

**SECTION 32 84 00**

**PLANTING IRRIGATION**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. This section specifies materials and procedures for furnishing and installing modifications to an existing automatically-controlled irrigation system, and all other appurtenances necessary to irrigate landscape areas indicated on the drawings.

**1.2 RELATED WORK**

- A. Plant materials: Section 32 90 00, PLANTING

**1.3 DEFINITIONS**

- A. Lateral Line Piping: Downstream from control valves to sprinklers, drip tubing and specialties. Piping is under pressure during flow.
- B. Mainline Piping: Downstream from point of connection to water distribution piping to, and including, control valves. Piping is under constant system pressure.
- C. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 volts or for remote-control, signaling power-limited circuits.

**1.4 ABBREVIATIONS**

- A. FPT: Female pipe thread
- B. HDPE: High-density polyethylene plastic
- C. NPT: National pipe thread
- D. PTFE: Polytetrafluoroethylene
- E. PVC: Polyvinyl chloride plastic
- F. WOG: Water, oil and gas

**1.5 PERFORMANCE REQUIREMENTS**

- A. Irrigation zone control shall be under automatic operation with controller and automatic control valves.
- B. Location of sprinklers and specialties on Drawings is approximate. Contractor to make minor adjustments necessary to avoid plantings and obstructions such as signs, utilities and light standards. Provide 100 percent irrigation coverage of areas indicated.
- C. Minimum Working Pressures: The following are minimum pressure requirements for piping unless otherwise indicated.

1. Irrigation Main Piping: 100 psi (640 kPa).
2. Lateral Piping: 80 psi (520 kPa).

#### **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic piping protected from direct sunlight. Support pipe to prevent sagging and bending.

#### **1.7 QUALITY ASSURANCE:**

##### **A. Products Criteria:**

1. When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.
2. A nameplate bearing manufacturer's name or trademark, including model number, shall be securely affixed in a conspicuous place on equipment. In addition, the model number shall be either cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.

##### **B. Installer Qualifications:**

1. Irrigation Contractor must be a licensed landscape contractor in the State of California possessing a current C-27 Landscape Contractor's license.
2. Must have demonstrated, using persons directly employed by the Contractor, experience with the installation of at least five (5) irrigation systems having large diameter gasketed pipe (3-inch and larger), electrically operated remote control valves.

##### **C. Installer Certification:**

1. Installer should be an employer of workers that include a certified irrigation designer qualified by The Irrigation Association Professional Class member of the American Society of Irrigation Consultants; Professional Technical Class member of the American Society of Irrigation Consultants to perform specified work, and have provided irrigation installations for 5 years.
2. Service provider qualifications shall be maintained and/or trained by the manufacturer to render satisfactory service within 8 hours of service request notification.

##### **D. System Requirements:**

1. Layout work as closely as possible to drawings. Drawings are diagrammatic to the extent that offsets and all fittings are not shown. Diagrammatic also refers to the location of the pipelines and valves, which may have been adjusted for clarity of the drawings.
2. Determine the exact location for the assemblies by verifying actual field conditions. The locations shall be staked in the field and coordinated with the Contracting Officer's Representative (COR) before installation. Construction cannot proceed unless staking of irrigation mainline, remote control valve locations, and sprinkler locations are reviewed and accepted by the COR.
3. One hundred (100) percent irrigation coverage of specified areas is required. The Contractor shall, at no additional cost to the Government, make minor adjustments necessary to avoid plantings and obstructions such as signs, utilities and light standards and achieve full and complete coverage of irrigated areas without overspray on roadways, sidewalks, window wells, or buildings and to protect trees from close high spray velocity.
4. Follow manufacturer's printed instructions for installation.
5. Install control wiring inside electrical conduits with pull boxes spaced at 200 to 250 feet on centers.

#### **1.8 SUBMITTALS**

- A. Submit product data as one package for each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories. Highlight items being supplied on the catalog cut sheets
- B. Provide qualification data for:
  1. A qualified irrigation Installer.
- C. 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 must be submitted and approved before charts are prepared.
  2. Provide one controller chart showing the area covered by controller for each automatic controller supplied at the maximum size controller door will allow. Chart shall be a reduced drawing of the actual "as-built" system. 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, inside the controller door.

3. Chart shall be a print with a different color used to show area of coverage for each station. Charts must be completed and approved prior to final inspection of the irrigation system.

#### **1.9 SUBSTITUTIONS**

- A. Unless otherwise noted, use specified equipment to match existing equipment. COR must approve equipment prior to construction. Changes and associated design costs to accommodate alternative equipment are Contractor's responsibility. "As-Built" information shall show the sizes installed.
- B. Pipe sizes referenced in the construction documents are minimum sizes, and may be increased at Contractor's option.

#### **1.10 TESTING**

- A. Notify the COR three 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 must 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 must be measured volumetrically to nearest 10 ml (0.025 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
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 liters (0.82 gallons) per 100 joints of 75 mm (3-inch) diameter pipe
- b. 4.09 liters (1.08 gallons) per 100 joints of 100 mm (4-inch) diameter pipe
- c. 6.13 liters (1.62 gallons) per 100 joints of 150 mm (6-inch) diameter pipe

- d. 8.18 liters (2.16 gallons) per 100 joints of 200 mm (8-inch) diameter pipe
  - e. 10.22 liters (2.70 gallons) per 100 joints of 250 mm (10-inch) diameter pipe
  - f. 12.26 liters (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, fittings, joints, valves, or other appurtenances. Repeat the test until the pipe passes test.
- 6. Cement or caulking to seal leaks is prohibited.
  - 7. Contractor may sub-contract testing to pipeline testing company approved by COR.
- 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 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 satellite controller manually at the controller, automatically from the Central Computer, and via any handheld units. Manual operation on the valves from the bleed valve on the remote control valve is not an acceptable method of activation. 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, fittings, joints, valves, sprinklers, or other appurtenances to correct leakage problems. Cement or caulking to seal leaks is prohibited. Repeat test(s) until each lateral passes all tests. Repeat tests, replace components, and correct deficiencies at no additional cost to the Owner.

#### **1.11 CONSTRUCTION REVIEWS**

- A. The purpose of on-site reviews by the Contracting Officer's Representative (COR) is to periodically observe the work in progress, the Contractor's interpretation of the construction documents, and to address questions with regard to the installation.
  1. Schedule reviews for irrigation system layout or testing with the COR as required by these specifications.
  2. Impromptu reviews may occur at any time during the project.
  3. A Final Inspection will occur at the completion of the irrigation Acceptance Test. The intent of the Final Inspection is to verify that all installation; testing; maintenance and operation submittals; and project record drawing submittals are completed prior to the start of the Maintenance and Warranty periods.

#### **1.12 WARRANTY**

- A. The Contractor shall remedy any defect due to faulty material or workmanship and pay for any damage to other work resulting therefrom within a period of one year from date of final acceptance.
- B. Contractor will provide all manufacturers' and supplier's written guarantees and warranties covering materials and equipment furnished under this Contract.
- C. Make repairs within 24 hours of notification from 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.
- D. Replace damaged items with identical materials and methods per contract documents or applicable codes. Make replacements at no additional cost to the contract price.
- E. 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 and Cemetery Maintenance Contractor. Coordinate temporary shut-down of existing

system with Cemetery Maintenance Contractor prior to construction. Disturbance to cemetery operations must be minimized. See irrigation plans and installation details and Specifications Sections for required coordination efforts related to the installation of specific irrigation components.

- B. Connections to the existing mainline must be approved by the COR while minimizing the impact on the operation of the existing irrigation system.
- C. Install irrigation components in landscaped areas unless specifically indicated otherwise.

#### 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 Society Of Mechanical Engineers (ASME):
- C. 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
  - D1784-08.....Rigid Poly Vinyl Chloride (PVC) Compounds and Chlorinated Poly Vinyl Chloride (CPVC) Compounds
  - D1785-06.....Poly Vinyl Chloride (PVC) Plastic Pipe, Schedule 40, 80, and 120
  - D1894-08.....Standard Test Method for Static and Kinetic Coefficients of Friction of Plastic Film and Sheet
  - D2241-09.....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



D2467-06.....Poly Vinyl Chloride (PVC) Plastic Pipe  
Fittings, Schedule 80

D2564-04(2009)e1.....Solvent Cements for Poly (Vinyl Chloride) (PVC)  
Plastic Piping Systems

D2609-02(2008).....Plastic Insert Fittings for Polyethylene (PE)  
Plastic Pipe

D2683-10.....Socket-Type Polyethylene Fittings for Outside  
Diameter-Controlled Polyethylene Pipe and  
Tubing

D2855-96(2010).....Making Solvent Cemented Joints with Poly (Vinyl  
Chloride) (PVC) Pipe and Fittings

D3139-98 (2005).....Joints for Plastic Pressure Pipes Using  
Flexible Elastomeric Seals

D3350-10 .....Standard Specification for PE Pipe & Fittings  
Materials

F477-08.....Elastomeric Seals (Gaskets) for Joining Plastic  
Pipe

F656-10.....Primers for Use in Solvent Cement Joints of  
Poly Vinyl Chloride (PVC) Plastic Pipe and  
Fittings

C906-07.....Polyethylene (PE) Pressure Pipe and Fittings, 4  
in. (100 mm) Through 63 in. (1600 mm), for  
Water Distribution and Transmission

D. 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  
C509-09.....Resilient-Seated Gate Valves for Water Supply  
Service

E. Manufacturers Standardization Society (MSS):

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

F. National Fire Protection Association (NFPA):

70 2011 Edition.....National Electrical Code

## **PART 2 - PRODUCTS**

### **2.1 PIPES, TUBES AND FITTINGS**

A. Comply with requirements in the piping schedule for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

B. Pipe:

1. Mainline Pipe (3" and larger): Polyvinyl Chloride (PVC) Pressure Pipe, AWWA C900, PVC 1120, minimum working pressure 1025 kPa (150 psi) rubber-gasketed pipe equipped with factory installed reinforced gaskets. Gasketed pipe joints must conform to the "Laboratory Qualifying Tests" section of ASTM D3139.

C. Mainline Pipe (2-1/2" and smaller): ASTM D1785, PVC 1120 compound, Schedules 40 and 80.

1. PVC socket fittings: ASTM D2467, Schedule 80.

2. PVC threaded fittings: ASTM D2464, Schedule 80.

3. PVC socket unions: Both headpiece and tailpiece shall be Schedule 80 PVC with threaded ends.

4. PVC nipples: ASTM D1785, PVC 1120, Schedule 80 PVC with threaded ends, lengths as required.

D. Lateral Pipe: Schedule 40, solvent welded socket type, ASTM D2466.

1. Solvent weld pipe Schedule 40, Type 1, PVC solvent weld fittings conforming to ASTM Standards D2466 and D1784 for PVC pipe.

2. PVC socket fittings shall be ASTM D2466, Schedule 40.

3. PVC socket unions: Both headpiece and tailpiece shall be Schedule 40 PVC with socket or threaded ends.

E. Threaded Pipe:

1. Polyvinyl Chloride, ASTM D1785, PVC 1120, Schedule 80, for threaded connections, risers and swing joints.

F. Swing joints:

1. Pre-assembled threaded fittings with elastomeric seals that allow 360 degree rotation, and designed for minimum 200 psi (1375 kPa) working pressure, may be used in lieu of standard threaded fittings.

G. Fittings:

1. Irrigation Mains [75 mm (3-inch) and larger]:
  - a. 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.
  - b. PVC Pipe: Push-on rubber-gasketed ductile iron fittings with gasketed joints conforming to ASTM A536 and ASTM F477. Acceptable manufacturer for ductile iron fittings is 'Leemco' or approved equal.
2. PVC Irrigation Mains [63.5 mm (2-1/2") and smaller]:
  - a. PVC, Schedule 40, solvent welded socket type, ASTM D2466.
3. Threaded Pipe (For use on Combination Valve assembly):
  - a. Galvanized Steel Dielectric Nipples with PEX liner, 300 PSI, ASTM A53, ANSI B1.20.1 and ASTM F492-95.

## **2.2 PIPE JOINING MATERIALS**

- A. Irrigation Mains [75 mm (3-inch) and larger]: Rubber gaskets, AWWA C111.
- B. Irrigation Mains [63.5 mm (2-1/2-inch) and smaller] and 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, ASTM F656. Solvent cement to conform to ASTM Standard D2564, of type approved by pipe manufacturer.
- C. 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.

## 2.3 PIPE AND FITTING RESTRAINTS

### A. Joint Restraints:

1. Mechanical joints conforming to ANSI A21.10 (AWWA C110) and ANSI A21.11 (AWWA C111) or flanged fittings conforming to ANSI/AWWA C110 and ANSI B16.1 (125#).

### B. Joint Restraint Harness:

1. Provide a joint restraint harness wherever joints are not positively restrained by flanged fittings.
2. Provide a joint restraint harness with transition fittings between metal and PVC pipe.
3. Provide bolts, nuts, retaining clamps, all-thread, or other joint restraint harness materials that are stainless steel. Provide retainer conforming to ASTM A536. Provide high strength, low alloy steel bolts and connecting hardware conforming to ANSI/AWWA C111/A21.11.
4. Acceptable manufacturer is 'Leemco', or approved equal.

### C. Saddle Taps:

1. Tapping saddles for installing remote control valves, quick-couplers, and air and pressure relief valve on 3-inch and larger pressure mainlines. Double stainless steel straps with painted steel saddle. Size as required for application.
2. Acceptable Manufacturer: 'Leemco'; 'Romac'; or approved equal.

## 2.4 VALVES

### A. Underground Shut-Off Valves:

1. Isolation Valves, [75 mm (3-inch) and larger]: Cast-Iron Gate Valves AWWA C-515, resilient-wedge, non-rising stem, ductile-iron body and bonnet, with stainless steel stem and bronze stem nut, and with restrained ends to mechanically attach to a fitting or PVC pipe; minimum Working Pressure: 250 PSI; End Connections: Mechanical joint or Flanged (as required by condition); Interior Coating: 14-16 mil fusion bonded epoxy complying with AWWA C550. Provide "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. Acceptable Manufacturer: 'Leemco'; 'American'; or approved equal.
2. Isolation valves, [63.5 mm (2-1/2 inches) and smaller]: Full-port ball valves with bronze body, PTFE seats, and 90 degree on/off handle. Ball valves to have NPT female end connections.

3. Gate valves [50 mm (2 inches) and smaller]: Bronze or brass body: MSS SP-80, Class 125, Type 1, non-rising stem turning clockwise to close, full-port, bronze or brass body with solid wedge, threaded ends, and brass wheel handle, C200 PSI/13.8 Bar Non-Shock Cold Working Pressure; Size to be same as pipe on which it is installed. Acceptable Manufacturer: 'Nibco'; or approved equal.
4. Valve ends shall accommodate the type of main pipe adjacent to valve.
- B. Combination (Air and Vacuum Release) Valve Assembly:
  1. Continuous acting combination air and vacuum and air release valve; 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 5 PSI to 150 PSI. Acceptable Manufacturer: 'Crispin'; or approved equal.
- C. Remote Control Valve Assembly:
  1. Remote Control Valves shall be globe type of heavy duty construction and shall have manual shut-off and flow control adjustment, equipped with pressure regulating device, and provide for manual and automatic operation.
  2. Heavy-duty Plastic Valves: Straight valve body bonnet shall be reinforced nylon, with trim and renewable seat.
    - a. Install valves with unions on each side to allow for easy removal.
    - b. Valves shall have a minimum of 150 psi (1025 kPa) working pressure.
    - c. Each sprinkler section shall be automatically operated by a remote control valve installed underground and operated by a 24 volt AC electric solenoid.
    - d. Each valve shall be in the specified valve box.
- D. Valves shall be completely serviceable from the top without removing valve body from the system. Valves to operate at no more than 7 psi (50 kPa) pressure loss at manufacturers maximum recommended flow rate.
- E. Valves shall be diaphragm type designed to operate in water containing sand and debris and shall have a self cleaning type contamination filter to filter all water leading to the solenoid actuator and the diaphragm chamber. Valve shall incorporate a non-adjustable type opening and closing speed control for protection against surge pressures.
- F. Valves shall be equipped with manufacturer's pressure regulation module.
- G. Available Manufacturer/Model: Rain Bird PESB-PRS-D. No approved equal.

## **2.5 PRESSURE REGULATING MODULE**

### **A. For Existing Remote Control Valves:**

1. Manufacturer's pressure regulating module used to adjust water pressure downstream of remote control valve. Device shall be capable of being retrofitted onto existing remote control valves of varying sizes.
2. Plastic Remote Control Valves, Manufacturer/Model: Rain Bird, Model PRS-Dial.

## **2.6 QUICK COUPLING VALVE ASSEMBLY:**

### **A. As presented in the installation details.**

1. Brass construction, 1-inch nominal size, operating pressure 35-860 kPa(5-125 psi) with locking non-potable purple rubber or vinyl cover. Acceptable manufacturer and model is 'Rain Bird 44-NP' to match existing equipment or approved equal.
2. Swing Joint: Use pre-manufactured triple swing joint. Quality of manufactured product shall meet or exceed that of products manufactured by Spears, Lasko, or approved equal.
3. Quick Coupler Anchor: Use pre-manufactured bolt on anchor.
4. Valve Box: Use plastic (ABS) 10-inch round valve box with black lid. Product quality shall meet or exceed that of Brooks Products or approved equal.
5. Filter Fabric: Use a spunbond polyester 3.5 oz per square yard landscape fabric.

## **2.7 VALVE BOXES**

- ### **A. Remote Control Valve Assemblies:** Super Jumbo rectangular valve boxes for remote control valves in landscape areas, shall be HDPE structural foam Type A, Class III, black in color. Box shall be minimum 640 mm (25-1/4 inches) long by 400 mm (15-3/4 inches) wide by 387 mm (15-1/4 inches) deep with black "T"-style lid.
1. After installation hot brand into lid of valve boxes in 75 mm (3-inch) high, 1 mm (3/16") deep stencils designating the controller letter and valve station numbers. Numbers shall be placed at center of valve cover and shall face nearest main road or service road.
  2. Available Product: 'Carson-Brooks' Model 1324; or approved equal.
- ### **B. Quick Coupling Valves:** Use plastic HDPE structural foam Type A, Class III, black in color. Box shall be 10-inch round valve box with black

"T"-style lid. Product quality shall meet or exceed that of 'Brooks Products'; or approved equal.

C. Mainline Shut-off Valves:

1. In turf and planter areas valve boxes shall be HDPE structural foam Type A, Class III, black in color. Box shall be minimum 475 mm (19 inches) long by 350 mm (14 inches) deep with black "T"-style lid.
2. Box shall be of such length to be adapted to depth of cover required over pipe at valve location. Set flush with finished grade.

D. Combination Valves:

1. Valve Box: Two (2) Plastic (HDPE) jumbo rectangular valve boxes joined bottom to bottom to form a "clam shell". Box shall be minimum 546 mm (21-1/2 inches) long by 380 mm (15 inches) deep with black "T"-style lid. Acceptable manufacturer is Brooks Products or approved equal. After installation, hot brand into lid of valve boxes with 50 mm (2-inch) high by 5 mm (3/16-inch) deep letters "AV".

E. Valve Box Accessories:

1. Galvanized steel wire mesh fabric; 16 gauge with 1/2-inch openings.
2. Filter Fabric: Spunbond polyester 3.5 oz. per square yard landscape fabric.
3. Support Blocks: precast concrete pavers, or bricks.
4. Drainage Backfill: Clean gravel or crushed stone, graded from 1/4 inch (6 mm) inch minimum to 3/4 inch (19 mm) maximum.
5. Valve I.D. Tags: Standard I.D. tags with hot-stamped black letters on a yellow background designating controller letter and valve station number in 1-inch minimum tall letters; 'Christy' or equal.

## **2.8 SPRINKLER HEADS**

A. Sprinkler heads: Heads to be as indicated on Drawings. The entire internal assembly including filter screen, to be capable of removal from the top without removing the sprinkler case from the riser.

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

1. Full Circle Sprinklers: To be a dual or tri-nozzle combination type with positive drive by means of a gear assembly. Sprinkler head to rotate uniformly and to be driven by means of a train of gears. Sprinklers to be equipped with an integral anti-drain valve to be self-closing at pressures of 3.0 m (10 feet) of head or less. Gears and pinions shall be assembled on stainless steel spindles in a water-lubricated sand-proof gear case. An inlet screen shall prevent debris

from entering the sprinkler and shall be removable with the internal assembly. Sprinklers outer case shall be constructed of corrosion resistant, impact resistant, heavy-duty ABS.

2. Part circle sprinklers to be variable arc type as required with same type drive used for full circle heads

C. Deep Root Watering System (Tree Bubblers):

1. Prefabricated subsurface deep root watering emission device consisting of HDPE swing joint assembly, basket weave PE canister and removable grate available in 102 mm (4-inch) diameter and 914 mm (36-inch) and 457 mm (18-inch) depths, and integrated bubbler nozzle with varying flow rates.
2. Approved Product: Manufacturer: Rain Bird, Model: RWS. See plans for model numbers indicating canister depth and bubbler nozzle flow rates.

## **2.9 LOW VOLTAGE CONTROL VALVE WIRE**

A. Pilot Wire: American Wire Gauge (AWG) #14 solid copper, Type UF, UL listed for direct underground burial. Use for remote control valves.

B. Common wire: American Wire Gauge (AWG) #12 solid copper, Type UF, UL listed for direct underground burial. Use for remote control valves.

C. Construction of UF Wire:

1. Conductor: Solid-annealed, uncoated copper conforming to UL Standard 719, Parts 18-22.
2. Insulation: Polyvinyl chloride, 60°C rated conforming to UL Standard 719, Parts 23-25.
3. Construction Data: UL heavy duty PVC, colored, conforming to UL Standard 44.
4. Manufacturer's Identification: Surface embossed with manufacturer's name, voltage rating, size and type designation.
5. Underwriter's Laboratories Approval: All cables will be tested physically and electrically in accordance with UL Standard 719 and will bear UL labels.

D. Colors: White for common ground wire. Provide easily distinguished colors for other control wires. Spare control wires will be of a color different from that of the active control wire.

## **2.10 WIRE SPLICING MATERIALS**

A. Waterproof Wire Connectors. '3M' DBY or DBR.



## **2.11 ELECTRICAL CONDUIT**

- A. Electrical Conduit and Fittings: High-impact Schedule 40 PVC C-2000 compound, UL approved, gray color, size as required. Solvent-weld fittings.

## **2.12 CONTROL WIRE PULL BOXES**

1. Valve boxes for remote control valves in landscape areas, shall be HDPE structural foam Type A, Class III, black in color. Box shall be minimum 475 mm (19 inches) long by 350 mm (14 inches) deep with black "T"-style lid. After installation, hot brand into lid of valve boxes with 50 mm (2-inch) high by 5 mm (3/16-inch) deep letters "PB".

## **2.13 WARNING TAPE**

1. Standard, 4-Mil polyethylene 76 mm (3 inch) wide tape, detectable type purple with black letters, and imprinted with "CAUTION BURIED IRRIGATION WATER LINE BELOW".

## **2.14 TRACER WIRES**

1. No. 14, Green, Type TW plastic-coated copper tracer wire shall be installed with non-metallic irrigation main lines.

## **2.15 SLEEVE MATERIAL**

- A. ASTM D2241, Schedule 40 PVC, or C-905 sewer pipe.

## **2.16 OTHER COMPONENTS**

- A. Tools and Spare Parts: Provide operating keys, servicing tools, spare parts and other items indicated in the General Notes of the drawings.
- B. Pipe Bedding and Initial Backfill: Clean plaster sand, ASTM C-33.
- C. Other Materials: Provide 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.

## **2.17 CONTROL SYSTEM COMPONENTS**

- A. Exiting automatic central control equipment with field satellites.

# **PART 3 - EXECUTION**

## **3.1 INSPECTIONS AND REVIEWS**

- A. Site Inspections:
1. The Contractor 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 sprinklers in existing burial sections. Use equipment access aisles as identified on the drawings.
- B. Stake out the irrigation system. Items staked include: irrigation mainline pipe, isolation valves, 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 the COR.
- D. Irrigation lines and control wire in cemetery applications shall run at boundaries of graves, through designated utility lanes or beside roadways so that any gravesite may be opened in the future without disruption of the irrigation system.
- E. Irrigation lines and control wire shall run through designated utility lanes or beside roadways where possible.
- F. Connect new system to existing mains.

### **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. Allow a minimum of 80 mm (3 inches) between parallel pipes in the same trench.
- D. Hold pipe securely in place while joint is being made.
- E. 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.

- F. 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.
- G. Install sprinkler lines to avoid electric ducts, storm and sanitary sewer lines, water and gas mains, all of which have right of way.
- H. 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.
- I. 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 conduit when not in common trench with mainline or lateral piping. (distance from top of conduit 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, nor more than 150 mm (6 inches).
- J. Install and maintain safety fencing around all unattended excavation. Place safety signs adjacent to construction area roadway to the satisfaction of the COR.
- K. All excavations must be backfilled by the end of each workday. Do not leave any open trenches overnight, on weekends or on holidays.
- L. 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.
- M. 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.

- N. Enclose pipe and wiring beneath roadways, walks, curbs, and other pavements 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.
- O. 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.
- P. Dress backfilled areas to original grade. Remove excess backfill to on-site location as directed by the COR.
- Q. Where utilities conflict with irrigation trenching and pipe work, contact the COR for trench depth adjustments.
- R. 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.
- S. 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.
- T. Warning tape shall be continuously placed above sprinkler system water mains at a depth of 200-250 mm (8-10 inches) below finish grade.
- U. Survey monuments:
  - 1. Protect markers during construction.
  - 2. If a survey marker is disturbed during construction, the Contractor is responsible for replacing the marker. The Contractor must 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 sleeves 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 edges of pavement with a chisel or saw.
- D. Verify that sleeve sizing is adequate prior to installation. Sleeves shall be twice line size or greater to accommodate retrieval for repair of wiring or piping 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. Maximum 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) Bevel ends of PVC pipe per pipe manufacturer's printed instructions.
  - c) Lubrication of the joint and rubber gasket shall be done in accordance with the pipe manufacturer's specifications.
  - d) 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 printed instructions. 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.

- e) 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 per manufacturer's printed instructions 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. Specialized Pipe and Fittings:

- 1. Mechanical joint connections: Install fittings, fasteners and gaskets per manufacturer's printed instructions 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.
- E. Joint Restraint Harness:
- 1. Install harness per manufacturer's printed instructions and in accordance with accepted industry practices.
  - 2. Use restrained casing spacers for gasketed pipe routed through sleeves. Install harness per manufacturer's printed instructions 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 sleeves. Provide correct number and type of restraints per manufacturer's requirements.

### **3.6 INSTALLATION OF MAINLINE COMPONENTS**

- A. Isolation Valves:
- 1. No valves shall be set under roads, pavement or walks.
  - 2. Clean interior of valves of foreign matter before installation.
  - 3. Set valve box cover flush with finished grade.
  - 4. Install as indicated in the installation details, per manufacturer's printed instructions.
  - 5. Install where indicated on the irrigation plans.
  - 6. 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 manufacturer's instructions.
  - 2. Install where indicated in the irrigation plans at high point(s) along mainline piping.
  - 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's instructions.
  - 2. Install where indicated in the irrigation plans and at ends of mainline runs.
  - 3. Install quick coupling valves on a swing joint assembly.



4. Brand "QC" 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. Locations of remote control valves are schematic. Remote control valves shall be grouped wherever possible and aligned at a set dimension back of curb along roads, and aligned with existing valves.
2. 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).
3. Install per manufacturer's printed instructions and where indicated on the drawings.
4. Adjust valve to regulate the downstream operating pressure to 379 kPa (55 psi) for rotor sprinklers, and 240 kPa (35 psi) for tree bubblers.
5. Wire connectors and waterproof sealant will be used to connect control wires to solenoid wires. Install connectors and sealant per the manufacturer's recommendations.
6. Install only one remote control valve to a valve box. Locate valve box 1.5m (5-feet) from and align square with nearby edges of paved areas.
7. Valve box shall be sized large enough to house all equipment within including ball valve and unions with sufficient clearances to allow removal of the valve

8. Attach ID tag with controller station number to control wiring at solenoid.
9. 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 150 mm (6-inches) from adjacent edges of planting beds, paved areas, walls or fences.
4. 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.
5. Install sprinklers perpendicular to the finish grade.
6. Install sprinklers on a swing joint assembly. Install swing joint with the appropriate angle between the lateral pipe and the lay length nipple per the installation details.
7. Supply appropriate nozzle or adjust arc of coverage of each sprinkler for best performance.
8. Adjust the radius of throw of each sprinkler for best performance.
9. Install 600 mm (2-foot) square piece of sod around all rotary sprinklers in areas to be seeded.

C. Deep Root Watering System 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 and per the manufacturer's printed instructions.
3. Locate root watering system at edges of planting pit excavation on opposite sides of the plant.
4. Install plumb and flush with finish grade.
5. Fill mesh tubing with pea gravel.

### **3.8 VALVE BOX INSTALLATION**

1. As presented in the installation details, per manufacturer's instructions.

2. Install flush with finish grade in to 1/2 inch above finish grade in lawns areas; and 1 inch above finish grade in mulched areas.

### **3.9 CONTROL WIRE INSTALLATION**

- A. Provide 12 inch (300 mm) expansion coils in wiring at each wire connection or change in wire direction. Provide 24 inch (600 mm) loop at remote control valves. Create coil by wrapping 24 inch (600 mm) length of wire around 1-inch (25 mm) diameter pipe.
- B. Run spare control wires into each valve box along mainline. Provide 24 inches (600 mm) coil of wire inside each valve box.
- C. Use water-proof wire connectors for wire connections.

### **3.10 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.

### **3.11 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.
- 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.

### **3.12 TESTING AND FLUSHING**

- A. Testing: Test irrigation system per procedures listed in article 1.10 "TESTING".
- B. Flushing: After testing, flush system per procedures listed in article 3.7. "INSTALLATION OF SPRINKLER IRRIGATION COMPONENTS AND QUICK COUPLERS", beginning with larger mains and continuing through smaller

mains in sequence. Flush lines before installing, valves, 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.

### **3.13 MAINTENANCE AND OPERATION INSTRUCTIONS**

- A. Maintenance and Operating Instructions: Provide Maintenance and Operating Instructions for the provided irrigation system in the form of manual(s) as follows:

1. Unless otherwise noted, provide irrigation operation and maintenance information in a 3-ring binder with table of contents and index sheet. Provide sections that are indexed and labeled. Provide the following information:
2. Manufacturer's Operation and Maintenance manuals.
3. Manufacturer's Technical Service Bulletins.
4. Manufacturer's Warranty Documentation.
5. Software License Information.
6. Operation and maintenance submittal package must be complete prior to being reviewed by the COR. Incomplete submittals will be returned without review.

### **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 systems, as described, or demonstrating a fully functional system in automatic operation for a period of 7 days, whichever is more stringent.

### **3.15 ADJUSTMENTS**

- A. Provide COR and cemetery maintenance staff with a written irrigation schedule to establish new plants throughout the planting maintenance period. Oversee adjusting of controller(s) settings and provide written

statement to COR that irrigation controller has been scheduled per Contractor's written instructions.

- B. Adjust automatic control valves to provide flow rate at rated operating pressure required for each sprinkler circuit.
- C. Adjust sprinklers and devices, so they will be flush with, or not more than 1/2 inch (13 mm) above, finish grade.
- D. Adjust sprinkler radius and arcs to minimize overspray onto structures and pavement.

### **3.16 CLEANUP**

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

- - - E N D - - -

**SECTION 32 90 00**

**PLANTING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

- A. The work in this section consists of furnishing and installing plants, landscape edging, root barriers, tree stakes, sod repair, decorative mulches and other landscape materials required as specified in locations shown.
- B. Additive Alternate work in this section consists of furnishing and installing soil preparation and fine grading for turf; seeding turf and topdressing with fiber mulch; and metal edging as a substitute for divot cut edging.

**1.2 RELATED WORK**

- A. Section 32 84 00, PLANTING IRRIGATION.

**1.3 DEFINITIONS**

- A. Backfill: The earth used to replace earth in an excavation.
- B. Balled and Burlapped Stock: ANSI Z60.1. Plants dug with firm, natural balls of earth in which they were grown, with ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball.
- C. Balled and Potted Stock: ANSI Z60.1. Plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required.
- D. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.
- E. Fabric Bag-Grown Stock: Healthy, vigorous, well-rooted plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is

not less than diameter, depth, and volume required by ANSI Z60.1 for type and size of plant.

- F. Finish Grade: Elevation of finished surface of planting soil.
- G. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- H. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- I. Planting Area: Any area to be planted with trees, shrubs, vines, groundcovers, or turf (seed and/or sod.)
- J. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
- K. Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, turf and grasses, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.
- L. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.
- M. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.
- N. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

#### **1.4 ABBREVIATIONS**

- A. TYP.: Typical.
- B. MIN.: Minimum
- C. MAX.: Maximum

#### **1.5 DELIVERY, STORAGE AND HANDLING**

- A. Notify the Contracting Officer's Representative (COR) of the delivery schedule in advance so the plant material may be inspected upon arrival at the job site. Remove unacceptable plant and landscape materials from the job site immediately.

B. Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws, as applicable. Keep seed and other packaged materials in dry storage away from contaminants.

C. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants. Keep bulk materials in dry storage away from contaminants.
2. Provide erosion control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk fertilizers, gypsum, and soil amendments, and rock mulches with appropriate certificates.

D. Do not prune trees before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

E. Handle planting stock by root ball.

F. The use of equipment such as "tree spades" is permitted provided the plant balls are sized in accordance with ANSI Z60.1 and tops are protected from damage.

G. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than 6 hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.

1. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
2. Do not remove container-grown stock from containers before time of planting.
3. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly-wet, condition.



- H. Harvest, deliver, store, and handle sod per requirements in TPI's "Guideline Specifications to Turfgrass Sodding". Deliver sod in time for planting within 24 hours of harvesting. Protect sod from breakage, seed contamination and drying.
- I. All pesticides and herbicides shall be properly labeled and registered with the U.S. Department of Agriculture. Deliver materials in original, unopened containers showing, certified analysis, name and address of manufacturer, product label, manufacturer's application instructions specific to the project and indication of conformance with state and federal laws, as applicable.

#### **1.6 PROJECT CONDITIONS**

- A. Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.
- B. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion. Plant during one of the following periods:
  - 1. Spring Planting: April 1 to June 1.
  - 2. Fall Planting: September 1 to November 1.
- C. Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions per manufacturer's written instructions and warranty requirements.
- D. Plant trees after finish grades are established and before planting turf areas unless otherwise indicated.
  - 1. When planting trees after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.
- E. Plant trees after finish grades and irrigation system components are established, but not before irrigation system components are installed, tested and approved.
  - 1. When planting trees protect irrigation system components and promptly repair damage caused by planting operations.

#### **1.7 QUALITY ASSURANCE:**

- A. Products Criteria:

1. When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.
  2. A nameplate bearing manufacturer's name or trademark, including model number, shall be securely affixed in a conspicuous place on equipment. In addition, the model number shall be cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.
- B. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of plants.
1. Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association with 5 years experience in landscape installation.
  2. Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
  3. Installer's field supervisor shall have certification in one of the following categories from the Professional Landcare Network and submit one copy of certificate to the Contracting Officer's Representative:
    - a. Certified Landscape Technician (CLT) - Exterior, with installation, maintenance, irrigation, designated CLT-Exterior.
    - b. Certified Ornamental Landscape Professional designated COLP.
  4. Pesticide Applicator: Licensed in state of project, commercial.
- C. A qualified Arborist shall be licensed and required to submit one copy of license to the Contracting Officer's Representative.
- D. Include an independent or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.
- E. For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ratio; deleterious material; pH; and mineral and plant-nutrient content of the soil.
1. Testing methods and written recommendations shall comply with USDA's Handbook No. 60, "Diagnosis and Improvement of Saline and Alkali Soils".

2. The soil-testing laboratory shall oversee soil sampling; with depth, location, and number of samples to be taken per instructions from Contracting Officer's Representative. A minimum of 3 representative samples shall be taken from varied locations for each soil to be used or amended for planting purposes.
3. Report suitability of tested soil for plant growth.
  - a. Based upon the test results, state recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1000 sq. ft. (92.9 sq. m) or volume per cu. yd. (0.76 cu. m) for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
  - b. Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problem materials are present, provide additional recommendations for corrective action.
- F. Provide quality, size, genus, species, variety and sources of plants indicated, complying with applicable requirements in ANSI Z60.1.
- G. Measure according to ANSI Z60.1. Do not prune to obtain required sizes.
  1. Measure trees with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container grown stock. Measure main body of tree for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches (150 mm) above the root flare for trees up to 4-inch (100 mm) caliper size, and 12 inches (300 mm) above the root flare for larger sizes.
  2. Measure other plants with stems, petioles, and foliage in their normal position.
- H. Contracting Officer's Representative may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Contracting Officer's Representative retains right to observe trees further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees immediately from Project site.

1. Notify Contracting Officer's Representative of plant material sources 14 days in advance of delivery to site.
- I. Include product label and manufacturer's literature and data for pesticides and herbicides.
- J. Conduct a pre-installation conference at Project site.

#### **1.8 SUBMITTALS**

- A. Submit product data for each type of product indicated, including soils:
  1. Include quantities, sizes, quality, and sources for plant materials.
  2. Include EPA approved product label, MSDS (Material Safety Data Sheet) and manufacturer's application instructions specific to the Project.
  3. Include color photographs in digital format of each required species and size of plant material as it will be furnished to the Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. For species where more than 20 plants are required, include a minimum of 3 photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.
- B. Submit samples and manufacturer's literature for each of the following for approval before work is started.
  1. Mineral Mulch: 1 quart (1-liter) volume of each mineral mulch required; in sealed plastic bags labeled with product description, product name, and source(s) of rock. Each Sample shall be typical of the lot of material to be delivered and installed on the site; and provide an accurate indication of rock sizes, color, and texture.
  2. Organic and Compost Mulch: 1 quart (1-liter) volume of each organic and compost mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.
  3. Root Barrier: Submit one (1) standard width root barrier panel in depth indicated and accessories.
  4. Weed Control Fabric: 12 by 12 inches (300mm by 300mm).
  5. Tree Wrap: Width of panel by 12 inches (300 mm).

- C. Qualification data for qualified landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.
- D. Prior to delivery, provide notarized certificates attesting that each type of manufactured product, from the manufacturer, meet the requirements specified and shall be submitted to the Contracting Officer's Representative for approval:
  - 1. Plant Materials (Department of Agriculture certification by State Nursery Inspector declaring material to be free from insects and disease).
  - 2. Manufacturer's certified analysis of standard products.
  - 3. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.
- E. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before start of required maintenance periods.

#### **1.9 PLANT AND TURF ESTABLISHMENT PERIOD**

- A. The establishment period for plants and turf shall begin immediately after installation, with the approval of the Contracting Officer's Representative, and continue until the date that the Government accepts the project or phase for beneficial use and occupancy. During the Establishment Period the Contractor shall maintain the plants and turf as required in Part 3.

#### **1.10 PLANT AND TURF MAINTENANCE SERVICE**

- A. Provide initial maintenance service for trees and turf by skilled employees of landscape Installer. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established but for not less than maintenance period below.
  - 1. Tree Maintenance Period: 90 calendar days from date of Substantial Completion.
  - 2. Turf Maintenance Period: 90 calendar days from date of Substantial Completion.
    - a. Lawn Establishment: If lawns are not established before the dormant period (November 15<sup>th</sup> to March 1<sup>st</sup>), maintain for a period

of 60 calendar days minimum after the dormant period and until  
Final Acceptance.

#### **1.11 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 basic  
designation only.

B. American National Standards Institute (ANSI):

Z60.1-04.....Nursery Stock

C. Association of Official Seed Analysts (AOSA): Rules for Testing Seed.

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

C136-06.....Sieve Analysis of Fine and Coarse Aggregates

C602-07.....Agricultural Liming Materials

D5268-07.....Topsoil Used for Landscaping Purposes

E. Hortus Third: A Concise Dictionary of Plants Cultivated in the United  
States and Canada.

F. Turfgrass Producers International (TPI): Guideline Specifications to  
Turfgrass Sodding.

G. United States Department of Agriculture (USDA): Handbook No. 60  
Diagnosis and Improvement of Saline and Alkali Soils; Federal Seed Act  
Regulations.

H. National Cemetery Administration (NCA):

Handbook 3420-08.....Turfgrass Maintenance

Appendix TL-08.....Cemetery Construction Requirements for  
Turfgrass and Landscape Plant Material  
Installation

#### **1.12 WARRANTY**

A. The Contractor shall remedy any defect due to faulty material or  
workmanship and pay for any damage to other work resulting therefrom  
within a period of one year from final acceptance, unless noted  
otherwise below. Further, the Contractor will provide all manufacturer's  
and supplier's written guarantees and warranties covering materials and  
equipment furnished under this Contract.

1. Plant and Turf Warranty Periods will begin from the date of Government acceptance of the project or phase for beneficial use and occupancy.
  - a. Trees: 12 months.
  - b. Turf: 12 months.
2. The Contractor shall have completed, located, and installed all plants and turf according to the plans and specifications. All plants and turf are expected to be living and in a healthy condition at the time of final inspection.
3. The Contractor will replace any dead plant material and any areas void of turf immediately, unless required to plant in the succeeding planting season. Provide extended warranty for period equal to original warranty period for replacement plant materials. Replacement plant and turf warranty will begin on the day the work is completed.
4. The Government will reinspect all plants and turf at the end of the Warranty Period. The Contractor will replace any dead, missing, or defective plant material and turf immediately. The Warranty Period will end on the date of this inspection provided the Contractor has complied with the warranty work required by this specification. The Contractor shall also comply with the following requirements:
  - a. Replace plants that are more than 25 percent dead, missing or defective plant material prior to final inspection.
  - b. A limit of one replacement for each plant will be required except for losses or replacements due to failure to comply with requirements.
  - c. Mulch and weed plant beds and saucers. Just prior to final inspection, treat these areas to a second application of approved pre-emergent herbicide.
  - d. Complete remedial measures directed by the Contracting Officer's Representative to ensure plant and turf survival.
  - e. Repair damage caused while making plant or turf replacements.
- B. Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
  1. Failures include, but are not limited to, the following:

- a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner, or incidents that are beyond Contractor's control.
- b. Structural failures including plantings falling or blowing over.
- c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

## **PART 2 - PRODUCTS**

### **2.1 PLANT MATERIAL**

- A. Plant and turf materials: ANSI Z60.1; will conform to the varieties specified and be true to botanical name as listed in Hortus Third; nursery-grown plants and turf material true to genus, species, variety, cultivar, stem form, shearing, and other features indicated on Drawings; healthy, normal and unbroken root systems developed by transplanting or root pruning; well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf; free of disease, pests, eggs, larvae, and defects such as knots, sun scald, windburn, injuries, abrasions, and disfigurement.
- 1. Trees-deciduous and evergreen: Single trunked with a single leader, unless otherwise indicated; symmetrically developed deciduous trees of uniform habit of growth; straight boles or stems; free from objectionable disfigurements; evergreen trees with well-developed symmetrical tops, with typical spread of branches for each species or variety. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch (19 mm) in diameter; or with stem girdling roots will be rejected.
  - 2. Provide plants well established in removable containers, integral containers, or formed homogeneous soil sections. Plants shall have been grown under climatic conditions similar to those in the locality of the project. Spray all plants budding into leaf or having soft growth with an anti-desiccant at the nursery before digging.
  - 3. The minimum acceptable sizes of all plants, measured before pruning with branches in normal position, shall conform to the measurements designated. Plants larger in size than specified may be used with the approval of the Contracting Officer's Representative, with no change



in the contract price. When larger plants are used, increase the ball of earth or spread of roots in accordance with ANSI Z60.1.

4. Provide nursery grown plant material conforming to the requirements and recommendations of ANSI Z60.1. Dig and prepare plants for shipment in a manner that will not cause damage to branches, shape, and future development after planting.
  5. Balled and burlapped (B&B) plant ball sizes and ratios will conform to ANSI Z60.1, consisting of firm, natural balls of soil wrapped firmly with burlap or strong cloth and tied.
  6. Container grown plants shall have sufficient root growth to hold the earth intact when removed from containers, but shall not be root bound.
  7. Make substitutions only when a plant (or alternates as specified) is not obtainable and the Contracting Officer's Representative authorizes a change order providing for use of the nearest equivalent obtainable size or variety of plant with the same essential characteristics and an equitable adjustment of the contract price.
  8. Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.
- B. Label each plant of each variety, size, and caliper with a securely attached, waterproof and weather-resistant label bearing legible the correct designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant as indicated in the Plant Schedule or Plant Legend shown on the Drawings. Labels shall be securely attached and not be removed.

## **2.2 INORGANIC SOIL AMENDMENTS**

- A. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent sulfur, with a minimum of 99 percent passing through No. 6 (3.35 mm) sieve and a maximum of 10 percent passing through No. 40 (0.425 mm) sieve.
- B. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
- C. Aluminum Sulfate: Commercial grade, unadulterated.
- D. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through No. 50 (0.30 mm) sieve.

E. Coarse Sand shall be concrete sand, ASTM C33 Fine Aggregate, clean, sharp free of limestone, shale and slate particles, and toxic materials.

## **2.3 ORGANIC SOIL AMENDMENTS**

A. Organic matter: Commercially prepared compost. Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1/2 inch (13 mm) sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

1. Tested, at minimum, every six months for noxious weeds.
2. Organic matter source (feedstock): Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.
3. Organic Matter Content: 50 to 65 percent of dry weight as determined by ash method.
4. Moisture Content: 30 to 60 percent by weight
5. Free of refuse (less than 1 percent by dry weight), plastics, contaminants or any material toxic to plant growth.
6. Processed to meet U.S. Composting Council's Seal of Testing Assurance Program, or equivalent.
7. Stability: Carbon dioxide evolution rate is less than 8 mg CO<sub>2</sub>-C per g OM per day.
8. Maturity (Bioassay): Seed emergence and seedling vigor is a minimum of 80 per cent relative to positive control.
9. Composted for a minimum of 9 months and reach a monitored temperature of 140 degrees Fahrenheit for at least one week.

B. Wood derivatives: Decomposed, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil, or toxic materials.

## **2.4 PLANT AND TURF FERTILIZERS**

A. Soil Test: Evaluate existing soil conditions and requirements prior to fertilizer selection and application to minimize the use of all fertilizers and chemical products. Obtain approval of Contracting Officer's Representative for allowable products, product alternatives, scheduling and application procedures. Evaluate existing weather and site conditions prior to application. Apply products during favorable weather and site conditions per manufacturer's written instructions and

warranty requirements. Fertilizers to be registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer applicable to specific areas as required for Project conditions and application. Provide commercial grade plant and turf fertilizers, free flowing, uniform in composition and conforms to applicable state and federal regulations.

B. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition shall be nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

C. Slow-Release Fertilizer: Granular or pellet fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition shall be nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

D. Plant Tablets: Tightly compressed chip type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.

1. Size: 21-gram tablets.

2. Nutrient Composition shall be 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.

## **2.5 PLANTING SOILS**

A. Planting Soil: ASTM D5268 topsoil, with pH range of 6.5 to 7.5; 4 to 10 percent organic material content; free of stones 1 inch (25 mm) or larger in any dimension and other extraneous materials harmful to plant growth. Mix topsoil with the soil amendments and fertilizers as recommended by the soils analysis. (See Attachment C of the Statement of Work.)

B. Existing Planting Soil: Existing, native surface topsoil formed under natural conditions retained during excavation process and stockpiled on-site. Verify suitability of native surface topsoil to produce viable planting soil. Clean soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.

1. Supplement with planting soil when quantities are insufficient.

2. Mix existing, native surface topsoil with soil amendments and fertilizers as recommended by the soils analysis.

C. Imported Planting Soil: Imported topsoil or manufactured topsoil from off-site sources can be used if sufficient topsoil is not available on site to meet the depth as specified herein. The Contractor shall furnish imported topsoil. At least 10 days prior to topsoil delivery, notify the Contracting Officer's Representative of the source(s) from which topsoil is to be furnished. Obtain imported topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches (100 mm) deep; do not obtain from agricultural land, bogs, or marshes.

## **2.6 BIOSTIMULANTS**

A. Mycorrhizae: Endomycorrhizal granules inoculum consisting of the following 4 species blend of propagules of arbuscular mycorrhizal fungi: Glomus intraradices, Glomus mosseae, Glomus aggregatum, and Glomus etunicatum. Minimum 100,000 spores/propagules per pound.

B. Available Products: 'MycoApply Endo' by Mycorrhizal Applications, Inc.; 'Endo Granular' by Mycorrhizal Products.com; or equal.

## **2.7 WEED-CONTROL BARRIERS**

A. Composite Fabric: Woven, needle-punched polypropylene substrate bonded to a nonwoven polypropylene fabric, 4.8 oz./sq. yd. (162 g/sq. m), and a 950 liter per minute flow rate per sq. meter. (90 gal. per minute flow rate per sq. ft.), composed of fibers formed into a stable network so that fibers retain their relative position. Fabric shall be inert to biological degradation and resist naturally-encountered chemicals, alkalis, and acids.

## **2.8 MULCH**

A. Mineral Mulch: Hard, durable stone, washed free of loam, sand, clay, and other foreign substances, of following type, size range, and color:

1. Decorative Gravel Mulch: 3/4 inch (19 mm) maximum, 1/4 inch (6.4 mm) minimum; Crushed rock from granitic sources; Color: gold. Mulch shall be placed within tree rows within cemetery burial sections as indicated in the Drawings.
  - a. 'California Gold' as available from Southwest Boulder & Stone (Tel.: 877.792.7625); or approved equal.
2. Cobble Mulch: 4" to 8" River cobble; Colors: mixture of grays and tans. Mulch shall be placed on the bank and up to road curb between

existing headwall and decorative gravel mulch as indicated. Provide weed control fabric under the cobble mulch.

B. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees, consisting of one of the following:

1. Type: Shredded hardwood; Ground or shredded bark; or Wood and bark chips.
2. Size Range shall be 1 inch (25 mm) maximum, 1/2 inch (13 mm) minimum.
3. Color shall be natural to match existing used on the cemetery.

C. Dry Applied Mulch (**Additive Alternate #2**)

1. Pelletized wood fiber mulch which secures soil binding upon wetting, the mulch granules expand and release tackifier to bind soil particles, increase water infiltration/retention and reduce sediment loss.
2. Available Product: Profile 'CoverGrow'.

## **2.9 COMPOST**

A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1 inch (25 mm) sieve; soluble salt content of 2 to 5 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

1. Organic Matter Content: 50 to 60 percent of dry weight.
2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.

## **2.10 TREE WRAP**

- A. Crinkle paper tree wrap: Two thicknesses of crinkled paper cemented together with a layer of bituminous material. Minimum of 4 inches (100 mm) wide with a stretch factor of 33 1/3 percent. Twine for tying shall be lightly tarred medium or coarse sisal yarn.
- B. Breathable synthetic fabric tree wrap: White in color, delivered in 3 inch (75 mm) wide rolls. Material shall be specifically manufactured for tree wrapping.
- C. Tape: bio-degradable tape suitable for nursery use degrades in sunlight a maximum 2 years after installation.

## **2.11 ROOT BARRIER**

- A. Root intrusion prevention panels for linear applications. Each panel includes joining mechanism for easy assembly; raised 90 degree molded root deflecting ribs; 1/2 inch (1.2 cm) ground lock tabs to prevent

lifting by tree; and double top edge for strength, safety, straight edge appearance, and root overgrowth protection. Panel dimensions shall be 24 inches height x 24 inches width (61 cm x 61 cm).

B. Materials and Manufacturing Process: Copolymer Polypropylene of 0.080 inch (2.032 mm) thickness; 75 percent reprocessed polypropylene; Injection molded; ISO 9002 certified; Tensile stress @ yield ASTM D638 3800 PSI (26,200 kPa or kN/m<sup>2</sup>); Elongation @ yield ASTM D638 6.3%; Flexural Modulus ASTM D790B 155,000 PSI (1,068,687 kPa or kN/m<sup>2</sup>).

C. Available Product: 'DeepRoot' Root Barrier, Model UB 24-2; or approved equal.

#### **2.12 TREE STAKES (GOVERNMENT-PROVIDED/CONTRACTOR-INSTALLED)**

A. Proprietary Devices: Proprietary stabilization system to secure each new planting by the trunk; sized as indicated and per manufacturer's written recommendations.

B. Products: Subject to compliance with requirements, provide the following: a screw in auger-type steel stake with an adjustable anti-rotational coupler and "L" bar, adjustable height strap-bar, UV-resistant adjustable vinyl strap with 2 bolts/washers/nuts, and powder-coated dark green.

##### **1. Stake Sizes:**

- a. 7 foot, 3/4 inch diameter, Schedule 40 for 15 gallon trees (less than 7 feet tall).
- b. 9 foot, 3/4 inch diameter, Schedule 40, for 15 gallon trees (taller than 7 feet) and 24-inch box trees.

2. Strap Bar: 3/8 inch by 12 inches and 18-inch flat bar with flexible PVC strap and hardware.

3. Anti-Rotational Device: Steel "L" bar.

2. Available Products: 'Reddy Stake' R2 Stake System for 7 and 9 foot stakes, as manufactured by J.R. Partners, (888) 333-3090; no known equal.

#### **2.13 WATER**

A. Water shall not contain elements toxic to plant life. Water to be obtained from Government at no cost to the Contractor.

#### **2.14 ANTIDESICCANT**

A. Antidesiccant: An emulsion specifically manufactured for agricultural use that will provide a protective film over plant surfaces permeable enough to permit transpiration.

## **2.15 TURF SELECTIONS**

- A. Grasses for Cool Regions shall be:
  - 1. Fescue: Tall (*Festuca arundinacea*)
  - 2. Bluegrasses: Kentucky (*Poa pratensis*).
  - 3. Ryegrasses: Perennial (*Lolium perenne*)
- B. All cemetery turf sod compositions shall conform to the species and cultivar requirements detailed in the "Appendix T/L for NCA Cemetery Construction Requirements". Any deviation from the turf species requirements must receive written approval by the NCA Chief Agronomist and appropriate MSN Agronomist in coordination with the Contracting Officer's Representative.

## **2.16 SOD (FOR TRENCH REPAIR IN EXISTING TURF)**

- A. Sod: Sod shall be produced from Blue Tag certified seed and State of California certified, including limitations on thatch, weeds, diseases, nematodes, and insects, complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding". Furnish viable sod of uniform density, color, and texture, strongly rooted, and capable of vigorous growth and development when planted.
- B. Sod Species: The composition of the grass species in the sod shall be a mix of 80% Tall Fescue; 10% Perennial Ryegrass; 10% Kentucky Bluegrass. The fescue shall be a blend of at least 3 regionally adapted cultivars.

## **2.17 SEED (ADDITIVE ALTERNATE #2)**

- A. Grass Seed: State-certified seed of latest season's crop delivered in original sealed packages, bearing producer's guaranteed analysis for percentages of mixtures, purity, germination, weed seed content, and inert material. Label in conformance with AMS Seed Act and applicable state seed laws. Wet, moldy, or otherwise damaged seed will not be acceptable. Field mixes will be acceptable when field mix is performed on site in presence of Contracting Officer's Representative.
- B. Seed Mixtures: Proportion seed mixtures by weight.
  - 1. Spring/Fall Seeding (March-May)/(September-October): Seed shall be a mix of 80% Tall Fescue; 10% Perennial Ryegrass; and 10% Kentucky Bluegrass. The fescue shall be a blend of at least 3 regionally adapted cultivars.
  - 2. Winter Seeding (November-February): Seed shall be mix of 50% Transitional Ryegrass (*Lolium hybridum*); 40% Tall Fescue and 10%

Kentucky Bluegrass. Available Transitional Ryegrass Product:  
'Transfix' Intermediate Ryegrass.

3. Summer Seeding (June-September) Seed shall be a mix of 90% Tall Fescue; and 10% Kentucky Bluegrass. The fescue shall be a blend of at least 3 regionally adapted cultivars.

#### **2.18 PESTICIDES**

- A. Consider IPM (Integrated Pest Management) practices to minimize the use of all pesticides and chemical products. Obtain approval of Chief Engineer for allowable products, product alternatives, scheduling and application procedures. Evaluate existing weather and site conditions prior to application. Apply products during favorable weather and site conditions according to manufacturer's written instructions and warranty requirements. Pesticides to be registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
- B. Pre-Emergent Herbicide (Selective and Non-Selective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
  1. Granular ornamental Pre-emergent herbicide containing 2.0 percent trifluralin and 0.5 percent isoxaben. Apply herbicide at 90 kg/hectare (200 lbs./acre).
- C. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

#### **2.19 TREE AERATION TUBES**

- A. 18" long x 3" diameter porous HDPE tube with 1,500 + sidewall openings. The top is engineered to allow continuous air convection (exchange) and water transfer from the surface to the tube to hydrate and aerate the plant. The tubes are able to accommodate third-party irrigation connections. The sidewall openings are engineered to minimize any soil entry.
- B. Available Product: ROOTWELL PRO-318; or approved equal.

#### **2.20 EDGING**

- B. **(BASE BID):** Machine-Cut Divot Edging: Edge plant beds with an excavated 'V' cut to provide clear division between plant bed/non-turf area and adjacent turf.



- C. **(ADDITIVE ALTERNATE #3)** Steel Edging: Commercial-grade steel product, in standard lengths, with steel loops for installation with stakes.
1. Edging Size: 6.4 mm (1/4 inch) thick by 152 mm (6 inches) deep.
  2. Stakes: Steel to match edging, tapered, minimum 380 mm (15 inches) long.
  3. Accessories: End pieces, end stakes, corner stakes, and splicing stakes.
  4. Finish: Painted.
  5. Paint Color: Black.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine areas to receive plants for compliance with requirements and conditions affecting installation and performance.
1. Verify that no materials that would inhibit plant growth are present in planting area. If such materials are present, remove soil and contaminants as directed by Contracting Officer's Representative and provide new planting soil.
  2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
  3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
  4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.
  5. Special conditions may exist that warrant a variance in the specified planting dates or conditions. Submit a written request to the Contracting Officer's Representative stating the special conditions and proposal variance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.

- B. Install erosion control measures to prevent erosion or displacement of soils and discharge of soil bearing water runoff or airborne dust to adjacent properties and walkways.
- C. Stake out planter bed outlines and individual tree locations on project site before digging plant pits. Obtain the Contracting Officer's Representative's approval of layout before excavating or planting. The Contracting Officer's Representative may direct adjustments to plant material locations to meet field conditions.
- D. Rotate plants so that the side with largest mass of vegetation faces into the strong summer westerly winds.
- E. Plants shall be set plumb to slightly leaning (2 degrees from plumb) into the westerly winds. In no case shall plants lean in the downwind direction.
- F. Apply anti-desiccant to trees using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.
  - 1. If deciduous trees are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.
- G. Wrap trees with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.

### **3.3 SOIL PREPARATION**

- A. Existing weeds and gravel shall be removed.
- B. Spread planting soil to depths required to meet finish grades after natural settlement.
  - 1. Import approved topsoil to backfill behind curbs and fill depressions as needed. Obtain approved topsoil from Cemetery spoils yard as directed by the COR.
  - 2. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
- C. Loosen subgrade of planting areas to a minimum depth of 200 mm (8 inches).
  - 1. Apply soil amendments and fertilizer per the recommendations of the attached soils report for the adjacent Section 9. (See Attachment C.) Spread amendments on the soil surface, and thoroughly incorporate into the top 8 inches of the soil.

- a. Mix soil amendments (i.e., compost, soil inoculum, and gypsum) with dry soil before mixing fertilizer.
  - b. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
2. Regardless of the recommendations of the soils report, spread 3 cubic yards of compost per 1000 square feet and thoroughly incorporate into the top 8 inches of the soil.

### **3.4 FINISH GRADING**

- A. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades. Grade to within plus or minus 1/2 inch (13 mm) of finish elevation. Area will be graded and compacted to provide a smooth and flowing transition through uneven terrain and to avoid any appearance of layering of soil. Grades shall conform to existing elevations to provide a smooth transition at curbs, trees, planters and uninterrupted drainage flow into existing drains, and to prevent any "scalping" of future turfgrass when mowed. Finish grades shall be 1-inch below top of curbs.
- B. Compact the soil to 85 percent relative density in accordance with ASTM D 698. The finished seed/sod bed must be fine in texture and firmly compacted and free of any plant or other debris greater than 1/2 inches. All irregularities in the finished surface shall be corrected to eliminate depressions and high spots.
- C. Remove stones larger than 1/2 inch (12 mm) in any dimension, gravel, sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Government's property.
- D. All finished topsoil areas shall be protected from damage from vehicular or pedestrian traffic. Valve boxes, sprinkler heads and related irrigation components are to be adjusted to 1-1/2 inch above finish grade or as directed by the COR.
- E. Before planting, obtain Contracting Officer's Representative acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

### **3.5 EXCAVATION FOR TREES**

- A. Planting Pits and Trenches: Excavate circular planting pits with sides sloping at a 45 degree angle. Excavations with vertical sides are not acceptable. Trim perimeter of bottom leaving center area of bottom

raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit glazed or smoothed during excavation.

1. Excavate approximately 2 times as wide as ball diameter for balled and burlapped, balled and potted, container-grown, fabric bag-grown stock.
  2. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
  3. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
  4. Maintain required angles of repose of adjacent materials as shown on the Drawings. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
  5. Maintain supervision of excavations during working hours.
  6. Keep excavations covered or otherwise protected after working hours and when unattended by Installer's personnel.
  7. Use topsoil to form earth saucers or water basins for watering around plants. Basins to be 3 inches (75 mm) high for trees.
- B. Subsoil removed from excavations may not be used as planting soil.
- C. Notify Contracting Officer's Representative if unexpected rock or obstructions detrimental to trees are encountered in excavations.
- D. Notify Contracting Officer's Representative if subsoil conditions evidence unexpected water seepage or retention in tree planting pits.
- E. Fill excavations with water and allow water to percolate away before positioning trees.

### **3.6 TREE PLANTING**

- A. Prior to planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.
- B. Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.
- C. Set plants plumb and in center of planting pit or trench with root flare 1 inch (25 mm) above adjacent finish grades.

1. Use native topsoil amended with compost and bio-stimulants for planting backfill mix. Thoroughly mix 1 part of compost to 5 parts of native topsoil to produce planting backfill mix.
  2. Carefully remove root ball from container without damaging root ball or plant. Do not use planting stock if root ball is cracked or broken before or during planting operation.
  3. Remove bottom of boxes, before setting boxed trees. Do not use planting stock if root ball is cracked or broken before or during planting operation. Cut metal bands and remove remainder of box material completely from the planting pit.
  4. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half full, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
  5. Place plant tablets in each planting pit when pit is approximately one-half filled; in quantities recommended by fertilizer manufacturer. Place tablets beside soil-covered roots about 1 inch (25 mm) from root tips; do not place tablets in bottom of the hole or touching the roots.
  6. Continue backfilling process. Water again after placing and tamping final layer of soil.
- D. When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

### **3.7 BIOSTIMULANT APPLICATION**

- A. Apply mycorrhizal inoculum to all turf areas and backfill mix for plants.
- B. For turf areas: Uniformly broadcast using calibrated equipment, granular endo mycorrhizal product at a rate 0.5 pound per 1000 square-feet and roto-till into the top 8 inches of soil.
- C. For trees: Add 5 pounds of granular endo mycorrhizal product to 1 cubic yard of plant backfill mix. Thoroughly incorporate the product into the backfill mix.

### **3.8 TREE PRUNING**

- A. Remove only dead, dying, or broken branches. Do not prune for shape.

B. Prune according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Contracting Officer's Representative, do not cut tree central leaders; remove only injured, dying, or dead branches from trees; and prune to retain natural character.

C. Do not apply pruning paint to wounds.

### **3.9 TREE WRAP**

A. Wrap the trunks of deciduous trees immediately after planting. Wrap the trunks of deciduous trees, 1-1/2 inches (40 mm) or greater in caliber with the specified material beginning at the base and extending to the first branches. Remove wrapping after one year. When using crinkled paper wrap, securely tie wrapping at the top and bottom and at 18 inch (450 mm) maximum intervals with twine.

### **3.10 TREE AERATION TUBE INSTALLATION**

A. Install 3 tree aeration tubes per tree. Install at the edge of the tree pit with the top of the tube 1/2 inch above finish grade per manufacturer's printed instructions.

### **3.11 ROOT-BARRIER INSTALLATION**

- A. Install linear root barrier where shown on Drawings.
- B. Align root barrier vertically and run it linearly along and adjacent to the cemetery turf burial section to be protected from invasive roots.
- C. Install root barrier continuously along the entire length of the tree row on both sides.
  - 1. Pull a string line to establish straight runs for root barriers. Temporarily stake root barrier in place to prevent distortion during backfill.
  - 2. Position top of root barrier 1/2 inch (13 mm) above finish grade per manufacturer's recommendations.
  - 3. Use manufacturer's joining feature to join root barrier panels.
  - 4. Backfill with 6 inches (150mm) width of drainage rock against inside faces of root barriers.
  - 5. Do not distort or bend root barrier during construction activities.
  - 6. Do not install root barrier surrounding the root ball of tree.

### **3.12 EDGING INSTALLATION**

A. (**Base Bid**): Install machine-cut divot edging where indicated to dimensions shown on the drawings. Fill divot with adjacent mulch material, or if none, fill with bark mulch.

- B. **(Additive Alternate #3):** Install steel edging where indicated per manufacturer's written instructions and as shown on the drawings. Anchor with steel stakes spaced approximately 30 inches (760 mm) apart, driven below top elevation of edging.
- C. Use manufacturer's "corner" pieces where angles are shown on the drawings. Bend corner pieces to angles required.
- D. Use manufacturer's "tapered ends" at ends of edgers and where continuous runs of edging are interrupted.

### **3.13 MULCH INSTALLATION**

- A. Apply pre-emergent herbicide to planting bed immediately before placing weed-control barrier.
- B. Install weed-control barriers before mulching with Gravel Mulch per manufacturer's written instructions. Completely cover area to be mulched, overlapping edges a minimum of 12 inches (300 mm) and secure seams with galvanized steel pins.
- C. Mulch backfilled surfaces of planting areas and other areas indicated. Keep mulch out of plant crowns and off buildings, pavements, utility standards, pedestals, and other structures.
  - 1. Mineral Mulch at Tree Rows: Apply 3 inch (75 mm) average thickness of mineral mulch over whole surface of planting area, and finish level with adjacent finish grades. Do not place mineral mulch within 3 inches of trunks or stems.
  - 2. Trees in Turf Areas: Apply organic mulch ring of 3 inch (75 mm) average thickness, with 36 inch (900 mm) radius around trunks or stems. Do not place mulch within 6 inches (150 mm) of trunks or stems.
  - 3. Organic Mulch in Planting Areas/Gravel Mulched Beds: Apply 3 inch (75 mm) average thickness of organic mulch with 24 inch (610 mm) radius around trunks or stems. Do not place organic mulch within 3 inches (75 mm) of trunks or stems.

### **3.14 PLANT MAINTENANCE**

- A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring plant saucers, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings. Spray or treat as required to keep trees free of insects and disease.

- B. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.
- C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use IPM (Integrated Pest Management) practices whenever possible to minimize the use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

### **3.15 SODDING (TRENCH REPAIR IN EXISTING TURF)**

- A. Prior to delivery of sod, the COR(s) shall inspect the work area. Any discrepancies in the ground preparation shall be corrected prior to the laying of sod in the work area.
- B. Prior to installation of the sod, the COR shall have the right to inspect and to assess the acceptability and quality of the proposed sod. The COR shall have the right to reject poor quality sod before installation. The contractor shall warranty the sod for one (1) year from the date of Final Acceptance.
- C. The sod shall be cut as thinly as possible (1.25 to 1.5 inch) to allow for faster rooting and shall be cut and delivered to the work site the same day of installation. Contractor shall make all necessary arrangements to protect delivered sod from excessive drying and wind damage.
- D. Moisten prepared sod beds before planting if soil is dry. Water thoroughly and allow surface moisture to dry before sodding. Do not create a muddy soil condition.
- E. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.
- F. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to subgrade or sod during installation.
- G. Tamp and roll lightly to ensure contact with subgrade, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.
  - 1. Lay sod across angle of slopes exceeding 3:1.



- H. Sod shall be cut and fitted around sprinkler heads, valve boxes, edges of pavement/curb lines, edging, and other objects.
- I. Sod shall be kept moist until it is well rooted and able to survive with standard watering. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently until sod is established.

### **3.16 SEEDING (ADDITIVE ALTERNATE #2)**

- A. Broadcast and Drop Seeding: Uniformly broadcast seed at rate of 8 to 10 pounds per 1000 square feet. Use broadcast or drop seeders. Sow one-half seed in one direction and sow remainder at right angles to first sowing. Cover seed uniformly to maximum 6 mm (1/4 inch) deep in clay soils and 13 mm (1/2 inch) deep in sandy soils by means of spike-tooth harrow, cultipacker, raking, or other approved device.
- B. Drill Seeding: Drill seed at rate of 8 to 10 pounds per 1000 sq. ft. Use grass seed drills. Drill seed uniformly to 13 mm (1/2 inch) deep.
- C. Rolling: Immediately after seeding, firm entire area, except for slopes in excess of 3 to 1, with roller not exceeding 130 kg/m (90 lb./ft.) of roller width. Eliminate rolling if seeding is done with cultipacker type seeder.
- D. Mulching: Protect seeded areas by broadcasting dry applied mulch within 24 hours after completing seeding operations. Broadcast mulch uniformly per manufacturer's printed instructions at a minimum rate of 1500 lbs./Acre, and roll surface smooth with a high-volume drop spreader, or large-opening broadcast spreader.
  - 1. Keep mulch and seed out of planting beds and off walks, structures and areas not to be seeded. Remove mulch and seed from plant beds and other areas by mechanical means or selective herbicide if encroachment occurs. Clean mulch from these areas to the satisfaction of the COR.
  - 2. Irrigate to activate mulch and to keep soil uniformly moist for seed germination and turf establishment.

### **3.17 TURF RENOVATION**

- A. Renovate existing turf damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.
  - 1. Re-establish turf where settlement or washouts occur or where minor regrading is required.
  - 2. Install new planting soil as required.

- B. Remove sod and vegetation from diseased or unsatisfactory turf areas; do not bury in soil.
- C. Remove topsoil containing foreign materials such as oil drippings, fuel spills, stones, gravel, and other construction materials resulting from Contractor's operations, and replace with new planting soil.
- D. Mow, dethatch, core aerate, and rake existing turf.
- E. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.
- F. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off Owner's property.
- G. Till stripped, bare, and compacted areas thoroughly to a soil depth of 6 inches (150 mm).
- H. Apply soil amendments and initial fertilizers required for establishing new turf and mix thoroughly into top 4 inches (100 mm) of existing soil. Install new planting soil to fill low spots and meet finish grades.
- I. Apply sod as required for new turf.
- J. Water newly planted areas and keep moist until new turf is established.

### **3.18 PLANT MAINTENANCE**

- A. Frequency: Begin maintenance immediately after plants have been installed. Inspect plants at least once week and perform required maintenance promptly.
- B. Promotion of Plant Growth and Vigor: Water, prune, fertilize, mulch, eradicate weeds, and perform other operations necessary to promote plant growth and vigor.
- C. Planter Beds: Weed, fertilize, and irrigate planter beds and keep pest free, pruned, and mulch levels maintained. Do not permit planter beds encroach into turf areas. Maintain edging breaks between turf areas and planter beds. Fertilize plant materials to promote healthy growth without encouraging excessive top foliar growth. Remove noxious weeds common to area from planter beds by mechanical means.
- D. Trees: Adjust stakes, ties, and water, fertilize, control pests, mulch, and prune for health and safety.

1. Fertilize trees to promote healthy plant growth without encouraging excessive top foliar growth. Inspect and adjust stakes, ties, guy supports to avoid girdling and promote natural development.

### **3.19 REMOVAL OF DYING OR DEAD PLANTS**

- A. Remove dead and dying plants and provide new plants immediately upon commencement of specified planting season and replace stakes, mulch, and eroded earth mound water basins. No additional correction period will be required for replacement plants beyond original warranty period. Plants will be considered dead or dying as follows:
  1. Tree: Main leader died back or minimum 20 percent of crown died.
  2. Shrub and Ground Cover: Minimum 20 percent of plant died.
  3. Determination: Scrape on maximum 2 mm (1/16 inch) square branch area to determine dying plant material cause and provide recommendations for replacement.

### **3.20 TURF MAINTENANCE (ADDITIVE ALTERNATE #2)**

- A. Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
  1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
  2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
  3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use IPM (Integrated Pest Management) practices whenever possible to minimize the use of pesticides and reduce hazards.
- B. Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches (100 mm).
  1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.

2. Water turf with fine spray at a minimum rate of 1 inch (25 mm) per week unless rainfall precipitation is adequate.

C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 1/3 of grass height. Remove no more than 1/3 of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:

1. Mow to a height of 2 to 3 inches (50 to 75 mm).

### **3.21 SATISFACTORY TURF (ADDITIVE ALTERNATE #2)**

A. Turf installations shall meet the following criteria as determined by Contracting Officer's Representative:

1. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.

2. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. (0.92 sq. m) and bare spots not exceeding 5 by 5 inches (125 by 125 mm).

B. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory.

### **3.22 PESTICIDE APPLICATION**

A. Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Contracting Officer's Representative before each application is performed.

B. Pre-Emergent Herbicides (Selective and Non-Selective): Applied to tree, shrub, and ground-cover areas in accordance with manufacturer's written recommendations. Do not apply to seeded areas.

C. Post-Emergent Herbicides (Selective and Non-Selective): Applied only as necessary to treat already-germinated weeds and in accordance with manufacturer's written recommendations.

### **3.23 CLEANUP AND PROTECTION**

- A. During planting, keep adjacent paving and construction clean and work area in an orderly condition.
- B. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.
- C. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- D. Erect temporary fencing or barricades and warning signs, as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.
- E. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.
- F. Remove non-degradable erosion control measures after grass establishment period.
- G. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Government's property.

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