For gasketed PVC pipe use ductile iron fittings and mechanical joints conforming to ANSI A 21.10 (AWWA C110) and A21.11 (AWWA C111) or flanged fittings conforming to ANSI/AWWA C110 and ANSI B16.1 850 kPa (125#). All fittings shall be installed with retainer glands designed for the pipe material, and shall be manufactured with twist off screws that shear off at the proper force to anchor the retainer gland to the pipe at the pressure rating for the pipe, or at the test pressure for the pipe, whichever is higher, without causing damage to the pipe.

3. Irrigation Laterals: Use Schedule 40, Type 1, PVC solvent weld fittings conforming to ASTM Standards D2466 and D1784 for PVC pipe. Use primer approved by pipe manufacturer. Solvent cement shall conform to ASTM Standard D2564, of type approved by pipe manufacturer.

4. Threaded pipes: Use only Teflon-type tape or Teflon based paste pipe joint sealant on plastic threads. Use non-hardening, non-toxic pipe joint sealant formulated for use on water-carrying pipes on metal threaded connections.

2.5 RESTRAINTS

A. Thrust Blocks:

1. Use concrete thrust blocks on mainline sized 2.5 inch.
2. Use 20 MPa (3,000-psi) concrete.
3. Use 50 micrometers (2-mil) plastic.
4. Use 12.7 mm (No. 4) Rebar wrapped or painted with asphalt tar based mastic coating.

PLANTING IRRIGATION

B. Joint Restraint Harness:

1. Use ductile iron fittings for gasketed PVC pressure pipe and joint restraint harnesses as presented in the installation details and/or wherever joints are not positively restrained by flanged fittings, threaded fittings, and/or retainer glands. Install mechanical joint restraints per manufacturer printed instructions including but not limited to, additional joint restraints on straight runs of pipe within the minimum allowable distance from an ell or tee fitting.
2. Use a joint restraint harness with all ductile iron fittings on pipe sized 3 inches and larger. Transition fittings between metal and PVC pipe, where extra support is required to retain a fitting or joint.
3. Use a joint restraint harness or retainer glands with preset torque shearing set screws.
4. Use bolts, nuts, retaining clamps, all-thread, or other joint restraint harness materials that are stainless steel. Use retainer conforming to ASTM A536. Use high strength, low alloy steel bolts and connecting hardware conforming to ANSI/AWWA C111/A21.11.

2.6 MAINLINE COMPONENTS

A. Valves (Except remote control valves):

1. General valve installation shall be as presented in the installation details. All valves shall meet or exceed any specified parameters identified herein, or the parameters for the existing valves being matched, whichever provided the higher quality product.
 - a. Underground Shut-Off Valves: Provide one or more of the following based upon project specific conditions. Use type in paragraph 1) unless there are special circumstances that require the other types:
 - 1) Gate valves 50 mm (2 inches) and larger: Iron body, bronze mounted, double disc with parallel or inclined seats, non-rising stem turning clockwise to close, 1375 kPa (200 psi) minimum working pressure. AWWA C509.
 - 2) Butterfly valves 80 mm (3 inches) and larger: cast iron body with stainless steel shaft, ductile iron valve disc and resilient rubber coated, 1375 kPa (200psi) minimum pressure. AWWA C504.
 - b. Air-Vacuum Relief Valve:
 - 1) Cast Iron body with epoxy coating, polypropylene float, glass fiber reinforced nylon kinetic float, Buna-N seals and O-

rings, stainless steel nuts and bolts, pressure range 14 kPa to 1580 kPa (2 psi to 230 psi). Use a continuous acting combination air and vacuum and air release valve.

c. Ball Valve:

1) Use full-port stainless steel two-piece ball valve with stainless steel handle and vinyl grip. Valve body, ball and handle shall be of 316 stainless steel conforming to ASTM A351 CF8M. Valve and stem seals shall be reinforced Teflon, live-loaded and adjustable seat. Acceptable manufacturer is Valworx 5518 series or approved equal.

d. Quick Coupling Valve Assembly:

- 1) As presented in the installation details.
- 2) Brass construction, 1-inch nominal size, operating pressure 35-860 kPa (5-125 psi) with locking rubber or vinyl cover. Acceptable manufacturer and model is Rain Bird 44-NP or approved equal.
- 3) Swing Joint: Use pre-manufactured triple swing joint. Quality of manufactured product shall meet or exceed that of products manufactured by Rain Bird, Spears, Lasko, or approved equal.
- 4) Quick Coupling Valve Stabilizer: Use pre-manufactured bolt on anchor. Acceptable manufacturer and model is LEEMCO LS-120 or approved equal.
- 5) Valve Box: Use plastic (ABS) 10-inch round valve box with black lid or larger as needed to fit all components including quick coupling valve stabilizer. Acceptable manufacturer is Carson, Pentek, Rain Bird, Brooks or approved equal.
- 6) Filter Fabric: Use a spunbond polyester 3.5 oz per square yard landscape fabric.

B. Flower Water Station Spigot Connection Assembly:

1. As presented in the installation details.
2. Flower Watering Station Spigot: As presented in the installation details and specified in Section 323000, Site Furnishings.
3. Curb Stop Valve: Brass body, 2070 kPa (300 psi) minimum working pressure. ASTM B-62, female threaded connections, with stop and waste feature. Acceptable manufacturers are Ford, Mueller, A.Y. McDonald or approved equal.

4. Inline pressure regulator, 275 kPa (40 psi) maximum, 1-inch maximum inlet and outlet. Acceptable manufacturers and models are Rain Bird PSI-M40X-100, Senniger Model PSR-40 or approved equal.
5. Copper Pipe: Use Type "M" soft tubing conforming to ASTM Standard B88. Use wrought copper or cast bronze fittings, soldered, flared mechanical, or threaded joint per installation details. Use a 95-percent tin and 5-percent antimony solder.
6. Valve Box: Use a concrete curb valve box with cast iron lid sized 200 mm ID x 300mm (8" ID x 12"). Valve box must be capable of being face anchored in concrete. Acceptable manufacturer and model is Christy Concrete Products F08 Box (standard) or approved equal.
7. The final configuration, including the mounting method shall be as approved during the submittal process.

C. Valve Box:

1. Gate and Butterfly Valve box:
 - a. Valve boxes in pavement shall be precast concrete with compressive strength of the concrete in excess of 30 Mpa (4000 psi). Acceptable manufacturer and model is Christy Concrete Products F08 Box (standard) or approved equal. In turf and planter areas valve boxes shall be HDPE structural foam Type A, Class III, green in color. Box shall be minimum 475 mm (19 inches) long by 350 mm (14 inches) deep with key-lockable hinged "T" lid. Acceptable manufacturers are Carson, Pentek, Rain Bird or approved equal.
 - b. Box shall be of such length to be adapted to depth of cover required over pipe at valve location. Mark box cover to identify as lawn irrigation system and set flush with finished grade. 2(two) "T" handlesocket wrenches of 15 mm (5/8 inch) round stock with sufficient length to extend 600 mm (2 feet) above top of deepest valve box cover.
 - c. Operations:
 - 1) Underground: furnish valves with 50 mm (2 inch) nut for T-Handle socket wrench operation.
 - 2) Above ground and in pits: MSS SP70, with handwheels.
 - 3) All butterfly valves 150 mm (6 inches) and above shall have enclosed gear drive operators.

4) Ends of valves shall accommodate the type of pipe installed.

Valves on buried irrigation mains shall have Mechanical Joint ends with retainer glands.

2. Remote Control Valve box:

a. When in pavement, valve boxes shall be precast concrete with compressive strength of the concrete in excess of 30 MPa (4000 psi) and "T" lid. Acceptable manufacturer and model is Christy Concrete Products F08 Box (standard) with "T" lid or approved equal. In planter areas, valve boxes shall be HDPE structural foam Type A, Class III, green in color. Box shall be minimum 475 mm (19 inches) long by 350 mm (14 inches) deep with key-lockable hinged lid. Acceptable manufacturers are Carson, Pentek, Rain Bird or approved equal.

1) After installation, label boxes with two 80 mm (3 inch) size stencils designated controller and circuit numbers with permanent white epoxy paint. Numbers shall be placed at center of valve cover and shall face nearest main road or service road.

b. Box shall be of such length to be adapted to depth of cover required over pipe at valve location. Mark box cover to identify as lawn irrigation system and set flush with finished grade.

2(two) "T" handle socket wrenches of 15 mm (5/8 inch) round stock with sufficient length to extend 600 mm (2 feet) above top of deepest valve box cover.

c. After installation, label boxes with two 80 mm (3 inch) size stencils designated controller and circuit numbers with permanent white epoxy paint. Numbers shall be placed at center of valve cover and shall face nearest main road or service road.

d. Furnish 2 (two) 750 mm (30 inch) long valve adjustment keys.

D. Backflow Preventer:

Furnish and install a reduced pressure principle backflow preventer in each new connection to existing potable water distribution system, ASSE 1013, except pressure drop at design flow shall not exceed 70 kPa (10 psi). See prepackaged pump station specification 32 84 00A. Confirm and refine as needed prior to ordering pump station.

E. Water Meter Assembly:

1. Water Meter: See related sections.

- a. General Contractor furnished and installed meter approved by Public Service Company.

2. Strainer:

- a. General Contractor furnished and installed meter approved by Public Service Company.

2.7 SPRINKLER IRRIGATION COMPONENTS

A. Remote Control Valve Assembly:

- 1. As presented in the installation details. Install valves with unions on each side to allow for easy removal. Install assembly over gravel sump as presented in the installation details.

- a. Use a normally closed 24 VAC 50/60 cycle solenoid actuated globe pattern design. The valve pressure rating shall not be less than 200 PSI. The valve body and bonnet shall be constructed of heavy-duty glass-filled UV resistant nylon and have stainless steel studs and flange nuts; diaphragm shall be of nylon reinforced nitrile rubber. The valve shall have both internal and external manual open/close control (internal and external bleed) to manually open and close the valve without electrically energizing the solenoid. The valve's internal bleed shall prevent flooding of the valve box. The valve shall house a fully encapsulated, one-piece solenoid. The solenoid shall have a captured plunger with a removable retainer for easy servicing and a leverage handle for easy turning. The 24 VAC 50/60 Hz solenoid shall open with 19.6 volt minimum at 200 PSI. At 24 VAC, average inrush current shall not exceed 0.41 amps. Average holding current shall not exceed 0.23 amps. Solenoid shall be compatible with the two-wire decoder control system. The valve shall have a flow control stem for accurate manual regulation and/or shutoff of outlet flow. The valve shall open or close in less than 1 minute at 200 PSI and less than 30 seconds at 20 PSI. The valve shall have a self-cleaning filter screen designed for use in dirty water applications. Provide for all internal parts to be removable from the top of the valve without disturbing the valve installation.
- b. Valves shall contain pressure regulators manufactured specifically for use in the specified valve assembly and by the valve manufacturer preferably, ordered installed into the valves by the manufacturer at the time of shipping to the selected

irrigation installer. Acceptable manufacture and model is Rain Bird PRS-DIAL or approved equal.

- c. Acceptable manufacture and model is Rain Bird PEB-PRS-D or approved equal.

2. Ball Valve:

- c. Use full-port stainless steel two-piece ball valve with stainless steel handle and vinyl grip. Valve body, ball and handle shall be of 316 stainless steel conforming to ASTM A351 CF8M. Valve and stem seals shall be reinforced Teflon, live-loaded and adjustable seat. Acceptable manufacturer is Valworx 5518 series or approved equal.

- 3. Filter Fabric: Use a spun bond polyester 3.5 oz. per square yard landscape fabric.

- 4. Wire connectors: Use 3M DBY or DBR.

- 5. Use standard I.D. tags with hot-stamped black letters on a yellow background. Acceptable manufacturer is Christy/Christies or approved equal.

- 6. Decoder: Single station decoder with surge suppression and ground wire. Acceptable manufacturer is Rain Bird model F43100-FD101TURF.

- 7. Lightning protection: Provide grounding apparatus as suggested by the decoder manufacturer and at intervals recommended by the decoder manufacturer. Acceptable manufacturer is Rain Bird model LSP-1TURF.

B. Pop-Up Gear-Driven Rotary Sprinkler Emission Device Assembly:

- 1. As presented in the installation details.

- a. Rotary Sprinkler Emission Devices:

Use a gear drive sprinkler capable of covering the radius with the discharge rate at the pressure as presented on the drawings. Furnish part circle sprinklers with an adjustable arc of 20- to 340-degrees, and full circle sprinklers with a non-adjustable arc. Furnish sprinkler with stainless steel pop-down spring. Furnish sprinkler with stainless steel risers, integral check valve in base of the case capable of holding back 10-feet of elevation. Minimum pop-up height is 3 1/2-inches. Acceptable manufacturer and models are as listed below or approved equal:

- 1) Rain Bird F4-FC-SS Turf Rotor with 4-inch pop-up height, stainless steel riser full circle with removable seal-a-matic check valve and 1 inch female threaded inlet;

- 2) Rain Bird F4-PC-SS Turf Rotor with 4-inch pop-up height, stainless steel riser part circle with removable seal-a-matic check valve and 1 inch female threaded inlet;
- 3) Rain Bird 5505-SS-ADJ Turf Rotor with 5-inch pop-up height stainless steel riser, standard trajectory nozzle, arc adjustable 50°-330° seal-a-matic check valve ¾ inch female inlet with nozzles 02 =orange, 03 =red, 04 =black, 05 =yellow, 06 =light blue, 08 =dark green, 10 =grey, 12 =beige;
- 4) Rain Bird 5505-SS Turf Rotor with 5-inch pop-up height, stainless steel riser, standard trajectory nozzle, 360° non-reversing full circle arc, seal-a-matic check valve ¾-inch female inlet with nozzles 02 =orange, 03 =red, 04 =black, 05 =yellow, 06 =light blue, 08 =dark green, 10 =grey, 12 =beige;
- 5) Rain Bird 5512 Turf Rotor with 12-inch pop-up height, standard trajectory nozzle, 360° non-reversing full circle arc, seal-a-matic check valve, ¾-inch female inlet with nozzles 02 =orange, 03 =red, 04 =black, 05 =yellow, 06 =light blue, 08 =dark green, 10 =grey, 12 =beige;

b. Swing Joint:

Use pre-manufactured triple swing joint. Acceptable manufacturer is Rain Bird, Spears, Lasco or approved equal.

C. Bubbler Emission Device Assembly:

1. As presented in the installation details.

- a. Use a pressure compensating bubbler capable of providing a constant discharge rate at the pressure as presented on the drawings. The bubbler shall have a "trickle" pattern discharge. The bubbler assembly shall have a plastic inlet filter screen to protect the nozzle against clogging. The pressure compensating bubbler shall be of a permanently assembled design constructed of durable, UV resistant plastic with an integral rubber flow washer for regulating the flow rate at an operating pressure range of 20 to 90 PSI. The pressure compensating bubbler shall have a 1/2-inch inlet for connection to the piping system riser. Acceptable manufacture and models are as listed below or approved equal:

- 1) Rain Bird 1401 Pressure Compensating Bubbler with 0.25 GPM; full-circle, trickle pattern
- 2) Rain Bird RWS-B-C-1401 Root Watering Series with pre-installed 1401 bubbler, check valve, factory installed swing assembly

PLANTING IRRIGATION

with 1/2-inch M NPT inlet, fixed riser, 36-inch semi-rigid mesh tube with 4-inch retaining cap and vandal resistant locking grate, and optional sand sock for sandy soils.

D. Pop-up Multi Stream Multi Trajectory Sprinkler Emmission Device Assembly

1. As presented in the installation details.

- a. Use a pop-up sprinkler body with built-in pressure regulation matched to the MSMT nozzle specified and integral drain check valve capable of holding back a minimum of 14-feet of elevation. Acceptable manufacturer and models are as listed below or approved equal:

- 1) Hunter PROS-06-PRS40-CV Pop-up Spray Sprinkler with co-molded wiper seal, drain check valve 1/2-inch female threaded inlet and internal pressure regulation set to 40PSI.
- 2) Hunter PROS-12-PRS40-CV Pop-up Spray Sprinkler with co-molded wiper seal, drain check valve 1/2-inch female threaded inlet and internal pressure regulation set to 40PSI
- 3) Hunter MP Rotator MultiStream Multi Trajectory rotating nozzles capable of covering the radius with the discharge rate at the pressure as presented on the drawings or listed herein.

b. Swing Pipe (Low Density polyethylene hose and fittings):

Use pipe specifically intended for use as flexible swing joint. Use spiral barb fittings supplied by the same manufacturer as hose. Acceptable manufacturer is Rain Bird or approved equal.

2.8 CONTROL SYSTEM COMPONENTS

A. Rain Bird brand automatic central control equipment—with field satellites:

1. Overall Control Concept: The automatic control system shall consist of central computer system which provides irrigation scheduling control and overriding capabilities of field satellite units in turn operating individual remote control valves in accordance with schedules programmed into the central. The number of units and location of the installations are shown on the drawings.
2. The Central Computer Control System consists of:
 - a) A Central Computer M1344STANDARD with Rain Bird IQ software IQ2006-IQADVCEDCD with all advanced feature packs and two-year Global Service Plan (GSP) coverage from the manufacturer I95200-GSPIQ2Y;

- b) A wall mount Rain Bird ESPLXME with requisite communication cartridge IQ4600-IQNCCRS and connection module IQ4620-IQFSCMLXME to serve as system server controller, hard-wire connected to the central computer via serial cable not to exceed 50 feet, included with IQ software and computer;
 - c) Modification of the existing east system ESP-LXD client controller with requisite cartridge IQ4600-IQNCCRS and connection module IQ4621-IQCMLXD to enable hard-wire communication with the server controller and added to the existing digital field decoder wire path, a flow sensor M80104-FS300P with decoder M13009-SD210TURF;
 - d) Hardwire communication to a newly installed client controller ESP-LXD F43100-ESPLXD with 75-station expansion module F43150-ESPLXDM75, stainless steel cabinet F42420-LXMMSS and stainless steel pedestal F42430-LXMMSSPED with requisite communication cartridge IQ4600-IQNCCRS and connection module IQ4621-IQCMLXD to enable hardwire communication with the server controller and connection to a flow sensor optocoupler port included with the packaged pump station assembly via separate digital field decoder wire and decoder M13009-SD210TURF.
3. The central computer shall be hardwired to the weather station M60506-WSPROLTSH via short-haul modems included with the weather station. A weather station 24volt power supply shall be included with the weather station and shall be connected to a 115volt port located at the booster pump station to furnish electric service to the weather station.
4. PE89 six pair shielded, direct burial telecom cable shall serve as connection wire between the server controller and client satellite controllers and between the central computer and the weather station. Acceptible manufacturer is Paige Electric or approved equal.
5. Central Computer Control System:
- a. Rain Bird™ IQ™ v2.0 Central Control Hardware system specifications include but are not limited to:
 - 1) The hardware shall utilize IQNCC Network Communication Cartridges to interface between the system controllers and the Rain Bird™ IQ™ v2.0.

- 2) The cartridge shall be designed to install into Rain Bird™ ESP-LXME, Rain Bird™ ESP-LXMEF and Rain Bird™ ESP-LXD Series controller faceplate.
 - i) No tools shall be required for the communication cartridge installation.
 - ii) The communication cartridge shall receive power through a ribbon cable connection to the controller front panel.
- 3) The communication cartridge shall be configured and monitored through a dedicated dial position on the controller front panel.
 - i) In this dial position the communication cartridge shall be in control of the controller display and user interface softkeys.
- 4) The user interface shall include a setup wizard to guide the user through the required configuration settings.
- 5) The communication cartridge shall be user configurable as a Direct, Server, or Client satellite controller.
- 6) The communication cartridge shall incorporate three communication ports to communicate with the system central computer as well as communicate with other communication cartridge equipped controllers via high-speed data cable and/or radio communication.
- 7) The communication cartridge shall incorporate status lights (LEDs) showing the real-time status of the cartridge communication ports.
- 8) The controller shall be configured as a Direct, Server, or Client Satellite with the cartridge installed.
- 9) Single controller sites shall use an IQ NCC cartridge configured as a Direct satellite.
 - i) A Direct satellite shall have an IQ central computer communication connection but no network connections to other satellites in the system.
 - ii) Communication cartridges configured as a Direct satellite shall communicate directly with the system central computer via the primary (IQ) communication port.
 - iii) Configuring the communication cartridge as a Direct satellite shall disable the IQNet™ high-speed data cable (CM) and radio (Radio) communication ports.

- 10) Multi-controller sites shall be able to use one IQ NCC cartridge configured as a Server satellite and the other NCC cartridges configured as Client satellites.
- 11) The Server satellite has an IQ central computer communication connection and shares this communication connection with the Client satellites though high-speed data cable or radios.
- 12) The communication connection between Server and Client satellites shall be called the IQNet™.
 - i) The IQNet™ communication shall be either radio or two wire path from the server to the various clients the server communicates too.
 - ii) The IQNet™ communication shall have the capability to mix-and-match between radio and hardwire clients.
- 13) Server and Client satellites using high-speed data cable for IQNet™ communication require installation of an IQ CM Communication Module.
 - i) IQCMLXD Connection Module for the ESP-LXD Controller.
- 14) Server and Client satellites using radio communication for IQNet™ communication require installation of an IQSSRADIO radio.
- 15) Satellites on a common IQNet™ can share weather sensors and master valves.
- 16) Communication cartridges configured as a Server satellite shall communicate directly with the system central computer via the primary (IQ) communication port.
 - i) Configuring the communication cartridge as a Server satellite shall enable the IQNet™ high-speed data cable (CM) and radio (Radio) communication ports for communication with Client satellite controllers.
 - ii) A single Server satellite shall be capable of networking up to 150 Client satellites across the IQNet™ network.
- 17) Communication cartridges configured as a Client satellite shall communicate via the IQNet™ network with a Server satellite.
 - i) The Client satellite shall not have direct communication with the system central computer but shall instead use the Server satellite connection.

- ii) Client satellite primary (IQ) communication port shall be disabled.
 - iii) Configuring the communication cartridge as a Client satellite shall enable the IQNet™ high-speed data cable (CM) and radio (Radio) communication ports for communication with a Server controller.
- 18) Satellite controllers on a single IQNet™ network can share up to 8 master valves and 32 weather sensors.
- 19) Master valves and weather sensors may be shared across ESP-LXME traditionally-wired and ESP-LXD two-wire controllers.
- 20) The cartridges shall be available with internal Phone, GPRS/Cellular, Ethernet and WiFi modems, RS-232 external modem port, direct connect cable, radio, or IQNet™ Communication Cable.
- i) Communication cartridges with GPRS/Cellular, Ethernet, and WiFi shall utilize static IP addresses for communication with the system central computer.
- 21) IQ NCC cartridges shall be initially configured through a setup wizard provided in the ESP-LX Series Controller IQ Settings dial position.
- 22) Communication setting parameters shall be configured through the IQ software or the IQ Configuration Software designed for netbook/laptop use on the site.
- 23) The Rain Bird™ IQ NCC-RS RS232 Cartridge shall include a RS-232 Port for IQ Direct Cable or external modem communication connection to the IQ central computer.
- i) Shall include an external modem cable (IQ Direct Cable provided with IQ Software Package)
 - ii) Shall be used for Client Satellite applications requiring IQNet™ high-speed data cable or radio communication with the Server Satellite.
 - iii) Shall be used for Direct or Server satellite applications requiring direct cable connection or external modem (radio or other 3rd-party device) communication with the IQ central computer.
- 24) Server and Client satellite controllers shall utilize a Connection Module to connect to the IQNet™ via high-speed data cable.

PLANTING IRRIGATION

- i) The Connection Module shall be controlled by the cartridge CM port.
 - ii) Connection Modules shall provide quick connect terminals for connection to the 2 communication conductors as well as ground.
 - 25) The system central computer shall be capable of upgrading (reflashing) the communication cartridge firmware through the IQ communication port.
 - 26) The communication cartridge shall keep a log of all controller and IQNet™ activity for upload to the system central computer.
 - 27) The IQ v2.0 Central Control System™ shall be as manufactured by Rain Bird™ Corporation.
2. Flow Sensing
- a. Rain Bird IQ v2.0 Central Control flow sensing system specifications include but are not limited to:
 - 1) The Rain Bird flow sensing system shall be configurable to the following systems:
 - (i) Rain Bird IQ v2.0 Central Control Software Systems
 - (ii) Maxicom2 Systems
 - (iii) SiteControl Systems
 - (iv) Rain Bird LXME
 - (v) Rain Bird LXMEF
 - (vi) Rain Bird LXD
 - b. Rain Bird flow sensing system shall include Flo-Watch™.
 - 1) Flo-Watch™ shall constantly monitors for low flow and excess flow conditions caused by broken lines or heads.
 - 2) Flo-Watch™ shall automatically quarantine and shut down the problem area(s) and continue to irrigate non affected areas.
 - c. The flow sensing system flow sensors shall provide a learn flow utility to measure the nominal flow rate of each station.
 - 1) The controller has the ability to automatically learn station flow rates.
 - 2) The learn flow rate shall be compared to the actual flow sensor flow rate each time the station operates.
 - 3) A user defined percentage above and below the learned flow rate shall be used to determine if the flow rate is problematic. The software shall allow the user to increase

or decrease the length of time of a flow event before the controller reacts.

- 4) User defined reactions shall be programmable including a diagnose mode where the cause of the problem flow rate is identified and the problem station or water source is shut off.
 - 5) The automatic collection of flow rates shall prevent the user from manually entering data from drawings or physically visiting each valve to collect flow data and manually entering the data collected into a controller.
- d. Rain Bird flow sensing system shall incorporate FloManager®.
- 1) The FloManager® shall provide real-time flow, power, and station management.
 - 2) The FloManager shall manage the number of stations operating at any point in time based on water source capacity, station flow rate, station module assignment, number of valves per station, station priorities, and user defined simultaneous stations per program and for the controller.
 - 3) The FloManager® shall determine the optimal station irrigating sequence.
 - 4) The system shall run at its fullest capacity until all programs are complete.
 - 5) The controller shall automatically select and run multiple valves at the same time within hydraulic parameters allowing for shorter water windows.
 - 6) Flow rates may be manually measured and entered into the controller to utilize FloManager® functionality.
- e. The flow sensing system shall be compatible with Rain Bird ESP-LXD series two-wire decoder controllers with 1 to 200 station capacity.
- 1) Rain Bird Two-Wire Decoder Sensor M13009-SD210TURF shall be required on two-wire decoder systems.
 - 2) A pulse transmitter shall be required if more than 55' of wire run is required.
- f. Surge protection shall be recommended for all systems.
- g. One shall be located at the flow sensor, and if more than 50' of wire run, one shall be located at the pulse transmitter.
- h. The flow sensor system model shall be:

PLANTING IRRIGATION

- 1) Rain Bird FS300P flow sensor by Data Industrial with M13009-SD-210TURF decoder shall be installed in a surface box upon the existing east system by the selected irrigation installer at a location outside the existing east system water point-of-connection vault, hard-wired into the existing digital two-wire path and programmed for operation in conjunction with the existing east system controller. The flow sensor-enabled east system controller shall enable flow management and reporting of the east system from the computer central control.
- 2) The packaged booster pump station serving the west system shall include a Data Industrial flow sensor with Opto-coupler and point of connection that shall be hard-wired to the west system controller. The flow sensor-enabled west system controller shall enable flow management and reporting of the west system from the computer central control. The selected irrigation installer shall furnish to the pump station manufacturer at the time of ordering, an M13009-SD-210TURF decoder for use by the pump station manufacturer when constructing the point of connection to the flow sensor section of the pump station.
- 3) All programming for all flow sensor resolution and function including but not limited to k-factor and offset factor shall be conducted according to manufacturer recommendations. Flow sensor functionality upon each assigned system and in conjunction with computer central control shall be confirmed and demonstrated to COR as a condition of system acceptance.

9. Central Computer Software

- a. The system shall be fully programmable, providing the operator with full control of the entire control system.
- b. The system shall be capable of controlling all functions at a central computer that could be completed at the physical satellite controller.
- c. The system shall have a Windows® graphical user interface (GUI) that allows programming and a graphical depiction of the satellite controller programming.
- d. The system shall have modular satellite controller capacity and features.

PLANTING IRRIGATION

- 1) The system shall allow the user to upgrade the system as the system requirements change.
- e. The system shall have the capacity to connect and manage 16,000+ satellites per system.
- f. The IQ Software and satellite controller capacity can be upgraded in 5-satellite increments.
 - 1) The additional capacity shall be added through purchased software activation keycodes.
- g. The system shall be compatible with the Rain Bird ESP-LXME and Rain Bird ESP-LXMEF series traditionally-wired controllers with 1 to 48 station capacity.
 - 1) Shall be able to control 7,200+ satellite stations per site for the ESP-LXME and ESP-LXMEF.
 - 2) Rain Bird ESP-LXME and Rain Bird ESP-LXMEF shall be capable of running 5 simultaneous stations.
 - 3) Each Server Satellite shall be capable of connecting to 149 Client Satellites for a total of 150 Satellites per site.
 - 4) The maximum number of simultaneous stations per site for the ESP-LXME and ESP-LXMEF shall be 750.
- h. The system shall be compatible with Rain Bird ESP-LXD series two-wire decoder controllers with 1 to 200 station capacity.
 - 1) Shall be able to control 30,000+ decoders addresses per site ESP-LXD.
 - 2) The maximum number of simultaneous stations per site shall be 1,200 for the ESP-LXD.
- i. The system shall have the capacity to control 999 sites per system.
- j. The system shall have an adjustable satellite controller capacity allowing the customer to expand the system capacity over time.
- k. The system shall allow virtual log-on passwords to administer access privileges to multiple users of the system.
- l. The controller shall have the ability to be programmed and operated in any one of six languages:
 - 1) English
 - 2) Spanish
 - 3) French
 - 4) German
 - 5) Italian

PLANTING IRRIGATION

- 6) Portuguese
- m. The system shall have user configurable formats for date, time, number, and units formats.
- n. The system shall allow virtual site configurations, allowing the user to group satellite controllers into a site to simplify common adjustments.
- o. The system shall incorporate a satellite controller Dry-Run feature that graphically depicts the following program operation features:
 - 1) Minute-by-minute program activity
 - 2) Expected flow rates
 - 3) Programs/stations operating at any point in time.
 - 4) The order in which stations irrigate and which stations will be simultaneously run together.
- p. The system shall incorporate program adjust values for each satellite controller program.
- q. The system shall include a site-level daily or monthly seasonal adjust percentage
 - 1) Shall adjust the station run times for all satellite controllers in the site.
- r. The system shall also offer site-level daily or monthly ET value adjustments as an alternative to seasonal adjustment percentage.
- s. The software shall utilize IQNCC Network Communication Cartridges to interface with the system controllers.
- t. The cartridges shall be available with internal Phone, GPRS/Cellular, Ethernet and WiFi modems, RS-232 external modem port, direct connect cable, radio, or IQNet™ Communication Cable.
 - 1) The controllers shall be configured as a Direct, Server, or Client Satellite with the cartridge installed.
- u. The Server satellite shall share its IQ central computer communication link with up to 149 Client satellites and be capable of sharing weather sensors and master valves amongst the 150 satellite controllers.
- v. The software shall incorporate a site configuration utility that contacts the satellite controller and shall:
 - 1) Report the hardware configuration and retrieve the configuration and programming data
 - 2) Report any learned flow rates the controller may have.

PLANTING IRRIGATION

- 3) Verify the satellite hardware configuration has not changed each time it contacts the satellite controller.
- w. The controller and IQNCC cartridge firmware shall be upgradeable (reflashed) from the system central computer.
- x. The software shall be capable of manually starting a program, test a program, or station on any satellite controller.
- y. The software shall be capable of overriding the satellite controller Auto/Off dial position and sensor Active/Bypass switch position.
- z. Satellite controllers equipped with flow sensors shall provide a learn flow utility to measure the nominal flow rate of each station.
 - 1) The satellite controllers shall come with Flo-Watch.
 - 2) Flow-Watch shall provide protection for high and low flow conditions with user defined reactions.
 - 3) The learn flow rate shall be compared to the actual flow sensor flow rate each time the station operates.
 - 4) A user defined percentage above and below the learned flow rate shall be used to determine if the flow rate is problematic.
 - 5) User defined reactions shall be programmable including a diagnose mode where the cause of the problem flow rate is identified and the problem station or water source is shut off.
- aa. A manual master valve water window shall be provided to automatically open the master valve and account for manual watering flow rates without turning off the flow sensing functions of the satellite controller.
 - 1) Both normally closed and open master valves shall be supported.
- bb. All flow sensing features shall be programmable through the software.
- cc. The system shall offer user definable station-level priorities and a program-level water window.
- dd. Stations are selected to operate based on their priority with high priority stations operating first.

PLANTING IRRIGATION

- ee. The station operation shall be paused and resumed at the start of the next water window if a program cannot complete the run time of all stations in the water window.
- ff. The system shall provide user definable number of simultaneous station to operate per program and for the whole satellite controller.
 - 1) The combination of these features shall be used to automatically shorten the overall operating time of the satellite controller programs.
- gg. All satellite controller features listed shall be programmable through the software.
- hh. The system shall offer optional software Rain Bird Feature Packs to expand the features of the system.
 - 1) The optional features shall be enabled through a purchased software keycode.
 - 2) Feature Pack features shall be enabled for all sites and satellites in the IQ software.
- ii. The feature packs shall include:
 - 1) Advanced communications
 - 2) Advanced programming
 - 3) Advanced ET
 - 4) Advanced flow sensing.
- jj. A system equipped with the Rain Bird Advanced Communication Feature Pack IQACOMFP specifications include but are not limited to:
 - 1) Shall provide automatic communication and email reports.
 - 2) Using Satellite "IQ Call-in" the satellite controller using phone communication shall be capable of initiating communication with the central computer to gather programming changes and sent log data.
 - 3) The Call-in feature shall be compatible with NCC-PH Phone Cartridge only.
 - 4) The Rain Bird Advanced Communication Feature Pack IQACOMFP shall function with any NCC cartridge.
 - 5) Automated satellites synchronize and retrieve logs and Weather Source retrieve weather data communications.

- 6) Shall send automated e-mail reports indicating alarm/warnings and satellite station run time reports up to 250 e-mail addresses.
- kk. A system equipped with the Rain Bird Advanced Programming Feature Pack IQAPGMFP specifications include but are not limited to:
 - 1) Shall provide satellite controller PIN-code lock-out and 2-way programming.
 - 2) Shall help prevent unauthorized personnel from making programming changes at satellites the PIN-Code protection.
 - 3) Each satellite shall have a maximum of 5 assigned PIN-codes.
 - 4) The satellite PIN-Code Protection shall be a 4-digit PIN-Code.
 - 5) Lockout options shall include full or partial lockout.
 - 6) All PIN-codes shall be programmed through the software.
 - 7) Changes made at the satellite shall be able to be viewed and accepted in the software.
 - 8) The Copy/Move Satellite Utility shall allow the user to copy or move a satellite to another site.
 - 9) The user shall be able to view a list of site personnel who have accessed each satellite with date and time access information.
 - 10) Shall allow the user to accept or reject programming changes made at the satellites to each IQTM v2.0 satellite from the central computer.
11. A system equipped with the Rain Bird Advanced ET Feature Pack IQAETFP specifications include but are not limited to:
 - 1) Shall provide automatic program adjustment based management allowed depletion scheduling.
 - 2) ET/rain weather sources shall include CIMIS Internet, ETMI ET Manager Weather Reach Service, and Rain Bird WSPROLT and Rain Bird WSPRO2 Weather Stations.
 - 3) Shall allow Automated MAD (Management Allowed Depletion) irrigation scheduling adjustments.
 - 4) The software shall use irrigation association terminology and formulas.
 - 5) Shall have four ET checkbooks per satellite controller.
 - 6) Shall have the functionality to export to Microsoft Excel® for customized reports.

- mm. A system equipped with Rain Bird Advanced Flow Sensing Feature Pack IQAFSENFSP specifications include but are not limited to:
- 1) Shall provide minute-by-minute flow logs in a graph comparing actual flow and projected flow.
 - 2) Shall retrieve minute-by-minute flow logs from flow sensor equipped Rain Bird™ ESP-LXMEF and Rain Bird ESP-LXD satellite controllers.
 - 3) Station flow rates shall be learned by the Learn Flow Utility.
 - 4) Shall compare real-time flow rates to learned flow rates.
 - 5) Shall automatically diagnose problem flows to determine whether they are caused by a break in a main line or lateral line.
 - 6) Shall produce Flow Logs vs. Projected Flow Graphical Report identifying which programs and stations are running at any point in time.
 - 7) Shall automatically close the master valve or station valve to isolate the problem.
 - 8) Actual flow totals shall be added to the satellite station run time report, included in the automated email reports.
 - 9) Shall be able to monitor and automatically react to a breakage in the pipe by using the Flow Sensing Feature Pack, the Flow Smart Module and a flow sensor.
- nn. The system shall include a context-sensitive help system.
- oo. The system shall allow the user to create custom computer programming to meet specific needs.
- pp. The system's recommended computer requirements shall be:
- 1) Operating System: Windows® XP or Windows® 7 32 and 64-bit
 - 2) Processor: Intel I5-540M or equivalent
 - 3) RAM Memory: 3 GB
 - 4) Available Hard Disk Space: 10 GB
 - 5) CD-ROM Drive: 8X speed minimum
 - 6) Display Resolution: 1024 x 768 minimum
 - 7) 56K Flex Phone Modem (Phone communication)
 - 8) Network Connection (for Ethernet, WiFi, GPRS communication)
 - 9) Serial Port or USB to Serial Adapter (for Direct Connect and External Modem communication)
- qq. The IQ v2.0 Central Control System™ shall be as manufactured by Rain Bird Corporation.

- rr. The selected irrigation installer shall be responsible for all programming, database configuration, flow sensor programming and operation including learn flow and entry into database, weather station integration, basic scheduling including ET-based schedules and all other hardware and software programming to make ready, test, adjust and place into service the landscape irrigation system with a fully functioning computer central control system and associated on-site weather station.
 - ss. A final commissioning excersize shall be arranged by the selected irrigation installer to include an Authorized Service Provider of the computer central control system manufacturer. The session shall be announced to the owner prior to commencing and shall be thoroughly documented. The Authorized Service Provider shall inspect the installation and basic functionality of the computer central control system and associated hardware for installation and preparation that meets or exceeds manufacturer recommended practices and shall furnish a report confirming such as a prerequisite to final acceptance of computer central control system hardare and software by the owner.
 - tt. Furnish not less than three training sessions for three user personnel, conducted by the control system manufacturer's training personnel including but not limited to a manufacturer Authorized Service Provider, on-site, using the project's central control system, at a place and time to be determined. Each training session shall be for a period of not less than 4-hours and scheduled on different days. The selected irrigaiton installer shall schedule and coordinate the training sessions. Training shall include an overview of system operations and functions, troubleshooting techniques, user maintenance as well as detailed one-on-one training for selected individuals.
 - uu. Provide three (3) copies of all user technical training manuals.
 - vv. The control system manufacturer shall provide phone-in support to the owner at no cost for a period of two (2) years from the initial commissioning of the central control system.
- B. Automatic Control Equipment–Independent Satellite Controllers:
- 1. Overall Control Concept. The central computer shall communicate via hard-wire connection with a controller that shall serve as "server controller". The central computer shall also communicate via hard-

wire and short-haul modems with a weather station for evapotranspiration-enabled scheduling and for real-time weather information. All components and software shall be of a standard package or component elements. Installed upon the server controller shall be a Rain Bird IQ4600-IQNCCRS cartridge to enable hard-wire connection to the computer central and Rain Bird IQ4620-IQFSCMLXME module to enable PE89 six pair shielded hard-wire communication with the two system "client controllers". A 15-foot serial cable included with the software or if needed, an extended standard serial cable not to exceed 50 total feet from the location of the central computer to the location of the server controller shall be terminated and placed into service by the selected irrigation installer. Communication cable shall be routed from the location of the server controller for termination by the selected irrigation installer upon the existing in-building client controller. A second communication cable shall be routed from the server controller to a junction box located at room M108 and shall continue continue utilizing one twisted pair of wires within a PE89 cable to the location of the new pedestal-based client controller C2 serving the system expansion area. A communication cable equipped with short-haul modem modules included with the weather station between the central computer and weather station, shall originate at the central computer and shall be extended to a junction box located at room 108. From the junction box at room 108, two twisted pairs from the PE89 cable (also serving as communication cable to client controller C2) shall extend to the weather station and corresponding second short haul modem unit. A twisted pair of cable from a separate PE89 cable harness shall continue and terminate from the weather station to the nearby booster pump station and shall be connected to a 24volt transformer at the booster pump station and terminated at the 115volt-to-24volt input terminal at the weather station. See related sections.

2. The server controller shall communicate via PE89 shielded six-pair communication cable with the existing east system client controller, modified for computer central control operation and flow data collection and communication and which shall be known as client controller 1 (C1). The server controller shall be wall-mounted in close proximity to the computer central control to enable serial

PLANTING IRRIGATION

- hard-wire connection in a neat and workmanlike fashion. Installed upon the server controller shall be a Rain Bird IQ4600-IQNCCRS communication cartridge to enable connection to the computer central and Rain Bird IQ4620-IQFSCMLXME connection module to enable two PE89 hard-wire communication cables to be extended and connected to the two (2) system client controllers C1 and C2. A communication cable section for communication between the server controller and client controller C1 shall be installed in a neat and workmanlike fashion utilizing one twisted pair between the server controller and client controller C1. Equipment shall be assembled and made operational by the selected irrigation installer. See related sections.
3. A second PE89 shielded six-pair communication cable shall extend from the server controller to the location of the junction box at room M108 and extend to client controller C2 utilizing one twisted pair. Client controller C2 - ESP-LXD F43100-ESPLXD with 75-station expansion module F43150-ESPLXDM75, stainless steel cabinet F42420-LXMMSS and stainless steel pedestal F42430-LXMMSSPED with requisite cartridge IQ4600-IQNCCRS and connection module IQ4621-IQCMLXD shall serve the system expansion area. Utilize one twisted pair between the server controller and client controller C2. 115volt power to operate client controller C2 shall originate from the location of the booster pump station. Equipment shall be furnished, assembled and made operational by the selected irrigation installer. See details and related sections.
 4. Two additional twisted pair from the second PE89 shielded six-pair communication cable shall extend from the junction box located at room M108 and shall extend to the weather station to enable short haul modem-based communication. Short haul modems shall be attached to each end of the selected two twisted pairs of the PE89 cable.
 5. A PE89 shielded six-pair communication cable utilizing one twisted pair shall extend from the weather station to a point of connection at the booster pump station for 24volt power to operate the weather station. See related sections.
 6. Existing east irrigation system shall have furnished, installed in a surface box and made operational by the selected irrigation installer, a flow sensor M80104-FS300P with M13009-SD210TURF decoder added to the east system client controller C1 digital field decoder

PLANTING IRRIGATION

- two-wire path to enable flow sensing functionality upon the existing east system.
7. New expansion irrigation system Client controller C2 shall have installed a separate digital field decoder two-wire path from controller C2 to a flow sensor opto-coupler located at the manufactured booster pump station to enable flow sensing functionality of the new expansion irrigation system. The selected irrigation installer shall include a Rain Bird M13009-SD-210TURF decoder upon the wire path at the opto-coupler location to enable communication with the server controller.
 8. Electrical conduit where necessary shall be PVC schedule 40 conforming to the dimensions and tolerances established by ASTM Standard D1785. Fittings for PVC conduit shall be schedule 40, Type 1, PVC solvent weld, ASTM Standards D2466 and D1784.
 9. Wire Markers at control valve locations shall be prenumbered or labeled with indelible nonfading ink made of permanent, nonfading material.
 10. Lightning protection shall include conforming to manufacturer recommendations and or one 12' x 36"x 0.0625" ground plate, one 5/8" x 10' copper clad UL listed ground rod, #6 AWG bare copper ground wire, 6-inch plastic round valve box, stacked as needed to preserve maintainability of equipment and one CADWELD connector at each weld-end.
 11. Power wire from the power source at the packaged pump station control center to client satellite controller C2 shall be solid or stranded copper, Type TC Round Jacketed multi conductor cable with ground, direct burial, UL listed, rated at 600 volts. Power wires shall be black, white, and green in color. Size as per local code. If the control system changes, the selected irrigation installer shall be responsible for verifying that the power wire sizes are compatible and adequate for the control system being used. Use 3M #82-A2 Series with Split Bolts or Butt Connectors for inline splices and 82-B1 or 90-B1 Series for "Y" splices. Use PVC Schedule 40 conduit conforming to dimensions and tolerances established by ASTM Standard D-1785. Use Schedule 40, Type 1, PVC solvent weld sweep fittings for PVC conduit conforming to ASTM Standards D2466 and D1784 for buried installations. Use rigid metallic conduit with sweep elbows for above grade installations. Electric power to

PLANTING IRRIGATION

- operate client satellite controller C2 shall originate from the packaged pump station and be connected by the selected irrigation installer per local code. See related sections.
12. Use single address decoders that interface with one solenoid as depicted in the drawings. Furnish and install line surge protection as required by control system manufacturer and as depicted in the drawings. Furnish and install grounding as required by control system manufacturer. Use 5/8"x8 foot copper clad UL listed grounding rod and related components at intervals recommended by control system manufacturer and as depicted in the drawings
 13. Communication cable shall be PE89 six pair shielded and jacketed cable designed for direct burial, as recommended by the central control system manufacturer.
 14. Digital field decoder two-wire shall be Maxi-Cable® as recommended by the central control manufacturer. Use one color per wire path. Use a separate color for each wire path. Do not close-loop digital two-wire decoder path.

C. Weather Station

1. Rain Bird M60305-WSPRO2DC advanced weather station, powered with short-haul communication modems shall be furnished, installed, programmed and made operational by the selected irrigation installer per manufacturer recommendations. Final location to be in a landscaped and irrigated area generally as depicted in the drawings and specifically by COR at the time of installation.
2. Weather station shall be permanently mounted to a concrete base sized per manufacturer recommendation and shall be grounded per manufacturer recommendation and or as listed herein, whichever is more conservative. A sweep el, furnished with the weather station shall be installed to accommodate communication wire, 24volt power wire and surge ground wire.
3. Communication with the weather station shall be from the computer central control via PE89 six pair shielded direct bury cable utilizing two twisted pairs to the location of the weather station. Short haul modems, furnished with the weather station shall be utilized.
4. Electric power to operate and maintain the weather station battery charge shall originate from the packaged pump station and be connected by the selected irrigation installer per local code. A

PLANTING IRRIGATION

transformer from line voltage to low voltage charging of the weather station shall be included in the weather station package.

5. Lightning protection of the weather station shall include conforming to manufacturer recommendations and or one 12' x 36"x 0.0625" ground plate, one 5/8" x 10' copper clad UL listed ground rod, #6 AWG bare copper ground wire, 6-inch plastic round valve box, stacked as needed to preserve maintainability of equipment and one CADWELD connector at each weld-end.
6. The selected irrigation installer shall furnish all necessary tools and know-how to make all terminal connections in a professional and workmanlike fashion and to program and place into operation the weather station.
7. Weather station shall be programmed by the selected irrigation installer at the IQ computer central control workstation to automatically download weather data to the central computer at intervals set by the user and report local evapotranspiration rates and rainfall. The weather station shall be programmed to terminate irrigation events at user-set wind thresholds, temperature thresholds and qualifying rain events.

D. Master Valve West System

1. The new landscape irrigation system shall have a master valve. The master valve shall be normally-closed. The master valve shall receive a 24-volt, constant current "enable" signal from the associated landscape irrigation controller during programmed events to allow irrigation water to pass through the master valve, into the associated landscape irrigation system.
2. The master valve shall be an included component of the packaged booster pump station and shall have included by the booster pump manufacturer, a location for connection of the 24volt signal wire to the master valve by the selected irrigation installer. The master valve function shall be used by the booster pump station control center for engagement in instances where the booster pump station operating parameters require engagement of the master valve. See related sections.
3. An extension of the Maxi-cable two-wire path from client controller C2 to the master valve at the pump station shall serve as signal wire between client controller C2 and the master valve. A Rain Bird field decoder M13011-FD101TURF shall be installed upon the two-wire

PLANTING IRRIGATION

- path at the location of the master valve and programmed for operation as a master valve at the corresponding client controller C2.
4. Programming of the client controller C2 and the IQ computer central control system shall include opening of the master valve upon scheduled irrigation events.
 5. Should irrigation system derived water be desired outside of scheduled irrigation events such as use of quick couplers, programming shall be included by the selected irrigation installer to open the normally closed master valve during defined non-irrigation periods. Confirm defined periods for with COR prior to programming.

E. Master Valve East System

1. The existing east landscape irrigation system shall have furnished and installed, a master valve. The master valve shall receive a 24-volt, constant current "enable" signal from the associated landscape irrigation controller during programmed events to allow irrigation water to pass through the master valve, into the associated landscape irrigation system.
2. The master valve shall be a Rain Bird 300-BPE 3" normally-closed valve of hybrid brass and glass-filled nylon bonnet construction.
3. The master valve shall be placed not less than 10 pipe diameters upstream of the east system flow sensor and shall be contained in a valve service box separately from the east system flow sensor. Installation procedure of the east system master valve shall be as described in this specification and as depicted upon drawings.
4. An extension of the Maxi-cable two-wire path from client controller C1 running along the existing 3" east system PVC mainline shall serve as signal wire between client controller C1 and the master valve. A Rain Bird field decoder M13011-FD101TURF shall be installed upon the two-wire path at the location of the master valve and programmed for operation as a master valve at the corresponding client controller C1.
5. Programming of the client controller C1 and the IQ computer central control system shall include opening of the master valve upon scheduled irrigation events.
6. Should irrigation system derived water be desired outside of scheduled irrigation events such as use of quick couplers,

PLANTING IRRIGATION

programming shall be included by the selected irrigation installer to open the normally closed master valve during defined non-irrigation periods. Confirm defined periods for with COR prior to programming.

PART 3 - EXECUTION

3.1 INSPECTIONS AND REVIEWS

A. Site Inspections:

1. The selected irrigation installer shall verify construction site conditions and note irregularities affecting work of this section. Report irregularities to the COR prior to beginning work.

B. Utility Locates ("Call Before You Dig"):

1. Arrange for and coordinate with local authorities the location of all underground utilities, and with cemetery maintenance personnel.
2. Repair any underground utilities damaged during construction. Make repairs at no additional cost to the contract price.

C. Irrigation System Layout Review: Irrigation system layout review will occur after the staking has been completed. Notify the COR one week in advance of review. The COR will identify and approve modifications during this review.

3.2 LAYOUT OF WORK

- A. Stake locations of alley and sprinklers in existing burial sections using a licensed surveyor. Use alleys as identified on the drawings.
- B. Stake out the irrigation system. Items staked include: irrigation mainline pipe, thrust blocks, isolation gate valve assemblies, air/vacuum relief valve assemblies, quick coupling valves, remote control valves, lateral piping, and sprinklers.
- C. If staked irrigation components conflict with utilities or other components or site features, coordinate rerouting of components with Contracting Officer's Technical Representative.

3.3 EXCAVATION, TRENCHING AND BACKFILLING

- A. Excavate to permit the pipes to be laid at the intended elevations and to permit workspace for installing connections and fittings.
- B. Do not lay pipe on unstable material, in wet trench or when, in the opinion of the COR, trench or weather conditions are unsuitable for the work.
- C. Concrete thrust blocks, where used shall be installed where the irrigation main changes direction as at ells and tees and where the

PLANTING IRRIGATION

irrigation main terminates. Pressure tests shall not be made for a period of 36 hours following the completion of pouring of the thrust blocks. Concrete thrust blocks for supply mains shall be sized and placed in strict accordance with the pipe manufacturer's specifications and shall be of an adequate size and so placed as to take all thrust created by the maximum internal water pressure.

- D. Allow a minimum of 80 mm (3 inches) between parallel pipes in the same trench.
- E. Hold pipe securely in place while joint is being made.
- F. Do not work over, or walk on, pipe in trenches until covered by layers of earth well tamped in place to a depth of 300 mm (12 inches) over pipe.
- G. Full length of each section of pipe shall rest upon the pipe bed with recesses excavated to accommodate bells or joints. Do not lay pipe on wood blocking.
- H. Install sprinkler lines to avoid electric ducts, storm and sanitary sewer lines, water and gas mains, all of which have right of way.
- I. Clean interior of pipe of foreign matter before installation. Keep pipe clean during laying operations by means of plugs or other methods. When work is not in progress, securely close open ends of pipe and fittings to prevent water, earth, or other substances from entering.
- J. Minimum cover:
 - 1. 900 mm (36-inches) over irrigation mainline pipe in landscaped areas and to bottom of road base. (distance from top of pipe to finish grade)
 - 2. 450 mm (18-inches) over irrigation lateral pipe to sprinklers. (distance from top of pipe to finish grade)
 - 3. 450 mm (18-inches) over control wire when not in common trench with mainline or lateral piping. (distance from top of control wire to finish grade)
 - 4. 450 mm (18-inches) vertical separation between lateral and mainline pipe installed in a common trench.
 - 5. 75 mm (3-inches) minimum horizontal separation between pipes and wiring in a common trench.
 - 6. Install sleeves at depth to maintain specified depth of pipe or wire routed through sleeve.
 - 7. Tops of remote control valves shall never be less than 75 mm (3 inches) below lid of valve box.

PLANTING IRRIGATION

- K. Install and maintain safety fencing around all unattended excavation. Place safety signs adjacent to construction area roadway to the satisfaction of the COR.
- L. All excavations must be backfilled by the end of each workday. Do not leave any open trenches overnight, on weekends or on holidays.
- M. If trenching operation restricts access to a burial section, provide plywood and safety fencing across open trench to allow access to burial section. Provide access to the satisfaction of the COR.
- N. Excavated material is generally satisfactory for backfill. Backfill will be free from rubbish, vegetable matter, frozen materials, and stones larger than 2-inches in maximum dimension. Remove material not suitable for backfill. Backfill placed next to pipe will be free of sharp objects that may damage the pipe.
- O. Enclose pipe and wiring beneath roadways, walks, curbs, etc in sleeves. Backfill sleeves in the following manner:
 - 1. Backfill trench using excavated material in 150 mm to 200 mm (6-inch to 8-inch) layers. Minimum compaction of backfill for sleeves shall be a minimum 95% Standard Proctor Density, ASTM D698-78. Backfill to bottom of road base under roads or to finish grade under walks and curbs.
- P. Backfill mainline pipe, lateral pipe and wiring in turf areas in the following manner:
 - 1. Backfill the trench by depositing the backfill material equally on both sides of the pipe or wire in 150 mm (6-inch) layers and compacting to the density of surrounding soil.
- Q. Dress backfilled areas to original grade. Remove excess backfill to on-site location as directed by the COR.
- R. Where utilities conflict with irrigation trenching and pipe work, contact the COR for trench depth adjustments.
- S. Existing sidewalks and curbs shall not be cut during trenching and installation of pipe. Install pipe under sidewalks and curbs by jacking, auger boring, or by tunneling. Repair or replace any concrete that cracks, due to settling, during the warranty period.
- T. Close pipe openings with caps or plugs during installation. Tightly cover and protect fixtures and equipment against dirt, water and chemical or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.

U. Warning tape shall be continuously placed above sprinkler system water mains at a depth of 200-250 mm (8-10 inches).

V. Survey monuments:

- a. Protect markers during construction.
- b. If a survey marker is disturbed during construction, the selected irrigation installer is responsible for replacing the marker. The selected irrigation installer shall hire a licensed surveyor to resurvey the location of the marker and replace it in the proper location.

3.4 SLEEVING AND BORING

- A. Furnish and install where pipe and control wires pass under walks, paving, walls, and other similar areas.
- B. Install sleeving at a depth that permits the encased pipe or wiring to remain at the specified burial depth.
- C. Extend sleeve ends a minimum of 300 mm (12-inches) beyond the edge of the paved surface. Cover pipe ends and mark edge of pavement with a chisel or saw.
- D. Verify that sleeve sizing is adequate prior to installation. Sleeving to be twice line size or greater to accommodate retrieval for repair of wiring or piping and shall extend 300 mm (12-inches) beyond edges of paving or construction. Cover pipe ends and mark edge of pavement with a chisel or saw. Note that sleeves required for pipe with restrained casing spacers are larger than twice the diameter of the pipe.
- E. Bed sleeves with a minimum of 100 mm (4 inches) of sand backfill above top of pipe.

3.5 ASSEMBLING PIPE AND FITTINGS

- A. General:
 1. Keep pipe free from dirt and pipe scale. Cut pipe ends square and debur. Clean pipe ends.
 2. Keep ends of assembled pipe capped. Remove caps only when necessary to continue assembly.
 3. Trenches may be curved to change direction or avoid obstructions within the limits of the curvature of the pipe. Minimum radius of curvature and offset per 6 meters (20-foot) length of mainline and lateral pipe by pipe size are shown in the following table. All curvature results from the bending of the pipe lengths. No deflection will be allowed at a pipe joint.

SIZE	RADIUS	OFFSET PER 6 m (20') LENGTH
38 mm (1 ½")	7.5 m (25')	2.3 m (7'-8")
50 mm (2")	7.5 m (25')	2.3 m (7'-8")
63 mm (2 ½")	30 m (100')	575 mm (1'-11")
75 mm (3")	30 m (100')	575 mm (1'-11")
100 mm (4")	30 m (100')	575 mm (1'-11")
150 mm (6")	45 m (150')	400 mm (1'-4")
200 mm (8")	60 m (200')	300 mm (1'-0")
250 mm (10")	75 m (250')	225 mm (9")
300 mm (12")	90 m (300')	200 mm (8")

B. Mainline Pipe and Fittings:

1. Plastic pipe:

- a. Shall be snaked in trench at least 1 meter to 100 meters (1 foot per 100 feet) to allow for thermal construction and expansion and to reduce strain on connections.

b. Joints

- 1) Solvent Welded Socket Type: ASTM D2855.
- 2) Threaded Type: Apply liquid teflon thread lubricant of teflon thread type. After joint is made hand tight (hard), a strap wrench should be used to make up to two additional full turns.
- 3) Elastomeric Gasket: ASTM F477.
 - a) Immediately before joining two lengths of PVC pipe, the inside of the bell or coupling, the outside of the spigot and the elastomeric gasket shall be thoroughly cleaned to remove all foreign material.
 - b) Lubrication of the joint and rubber gasket shall be done in accordance with the pipe manufacturer's specifications.

- c) Care shall be taken that only the correct elastomeric gasket, compatible with the annular groove of the bell, is used. Insertion of the elastomeric gasket in the annular groove of the bell or coupling shall be in accordance with the manufacturer's recommendations. Pipe that is not furnished with a depth mark shall be marked before assembly to assure that the spigot end is inserted to the full depth of the joint.
- d) The spigot and bell or coupling shall be aligned and pushed until the reference line on the spigot is flush with the end of the bell or coupling. Pushing shall be done in a smooth, steady motion.

2. Ductile iron pipe:

a. Installation: AWWA C600.

b. Joints:

- 1) Mechanical: AWWA C111. Provide sufficient quantities of bolts, nuts, glands and gaskets for each socket opening on pipe and fittings.
- 2) Push-on: Apply thin film of lubricant to gasket and place in proper position in contour of bell. Insert beveled end of joining pipe and make contact with gasket. Force beveled end of pipe to bottom of bell without displacing gasket. Do not caulk. Use only lubricant furnished by manufacturer of pipe.
- 3) Flanges: AWWA C115. Install only in concrete pits. Make watertight and set not less than 150 mm (6 inches) from walls or floor.

C. Lateral Pipe and Fittings:

1. PVC Solvent Weld Pipe:

- a. Use primer and solvent cement. Join pipe in manner recommended by manufacturer and in accordance with accepted industry practices.
- b. Cure for 30 minutes before handling and 24 hours before pressurizing or installing with vibratory plow.
- c. Snake pipe from side to side within trench.
- d. In irrigation isles, coordinate with the location of the monuments to avoid conflicts.

2. Fittings: The use of cross type fittings is not permitted.

D. Emitter hose:

- 1. Use Type 1/11 solvent weld.

PLANTING IRRIGATION

2. Bushing for adaptation from PVC Schedule 40 fittings to flex-vinyl hose shall be line size by 10 mm (3/8 inch) insert bushings.

E. Specialized Pipe and Fittings:

1. Mechanical joint connections: Install fittings, fasteners and gaskets in manner recommended by manufacturer and in accordance with accepted industry practices.
2. PVC Threaded Connections:
 - a. Use only factory-formed threads. Field-cut threads are not permitted.
 - b. Apply thread sealant in manner recommended by component, pipe and sealant manufacturers and in accordance with accepted industry practices.
 - c. Use plastic components with male threads and metal components with female threads where connection is plastic-to-metal.

F. Thrust Blocks:

1. Use cast-in-place concrete bearing against undisturbed soil.
2. Size, orientation and placement will be as shown on the installation details.
3. Wrap fitting with plastic to protect bolts, joint, and fitting from concrete.
4. Install rebar with mastic coating as shown on the installation details.

G. Joint Restraint Harness:

1. Install harness in the manner recommended by the manufacturer and in accordance with accepted industry practices.
2. Use restrained casing spacers for gasketed pipe routed through sleeving. Install harness in the manner recommended by the manufacturer and in accordance with accepted industry practices. Install self-restraining casing spacers at all gasketed pipe bell joints and every 10-feet along the gasketed mainline pipe installed through sleeving. Provide correct number and type of restraints per manufacturer's requirements.

3.6 INSTALLATION OF MAINLINE COMPONENTS

A. Setting of valves:

1. No valves shall be set under roads, pavement or walks.
2. Clean interior of valves of foreign matter before installation.
3. Where pressure control valves are installed adjacent to remote control valve, they shall be housed in the same valve box.

PLANTING IRRIGATION

4. Set valve box cover flush with finished grade.
5. Install as indicated in the installation details, per manufacturer's instructions.
6. Install where indicated on the irrigation plans.
7. Brand or cast "GV" in 50 mm (2-inch) high by 5 mm (3/16-inch) deep letters on valve box lid.

B. Air/Vacuum Relief Valve Assembly:

1. As presented in the installation details, per manufacture's instructions.
2. Install where indicated in the irrigation plans.
3. Brand "AV" in 2-inch high by 3/16-inch deep letters on valve box lid.

C. Quick Coupling Valve Assembly:

1. As presented in the installation details, per manufacturer instructions.
2. Install where indicated in the irrigation plans.
3. Brand "QC" in 2-inch high by 3/16-inch deep letters on valve box lid.

D. Flower Watering Station Hydrant Connection Assembly:

1. As presented in the installation details, per manufacturerer instructions.
2. Sequence of construction:
 - a. Coordinate exact location with COR.
 - b. Components are to be installed before concrete pad. Coordinate installation with concrete contractor.
3. Location:
 - a. Stations will be installed at locations indicated on drawings, centered between adjacent sprinkler locations.
 - b. Route adjacent piping around stations. No mainline or lateral pipe is to be installed under Flower Watering Stations.
4. Paint "FW" in 2-inch high by 3/16-inch deep letters on valve box lid.

3.7 INSTALLATION OF SPRINKLER IRRIGATION COMPONENTS AND QUICK COUPLERS

A. Remote Control Valve Assembly:

1. Mainline Flushing:
 - a. Thoroughly flush mainline before installation of Remote Control Valve Assemblies.

- b. Identify remote control valve service tee(s) to be used for mainline flushing. Plug service tees not being used for flushing.
 - c. Connect 50 mm (2-inch) pipe to flushing service tee(s). Use pipe to direct water away from trench and into drainage swale, curb section or storm sewer, i.e. to an area that will direct the water away from the work area. Direct water so that it does not disrupt the cemetery operations.
 - d. Use a volume of water such that the velocity in the largest pipe flushing to this point is 0.9 m/s (3 FPS).
 - e. Multiple points may be flushed simultaneously.
 - f. Flush for a minimum of 20 minutes. Continue flushing until the water is clear of any and all debris.
 - g. The COR will review the flushing operation and clarity of water before stopping the flushing operation.
 - h. Disconnect pipe from service tee(s) and install remote control valve(s).
- 2. Install per manufacturer's recommendations where indicated on the drawings.
 - 3. Adjust valve to regulate the downstream operating pressure to 480 kPa (70 psi) for rotor sprinklers, 310 kPa (45 psi) for rotating stream nozzles and 240 kPa (35 psi) for spray sprinklers.
 - 4. Wire connectors and waterproof sealant will be used to connect control wires to solenoid wires. Install connectors and sealant per the manufacturer's recommendations.
 - 5. Install only one remote control valve and decoder to a valve box. Locate valve box 1.5m (5-feet) from and align square with nearby edges of paved areas.
 - 6. Attach ID tag with controller station number to control wiring at solenoid.
 - 7. Brand controller and station number in 50 mm (2-inch) high by 5 mm (3/16-inch) deep letters on valve box lid.
- B. Pop-Up Gear-Driven Rotary Sprinkler Assembly:
- 1. Thoroughly flush lateral pipe before installing sprinkler assembly. Water must be clear of any debris before flushing operation stops.
 - 2. Install per the installation details at locations shown on the drawings.
 - 3. Locate rotary sprinklers 75 mm (3-inches) from adjacent edges of paved areas, walls or fences or as noted on system drawings.

PLANTING IRRIGATION

4. Install sprinklers perpendicular to the finish grade.
5. Install swing joint with the appropriate angle between the lateral pipe and the lay length nipple per the installation details.
6. Supply appropriate nozzle or adjust arc of coverage of each sprinkler for best performance.
7. Adjust the radius of throw of each sprinkler for best performance.
8. Install 600 mm (2-foot) square piece of sod around all rotary sprinklers in areas to be seeded.

C. Pop-Up Spray Sprinkler Assembly:

1. Thoroughly flush lateral pipe before installing sprinkler assembly. Water must be clear of any debris before flushing operation stops.
2. Install per the installation details at locations shown on the drawings.
3. Locate rotary sprinklers 75 mm (3-inches) from adjacent edges of paved areas, walls or fences or as noted on system drawings.
4. Install sprinklers perpendicular to the finish grade.
5. Install swing joint with the appropriate angle between the lateral pipe and the lay length nipple per the installation details.
6. Supply appropriate nozzle or adjust arc of coverage of each sprinkler for best performance.
7. Adjust the radius of throw of each sprinkler for best performance.

D. Sprinkler Heads and Quick Couplers:

1. Shall be placed on temporary nipples extending at least 80 mm (3 inches) above finished grade. After turf is established, remove temporary nipples, ensuring that no dirt or foreign matter enters outlet, and install sprinkler heads and quick couplers at ground surface as detailed.
2. Place part-circle rotary sprinkler heads no more than 150 mm (6 inches) from edge, of and flush with top of adjacent walks, header boards, curbs, and mowing aprons, or paved areas at time of installation.
3. Install all shrub sprays, sprinklers and quick couplers on swing joints as detailed on plans.
4. Set shrub heads 200 mm (8 inches) above grade and 300 mm (1 foot) from edge of curb or pavement. Place adjacent to walls. Stake heads prior to backfilling trenches. Stakes to be parallel to riser.
5. Install sprinklers and quick coupling valves on a swing joint assembly.

PLANTING IRRIGATION

3.8 INSTALLATION OF CONTROL SYSTEM COMPONENTS

A. Control Units:

1. Install control units at location(s) shown in the drawings and as described elsewhere in this section. See related sections.
2. Install electrical connections per control system manufacturer's recommendations and is shown in the drawings.
3. Lightning protection: Drive grounding rod(s) into soil its full length. Furnish and install grounding plate(s) as indicated or as required to create the grounding connection with the field tested resistance value equal to or lower than the specified values identified in this specification. Connect 4mm diameter (#6 AWG) copper grounding wire to rod and plate using CADWELD style connections. Brand "GR" in 50 mm (2-inch) high by 5 mm (3/16-inch) deep letters on valve box lid.
4. Attach wire markers to the ends of control wires inside the controller unit housing. Label wires with the identification number (see drawings) of the remote control valve to which the control wire is connected.
5. Connect control wire to the corresponding control unit terminal.

B. Power Wire:

1. Route power wire as directed on plans. Install with a minimum number of field splices. If a power wire must be spliced, make splice with recommended connector, installed per manufacturer's recommendations. Locate all splices in a separate 300 mm (12-inch) standard valve box. Coil 600 mm (2 feet) of wire in valve box. Brand "WS" in 50 mm (2-inch) high by 5 mm (3/16-inch) deep letters on valve box lid.
2. All power wire shall be laid in trenches. The use of a vibratory plow is not permitted.
3. Green wire shall be used as the common ground wire from power source to all satellites. White shall be the common (neutral) wire. All wiring is to be NEC Code compliant.
4. Carefully backfill around power wire to avoid damage to wire insulation or wire connectors.
5. Unless noted on plans, install wire parallel with and below mainline pipe. Install wire a minimum 50 mm (2-inches) below top of PVC mainline pipe.
6. Encase wire not installed with PVC mainline pipe in electrical conduit with a continuous run of warning tape placed in the

backfill, 200 - 250mm (8-10 inches) below the ground surface, directly over the wiring.

7. Surface mount wire installed above grade in a professional manner with routing approved by the Contracting Officer.
8. Connect wire to power source.

C. Control Wire:

1. Install digital two-wire decoder cable in the same trench as mainline, preferably to the side of mainline below top of pipe in a consistent fashion. Do not wrap wire around mainline or fittings. Separate wire from mainline into separate sleeves one for pipe, one for wire when crossing under hard surfaces.
2. Control wiring may be chiseled into the soil utilizing a vibratory plow device specifically manufactured for pipe pulling and wire installation. Appropriate chisel must be used so that wire is fed into a chute on the chisel, and wire is not subject to pulling tension. Minimum burial depth must equal minimum cover previously listed.
3. Provide a 600 mm (24-inch) excess length of wire in an 200mm (8-inch) diameter loop at each 90 degree change of direction, at both ends of sleeves, and at 30 m (100-foot) intervals along continuous runs of wiring. Do not tie wiring loop. Coil 600mm (24-inch) length of wire within each remote control valve box.
4. If a control wire must be spliced, make splice with wire connectors and waterproof sealant, installed per the manufacturer's instructions. Locate splice in turf areas using a valve box that contains an irrigation valve assembly, or in a separate valve box. Use same procedure for connection to valves as for in-line splices. If a separate valve box is used for wire splices, brand "WS" in 50 mm (2-inch) high by 5 mm (3/16-inch) deep letters on valve box lid.
5. Unless noted on plans, install wire parallel with and below mainline pipe.
6. Protect wire not installed with PVC mainline pipe with a continuous run of warning tape placed in the backfill 150 mm (6-inches) above the wiring.
7. Cap all exposed wire ends with wire nuts.
8. Wiring from server controller to client controllers and stub-cuts for future extension shall be located in trench with new mains or in separate trench at back of curb, unless cross-country route is

shown. Locate in trench with mains when possible on cross-country routes.

9. Wiring located with piping shall be set with top of the bundle below top of the pipe. No two wires in any bundle shall be of the same color.
10. Splicing shall be held to a minimum. When wire is contained in conduit, a pullbox shall be provided at each splice. No splices will be allowed between field located controllers and remote control valves.
11. Provide 300 mm (12 inch) expansion loops in wiring at each wire connection or change in wire direction. Provide 600 mm (24 inch) loop at remote control valves.
12. Power wiring for the operation of irrigation system shall not be run in same conduit as control wiring.

D. Instrumentation:

1. Install per manufacturer's recommendations at location indicated on drawings.
2. Provide electrical connections between central control system hardware and weather station under the advice or direction and observation of central control system manufacturer's authorized personnel.

3.9 TRACER WIRE INSTALLATION

- A. Tracer wire shall be installed on bottom of trench, adjacent to vertical pipe projections, carefully installed to avoid stress from backfilling, and shall be continuous throughout length of pipe with spliced joints soldered and covered with insulation type tape.
- B. Tracer wire shall follow main line pipe and branch lines and terminate in yard box with gate valve controlling these main irrigation lines. Provide sufficient length of wire to reach finish grade, bend back end of wire to make a loop and attach a Dymo-Tape type plastic label with designation "Tracer Wire."
- C. Record locations of tracer wires and their terminations on project record documents.

3.10 INSTALLATION OF OTHER COMPONENTS

- A. Tools and Spare Parts:
 1. Prior to the Review at completion of construction, provide operating keys, servicing tools, spare parts, and any other items indicated on the drawings.

PLANTING IRRIGATION

- B. Other Materials: Install other materials or equipment shown on the drawings or installation details that are part of the irrigation system, even though such items may not have been referenced in these specifications.

3.11 TEST AND FLUSHING

- A. Test irrigation system per procedures listed in section 1.10.
- B. Flushing: After testing, flush system per procedures listed in section 3.7. beginning with larger mains and continuing through smaller mains in sequence. Flush lines before installing sprinkler heads and quick couplers.
- C. Operation Test: Upon completion of the final adjustment of the sprinkler heads to permanent level at ground surface, test each sprinkler section by the pan test and visual test to indicate a uniform distribution within any one sprinkler head area and over the entire area. Operate the entire installation to demonstrate the complete and successful operation of all equipment.

3.12 MAINTENANCE AND OPERATION INSTRUCTIONS

- A. Prior to final acceptance, provide on-site, face-to-face verbal instructions, for a period of not less than 16 hours, to the operating personnel. Provide two additional years of software support for one hour each month in addition to support furnished by the manufacturer. Provide Maintenance and Operating Instructions for the newly installed irrigation equipment in the form of manual(s) as follows:
 - 1. Unless otherwise noted, provide irrigation operation and maintenance information in three (3) copies of a 3-ring binder with table of contents and index sheet. Provide sections that are indexed and labeled. Provide the following information:
 - 2. Catalog cut sheets for control system, valves, sprinklers, pipe and fittings, wire and wire connectors, ID tags, shop drawings, and all other irrigation equipment shown or described on the drawings and within these specifications.
 - 3. Manufacturer's Operation and Maintenance manuals.
 - 4. Manufacturer's Technical Service Bulletins.
 - 5. Manufacturer's Warranty Documentation.
 - 6. Software License Information.
 - 7. All computer central control installation, operation, programming materials, warranty identification information and manufacturer-sponsored technical support contact information.

8. All weather station installation, operation, programming materials, warranty identification information and manufacturer-sponsored technical support contact information.
9. Printed depictions of computer central control program settings, schedule settings and parameters at the time of owner training including color-coded depictions, graphics, tables, charts and other material necessary to efficiently and effectively convey the computer central control system programming and schedule parameters.
10. Recommended routine maintenance inspections for weekly, monthly and annual inspections and recommended actions for the inspections and a recommended method for recording the findings of the inspections.
11. Predictive schedule for component replacement.
12. Listing of technical support contacts.
13. Operation and maintenance submittal package must be complete prior to being reviewed by the COR. Incomplete submittals will be returned without review.
14. Provide clear and distortion-free video and audio taping of the training for the equipment provided for the project. Training shall be produced on DVD or CD, whichever is compatible with the computer system provided for the central computer, where applicable. Training shall be suitable for refresher by the previously trained employees, or for use by new employees to learn the system equipment. Coordinate the final training presentation with the COR in outline form prior to creation, to insure that the format and organization of the content is applicable for the facility staff utilization.

3.13 WINTERIZATION AND SPRING START-UP

- A. Winterize the new irrigation system in accordance with local practices in the first fall after completion of construction of the irrigation system and start up in the spring after completion of construction. Repair any damage caused in improper winterization at no additional cost to the Owner. Coordinate the winterization and start-up with the cemetery landscape maintenance personnel.

3.14 TESTING, OPERATIONAL PERFORMANCE AND ACCEPTANCE

- A. Provide the testing as indicated in previous sections of the specifications.

- B. Demonstrate the operations of the systems as indicated in the project specifications.
- C. Acceptance shall be predicated upon a successful demonstration of the operation of the system(s), as described, or demonstrating a fully functional system in automatic operation for a period of 7 days, whichever is more stringent.

3.15 MAINTENANCE

- A. Operate and maintain the irrigation system for a duration of 30 calendar days after Final Inspection. Make periodic examinations and adjustments to irrigation system components.
- B. Include in the 30 calendar day operation of the system, monitoring and adjustment of pump station performance.
- C. Include in the 30 calendar day operation of the system, monitoring and adjustment of the weather station including computer central control interphase parameters and alarm condition parameters.
- D. Include in the 30 calendar day operation of the system, any and all necessary adjustments, refinements and manipulation of the computer central control programming and scheduling to assure delivery of efficient irrigation events and a healthy landscape with as little water or energy waste as possible.

3.16 SPARE PARTS

- A. Upon completion of the work furnish the Owner the following for his maintenance stock.

3.17 CLEANUP

- A. Upon completion of work, remove from site all machinery, tools, excess materials, and rubbish. Restore site to normal or original condition.

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