

## Attachment B

### Specifications (2 Sections)

- Section 32 84 00 – Planting Irrigation
- Section 32 90 00 – Planting

**SECTION 32 90 00**

**PLANTING**

**PART 1 - GENERAL**

**1.1 DESCRIPTION**

A. The work in this section consists of furnishing and installing plants, tree stakes, slope scarifying, compost socks, compost blanket, seed, erosion control netting, decorative mulches and other landscape materials required as specified in locations shown.

**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 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.
- J. **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.
- K. **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.
- L. **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.
- M. **Subsoil:** All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- N. **Compost Sock:** Tubular mesh sleeve designed to containing compost.

#### **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, compost, 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, compost, 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 according to 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 according to manufacturer's written instructions and warranty requirements.
- D. Plant trees after finish grades are established and before planting shrubs and groundcovers unless otherwise indicated.
  1. When planting trees after planting groundcovers, protect groundcovers 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. Soil Fertility and Agricultural Suitability-Testing Laboratory Qualifications: An independent 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.
1. Acceptable Soil Testing Laboratories are:
    - a. Soil and Plant Laboratory, Inc., (503) 557-4959.
    - b. A & L Western Agricultural Laboratories, (503) 968-9225.
    - c. Western Laboratories, Inc, (800) 658-3858.
- F. Soil Analyses: Furnish soil analyses by a qualified soil-testing laboratory stating:

1. Soil Composition: USDA particle size analysis indicating percentages of sand, silt and clay, and percent organic matter.
  2. Macro and micro nutrient fertility tests as determined by pH, salinity, nitrate nitrogen, ammonium nitrogen, phosphate phosphorous potassium, calcium, magnesium, soluble copper, zinc, manganese, iron, saturation extract boron and sodium analyses.
  3. Recommendations by the soil testing lab for fertilizer and soil amendments in pounds per 1,000 square foot or tons per acre, as necessary to correct soil deficiencies.
- G. Compost Testing Laboratory Qualifications: An independent laboratory, with the experience and capability to conduct the testing indicated following U.S. Composting Council Seal of Testing Assurance (STA) procedures, or equivalent.
1. Acceptable STA Compost Testing Laboratories are:
    - a. A & L Western Agricultural Laboratories, (503) 968-9225.
    - b. Control Laboratories, (831) 724-5422.
- H. Compost Analysis: Provide documentation from supplier that compost has reached a monitored temperature of 140 degrees Fahrenheit for at least one week. Engage an independent soil testing laboratory to test representative sample(s) of compost and furnish compost analysis report for the following parameters:
1. Percent organic matter, percent moisture, percent inerts (foreign matter), pH, soluble salts, and particle size.
  2. Nutrient content, including: Nitrogen (N), Phosphorus (P), Potassium (K), Calcium (Ca), and Magnesium (Mg) and Sulfur (S).
  3. Trace Metals, including: Arsenic (As), Cadmium (Cd), Chromium (Cr), Copper (Cu), Lead (Pb), Mercury (Hg), Nickel (Ni), and Zinc (Zn).
  4. Maturity Indicator. Provide bio-assay results. Provide Carbon-Nitrogen ratio.
  5. Stability Indicator: Provide respiration test results.
- I. 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.
- J. Provide quality, size, genus, species, variety and sources of plants indicated, complying with applicable requirements in ANSI Z60.1.
- K. 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.
- L. 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.

M. Include product label and manufacturer's literature and data for pesticides and herbicides.

N. Conduct a pre-installation conference at Project site.

#### **1.8 SUBMITTALS**

A. Submit product data for each type of product indicated:

1. Include quantities, sizes, quality, and sources for plant materials.

2. Include EPA approved product label, SDS (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. Compost: 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. Organic 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.

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. Soil Test Reports: For existing native surface topsoil.

F. Compost Analysis: Provide analysis for one representative sample of compost minimum 30 days prior to compost being delivered to Project Site.

G. Maintenance Instructions: Recommended procedures to be established by Government for maintenance of plants during a calendar year. Submit before start of required maintenance periods.

#### **1.9 PLANT ESTABLISHMENT PERIOD**

A. The establishment period for plants 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 MAINTENANCE SERVICE**

A. Provide initial maintenance service for trees shrubs, ground cover and other plants 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. Maintenance Period: 12 months from date of Substantial Completion.

**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, Shrubs, Vines, and Ornamental Grasses: 12 months.
    - b. Ground Covers, Biennials, Perennials, and Other Plants: 12 months.
  2. The Contractor shall have completed, located, and installed all plants according to the plans and specifications. All plants 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 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 warranty will begin on the day the work is completed.
  4. The Government will reinspect all plants at the end of the Warranty Period. The Contractor will replace any dead, missing, or defective plant material 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 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 the Government, 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 materials: ANSI Z60.1; will conform to the varieties specified and be true to botanical name as listed in Hortus Third; nursery-grown plants 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 particular 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 or transporting.
  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. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through No. 50 (0.30 mm) sieve.

## **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. 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.
- 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 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 according to 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 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, a minimum of 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 ASTM D5268 topsoil with the following soil amendments and fertilizers as recommended by the soils analysis.
- 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 BIO-STIMULANTS**

- 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 plus organic sources of nutrients. Minimum 100,000 spores/propagules per pound.
- B. Available Products:
1. 'MycoApply Endo' by Mycorrhizal Applications, Inc.; 'Endo Granular' by Mycorrhizal Products;
  2. 'Sanctuary 8-0-4 + Mycorrhizae' probiotic at 20 lbs / 1000 with wetting agent.
  3. Or approved 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. Type: Rounded riverbed gravel or smooth-faced stone.
2. Size Range: 3 inches (75 mm) maximum 1 inch (25 mm) minimum in accordance with ASTM C136.
3. Color: Bright mix of pastel colors (pink, gray, tan) to match existing cobble and acceptable to Contracting Officer's Representative.

a. 'Arizona Salt River Rock' as available from Bedrock Boulders & Landscape Products (Tel.: 619.442.0574); or approved equal.

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.

**2.9 SEED**

A. Chaparral Sage Scrub Mix

Botanical Name	Common Name	Bulk Pounds/Acre	Min % PLS*
Acmispon glaber	(Deerweed)	6.00	81
Artemisia californica	(California Sagebrush)	2.00	18
Encelia farinose	(Brittlebush)	2.00	30
Eriogonum fasciculatum	(California Buckwheat)	8.00	10
Eriodictyon trichocalyx	(Hairy Yerba Santa)	2.00	83
Eschscholzia californica	(California Poppy)	8.00	90
Festuca microstachys	(Small Fescue)	0.50	79

Hesperoyucca whipplei	(Our Lord's Candle)	1.00	68
Lasthenia californica	(Dwarf Goldfields)	2.00	83
Lupinus hirsutissimus	(Stinging Lupine)	0.50	3
Phacelia ciliate	(Great Valley Phacelia)	2.00	90
Salvia apiana	(White Sage)	2.00	35
Salvia mellifera	(Black Sage)	2.00	60
Stipa pulchra	(Purple Needlegrass)	4.00	73
Trifolium willdenovii	(Tomcat Clover)	<u>2.00</u>	88

B. Seeding rate: 1 pound per 1000 square feet (44 lbs per acre)

C. Approved Supplier: S&S Seeds Tel. (805) 684-0436; or approved equal.

**2.10 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 1/2 inch (12 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.

**2.11 COMPOST/SEED MIXTURE**

A. A uniform mixture of compost, seed, fertilizer and bio-stimulants. Incorporate seed at the prescribed seeding rate of 1-pound of seed per 6 cubic yards of compost for a 2-inch thick compost blanket layer.

**2.12 COMPOST SOCK**

- A. Sock: Biodegradable 200mm (8-inch) diameter tubular roll containing compost/seed mixture, and fertilizer. Sock to be fabricated from coir or burlap and be beige in color. Longevity of fabric shall be 12 months min./24 months max.
- B. Wood stakes: 18mm x 18mm (¾" x ¾") fir stake, length as required.
- C. Rope Tie: 9mm (3/8") jute twine.

**2.13 EROSION CONTROL NETTING**

A. Erosion Control Net: 100% biodegradable woven jute blanket. Heavy, twisted jute mesh weighing approximately 498 to 700 grams per meter (14.7 to 20.6 ounces per square yard) and 1200 mm (4 feet) wide with mesh openings approximately 19 mm (3/4 inch) square; 50% to 55% open

area. Longevity of fabric shall be 12 months min./24 months max. For use on slopes with 2:1 gradient.

- B. Erosion Control Material Anchors: As recommended by erosion control material manufacturer.
- C. Available Supplier/Product: 'Belton Industries' / Anti-Wash Geojute; or approved equal.

#### **2.14 TACKIFIER**

- A. M-Binder tackifier botanical glue used to stabilize compost blanket. M-Binder is derived from the seed of the plantago plant (*Plantago insularis*), 100% organic, non-toxic and biodegradable.

#### **2.15 TREE WRAP**

- A. Crinkle paper tree wrap: Two thicknesses of crinkled paper cemented together with a layer of bituminous material. Wrapping material shall be a minimum of 4 inches (100 mm) in width and have a stretch factor of 33 1/3 percent. Twine for tying shall be lightly tarred medium or coarse sisal yarn.
- B. Extruded, translucent, twin walled polypropylene protection board sheets: 1/8 inch (3 mm) thick, 6 ft. (1800 mm) long tree shelters may be utilized for short trunk trees 3 inch (75 mm) caliper or less.
- C. Breathable synthetic fabric tree wrap: White in color, delivered in 3 inch (75 mm) wide rolls. Material shall be specifically manufactured for tree wrapping.
- D. Tree wrap shall be secured to the trunk using bio-degradable tape suitable for nursery use and which is expected to degrade in sunlight in less than 2 years after installation.

#### **2.16 TREE STAKES**

- A. Tree Tie: Plastic chain-type, approximately 1 inch wide by 1/8 inch thick.
- B. Tree Support Stakes: Rough sawn hardwood free of knots, rot, cross grain, bark, long slivers, or other defects that impair strength. Minimum 50 mm (2 inches) diameter by 2.4 m (8 feet) long, pointed at one end.

#### **2.17 WATER**

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

### **2.18 ANTIDESICCANT**

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

### **2.19 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.
- C. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

## **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 foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
  - 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.
  - C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Contracting Officer's Representative and replace with new planting soil.

### **3.2 PREPARATION**

- A. Protect structures, utilities, sidewalks, pavements, and other facilities 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. Lay out individual tree locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain approval by the Contracting Officer's Representative of layout before excavating or planting. The Contracting Officer's Representative may approve adjustments to plant material locations to meet field conditions.
- D. 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.
- E. 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 PLANTING AREA ESTABLISHMENT**

- A. Loosen subgrade of planting areas to a minimum depth of 12 inches (300 mm). Remove stones larger than 2 inches (50 mm) in any dimension and

sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Government's property.

1. Spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil.
  - a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
  - b. Mix soil amendments (i.e., soil sulfur and/or gypsum) with dry soil before mixing fertilizer.
2. Spread planting soil to a depth of 12 inches (300 mm) but not less than required to meet finish grades after natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
  - a. Spread approximately one-half the thickness of planting soil over loosened subgrade. Mix thoroughly into top 4 inches (100 mm) of subgrade. Spread remainder of planting soil.
- B. 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.
- C. Before planting, obtain Contracting Officer's Representative acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

### **3.4 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.

### **3.5 TREE, SHRUB, AND VINE 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 unless noted otherwise. Thoroughly mix 1 part of compost to 5 parts of native topsoil to produce planting backfill mix.
  2. Use native topsoil treated with bio-stimulants for backfill of California native plants. Use no compost in the backfill mix for native plants.
  3. 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.
  4. 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.

5. 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.
  6. 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.
  7. 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.

### **3.6 BIOSTIMULANT APPLICATION**

- A. Apply mycorrhizal inoculum to backfill mix for plants.
- B. 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.
- C. For Compost Blanket and Compost Socks: Add 5 pounds of granular endo mycorrhizal product to 1 cubic yard of compost. Thoroughly incorporate the product into the compost.

### **3.7 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 leaders; remove only injured, dying, or dead branches from trees; and prune to retain natural character.
- C. Do not apply pruning paint to wounds.

### **3.8 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.

### **3.9 MULCH INSTALLATION**

#### **A. Mineral (Inert) Mulch:**

1. Excavate to lines and levels required and install weed-control barriers before mulching with mineral mulch according to manufacturer's written instructions. Completely cover area to be mulched with weed-control barrier, overlapping edges a minimum of 12 inches (300 mm) and secure seams with galvanized steel pins.
2. Mineral Mulch at Curb Lines: Apply 3 inch (75 mm) average thickness of cobblestone mulch in a 24-inch wide band abutting curb lines as indicated, and finish level with adjacent finish grades. Do not place mineral mulch within 12 inches of trunks or stems of plants.

#### **B. Organic Mulch:**

1. 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.
2. Organic Mulch in Planting Areas: Apply 3 inch (75 mm) average thickness of organic mulch throughout planting beds. Do not place organic mulch within 3 inches (75 mm) of trunks or stems.

### **3.10 SLOPE SCARIFICATION**

- A. Scarify existing cut slopes by etching 2-inches minimum deep by 2-inches wide horizontal grooves into the exposed face of the slope at 6-inch on centers, maximum.
- B. Remove and dispose sloughed-off materials from scarification activities to a location on the cemetery as directed by the COR.

### **3.11 COMPOST SOCKS**

- A. Fill compost socks with approved compost/seed mixture and tie ends with twine.
- B. Place compost socks horizontally on slopes, at top, midpoint at bottom of slopes. Stake and tie compost socks as indicated. Overlap ends of adjoining compost socks a minimum of 24 inches and secure together with twine.

### **3.12 COMPOST BLANKET**

- A. Apply a 2-inch layer of approved compost/seed mixture to scarified slope.

- B. Apply tackifier at 80-100 lbs. per acre per manufacturer's printed instructions for dry application.
- C. Extend the compost blanket 3 feet minimum beyond the shoulder of the slope and down to the edge of the mineral mulch band.
- D. Cover compost blanket with jute netting running from top to bottom of slope at the edge of the mineral mulch band. Secure netting to slope by burying ends of fabric as indicated. Overlap adjacent panels of jute netting a minimum of 12 inches and secure to slope with steel staples.
- E. Irrigate compost blanket to keep blanket and surface of slope uniformly moist to germinate seeds.

### **3.13 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.

### **3.14 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.

### **3.15 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 waste material including excess soil, unsuitable soil, trash, and debris and legally dispose of them off Government's property. Suitable soil spoils from planting and mulching operations may be stockpiled or spread in a location on the cemetery property as directed by the COR.

--- END ---

**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.
- B. Products and installation shall match existing irrigation system unless noted otherwise.

**1.2 RELATED WORK**

- A. Section 32 90 00 PLANTING

**1.3 DEFINITIONS**

- A. Lateral 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. NPT: National pipe thread
- C. PVC: Polyvinyl chloride plastic
- D. PE: Polyethylene

**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. Mainline Piping: 100 psi (640 kPa).
2. Lateral Piping: 80 psi (520 kPa).

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. 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. Assembled Units: Components are compatible with each other and with the total assembly for the intended service.
3. 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 and has previous experience with installation of two-wire decoder based irrigation control systems.

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 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.

**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. As-Built Record Drawings: Maintain a complete set of as-built drawings which shall be corrected daily to show changes in locations of all pipe, two-wire path when not located next to mainline, valves, and related irrigation equipment. Valves shall be shown with dimensions to reference points.
- D. Controller Chart:
  1. Prepare a map diagram showing location of all valves, decoders, 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 distinct 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 regarding 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  
Sheeting
- 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
- 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
- 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

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

**PART 2 - PRODUCTS**

**2.1 LOW VOLTAGE CONTROL VALVE WIRE**

A. Decoders for Two-Wire Operation:

1. The decoders shall be of solid-state design and housed in a watertight molded plastic housing. The decoder leads shall be 18-gauge, insulated, stranded copper conductors of colors as indicated below. Wire leads shall be not less than 12" long. All decoder wire connections shall be made using watertight electrical connections suitable for the wire type being connected, as recommended by the manufacturer.
2. Decoders shall be mounted underground in separate 12" by 18" valve boxes, or with remote control valves. The decoders shall be fastened to the inside of remote control valve boxes using stainless steel self-tapping screws. The valve boxes which house decoders shall have lids branded with "FD" in 2" high letters and painted with permanent white epoxy paint; the boxes shall be placed on an 18" deep bed of pea gravel to provide adequate drainage.
3. Decoders shall have addresses pre-coded from the factory of manufacture and available with 4 addresses, with each address activating one remote valve solenoid.
4. Provide manufacturer's optional barcode scanner-based decoder programming unit to input decoder addresses. Programs shall be capable of being backed up and restored with the programming unit. Acceptable Manufacturer and Model: Rain Bird DPU210.
5. Decoders shall be as manufactured and furnished by Rain Bird; as indicated in the irrigation controller manufacturer's printed instructions.
  - a. Field Decoders: FD-401TURF, 4 Rain Bird Solenoids (one per address).
  - b. Field Decoders: FD-202TURF, 2 Rain Bird Solenoids (one per address).

**B. Decoder Cable:**

1. 2-conductor control cable design consisting of tin coated copper conductors, insulated with PVC and having a high-density polyethylene direct burial jacket. Conductors are listed as Type UF by UL or ETL or CSA.
2. Conductor: Minimum conductor size 14 AWG; soft annealed tin coated solid copper conforming to ASTM B-33.
3. Insulation: Polyvinyl Chloride conforming to UL Standard 493 for TYPE UF rated 60°C.
4. Cable Assembly: Insulated conductors are laid parallel.
5. Outer Jacket: Pressure Extruded High Density PE conforming to ICEA S-61-402, and NEMA WC5 Jacket Thickness 3/64" minimum jacket material to completely fill interstices between the two insulated conductors.
6. Color Coding: Black, Red.
7. Acceptable Manufacturer and Model: MAXI Wire, Size 600V sunlight-resistant direct-burial for Rain Bird two-wire control systems; as indicated in the irrigation controller manufacturer's printed instructions, or approved equal.
8. Single-strand copper, UL approved for direct burial, AWG-UF type, sized per manufacturer's recommendations, No. 14 gauge minimum for pilot wires, and No. 12 gauge minimum for common wire. Provide colored PVC jackets as listed below:
9. Use white jacket wire for common wires.
10. Use red jacket for lead-in wires to control valves.
11. Decoder-to-Solenoid (DTS) Cables 14 AWG, solid copper; 2-conductor; Paige Electric P7351D.
12. Decoder Cable Connectors: 3M/ DBY and DBR connectors, or equal.

**2.2 PIPE 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. Mainline Pipe [75 mm(3-inch) and larger]: Purple Polyvinyl Chloride (PVC), 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 [63.5 mm (2-1/2-inch) and smaller]: Purple Polyvinyl Chloride (PVC), 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: Purple Polyvinyl Chloride (PVC), Schedule 40, solvent welded socket type, ASTM D2466.
- E. Lateral Pipe on Grade: UVR Schedule 40 solvent weld Polyvinyl Chloride (PVC), ASTM D1785.
1. Install adhesive non-potable purple marking tape for reclaimed pipe stating, "CAUTION RECLAIMED WATER LINE" along length of pipe.
- F. Threaded Pipe:
1. Polyvinyl Chloride, ASTM D1785, PVC 1120, Schedule 80, for threaded connections, risers, and swing joints.
- G. 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.
- H. Fittings:
1. Mainline Pipe [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. Mainline Pipe [63.5 mm (2-1/2-inch) and smaller]:

- a. PVC, Schedule 40, solvent welded socket type, ASTM D2466.
- 3. Lateral Pipe:
  - a. Solvent weld pipe Schedule 40, Type 1, PVC solvent weld fittings conforming to ASTM Standards D2466 and D1784 for PVC pipe.
- 4. Lateral Pipe on Grade:
  - a. UVR Schedule 40 PVC fittings, ASTM D2466.
  - b. The solvent cement should conform to ASTM D2564 and the primer to ASTM F656.

### **2.3 PIPE JOINING MATERIALS**

- A. Mainline Pipe [75 mm (3-inch) and larger]: Rubber gaskets, AWWA C111.
- B. Mainline Pipe [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.

### **2.4 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.

## 2.5 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 inch) 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. Valve ends shall accommodate the type of main pipe adjacent to valve.

### B. 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.

3. 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.
4. 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.
5. Valve shall be equipped with purple flow control handle for reclaimed water irrigation applications.
6. Valves shall be equipped with manufacturer's pressure regulation module.
7. Available Manufacturer/Model: Rain Bird PESBR-PRS-D. No approved equal.

#### C. QUICK COUPLERS

1. Shall have all parts contained in a two-piece unit and shall consist of a coupler water seal valve assembly and a removable upper body to allow the spring and key track to be serviced without shut down of the main.
2. Metal parts shall be brass.
3. Lids shall be lockable purple vinyl covered and have springs for positive closure on key removal.
4. Quick coupler valve shall be equipped with Acme threads.
5. Manufacturer/Model: To match existing.

#### 2.6 PRESSURE REGULATING MODULE

##### A. For Remote-Control Valves:

1. Manufacturer's pressure regulating module used to adjust water pressure downstream of remote-control valve.
2. Plastic Remote-Control Valves, Manufacturer/Model: Rain Bird, Model PRS-Dial.

#### 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, non-potable purple 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 non-potable purple "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. Manufacturer/Model: To match existing.
- B. Mainline Shut-off Valves:
1. In turf and planter areas valve boxes shall be HDPE structural foam Type A, Class III, non-potable purple in color. Box shall be minimum 475 mm (19 inches) long by 350 mm (14 inches) deep with non-potable purple "T"-style lid, to match existing.
  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.
- A. Quick Coupler and Decoder Boxes: Boxes shall be 254 mm (10 inch) round, injection molded of structural foam polyethylene material with a melt index between 10-12. Coloring and UV stabilizers shall be added along with processing lubricants when needed. The 254mm (10 inch)round body shall have 8 structural support ribs on the underside of the seat, each with a minimum thickness of 6.35mm (0.25 inches). The bottom of the body shall have a 12.7mm (0.50 inch)flange. Boxes shall be purple in color with bolt down overlapping cover. Valve boxes shall match existing NDS Pro Series.
- B. Valve Box Accessories:
1. Valve Box Extensions: Extensions shall be manufactured by same manufacturer as valve box and shall only be used with prior approval.
  2. Galvanized steel wire mesh fabric; 16 gauge with 1/2-inch openings.
  3. Filter Fabric: Spunbond polyester 3.5 oz. per square yard landscape fabric.
  4. Support Blocks: precast concrete pavers, or bricks.
  5. Drainage Backfill: Clean gravel or crushed stone, graded from 1/4-inch (6 mm) minimum to 3/4-inch (19 mm) maximum.
  6. Valve I.D. Tags: Standard I.D. tags with hot-stamped black letters on a non-potable purple 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. Spray Heads:
1. Sprinkler head body shall be pop-up spray type of configuration as noted on plans. The sprinkler body, stem, nozzle, and screen shall be constructed of heavy-duty, ultraviolet resistant plastic. It shall have a heavy duty stainless steel retract spring and a ratcheting system for alignment of the pattern. The sprinkler shall have a soft elastomer pressure-activated co-molded wiper seal for cleaning debris from the pop-up stem.
  2. The sprinkler shall have an in-riser pressure regulator that maintains constant 30 PSI (2.5 Bar) outlet pressure to eliminate misting and fogging caused by pressures above 30 PSI (2.5 Bar).
  3. Sprinkler head shall have a purple cap for effluent applications.
  4. Approved Product: Manufacturer/Model: Toro 570ZPR. No approved equal.
- C. Spray nozzles:
1. The 570Z or equivalent spray head shall be equipped with a Precision™ Series Spray Nozzle. All nozzles shall have a precipitation rate of 1"/hr.
  2. The spray nozzles of any given radius shall be comprised of a selection for 60°, 90°, 120°, 150°, 180°, 210°, 240°, 270°, and 360° arcs. Appropriate arcs shall be installed per the irrigation plan of this Project Specification.
  3. The nozzle shall utilize an internal oscillating chamber (chip) to accomplish water distribution from the spray head. These chips shall be mounted in sequence around the circumference of the nozzle turret to deliver greater arcs than the standard 90° or 60° arcs.
  4. The nozzles shall be constructed of a non-corrosive, impact-resistant, UV-resistant, heavy duty plastic material (PBT). The attached screen shall be molded of high density polypropylene. The chip material shall be PBT.
  5. The screen mesh shall be constructed such that any material moving through the screen will be smaller than the smallest orifice of any

nozzle preventing any nozzle plugging from external or internal debris.

6. The nozzles shall have a stainless-steel radius reduction screw. This screw shall allow reduction of radius of up to 25% of the original designated radius without affecting the precipitation rate.
7. The nozzles shall be color coded and stamped as follows:
  - a. Color coding on top shall indicate radius—red for 5', green for 8', blue for 10', brown for 12', and black for 15'
8. Approved Product: Manufacturer/Model: Toro Precision™ Series Spray Nozzle. No approved equal.

D. Shrub Heads:

1. Shrub head shall be purple for effluent applications.
2. The spray nozzle shall be a pressure compensating precision series.
3. Approved Product: Manufacturer/Model: Toro 570S.

**2.9 SHRUB SPRAY W/PIPE ON GRADE INSTALLATION**

A. Pipe Stabilizer:

1. Use an 18" pipe stabilizer between sprinkler heads to control the movement of the pipe.
2. Stabilizer shall be vinyl covered with double "J" to secure pipe to ground with a vertical striking area.
3. Approved Product: Manufacturer/Model: Strong Box PS 18.

B. Straight Riser Stake:

1. Use an 18" Straight riser stake to stabilize sprinkler riser to prevent movement.
2. Approved Product: Manufacturer/Model: Strong Box RS 18.

C. Sprinkler Tie:

1. Use a 9" sprinkler tie for shrub heads to secure the sprinkler to the sprinkler stabilizer.
2. Approved Product: Manufacturer/Model: Strong Box ST 9.

**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, non-potable purple in color. Box shall be minimum 475 mm (19 inches) long by 350 mm (14 inches) deep with non-potable purple "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 non-potable 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 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.

## **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 out the irrigation system. Items staked include: mainline pipe, isolation valves, air/vacuum relief valve assemblies, quick coupling valves, remote-control valves, lateral piping, and sprinklers.
- B. If staked irrigation components conflict with utilities or other components or site features, coordinate rerouting of components with the COR.
- C. 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.
- D. Irrigation lines and control wire shall run through designated utility lanes or beside roadways where possible.
- E. Connect new system to existing mainline.

### **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 lines, 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) or to match existing over 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. 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. 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.

M. 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.

N. Dress backfilled areas to original grade. Remove excess backfill to on-site location as directed by the COR.

O. Where utilities conflict with irrigation trenching and pipe work, contact the COR for trench depth adjustments.

P. 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.

- Q. Warning tape shall be continuously placed above sprinkler system water mainlines at a depth of 200-250 mm (8-10 inches) below finish grade. Tape shall be non-potable purple with black letters for reclaimed water and imprinted with "CAUTION BURIED IRRIGATION WATER LINE BELOW."

**3.4 ASSEMBLING PIPE AND FITTINGS**

A. General:

1. Keep pipe free from dirt and pipe scale. Cut pipe ends square and deburr. 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.

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.

### 3.5 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.
7. Brand "AV" in 2-inch high by 3/16-inch deep letters on valve box lid.

### **3.6 INSTALLATION OF SPRINKLER IRRIGATION COMPONENTS**

#### **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 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 spray zones.
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 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 pop-up spray sprinklers 75 mm (3-inches) from adjacent edges of paved areas, walls, or fences.
  4. Install sprinklers perpendicular to the finish grade.
  5. Install swing joint with the appropriate angle between the lateral pipe and the lay length nipple per the installation details.
  6. Supply appropriate nozzle as indicated on drawing.
- C. Shrub Spray 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. Install shrub sprays perpendicular to the finish grade.
  4. Install swing joint with the appropriate angle between the lateral pipe and the lay length nipple per the installation details.
  5. Supply appropriate nozzle as indicated on drawing.
- D. Shrub Spray w/Pipe on Grade
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. Install shrub sprays perpendicular to the finish grade.

4. Install riser stake with sprinkler tie to stabilize shrub spray assembly per the installation details.
5. Supply appropriate nozzle as indicated on drawing.

### **3.7 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.

### **3.8 CONTROL WIRE INSTALLATION**

#### **A. Two-Wire Decoder Cables:**

1. Install two-wire decoder cable in a loop wiring configuration from the irrigation controller to all decoders in the field per the manufacturer's approved routing method.
2. Provide two-wire cable for decoder based controller in trench with new mains or in a separate trench at back of curb. Locate in trench with mains when possible. Install line surge protection per manufacturer's printed instructions. Locate all splices in valve boxes with valves or in separate splice boxes with non-potable purple covers branded with "WS" and painted with permanent white epoxy paint.
3. All wire splicing shall occur only at the valves, at the controller, or at splits in the two-wire cable path. Install Decoder Cable Fuse Devices at each split in the two-wire cable path and along long runs of cable greater than 600-feet as show in the Drawings and per the manufacturer's printed instructions.
4. Provide lighting/surge protection consisting of a lightning arrestor and copper clad grounding rod in decoder cable at 600-foot intervals or less along the two-wire path and as recommended by irrigation

#### **B. Decoder-to-Solenoid Cables:**

1. Provide decoder-to-solenoid (DTS) cable from decoders to solenoids on remote control valves.
2. Two-conductor DTS control cable from decoders to each solenoid shall have a colored jacket matching the wire jacket color on the decoder for ease of installation and repair. Wire the cables from the decoders to the solenoids per manufacturer's printed instructions and as indicated in the Drawings.
3. Install DTS cable in sleeves under paving.

4. Provide 1 spare wire, 2-conductor decoder-to-solenoid (DTS) cable, yellow in color, making a circuit from each decoder to all valves served by that decoder. Coil 24 inches length neatly in each box.

C. Decoders:

1. Decoders for two-wire systems shall be placed in valve box with remote control valve wherever practicable.
2. Program decoder two-wire interface modules per manufacturer's printed instructions using the decoder field programmer. Assign unique station numbers to each decoder before installing decoders in the field at the valve locations.
3. Test the decoders by validating that the station numbers have been correctly accepted into the decoder.
4. Write down the decoder number and the station(s) assigned to it onto the irrigation as-built drawing in the blank chart provided with the irrigation plans.
5. Secure decoders to interior of valve boxes with self-taping stainless-steel screws.
6. The distance from the furthest valve to the controller shall not exceed 5000 feet.
7. The distance from a valve to its decoder shall not exceed 100 feet.

D. Control Wire:

1. Install two-wire decoder cable in the same trench as mainline, preferably to the side of mainline below top of pipe in a consistent fashion. Do not wrap wire around mainline or fittings. Separate wire from mainline into separate sleeves one for pipe, one for wire when crossing under hard surfaces.
2. Bundle control wires where two or more are in the same trench. Bundle with pipe wrapping tape spaced at 3 m (10-foot) intervals.
3. Control wiring may be chiseled into the soil utilizing a vibratory plow device specifically manufactured for pipe pulling and wire installation. Appropriate chisel shall be used so that wire is fed into a chute on the chisel, and wire is not subject to pulling tension. Minimum burial depth shall equal minimum cover previously listed.
4. Provide a 600 mm (24-inch) excess length of wire in a 200mm (8-inch) diameter loop at each 90-degree change of direction, at both ends of sleeves, and at 30 m (100-foot) intervals along continuous runs of

- wiring. Do not tie wiring loop. Coil 600mm (24-inch) length of wire within each remote-control valve box.
5. Splicing shall be held to a minimum. A pull box shall be provided at each splice. No splices will be allowed between field located controllers and remote-control valves.
  6. If a control wire must be spliced, make splice with wire connectors and waterproof sealant, installed per the manufacturer's instructions. Locate splice in turf areas using a valve box that contains an irrigation valve assembly, or in a separate valve box. Use same procedure for connection to valves as for in-line splices. If a separate valve box is used for wire splices, brand "WS" in 50 mm (2-inch) high by 5 mm (3/16-inch) deep letters on valve box lid and painted with permanent white epoxy paint.
  7. Install control wire not installed with PVC mainline inside of Schedule 40 PVC electrical conduit. Protect conduit with a continuous run of low-voltage electrical warning tape placed in the backfill 150 mm (6-inches) above the conduit.
  8. Cap all exposed wire ends with waterproof wire connectors.
  9. Wiring bundles located with piping and shall be set below and to one side of the pipe. Wires shall be bundled, and tied or taped at 4.5 m (15 foot) intervals.
  10. Power wiring for the operation of irrigation system shall not be run in same conduit as control wiring.

### **3.9 VALVES**

- A. Control Valves:
- B. Provide brass shut-off globe valve with integral union on upstream side of remote control valve. Provide schedule 80 PVC threaded nipples on both sides of each remote-control valve and one schedule 80 PVC union downstream of the valve.
- C. Provide schedule 80 PVC threaded nipples on both sides of each control valve. Provide unions as shown in the Drawings.
- D. Install decoder and wiring per manufacturer's printed instructions. Secure decoder to inside of valve box with galvanized steel bracket.
- E. Install ground rod per manufacturer's printed instructions.
- F. Brand controller letter and alpha-numeric decoder station number in 50 mm (2-inch) high by 5 mm (3/16-inch) deep letters on valve box lid.  
(e.g., A-G4)



### **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 mainlines and continuing through smaller mainlines 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.

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