
SECTION 32 01 90
OPERATION AND MAINTENANCE OF PLANTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Monitoring and Maintenance of Plant Material.
 - 2. Monitoring and Maintenance of Irrigation Systems.
 - 3. Maintenance of Aggregate Mulch and Wood Chip Mulch.
- B. Related Sections:
 - 1. Irrigation Systems: Section 32 84 00.
 - 2. Planting Soil Preparation: Section 32 91 13.
 - 3. Topsoil: Section 32 91 18.
 - 4. Landscape Grading: Section 32 91 19.
 - 5. Turf and Grasses: Section 32 92 00.
 - 6. Plants: Section 32 93 00.

1.2 REFERENCES (Latest edition unless otherwise noted)

- A. American National Standards Institute (ANSI)
 - A300 Tree, Shrub, and Other Woody Plant Maintenance, Standard Practices.
 - Z60.1 American Standard for Nursery Stock, Current Edition.
 - ICBN International Code of Botanical Nomenclature.
- B. American Society for Testing and Materials (ASTM):
 - D 1557 Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.
- C. International Code of Nomenclature of Cultivated Plants (ICNCP).

1.3 DEFINITIONS

- A. IPM — Integrated Pest Management: An approach to pest control that utilizes regular monitoring to determine if and when treatments are needed and employs physical, mechanical, cultural, biological and educational tactics to keep pest numbers low enough to prevent intolerable damage or annoyance. Least-toxic chemical controls are used as a last resort.
- B. Excessive Compaction: Planting area soil compaction greater than 75 percent of maximum dry density as determined by ASTM D 1557.
- C. Pesticide: Any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest. Pests can be insects, mice and other animals, unwanted plants (weeds), fungi, or microorganisms like bacteria and viruses. Though often misunderstood to refer only to insecticides, the term pesticide also applies to herbicides, fungicides, and various other substances used to control pests. Under United States law, a pesticide is also any

substance or mixture of substances intended for use as a plant regulator, defoliant, or desiccant.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Product Purchase and Delivery Documentation for Pesticides and Fertilizers: For informational purposes, within 5 working days of each application, submit purchase orders, invoices, and receipts showing supplier name and address, person who sold product, date of purchase, specific product purchased, quantity purchased, and delivery date.
- B. Documentation of Accepted Conditions: Within 7 working days after the Owner's acceptance of maintenance responsibility, submit color photographs and a written report documenting the accepted conditions of the plant material.
- C. Inspection Reports: For informational purposes, submit monthly plant inspection report documenting signs of stress.
- D. Record of Irrigation Watering Times: For informational purposes, weekly submit a log of daily watering times for each remote control valve.
- E. Record of Soil Moisture Conditions: For informational purposes, weekly submit a log of tensiometer readings and observations of the moisture conditions of the soil that is physically extracted with a soil sampling tube or soil auger.

1.5 QUALITY ASSURANCE

- A. Landscape Maintenance Contractor Qualifications:
 - 1. Demonstrated experience in maintenance of commercial landscape projects.
 - 2. Demonstrated experience in landscape maintenance supervision, with experience and training in integrated pest management, turf management, entomology, pest control, soils, fertilizers and plant identification.
 - 3. Thoroughly familiar and trained in the work to be accomplished and perform the task in a competent efficient manner.
 - 4. Must directly employ and supervise the Work force at all times.
 - 5. Must notify the Owner's Representative of changes in supervision.
 - 6. Must provide proper identification for landscape maintenance firm's labor force.
- B. Regulatory Requirements:
 - 1. Meet requirements of applicable laws, codes, and regulations required by authorities having jurisdiction over Work.
 - 2. Provide for inspections and permits required by Federal, State, or local authorities in furnishing, transporting, and installing of chemicals.
 - 3. Submit a record of herbicides, insecticides and disease control chemicals used to the County Agricultural Commissioner's Office as required by law.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Plant Material: Meet requirements of Section 32 93 00.
- B. Sod: Meet requirements of Section 32 92 23.

1.7 SITE CONDITIONS

- A. Environmental Requirements: Do not apply chemicals during windy conditions.

1.8 SEQUENCING AND SCHEDULING

- A. Work Schedule:
1. Perform maintenance during normal working hours.
 2. Be present at the project site at least once a week and as often as necessary to perform specified maintenance.
- B. Chemical Applications:
1. Notify the Owner's Representative in advance of required chemical applications.
 2. Obtain the Owner's Representative's approval of application schedule.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Replacement Plant Material:
1. Match existing genus, species, cultivar and size.
 2. Meet requirements of Section 32 93 00.
 3. Meet requirements of ANSI Z60.1, ICBN and ICNCP.
- B. Seed: Match existing genus, species, varieties and cultivars.
- C. Fertilizers for Lawn, Ground Cover, Shrub, and Tree Areas: As specified by the maintenance fertilization program accepted by the Architect.
- D. Pesticides: Legal commercial quality non-staining materials with original manufacturers' containers, properly labeled with guaranteed analysis, least toxic required.
- E. Replacement Staking Materials: Same as original installation.
- F. Mulch: Same as original installation.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protection of Existing Conditions:
1. Use all reasonable precautions to prevent damage to existing conditions to remain such as structures, utilities, plant materials and walks on or adjacent to the site of the Work.
 2. Provide barricades, fences or other barriers to protect existing conditions from damage during maintenance operations.
 3. Use all reasonable precautions to prevent excessive compaction of planting area soil within or adjacent to the areas of Work.
 4. Do not store materials or equipment, permit burning, or operate or park equipment under the branches of existing plants.

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5. Submit written notification of damaged plants and structures to the Owner's Representative immediately.

3.2 GENERAL MAINTENANCE

- A. Maintenance Period: Continuously maintain plants, planted areas, and irrigation system during progress of Work, and for a minimum period of 1 year after date of Substantial Completion of entire Project and until the Owner accepts maintenance responsibility.
- B. Integrated Pest Management: Employ principles of integrated pest management for each aspect of maintenance.

3.3 TREE AND SHRUB MAINTENANCE

- A. General Watering:
 1. Using a soil sampling tube or soil auger and tensiometers, check rootball moisture and surrounding soil moisture at representative plants at least twice a week.
 2. Form and maintain watering basins around trees and shrubs if required to apply enough water to establish moisture through root zones.
 3. In rainy season, open basins to allow surface drainage away from the root crown where excess water may accumulate.
 4. Restore watering basins at end of rainy season, if basins are still needed for adequate watering of plants.
 5. Remove watering basin berms at the end of the maintenance period and form mulch area around trees and shrubs as indicated on the Drawings.
 6. Adjust frequency and length of time for watering cycles according to changing soil and weather conditions.
 7. If required to provide the correct amount of water to the trees, provide supplemental water via hand watering of tree root zones, using a water wand to break the water force.
 8. Do not permit crown roots to become exposed to air through dislodging of soil and mulch.
 9. Maintain depth of mulch to reduce evaporation and frequency of watering.
 10. Weekly, submit a log of tensiometer readings and soil moisture observations for the previous week for informational purposes.
- B. Settled or Leaning Plants: Reset plants to proper grades or upright position when weather and soil conditions permit.
- C. Weed Control:
 1. Keep mulched areas between plants and watering basins weed free.
 2. As a last resort use least toxic herbicides that will be effective in controlling weeds.
 3. Avoid frequent soil cultivation that destroys shallow roots.
- D. General Tree Pruning:
 1. Meet requirements of ANSI A300 for Definitions, Pruning Tools and Equipment, Pruning Cuts, and Wound Treatment.
 2. Perform crown cleaning to eliminate weak branches, water sprouts, dead growth, dying growth, diseased growth, and damaged growth.
 3. Perform crown thinning to reduce toppling and wind damage.
 4. Perform crown reduction and shaping to maintain growth within space limitations and maintain a natural appearance.
 5. Retain lower branches in a "tipped back" or pinched condition to promote caliper trunk growth.

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6. Do not cut back to fewer than six buds or leaves on branches.
 7. Prune damaged trees or those that constitute health or safety hazards at any time of year.
- E. Tree Staking:
1. Inspect stakes and ties at least once a week to check for rubbing that causes bark wounds.
 2. Adjust tree stakes and ties as often as required to allow tree caliper growth and prevent bark wounds.
 3. Replace defective materials with materials to match original materials.
- F. Dust Removal:
1. Remove dust caused by construction traffic and operations from the foliage of plants as often as required to keep dust from having a detrimental effect on the health of the plants.
 2. Remove dust by spraying with potable water.
- G. Replacement of Plants: Replace, at no additional cost to the Owner, and as soon as weather conditions permit, plants not in a vigorous, thriving condition, as determined by the Arborist.

3.4 GROUND COVERS

- A. Watering:
1. Using tensiometers and a soil sampling tube or soil auger, check for moisture penetration throughout the root zone at least twice a week.
 2. Water as frequently as necessary to maintain healthy growth of ground covers and trees planted within ground cover areas.
 3. Adjust frequency and length of time for watering cycles according to changing soil and weather conditions.
 4. Weekly, submit a log of tensiometer readings and soil moisture observations for the previous week.
- B. Weed Control:
1. Maintain mulch layer.
 2. Minimize hoeing of weeds to avoid plant damage.
 3. As a last resort use least toxic, effective herbicides required.
- C. Fertilization During Growing Season:
1. Apply fertilizer as specified by the accepted fertilization program, after planting, until the Owner accepts maintenance.
 2. Meet requirements of fertilizer manufacturer's current printed instructions.
 3. Apply fertilizers evenly over planting areas by spreading half the fertilizer in one direction and half in a direction 90 degrees to the first direction to assure even application.
 4. Apply dry fertilizers with either a broadcast centrifugal or gravity spreader on planting bed areas.
 5. Water planting areas thoroughly after application.
- D. Replacement of Ground Cover: Replace, at no additional cost to the Owner, and as soon as soil and weather conditions permit, ground cover plants not in vigorous, thriving condition, as determined by the Horticulturalist.

3.5 LAWN

A. Watering:

1. Using tensiometers and a soil sampling tube or soil auger and tensiometers, check for moisture penetration throughout the root zone at least twice a week.
2. Water lawns at such frequency as weather conditions require to replenish soil moisture to 6 inches below root zone.
3. As a general rule, provide a total of 1-1/2 inches of water weekly during hot summer weather, in 3 applications per week.
4. Apply less water if required to prevent trees from being over-watered.
5. Water at night.
6. Weekly, submit a log of tensiometer readings and soil moisture observations for the previous week.

B. Weed Control:

1. As a last resort, control broadleaf weeds with least toxic herbicides.
2. Coordinate application of herbicides with thatch control and reseeding schedule.

C. Mowing and Edging:

1. Mow to a height of 2 inches when it reaches a height of 2 1/2 inches.
2. Trim edges at least twice a month or as needed for neat appearance.
3. Remove and dispose of grass clippings.

D. Fertilization During Growing Season:

1. Apply fertilizer as specified by the accepted fertilization program after planting until the Owner accepts maintenance.
2. Meet requirements of fertilizer manufacturer's current printed instructions.
3. Apply fertilizers evenly over planting areas by spreading half the fertilizer in one direction and half in a direction 90 degrees to the first direction to assure even application.
4. Apply dry fertilizers with either a broadcast centrifugal or gravity spreader on planting bed areas.
5. Water planting areas thoroughly after application.

E. Resodding of Lawn Areas: Replace, at no additional cost to the Owner, and as soon as weather conditions permit, lawn areas not in a vigorous, thriving condition, as determined by the Horticulturalist.

F. Aeration:

1. Aerate lawn areas two times during maintenance period, once in spring and once in fall.
2. Aerate just prior to fertilizer application or reseeding.
3. Do not aerate during times of drought, high heat, or weed infestations.
4. Do not aerate until roots are well established.
5. Use a piston-driven type aerifier with 4-inch long by 1/2-inch diameter hollow tines.
6. Moisten soil to 6-inch depth a few days prior to aeration to help achieve full depth penetration with the tines.
7. Remove cores from the lawn surface and dispose of cores.

3.6 PESTS AND DISEASE CONTROL

A. General:

1. Employ principles of IPM in the selection of preventative and control measures for plant pests and diseases.

2. Insignificant pests are acceptable providing they do not seriously threaten planting health and appearance, as determined by the Arborist and Landscape Architect.
3. Monitor the site closely and take timely action to address problems identified.
4. Use a licensed pest control operator for spraying pesticides and use only materials approved by the EPA and that conform to applicable laws, codes and regulations.
5. Spray with extreme care to avoid hazards to any person, animal, or automobile in the area or adjacent areas.
6. Meet requirements of pesticide manufacturer's current printed instructions.
7. The Contractor shall be held liable for plant damage due to the use of pesticides.

B. Inspection:

1. Inspect plant material weekly for signs of stress and damage.
2. Submit a written and photographic inspection report of findings monthly to the Owner's Representative.

C. Spraying:

1. When necessary apply the least toxic pesticide required for the existing problem.
2. Meet requirements of pesticide manufacturer's current printed instructions.
3. Apply pesticide only if a pest or disease is a serious threat and cease application after problem is under control.

D. Herbicide Treatment of Lawn:

1. Apply Pythium damping-off herbicide immediately after sodding, according to label instructions.
2. Apply herbicide a second time 7-14 days later, and apply a third time 7-14 days after the second application.

3.7 IRRIGATION SYSTEM

A. Damages:

1. Repair at no additional cost to the Owner damages to system caused by Contractor's operations.
2. Perform repairs before next irrigation cycle commences.

B. Cleaning and Monitoring the System:

1. Continually monitor the irrigation systems to verify that they are functioning properly as designed.
2. Clean filters and strainers at least once a month and as often as necessary to keep the irrigation systems free of sand and other debris.
3. Set and continuously adjust and program automatic controller for seasonal water requirement.
4. Make program adjustments as required by changing field conditions.
5. At least once a week, daily when required, use a soil sampling tube and tensiometers to check the rootball moisture of representative plants as well as the surrounding soil.
6. Prevent or minimize spraying on paving, windows, building walls, and other structures, by balancing the throttle control on the remote control valves and the adjustment screws on the sprinkler heads.
7. Do not allow water to atomize and drift.
8. Daily record watering times set for each remote control valve, and submit a log of times weekly, for informational purposes.

3.8 AGGREGATE MULCH AND WOOD CHIP MULCH AREAS

- A. Surface Smoothness: Smooth out finished surfaces of mulch twice monthly.
- B. Weed Control:
 - 1. Maintain areas weed-free.
 - 2. As a last resort, control weeds with pesticides and use least toxic pesticides required to control weeds.
- C. Mulch Replenishment: During the last month of the maintenance period, add mulch to settled areas to bring finished surfaces back to the levels indicated on the Drawings.

3.9 FIELD QUALITY CONTROL

- A. Maintenance Review:
 - 1. At the end of the one-year maintenance period, request the Architect, Arborist, and Horticulturalist to review Work.
 - 2. Submit a written request at least five working days prior to the anticipated date of review.
 - 3. If the Architect, Arborist, or Horticulturalist observe Work that fails to meet the Contract Document requirements the Contractor will receive written notification from the Architect of corrective Work preventing Owner acceptance of the maintenance Work.
 - 4. Perform corrective Work within 10 calendar days after the review.
 - 5. Upon completion of the corrective Work, request the Architect to review the Work.
 - 6. Corrective Work followed by Architect's, Arborist's, and Horticulturalists review will be required until the Architect, Arborist, and Horticulturalist no longer observe Work not meeting the Contract Document requirements.
- B. Owner's Acceptance of Maintenance Responsibility:
 - 1. When it appears to the Landscape Architect, Arborist, and Horticulturalist that the maintenance Work conforms to the requirements of the Contract Documents the Contractor will receive written notification designating the day which the Owner will accept maintenance responsibility.
 - 2. Continue maintenance of landscape Work until the date that the Owner accepts maintenance responsibility.

END OF SECTION

SECTION 32 05 23
CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section shall cover site work concrete constructed upon the prepared subgrade and in conformance with the lines, grades, thickness, and cross sections shown. Construction shall include the following: equipment pads, curbs, vehicular driveways, and parking lots.
- B. Pavement work includes colored concrete and special finishing as specified under Section 32 13 15, ARCHITECTURAL SITE CONCRETE for work indicated on the MATERIALS PLAN of Landscape Drawings.
- C. Alternate: See Section 01 23 00 – Alternates for description of work under this Section affected by alternates.

1.2 RELATED WORK

- A. Laboratory and Field Testing Requirements: Section 01 45 29, TESTING LABORATORY SERVICES.
- B. Subgrade Preparation: Section 31 20 00, EARTH MOVING.
- C. Concrete Materials, Quality, Mixing, Design and Other Requirements: Section 03 30 01, CAST-IN-PLACE-CONCRETE (SITE STRUCTURES).
- D. Metal Components of Steps (Railing): Section 05 50 00, METAL FABRICATIONS.
- E. Colored Concrete, Curb, and Paving Finishes: Section 32 13 15, ARCHITECTURAL SITE CONCRETE.
- F. Sealants: Section 07 92 05, SITE SEALANTS.
- G. Finishes, form materials, quality control, and execution requirements for concrete paving, curbs, curb ramps, as indicated on the MATERIALS PLAN of Landscape Drawings: Section 32 13 15, ARCHITECTURAL SITE CONCRETE.

1.3 DESIGN REQUIREMENTS

- A. Design all elements with the latest published version of applicable codes.

1.4 WEATHER LIMITATIONS

- A. Placement of concrete shall be as specified under Article 3.8, COLD WEATHER and Article 3.7, HOT WEATHER of Section 03 30 01, CAST-IN-PLACE CONCRETE (SITE STRUCTURES).

1.5 SUBBASE MATERIAL

- A. Subbase material is specified in Section 31 20 00, Earthmoving.

1.6 SUBMITTALS

- A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:
- B. Manufacturers' Certificates and Data certifying that the following materials conform to the requirements specified.
1. Expansion joint filler
 2. Hot poured sealing compound
 3. Reinforcement
 4. Curing materials
- C. Data and Test Reports: Select subbase material.
1. Job-mix formula.
 2. Source, gradation, liquid limit, plasticity index, percentage of wear, and other tests as specified and in referenced publications.

1.7 QUALITY ASSURANCE

- A. Job Mock-ups: See Section 32 13 15, ARCHITECTURAL SITE CONCRETE.

1.8 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. Refer to the latest edition of all referenced Standards and codes.
- B. American Association of State Highway and Transportation Officials (AASHTO):
- M031MM031-07-UL.....Deformed and Plain Billet Steel Bars for Concrete Reinforcement (ASTM A615/A615M-96A)
- MO55MM055-09-UL.....Welded Steel Wire Fabric for Concrete Reinforcement (ASTM A185)
- M147-65-UL.....Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses (R 1996)
- M148-05-UL.....Liquid Membrane-Forming Compounds for Curing Concrete (ASTM C309A)

- M171-05-UL Sheet Materials for Curing Concrete (ASTM C171)
- M182-05-UL Burlap Cloth Made from Jute or Kenaf
- M213-01-UL Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Type) (ASTM D1751)
- M233-86-UL Boiled Linseed Oil Mixer for Treatment of Portland Cement Concrete
- TO99-09-UL Moisture-Density Relations of Soils Using a 2.5 kg. (5.5 lb) Rammer and a 305 mm (12 in.) Drop
- T180-09-UL Moisture-Density Relations of Soils Using a 4.54 kg (10 lb.) Rammer and a 457 mm (18 in.) Drop
- C. American Society for Testing and Materials (ASTM):
- C94/C94M-09 Ready-Mixed Concrete
- C143/C143M-09 Slump of Hydraulic Cement Concrete

PART 2 - PRODUCTS

2.1 GENERAL

- A. Concrete shall be Type C, air-entrained as specified in Section 03 30 01, CAST-IN-PLACE CONCRETE (SITE STRUCTURES), with the following exceptions:

<u>TYPE</u>	<u>MAXIMUM SLUMP*</u>
Curb & Gutter	3"
Pedestrian Pavement	3" (See Note 1)
Vehicular Pavement	2" Machine Finished 4" Hand Finished
Equipment Pads	3" to 4"
<ul style="list-style-type: none"> For concrete to be vibrated: Slump as determined by ASTM C143. Tolerances as established by ASTM C94. Additives such as Super-P may be added with the Resident Engineer's prior approval. Vehicular concrete shall have a minimum flexural strength of 650 psi. (See Note 1) 	

Note 1: See Section 32 13 15 for exception for Architectural Site Concrete.

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- B. All concrete exposed-to-view, including but not limited to sidewalks, driveways and curbs shall contain shrinkage compensating mineral admixture (50% compensating). See Section 033001, 2.2 Materials, for requirements.

2.2 REINFORCEMENT

- A. The type, amount, and locations of steel reinforcement shall be as shown on the drawings and in the specifications.
- B. Welded wire-fabric shall conform to AASHTO M55.
1. Sidewalk paving: 6x6 W2.9xW2.9 (Grade 60 minimum).
 2. 8 inch concrete paving: no 4 bars @ 12 inches on center each way.
 3. See Section 32 13 15 for corrosion protection for reinforcement in Architectural Site Concrete.
- C. Dowels shall be plain steel bars conforming to AASHTO M31. Tie bars shall be deformed steel bars conforming to AASHTO M31. See site drawings for requirements.
- D. Micro – Reinforcement: Section 32 13 15 for this requirement for Architectural Site Concrete.

2.3 SUBBASE

- A. Subbase material is specified in Section 31 20 00 Earthmoving.
- B. Subbase material shall produce a compacted, dense-graded course, meeting the density requirement specified herein.

2.4 FORMS

- A. Use metal or wood forms that are straight and suitable in cross-section, depth, and strength to resist springing during depositing and consolidating the concrete, for the work involved.
- B. Do not use forms if they vary from a straight line more than 1/8 inch in any ten foot long section, in either a horizontal or vertical direction.
- C. Wood forms should be at least 2 inches thick (nominal). Wood forms shall also be free from warp, twist, loose knots, splits, or other defects. Use approved flexible or curved forms for forming radii.

2.5 CONCRETE CURING MATERIALS

- A. Concrete curing materials shall conform to one of the following:
1. Burlap conforming to AASHTO M182 having a weight of 233 grams (seven ounces) or more per square meter (yard) when dry. (Burlap shall not be used on Architectural Site Concrete.)
 2. Impervious Sheeting conforming to AASHTO M171.
 3. Liquid Membrane Curing Compound conforming to AASHTO M148 (ASTM C309), Type 2 and shall be free of paraffin or petroleum.

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4. Architectural Site Concrete: See Section 32 13 15.

2.6 EXPANSION JOINT FILLERS

- A. Material shall conform to AASHTO M213.
1. Expansion joint material shall be "REDWOOD". Thickness and location as shown on the drawings.
 2. Expansion joint fillers: See Section 32 13 15.

PART 3 - EXECUTION

3.1 SUBGRADE PENETRATION

- A. Prepare, construct, and finish the subgrade as specified in Section 31 20 00, EARTH MOVING.
- B. Maintain the subgrade in a smooth, compacted condition, in conformance with the required section and established grade until the succeeding operation has been accomplished.

3.2 SUBBASE

- A. Reference Section 31 20 00 Earthmoving for additional information on site preparation, filling, backfilling, and grading requirements.
- B. Placing:
1. Place structural fill on the prepared subgrade in a uniform layer to the required contour and grades, and to a loose depth not to exceed 8 inches, and that when compacted, will produce a layer of the designated thickness.
 2. When the designated compacted thickness exceeds 6 inches, place the material in layers of equal thickness. Remove unsatisfactory areas and replace with satisfactory material in the area.
 3. In no case will the addition of thin layers of material be added to the top layer in order to meet grade.
 4. If the elevation of the top layer is 1/2 inch or more below the grade, excavate the top layer and replace with new material to a depth of at least 3 inches in compacted thickness.
- C. Compaction:
1. Perform compaction with approved equipment (hand or mechanical) well suited to the material being compacted.
 2. Moisten or aerate the material as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used.
 3. Compact each layer to at least 95 percent of maximum dry density as determined by ASTM D1557.
- D. Smoothness Test and Thickness Control:
- Test the completed subbase for grade and cross section with a straight edge.
1. The surface of each layer shall not show any deviations in excess of 3/8 inch.
 2. The completed thickness shall be within 1/2 inch of the thickness as shown.

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- E. Protection:
1. Maintain the finished subbase in a smooth and compacted condition until the concrete has been placed.
 2. When Contractor's subsequent operations or adverse weather disturbs the approved compacted subbase, excavate, and reconstruct it with new material meeting the requirements herein specified, at no additional cost to the VA.

3.3 SETTING FORMS

- A. Base Support:
1. Compact the base material under the forms true to grade so that, when set, they will be uniformly supported for their entire length at the grade as shown.
 2. Correct imperfections or variations in the base material grade by cutting or filling and compacting.
- B. Form Setting:
1. Set forms sufficiently in advance of the placing of the concrete to permit the performance and approval of all operations required with and adjacent to the form lines.
 2. Set forms to true line and grade and use stakes, clamps, spreaders, and braces to hold them rigidly in place so that the forms and joints are free from play or movement in any direction.
 3. Forms shall conform to line and grade with an allowable tolerance of 1/8 inch when checked with a straightedge and shall not deviate from true line by more than 1/4 inch at any point.
 4. Do not remove forms until removal will not result in damaged concrete or at such time to facilitate finishing.
 5. Clean and oil forms each time they are used.
- C. The Contractor's Registered Professional Land Surveyor, specified in Section 00 72 00, GENERAL CONDITIONS, shall establish and control the alignment and the grade elevations of the forms or concrete slip forming machine operations.
1. Make necessary corrections to forms immediately before placing concrete.
 2. When any form has been disturbed or any subgrade or subbase has become unstable, reset and recheck the form before placing concrete.

3.4 EQUIPMENT

- A. The Resident Engineer shall approve equipment and tools necessary for handling materials and performing all parts of the work prior to commencement of work.
- B. Maintain equipment and tools in satisfactory working condition at all times.

3.5 PLACING REINFORCEMENT

- A. Reinforcement shall be free from dirt, oil, rust, scale or other substances that prevent the bonding of the concrete to the reinforcement.
- B. Before the concrete is placed, the Resident Engineer shall approve the reinforcement, which shall be accurately and securely fastened in place with suitable supports and ties. The type, amount, and position of the reinforcement shall be as shown.

3.6 PLACING CONCRETE - GENERAL

- A. Obtain approval of the Resident Engineer before placing concrete.
- B. Remove debris and other foreign material from between the forms before placing concrete. Obtain approval of the Resident Engineer before placing concrete.
- C. Before the concrete is placed, uniformly moisten the subgrade, base, or subbase appropriately, avoiding puddles of water.
- D. Convey concrete from mixer to final place of deposit by a method which will prevent segregation or loss of ingredients. Deposit concrete so that it requires as little handling as possible.
- E. While being placed, spade or vibrate and compact the concrete with suitable tools to prevent the formation of voids or honeycomb pockets. Vibrate concrete well against forms and along joints. Over-vibration or manipulation causing segregation will not be permitted. Place concrete continuously between joints without bulkheads.
- F. Install a construction joint whenever the placing of concrete is suspended for more than 30 minutes and at the end of each day's work.
- G. Workmen or construction equipment coated with foreign material shall not be permitted to walk or operate in the concrete during placement and finishing operations.

3.7 PLACING CONCRETE FOR CURB AND GUTTER, AND PEDESTRIAN PAVEMENT

- A. Place concrete in the forms in one layer of such thickness that, when compacted and finished, it will conform to the cross section as shown.
- B. Deposit concrete as near to joints as possible without disturbing them but do not dump onto a joint assembly.
- C. After the concrete has been placed in the forms, use a strike-off guided by the side forms to bring the surface to the proper section to be compacted.
- D. Consolidate the concrete thoroughly by tamping and spading, or with approved mechanical finishing equipment.
- E. Finish the surface to grade with a wood or metal float.
- F. All Concrete pads and pavements shall be constructed with sufficient slope to drain properly. Areas which experience ponding shall be replaced at the expense of the Contractor.

3.8 PLACING CONCRETE FOR VEHICULAR PAVEMENT

- A. Deposit concrete into the forms as close as possible to its final position.
- B. Place concrete rapidly and continuously between construction joints.

- C. Strike off concrete and thoroughly consolidate by a finishing machine, vibrating screed, or by hand-finishing.
- D. Finish the surface to the elevation and crown as shown.
- E. Deposit concrete as near the joints as possible without disturbing them but do not dump onto a joint assembly. Do not place adjacent lanes without approval by the Resident Engineer.

3.9 CONCRETE FINISHING - GENERAL

- A. The sequence of operations, unless otherwise indicated, shall be as follows:
 - 1. Consolidating, floating, straight-edging, troweling, texturing, and edging of joints.
 - 2. Maintain finishing equipment and tools in a clean and approved condition.
- B. Refer to Section 32 13 15 ARCHITECTURAL SITE CONCRETE, for additional information on Finish Requirements.

3.10 CONCRETE FINISHING CURB

- A. Round the edges of the gutter and top of the curb with an edging tool to a radius of 1/4 inch or as otherwise detailed.
- B. Float the surfaces and finish with a smooth wood or metal float until true to grade and section and uniform in textures.
- C. Finish the surfaces, while still wet, with a bristle type brush with longitudinal strokes.
- D. Immediately after removing the front curb form, rub the face of the curb with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. Brush the surface, while still wet, in the same manner as the gutter and curb top.
- E. Except at grade changes or curves, finished surfaces shall not vary more than 1/8 inch for gutter and 1/4 inch for top and face of curb, when tested with a 10 foot straightedge.
- F. Remove and reconstruct irregularities exceeding the above for the full length between regularly scheduled joints.
- G. Correct any depressions which will not drain.
- H. Visible surfaces and edges of finished curb shall be free of blemishes, form marks, and tool marks, and shall be uniform in color, shape, and appearance.
- I. Refer to Section 32 13 15 ARCHITECTURAL CONCRETE, for additional information on Curb Finishing Requirements.

3.11 CONCRETE FINISHING FOR VEHICULAR PAVEMENT

- A. Accomplish longitudinal floating with a longitudinal float not less than 10 feet long and 6 inches wide, properly stiffened to prevent flexing and warping. Operate the float from foot bridges in a

sawing motion parallel to the direction in which the pavement is being laid from one side of the pavement to the other, and advancing not more than half the length of the float.

- B. After the longitudinal floating is completed, but while the concrete is still plastic, eliminate minor irregularities in the pavement surfaces by means of metal floats, 5 feet in length, and straightedges, 10 feet in length. Make the final finish with the straightedges, which shall be used to float the entire pavement surface.
- C. Test the surface for trueness with a 10 foot straightedge held in successive positions parallel and at right angles to the direction in which the pavement is being laid and the entire area covered as necessary to detect variations. Advance the straightedge along the pavement in successive stages of not more than one half the length of the straightedge. Correct all irregularities and refinish the surface.
- D. The finished surface of the pavement shall not vary more than 1/4 inch in both longitudinal and transverse directions when tested with a 10 foot straightedge.
- E. The thickness of the pavement shall not vary more than 1/4 inch.
- F. When most of the water glaze or sheen has disappeared and before the concrete becomes nonplastic, give the surface of the pavement a broomed finish with an approved fiber broom not less than 450 mm (18 inches) wide. Pull the broom gently over the surface of the pavement from edge to edge. Brooming shall be transverse to the line of traffic and so executed that the corrugations thus produced will be uniform in character and width, and not more than 3 mm (1/8 inch) in depth. Carefully finish the edge of the pavement along forms and at the joints with an edging tool. The brooming shall eliminate the flat surface left by the surface face of the edger.
- G. The finish surfaces of new and existing abutting pavements shall coincide at their juncture.
- H. Refer to Section 32 13 15 ARCHITECTURAL CONCRETE, for additional information on Vehicular Pavement Finish Requirements.

3.12 CONCRETE FINISHING EQUIPMENT PADS

- A. After the surface has been struck off and screened to the proper elevation, give it a smooth dense float finish, free from depressions or irregularities.
- B. Carefully finish all slab edges with an edger having a radius as shown in the Drawings.
- C. After removing the forms, rub the faces of the pad with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. The finish surface of the pad shall not vary more than 1/8 inch when tested with a 10 foot straightedge.
- D. Correct irregularities exceeding the above.

3.13 JOINTS - GENERAL

- A. Place joints, where shown, conforming to the details as shown, and perpendicular to the finished grade of the concrete surface.
- B. Joints shall be straight and continuous from edge to edge of the pavement.

3.14 CONTRACTION JOINTS

- A. Cut joints to depth as shown by sawing with a blade producing the required width and depth as indicated on the drawings. Immediately cut joints into hardened concrete as soon as a surface will not be torn, abraded, or otherwise damaged by cutting action. Defects resulting from improper cut times will be rejected.
- B. Construct joints in curbs by inserting 1/8 inch steel plates conforming to the cross sections of the curb. Curb joints locations shall align with concrete pavement joints.
- C. Plates shall remain in place until concrete has set sufficiently to hold its shape and shall then be removed.
- D. Finish edges of all joints with an edging tool having the radius as shown.
- E. Sawcut pedestrian pavement with a blade producing the required width and depth as indicated on the drawings. Immediately cut joints into hardened concrete as soon as a surface will not be torn, abraded, or otherwise damaged by cutting action. Defects resulting from improper cut times will be rejected.

3.15 EXPANSION JOINTS

- A. Use an expansion joint filler material of type and thickness as shown to form expansion joints.
- B. Material shall extend the full depth of concrete, cut and shaped to the cross section as shown, except that top edges of joint filler shall be below the finished concrete surface where shown to allow for sealing.
- C. Anchor with approved devices to prevent displacing during placing and finishing operations.
- D. Round the edges of joints with an edging tool having the radius as shown.
- E. Form expansion joints as follows:
 - 1. Without dowels, about structures and features that project through, into, or against any site work concrete construction.
 - 2. Using joint filler of the type, thickness, and width as shown.
 - 3. Installed in such a manner as to form a complete, uniform separation between the structure and the site work concrete item.

3.16 CONSTRUCTION JOINTS

- A. Locate longitudinal and transverse construction joints between slabs of vehicular pavement as shown.
- B. Place transverse construction joints of the type shown, where indicated and whenever the placing of concrete is suspended for more than 30 minutes.
- C. Use a butt-type joint with dowels in curb if the joint occurs at the location of a planned joint.
- D. Use keyed joints with tiebars if the joint occurs in the middle third of the normal curb joint interval.

3.17 FORM REMOVAL

- A. Forms shall remain in place at least 12 hours after the concrete has been placed. Remove forms without injuring the concrete.
- B. Do not use bars or heavy tools against the concrete in removing the forms. Promptly repair any concrete found defective after form removal.

3.18 CURING OF CONCRETE

- A. Cure concrete by one of the following methods appropriate to the weather conditions and local construction practices, against loss of moisture, and rapid temperature changes for at least seven days from the beginning of the curing operation. Protect unhardened concrete from rain and flowing water. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready to install before actual concrete placement begins. Provide protection as necessary to prevent cracking of the pavement due to temperature changes during the curing period. If any selected method of curing does not afford the proper curing and protection against concrete cracking, remove and replace the damaged pavement and employ another method of curing as directed by the Resident Engineer.
- B. Burlap Mat: Provide a minimum of two layers kept saturated with water for the curing period. Mats shall overlap each other at least 6 inches.
- C. Impervious Sheeting: Use waterproof paper, polyethylene-coated burlap, or polyethylene sheeting. Polyethylene shall be at least 4 mils in thickness. Wet the entire exposed concrete surface with a fine spray of water and then cover with the sheeting material. Sheets shall overlap each other at least 12 inches. Securely anchor sheeting.
- D. Liquid Membrane Curing:
 - 1. Apply pigmented membrane-forming curing compound in two coats at right angles to each other at a rate of 200 square feet per gallon for both coats.
 - 2. Do not allow the concrete to dry before the application of the membrane.
 - 3. Cure joints designated to be sealed by inserting moistened paper or fiber rope or covering with waterproof paper prior to application of the curing compound, in a manner to prevent the curing compound entering the joint.
 - 4. Immediately re-spray any area covered with curing compound and damaged during the curing period.
- E. See section 32 13 15, Architectural Site Concrete, for curing procedures.

3.19 CLEANING

- A. After completion of the curing period:
 - 1. Remove the curing material (other than liquid membrane).
 - 2. Sweep the concrete clean.
 - 3. After removal of all foreign matter from the joints, seal joints as herein specified.
 - 4. Clean the entire concrete of all debris and construction equipment as soon as curing and sealing of joints has been completed.

3.20 PROTECTION

- A. The contractor shall protect the concrete against all damage prior to final acceptance by the Government. Remove concrete containing excessive cracking, fractures, spalling, or other defects and reconstruct the entire section between regularly scheduled joints, when directed by the Resident Engineer, and at no additional cost to the Government. Exclude traffic from vehicular pavement until the concrete is at least seven days old, or for a longer period of time if so directed by the Resident Engineer.

3.21 FINAL CLEAN-UP

- A. Remove all debris, rubbish and excess material from the Station.

--- E N D ---

SECTION 32 12 00
STABILIZED FLEXIBLE AGGREGATE PAVING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Stabilized Aggregate Paving.
- B. Related Sections:
 - 1. Colors, finishes, and textures: Section 09 06 00, SCHEDULE FOR FINISHES and NOTES & LEGENDS on Landscape Drawings.
 - 2. Landscape Grading: Section 32 91 19.

1.2 REFERENCES

- A. ASTM — ASTM International:
 - 1. C 136, Method for Sieve Analysis for Fine and Course aggregate.
 - 2. D 1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.

1.3 DEFINITIONS

- A. Acceptance, Acceptable, or Accepted: Acceptance by the Architect in writing.
- B. Finished Surface: The required final grade elevations of stabilized aggregate paving indicated on the Drawings.
- C. Excessive Compaction: Topsoil compaction greater than 75 percent of maximum dry density as determined by ASTM D 1557.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Product Data: Stabilizer.
- C. Samples: Aggregate: 1-pound plastic bag.
- D. Test Reports: Aggregate Sieve Analysis.

1.5 QUALITY ASSURANCE

- A. Blender Requirements: Currently licensed by Stabilizer Solutions to blend and transport stabilizer-aggregate mix.
- B. Regulatory Requirements: Meet requirements of applicable laws, codes, and regulations required by authorities having jurisdiction over such Work.
- C. Mock-Ups:
 - 1. Coordinate mock-up with mock-up required by Section 01 43 39.

2. Employ stabilizer manufacturer's representative to be present during mock-up construction to supervise placement and compaction of stabilizer-aggregate mix.
3. Construct a 10-foot by 10-foot area of stabilized aggregate paving.
4. Install over compacted aggregate base and subgrade.
5. Remove rejected mock-ups immediately from the site.
6. Mock-ups may be installed and remain as part of the permanent installation if found acceptable by the Landscape Architect.
7. The mock-up, when accepted, shall become the project standard for compaction, aggregate consolidation, tolerances and appearance.

1.6 SITE CONDITIONS

A. Environmental Requirements:

1. Meet stabilizer manufacturer's requirements.
2. Do not apply stabilized aggregate during, just prior to, or immediately following rainfall.
3. Do not install stabilized aggregate when ambient temperature is below 40 degrees Fahrenheit.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS AND SUPPLIERS

A. Subject to compliance with the requirements, manufacturers offering stabilized aggregate paving products include, but are not necessarily limited to, the following:

1. Basis of Design:
 - a. Aggregate and Stabilizer-Aggregate Paving Mix: Natural Sand Company, Slippery Rock, Pa (866-867-0052) www.naturalsand.com.
 - b. Stabilizer: Stabilizer Solutions Inc., Phoenix, Ariz.; (800) 336-2468; (602) 225-5900; www.stabilizersolutions.com.

2.2 MATERIALS

A. Aggregate: See . See NOTES & LEGENDS on drawings

1. Color: See NOTES & LEGENDS on drawings.
2. Gradation:

Sieve Designation	% Passing
3/8"	100
No. 4	90-100
No. 8	75-80
No. 16	55-65
No. 30	40-50
No. 100	15-20
No. 200	10-15

- #### B. Stabilizer: Patented, non-toxic, organic binder that is a colorless and odorless concentrated powder that binds decomposed granite or crushed aggregate size less than ¼ inch.

2.3 MIXES

A. Stabilizer-Aggregate Mix:

1. Employ blender to blend and deliver stabilizer-aggregate mix to site.
2. Blender shall thoroughly blend stabilizer binder with aggregate paving material at the manufacturer's recommended rate.
3. Blender shall blend materials in accordance with the manufacturer's recommendations using a mechanical blending unit approved by the manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of General Conditions: Examine site and verify that conditions are suitable to receive Work and that no defects or errors are present which would cause defective installation of products or cause latent defects in workmanship and function.
- B. Aggregate Base: Review aggregate-base course to verify that it has been graded to the correct grades and compacted as required for correct installation of the aggregate paving.
- C. Unsuitable conditions: Before proceeding with Work, notify the Owner's Representative in writing of unsuitable conditions and conflicts.

3.2 PREPARATION

A. Protection of Existing Conditions:

1. Use every possible precaution to prevent damage to existing conditions to remain such as structures, utilities, irrigation systems, plant materials and paving on or adjacent to the site of the Work.
2. Use every possible precaution to prevent excessive compaction of topsoil within or adjacent to the areas of Work.
3. Provide barricades, fences or other barriers as necessary to protect existing conditions to remain from damage during construction.
4. Do not store materials or equipment, permit burning, or operate or park equipment under the branches of existing plants to remain.
5. Submit written notification of conditions damaged during construction to the Owner's Representative immediately.

3.3 SURVEY REQUIREMENTS

- A. Lines and Levels: Establish lines and levels, locate and lay out by instrumentation and similar appropriate means for aggregate paving finish grades.
- B. Staking: Provide a sufficient quantity of grade stakes as required to provide aggregate paving with smooth finish grades and positive drainage.

3.4 INSTALLATION OF STABILIZED AGGREGATE PAVING

A. Placement:

1. Place the stabilizer-aggregate mix on prepared substrate, and rake smooth to the specified grade and cross section profile, allowing for settlement and compaction.
2. Place mix to avoid segregation, in one layer of 2-inch minimum thickness.
3. Depth: Unless otherwise shown on drawings; 3 inches for heavy foot traffic and light vehicles.

B. Watering: Water heavily for full-depth moisture penetration of the stabilized pathway profile in accordance with manufacturer's recommendations. Water activates stabilize. To achieve saturation of stabilized pathway profile, 25 to 45 gallons of water per 1-ton of aggregate mix must be applied. During water application, randomly test for depth of saturation using a probing device which reaches full depth.

C. Compaction:

1. After watering, do not begin compaction sooner than 6 hours nor later than 48 hours.
2. Compact paving mix to 85% relative compaction using a 2 to 4-ton double-drum roller or a 1,000 lb. single drum roller, until surface is firm and smooth and no loose material is present on paving surface.
 - a. Do not use a vibratory plate compactor or vibratory function on roller as vibration separates large aggregate particles.
3. Using a manual tamper, compact edges, joints areas not accessible by the drum roller, until surface is firm and smooth and no loose material is present on paving surface.

D. Watering Compacted Paving Mix: Following compaction, uniformly apply water to the surface of paving mix with a very light spray, taking care not to displace aggregate surface with the spray action.

3.5 FIELD QUALITY CONTROL

A. Inspection of Installed Stabilized Aggregate Paving:

1. Finished surface of paving shall be smooth, uniform and solid, with no evidence of chipping or cracking.
2. Dried, compacted paving material shall be firm through depth of paving with no soft areas.
3. Loose material shall not be present on the surface initially.
4. After the first year of use, a minor amount of loose material is expected on the surface.
5. Amount of loose material present depends on use type and frequency.
6. Repair paving areas that are soft, cracked, chipped, or contain loose material on surface.

3.6 REPAIR

A. Patching Stabilized Aggregate Paving:

1. Excavate cracked, chipped, and soft areas, and replace with new stabilizer-aggregate mix.
2. If excavated area is dry, moisten area lightly, immediately prior to installing stabilizer-aggregate mix.
3. Place stabilizer-aggregate mix over excavated area.
4. Compact small areas of paving mix to finished surface elevation using an 8 to 10-inch square hand tamp or a 1,000-pound roller.
5. Compact large areas of paving mix as specified for the initial installation.

3.7 PROTECTION

- A. Stabilized Aggregate Paving: Protect surface and edges from vehicular and foot traffic for a minimum of 48 hours after compaction by using barricades, fencing or other accepted methods.

END OF SECTION

SECTION 32 13 15
ARCHITECTURAL SITE CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies, but does not provide, items listed below for concrete work indicated on the MATERIALS PLAN of Landscape Drawings, but placed and finished under Sections 03 30 01 and 32 05 23; see RELATED WORK below.
1. Colored and non-colored concrete.
 2. Form materials and Finishes:
 - a. Broom finish.
 - b. Sand blast finish.
 - c. Smooth form finish.
 3. Procedures
 4. Admixtures
 - a. Integral waterproofing.
 - b. Shrinkage compensating.
 5. Joint materials
 6. Quality and execution requirements
 7. Saw cut joint patterns.
 8. Expansion joints and dowels.
 9. Embedded items.
 10. Mix design.
- B. Requirements of this Section supersede similar or same requirements of referenced Sections.
- C. Alternate: See Section 01 23 00, Alternates for description of work under this Section affected by alternates.

1.2 RELATED WORK:

- A. Formed concrete site work: Section 03 30 01, Cast-In-Place Concrete (SS).
- B. Paving and Equipment pads: Section 32 05 23, Cement and Concrete for Exterior Improvements.
- C. Water Feature Coping: Section 06 12 14, Ultra High Performance Concrete Panels.
- D. Water Repellant: Section 07 19 16.
- E. Site Sealants: Section 07 92 05.

1.3 REFERENCES (Latest edition unless otherwise noted)

- A. See 03 30 01, Cast-In-Place Concrete for references cited but not included below.
- B. American Concrete Institute (ACI)

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- C. American Society for Testing and Materials (ASTM):
1. A 767 Zinc-Coated (Galvanized) Steel Bars For Concrete Reinforcement.
 2. A 775 Epoxy-Coated Steel Reinforcing Bars.
 3. A 884 Epoxy-Coated Steel Wire and Welded Wire Reinforcement.
 4. C 171 Sheet Materials For Curing Concrete.
 5. C 309 Liquid Membrane-Forming Compounds For Curing Concrete.
 6. C 979 Pigments for Integrally Colored Concrete.
 7. C 1116 Fiber Reinforced Concrete and Shotcrete.
 8. D 1751 Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
 9. D 1752 Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.

1.4 DEFINITIONS

- A. Installer or Contractor: For purposes of this Section, references to Installer or Contractor shall mean the installing contractor and crew which are assumed to possess specialized technical knowledge and expertise in successful placing and finishing of Architectural Site Concrete required of this Section.

1.5 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Basic Submittals: Submit items required under Sections 03 30 01 and 32 05 23 applicable to this Section, and for all materials and accessories indicated in this Section.
- C. In addition to submittals required under referenced Sections , submit the following for approval:
1. Product Data: Submit for the following:
 - a. Color admixture. Submit color chips not less than 2" x 4" for preliminary selection from manufacturer's full range
 - b. Integral waterproofing,
 - c. Plate dowels, reinforcing, and accessories. . .
 2. Shop Drawings: Note all items receiving color or integral waterproofing.
 - a. Submit field measured drawing of entire paving area. Show locations of contraction and expansion joints.
 - 1) Overall Plan: Scale: Not less than 1/10" = 1'-0".
 - 2) Detail Plans: Scale: Not less than 1" = 1'-0". Include building features including doors, and column centerlines.
 - b. Submit elevations and sections of retaining wall and steps. Show reinforcing.
 - c. Submit plans, and sections of water feature. Show reinforcing.
 - d. Detail joints. Show each type required. Show size, reinforcing, dowels, and sealant assembly. Scale: Not less than half size.
 3. Formwork: Submit shop drawings for fabrication and erection of Architectural concrete formwork for exterior exposed surfaces. Show general construction of forms including jointing, special form joint or rustications, location and pattern of form tie placement, and other items which affect exposed concrete visually.
 - a. Architect's review is for general architectural applications and features only. Design of formwork for structural stability and efficiency is Contractor's responsibility.

- b. Submit sample of plywood forms for approval of surface characteristics; minimum size 1 foot x 1 foot. Sample to be representative of material used for construction.
- 4. Installer Data: Submit data substantiating minimum criteria required by "Colored Concrete Installer" under QUALITY ASSURANCE below including ACI craftsmanship certifications. Approval of installer by color additive manufacturer to be on manufacturer's letter head.
- 5. Manufacturer's Color Additive Agreement: Submit letter by color additive manufacturer indicating that a technical representative will be available for on site inspection as required under FIELD QUALITY CONTROL in Part 3 below.

1.6 QUALITY ASSURANCE

- A. Job Mockups: After approval of samples and before starting work, build Mockup on site for approval. See "Samples" under SUBMITTALS above. Mockups to show finish/texture/color of approved samples. Accepted mockups to remain as an acceptable standard of workmanship and can be part of completed Work. Install at a locations acceptable to Architect.
 - 1. Paving Mockup: Provide minimum 10 foot x 20 foot Mockup of each finish type to match approved 12-inch sample.
 - a. Joints: Mockup to have joint pattern similar to that required for actual paving, including one expansion joint, one transverse contraction joint and one longitudinal contraction joint.
 - b. Textures to be representative of permanent paving. See FINISHES in Part 3 below for textures required.
 - c. Architect's approval required before placing permanent colored paving.
 - d. Repeat process until Mockup is approved by Architect.
 - e. Construct as many mock-ups as necessary to achieve an accepted finish over the entire surface of each mock-up.
 - 2. Wall Mockup: Mockup finish to match approved 12-inch sample.
 - a. Size:
 - 1) Wall: 6 feet wide x 3 feet high x 12 inches thick.
 - 3. Mockup to show the following:
 - a. Finish/texture/color of approved samples.
 - b. Mockup to have joint pattern similar to that required for actual work. Wall to include the following:
 - 1) One vertical expansion joint and one vertical control joint, sawed.
 - 2) Hand tooled edges and corners as approved.
 - 3) Form tie-hole treatment
 - c. Textures and color to be representative of permanent work. See FINISHES in Part 3 below for textures required.
 - d. Architect's approval required before placing permanent work.
 - e. Repeat process until Mockup is approved by Architect.
 - f. Remove rejected mockups from project site.
 - 4. Entire mockup must be acceptable, not portions thereof.
 - 5. After approval, Mockups will be used as a standard for approval of subsequent work of this Section. Accepted mockups to remain as an acceptable standard of workmanship and can be part of completed Work. Install at a location acceptable to Architect.
- B. Colored Concrete Installer:
 - 1. Key personnel including on site Supervisor(s) and Finishers must be Certified under ACI Craftsmanship Certification Programs for
 - a. Concrete Flatwork Finishers.
 - b. Decorative Flatwork (when available; currently under development).

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2. Experience: Successful experience with installation of work of the type required by this project (integrally colored concrete):
 - a. Time: Not less than 5 years.
 - b. Projects: Completed minimum three projects of not less than size required by this. The project sizes must represent the minimum amount of integrally colored concrete formed concrete and flatwork and shall include textures similar to those required for this project.
 - 1) Minimum of 50,000 sq. ft. of colored flatwork in the last 3 years. Furnish list of projects, locations, size, finish texture (sand blasted or troweled), contractor/construction manager, and Architect.
 3. Approved by color additive manufacturer as a qualified installer of concrete of the type required by this project.
- C. Manufacturer's Representative: Manufacturer's representative to be present prior to and at beginning of installation of all colored paving work, including mock-up, to assure proper instruction on mixes installation, and curing procedures. In addition, manufacturer's representative to be present at sufficient intervals during progress of work to assure proper use of their materials.
- D. Pre-Construction Meeting: At least 15 days prior to submittal of design mixes, conduct a meeting to review proposed method of concrete construction to achieve the required results. This meeting may be combined with Pre-Concrete Conference specified under Section 03 30 01, but must address requirements of this Section.
1. Agenda: Includes, but not limited to:
 - a. Submittals
 - b. Coordination of work including concrete work under other Sections.
 - c. Availability of material.
 - d. Concrete mix designs including admixtures.
 - e. Slump; with or without high range admixture.
 - f. Methods of placing, finishing and curing.
 - g. Specialty crew and finishers for colored concrete.
 - h. Controls for color uniformity.
 - i. Weather limitations and protective procedures for rain and ponding water.
 - j. Mockups and evaluation process.
 - k. Material inspection and testing.
 2. Attendees: Include, but not limited to, representatives of Contractor, subcontractors involved in supplying, conveying, placing, finishing, and curing concrete; admixture manufacturers including colored concrete admixture; Resident Engineer, Architect, Landscape Architect, and Owner's retained testing laboratory for testing concrete.
 3. Minutes of the Meeting: Contractor shall take minutes and distribute typed minutes electronically to attendees within 5 days of the meeting.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Color Additives: Comply with manufacturer's instructions. Deliver color additives in original, unopened packaging. Store in dry conditions.
- B. Refer to Section 32 05 23.

1.8 ENVIRONMENTAL CONDITIONS

- A. Colored Concrete Environmental Requirements:

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1. Schedule placement to minimize exposure to wind and hot sun before curing materials are applied.
 2. Avoid placing concrete if rain, snow, or frost is forecast within 24 hours. Protect fresh concrete from moisture and freezing.
- B. Schedule delivery of concrete to provide consistent mix times from batching until discharge.
- C. Weather Conditions: Concrete work to comply with the following requirements as applicable:
1. "Hot Weather Concreting," ACI 305.
 2. "Cold Weather Concreting," ACI 306.
- D. Temperature: When air temperature during placement is less than 40 degrees F or may be within 24 hours, temperature of concrete as placed to conform to limits specified below. Maintain concrete temperature within these limits for the full curing period.
1. Sections Less than 12 Inches Thick: Between 55 and 90 degrees F.
 2. Sections 12 Inches Thick or Greater: Between 50 and 90 degrees F.
- E. Do not place concrete when adverse weather conditions may have a detrimental effect on appearance or integrity of concrete work unless suitable protection is provided.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. All materials to conform to requirements of Section 32 05 23 except as listed below.
- B. Concrete Materials: As specified in Section 32 05 23 - Cement and Concrete for Exterior Improvements.
- C. Color Admixtures: A product for integrally colored concrete, ASTM C979.
1. Colors: See NOTES & LEGENDS on Landscape Drawings.
 2. Color additives shall contain pure, concentrated mineral pigments specially processed for mixing into concrete and complying with ASTM C 979.
 3. Color additives containing carbon black are not acceptable.
 4. Packaging: Package admixture such that one sack contains the proper dosage for one cubic yard of concrete.
 5. Subject to compliance with the requirements, manufacturers offering color admixture products include, but are not necessarily limited to, the following:
 - a. Basis of Design: "Chromix" by L. M. Scofield Co.
 - b. Davis Colors.
 - c. Soloman Colors, Inc.
- D. Waterproofing Admixture and Crack Repair Material: Products for integrally waterproofing concrete and repairing cracks in same, Subject to compliance with the requirements, manufacturers offering waterproofing admixture products include, but are not necessarily limited to, the following:
1. Basis of Design: Xypex.
 2. Anti-Hydro International, Inc.
 - a. Waterproofing Admixture: "Anti-Hydro" or "Anti-Hydro R".
 - b. Crack Repair Material: Anti-Hydro Epoxy Patch No. 122.

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- E. Reinforcing: Bars and welded wire fabric as specified in referenced concrete Sections except reinforcing in paving and curbs to be epoxy or zinc corrosion coated as follows:
1. Bars: ASTM A 775 for epoxy or ASTM 767 for zinc.
 2. Wire Fabric: ASTM A 884 for epoxy
- F. Welded Wire Fabric: Furnish in flat mats for paving or provide equivalent bars.
- G. Micro-Reinforcement: ASTM C 1116, ¾" long, 100 percent pure virgin Nylon-6 fibers.
- H. Formwork: To conform to ACI 347.
1. APA High Density Overlay (HDO) Plywood which will provide an ultra-smooth surface; minimum ¾ inch thick, sealed all edges. Provide in 12 foot minimum lengths to minimize joints.
 - a. Include curb faces if form liner is not used.
 2. Rustication or Chamfer Strips: Not permitted. All joints hand tooled and saw cut.
 3. Ties Below Grade: Standard coil or snap ties with ¾ inch plastic cones on Architectural concrete surfaces.
 4. Ties above Grade: Not permitted. Brace form work without use of ties.
- I. Curing Compound: VOC compliant products compatible with color admixture. Acrylic rubber, non-yellowing, non-staining, ASTM C 309, Class B, except moisture loss not to exceed 0.34 kg/sq.m in 72 hours, 20 percent solids minimum.
1. Dissipating Curing Compound: ASTM C 309, Type 1, Class B, except moisture loss not to exceed 0.18 kg/sq.m in 72 hours, 14 percent solids minimum
 2. Colored Concrete: As recommended by color additive manufacturer.
- J. Abrasive Grit for Sandblasting: Water quenched mineral slag with less than 1.0 percent silica, and a Mohs hardness of not less than 7.0, number 16-30 mesh size. Sand not acceptable.
1. Basis of Design: Opta Minerals Inc., "Ebonygrit" #EG 13, copper slag.
- K. Adhesive for Anchoring Dowels in Concrete: ASTM C 881, 2 component, chemical-resistant, structural epoxy bonding system designed for use in anchoring threaded rods, bolts, reinforcing bars, and smooth dowels into solid material.

2.2 ACCESSORIES

- A. Expansion Joints: Provide the following types where shown:
1. Filler: ASTM D 1752, Type I, closed-cell neoprene sponge rubber with 30 - 40 pounds per cubic foot density, compatible with joint sealant.
 - a. Basis of Design: Sponge Rubber Expansion Joint by W. R. Meadows.
 2. Redwood, clear all heart.
- B. Dowel Bars: Plain steel bars, ASTM A 615, Grade 60. Cut bars true to length with ends square and free of burrs. Sizes as indicated on drawings.
1. Round Dowel Caps: Plastic, approximately 4 inches long, specifically designed and manufactured to fit over expansion joint dowels to allow longitudinal movement of the dowels after the concrete has hardened.
- C. Plate Dowels: Load transfer devices for formed construction joints in slabs.
1. Device composed of plastic pocket former and 4-1/2" square steel plate, ¼" thick, with paint finish.

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2. Devices color coded for plate thickness; orange for ¼" thick plates; yellow for 3/8" thick plates.
 3. Provide ¼" thick plates for slabs up to 7" thick.
- D. Debonding Compound: Product specifically engineered and sold for use on dowel bars, giving complete bond breakage after concrete hardens.
- E. Railing Sleeves: Temporary plastic devices with bottom and tapered sides; minimum 3 inch diameter x 6 inches deep.
- F. Expandable Waterstops: Hydrophilic waterstop composed of modified chloroprene rubber capable of expanding up to eight times its original volume when exposed to water to create an effective compression seal within confined joints. Can withstand hydrostatic pressures of 150 foot head. Provide types suitable for conditions of use. Include manufacturer's recommended adhesive for joints in waterstop.
1. Basis of Design: Hydrotite by Greenstreak, is not a limitation to other manufacturers of comparable products.

2.3 MIXES

- A. The Contractor, with his specialized expertise and experience, is permitted to have input for minor modifications to the mix designs for his work including cement content, use or non-use of admixtures, fly ash, and slump; all predicated on placing acceptable mockups. Such input to be discussed and agreed upon at the Pre-Construction Meeting; see "Pre-Construction Meeting" under QUALITY ASSURANCE in Part 1 above.
- B. Cement Content: A range of 564 to 600 lbs. per cubic yd. is acceptable and is primary control over strength.
- C. Water Cement Ratio: 0.48 maximum.
- D. Formed Work: Nominal 4,000 psi, compressive strength at 28 days with air-entrainment and water reducer as specified in Section 03 30 01, Cast-In-Place Concrete (SS) with the following adjustments:
1. Waterproofing admixture required for water feature.
 2. Shrinkage Compensating Admixture: Provide for Water Feature concrete work
- E. Flatwork: Nominal 4,000 psi, compressive strength at 28 days with air-entrainment and water reducer as specified in Section 32 05 23, Cement and Concrete for Exterior Improvements with the following adjustments:
1. Slump: 4 inches, +/- 1". Not to exceed 5 inches.
 2. High range water reducing admixture (superplasticizer) not permitted for colored concrete, pending preference of contractor.
 3. Fly ash or slag not permitted for colored concrete, pending preference of contractor.
 4. Nylon micro reinforcement required.
 5. Color where indicated on drawings.
- F. Admixtures:
1. Color Admixture: Incorporate at rate necessary to match approved sample. Minimum 2% dosage rate.
 2. Waterproofing Admixture: Incorporate at rate recommended by manufacturer. Provide for Water Feature work only.

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3. Water Reducing Admixture: All concrete shall contain the specified water reducing admixture, or water reducing retarding admixture as needed to meet slump and water/cement ratio; do not use additional water for ease of placement.
 4. Admixtures Not Permitted:
 - a. Calcium chloride or admixtures containing chloride ions are not permitted (3.7.1).
 - b. High range water reducing admixture (superplasticizer) for colored concrete, pending preference of contractor.
 5. Shrinkage Compensating Admixture: As specified under Section 32 05 23, Cement and Concrete for Exterior Improvements. Provide for all work of this Section.
- G. Micro-Reinforcement: Add to mix at rate recommended by manufacturer. Provide for all work of this Section.
- H. Mixing:
1. Mix in accordance with manufacturer's instructions. Mix until color additives are uniformly dispersed throughout mixture and disintegrating bags, if used, have disintegrated.
 2. Do not retemper mix by adding water in field.
 3. Dosage rate of color additive shall not exceed 10 percent of weight of cementitious materials in mix.
 4. Concrete: All concrete is to be ready-mixed (7.2).
 5. Admixtures: All admixtures to be added at batch plant. Meet manufacturer's requirements for dosage rates and mixing.
 - a. Micro reinforcement.
 - b. Color.
 - c. Waterproofing. Provide for Water Feature work only.
 - d. Chemical.
 - 1) Do not use chemical admixtures or mineral admixtures (fly ash) that will affect color of concrete.
 - 2) Provide written documentation from chemical admixture producer that no incompatibilities exist between admixtures used.
 - e. Shrinkage Compensating Admixture: Provide for Water Feature concrete work
- I. Minimum Quantity: Delivered mixed concrete subject to the following quantity limitations:
1. Quantity: Minimum 3 yards.
 2. Mixer Size: Not less than 40% of the capacity of the mixing drum; e.g. a minimum of 4 cubic yards in a 9-yard truck.
 3. Fractional Yardage: Quantities shall be in full-yard increments; e.g. 4, 5, 6, 7, 8, 9 cubic yards. $\frac{1}{4}$, $\frac{1}{3}$, $\frac{1}{2}$, or other fractional yardage not permitted.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Determine field conditions by actual measurement.
- B. Notify the Architect not less than 24 hours in advance of placing concrete. Place concrete only when the Architect is present, unless this requirement is specifically waived.
- C. Examine surface of aggregate base for conformity with required elevations and verify that paving can be satisfactorily installed; proceed only after unsatisfactory conditions have been

corrected. Establish and maintain required lines and grade elevations for each course, including crown and cross-slope.

3.2 PAVING - GENERAL

- A. See COLORED PAVING below.
- B. Reinforcing: In accordance with ACI 301.
 - 1. Place all reinforcing on supports; center in slab thickness unless shown otherwise.
 - 2. Re-Entrant (inside) Corners: Where re-entrant corners cannot be isolated by control joints, provide additional reinforcing as follows:
 - 3. Minimum 2-#4 bars x 24 inches placed at 45 degrees and centered on each corner condition.
- C. Place concrete for full thickness in one operation, without change in proportions; screed to proper elevations; finish and cure as specified.
- D. Prohibited Practices: Prohibited practices include, but are not limited to, the following:
 - 1. Fogging or spraying surface with water.
 - 2. Applying color additives meant for integral coloring to surface.
 - 3. Dusting surfaces with cement.
 - 4. Adding water to concrete at job site.
- E. Construct concrete paving on compacted base accurately formed for required slab thickness and base.
- F. Concrete Curbs and Curb Ramps: Provide as detailed on Landscape Drawings.

3.3 COLORED PAVING

- A. Install materials in accordance with manufacturer's written instructions and approved product data.
- B. Paving to match approved mock-up. Paving not matching approved mock-up to be removed and replaced with new conforming paving at no additional cost to Owner.
- C. Each paved area to use concrete from same batch.
 - 1. Where areas exceed capacity of ready-mix truck, provide construction joints at expansion joint locations indicated on the Drawings so concrete for each subdivided area is placed using materials from single batch.
 - 2. Above requirement may be waived if contractor can demonstrate color control acceptable to Architect.
- D. Curing: See CURING below.
- E. Precautions:
 - 1. Approved mock-up required. See QUALITY ASSURANCE in Part 1 above.
 - 2. Manufacturer's representative present.
 - 3. Water/cement ratios to be kept low and constant.
 - 4. Sand and cement type/brand must be unchanged.
 - 5. Proper placing, finishing, and curing methods to be uniform.

3.4 PAVING JOINTS

- A. Location: Locate as shown on drawings. In absence of information on drawings, provide joints as specified below.
- B. Control Joints (Slabs): Sawed within 8 hours of concrete placement.
 - 1. Sawed: Saw within the time periods specified below. Contractor shall exercise his expertise to determine the optimum time to cut joints in relation to weather conditions.
 - a. Earliest: Upon achieving sufficient hardness that:
 - 1) Surface texture and color is not damaged, and
 - 2) Cut edges do not fray or chip.
 - b. Latest: Before initial shrinkage of slab occurs.
 - 2. Spacing: As indicated on the Drawings.
 - 3. Minimum Depth of Joint: 1/4 slab thickness.
 - 4. Curbs:
 - a. Maximum 10 feet on center and aligned with joints in vehicular paving.
 - b. Minimum depth of joint 1-1/2 inches.
- C. Decorative Joints (Pile-Supported Slabs): Same as "Control Joints" above except minimum depth of joint is 1/4 inch.
- D. Expansion Joints: Formed before concrete placement. Provide expansion joints where indicated on the Drawings and as detailed on the Drawings.
 - 1. Provide joints at the following conditions:
 - a. Where slabs abut vertical surfaces, such as building walls, columns, light pole bases, utility structures,
 - b. Where specifically shown on Drawings.
 - 2. Joints: Full depth of slab or curb.
 - a. Type: Redwood or sealant as shown on drawings.
 - b. Form: Form joints or curbs with the following:
 - 1) Redwood: Set top flush with paving finished surface.
 - 2) Sealant: Set top of joint filler a distance below the paving finished surface equal to the sealant depth recommended by the sealant manufacturer.
 - c. Widths: As shown on drawings.
 - 3. Plate Dowels:
 - a. Install plate dowels in accordance with the manufacturer's current printed installation instructions and at locations, spacing, and vertical positions indicated on the Drawings.
 - b. Cut holes in filler material to fit tightly around plates so that concrete will not leak into gaps between dowel plates and filler material.
 - 4. Round Dowels: Unless indicated otherwise on Drawings:
 - a. Center vertically in slab.
 - b. Center longitudinal position of each dowel horizontally on joint.
 - c. Install at same spacing as slab bar.
 - d. Install a sleeve on one end of each dowel as indicated on the Drawings.
 - e. Prior to installing the sleeve on the dowels, completely coat surfaces of each dowel on the sleeve-side of the expansion joint with debonding compound.
 - f. Cut holes in expansion joint fill material accurately to fit tightly around dowels so that concrete will not leak into gaps between the dowels and expansion joint material.
 - g. Install dowels 90 degrees horizontally and vertically to expansion joint using dowel aligners to help maintain this alignment.
 - h. Install the sleeves in accordance with the manufacturer's current printed instructions.

5. Sealant: Refer to Section 07 92 10.
6. Curbs: Align with joints in pavement or in absence of concrete pavement provide at intervals not to exceed 10 feet.

3.5 FORMWORK

- A. Formwork to conform to ACI 347 and this article.
 1. Erect in accordance with approved shop drawings.
 2. Construct accurately to dimensions, plumb and true to line and grade.
 3. Provide forms that are strong, mortar tight, braced and tied to maintain position and shape during placement of reinforcing and concrete.
 4. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-in-place surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 5. Wavy surfaces, bulged walls or slab surfaces resulting from settlement or springing of formwork will be rejected.
 6. Rustication or Accent strips: Not permitted. Hand tool all joints.
 7. Control Joints: Saw cut
 8. Ties:
 - a. Above Grade: Not permitted. Brace forms as needed without use of ties in concrete.
 - b. Below Grade: Provide below surface snap ties with voids patched after removal.
 9. Flush Joints: Exposed flush joints (without rustication or accent strips) to be taped, caulked, or otherwise sealed in an approved manner to prevent leaks and subsequent discoloration.
 - a. This type joint to be limited to the maximum extent possible.
 - b. Locate joints at rustications, designated control and expansion joints to the maximum extent possible.
 10. Corners:
 - a. Form intersecting planes to provide true, clean-cut corners, with edge grain of plywood not exposed to face of concrete.
 - b. Form exposed corners to produce square smooth, solid unbroken lines, unless indicated otherwise.
 11. Chamfer Strips: Not permitted. Hand tool all external edges and corners.
- B. Control Joints: Sawed: Saw within the time periods specified below. Contractor shall exercise his expertise to determine the optimum time to cut joints in relation to weather conditions.
 1. Earliest: Upon achieving sufficient hardness that:
 - a. Surface texture and color is not damaged, and
 - b. Cut edges do not fray or chip.
 2. Latest: Before initial shrinkage of wall occurs.
 3. Maximum depth of joint 1/2 inches at structurally supported concrete.
- C. Tolerances for Exposed Concrete: When checked with a 10-foot straightedge, units not to vary more the following:
 1. Top Elevations: 1/8 inch.
 2. Horizontal Faces: 1/4 inch.
 3. Vertical Faces: 1/8 inch.
- D. Walls: Form shear keys at all construction joints.

- E. Maintain continual inspection of shores and forms during concrete placement in order to immediately correct any settlement or movement that may occur. Inspection shall continue until concrete has hardened (4.2.6).
- F. Except as listed below, forms and shoring may be removed when concrete has reached a strength of 3,000 psi but not before 7 days from date of placement (4.5.1). Contractor is cautioned to consider affects of form removal timing on color of completed concrete.
 - 1. Exception: Non-structural walls receiving steel trowel finish. After finish is applied, continue curing as specified under CURING AND PROTECTION below.
- G. Railing Sleeves: Set in accurate locations where indicated on drawings.

3.6 REINFORCING

- A. Install reinforcing in accordance with drawings and approved shop drawings.
 - 1. Provide minimum concrete cover as scheduled on structural drawings and ACI 301.
- B. Placement of reinforcing shall be reviewed by the Architect's representative before any arrangements for delivery of concrete are made final.
- C. Supports:
 - 1. Accurately and securely fasten or support reinforcements to prevent displacement before or during concrete placing.
 - 2. Hang footing bars from forms.
- D. Reinforcement Splices:
 - 1. Overlap welded wire fabric one mesh minimum.
 - 2. Reinforcing bar splices shall be ACI Class A lap splices, except where indicated otherwise.
- E. Expansion/Construction Joints:
 - 1. Expansion joints: Reinforcing to be discontinuous at all expansion joints.
 - 2. Construction joints: Continue reinforcing through construction joints.
- F. Dowels: Provide as shown; plate dowels at paving.
- G. Round Expansion Joint Dowels:
 - 1. Unless indicated otherwise on Drawings:
 - a. Center vertically in slab.
 - b. Center longitudinal position of each dowel horizontally on joint.
 - c. Install at same spacing as slab bar.
 - 2. Install a cap on one end of each dowel as indicated on the Drawings.
 - 3. Prior to installing the caps on the dowels, completely coat surfaces of each dowel on the cap-side of the expansion joint with debonding compound.
 - 4. Cut holes in expansion joint fill material accurately to fit tightly around dowels so that concrete will not leak into gaps between the dowels and the expansion joint material.
 - 5. Install dowels 90 degrees horizontally and vertically to expansion joint using dowel aligners to help maintain this alignment.
 - 6. Install the dowel aligned in accordance with the manufacturer's current printed instructions.
- H. Clearances: Except where indicated otherwise on drawings:
 - 1. Provide 2-inch clearance between bar and concrete top and formed side surfaces.

2. Provide 3-inch clearance between bar and bottom of concrete at unformed surfaces of footings and foundations

3.7 SLEEVES

- A. Sleeves for Subdrain Pipe: Install PVC sleeves where pipes pass through water feature pool edge foundation walls.

3.8 PLACING

- A. Preconditions:
 1. Give due notice to the Architect, testing laboratory, and all Contractors affected before placing concrete. Allow adequate time for revision or installation of forms, reinforcing, conduit, inserts, sleeves, etc.
 2. Frames or other items shall be placed to the satisfaction of the Architect and all Contractors affected.
 3. Review of reinforcing.
- B. Concrete shall be discharged from the mixer within 1-1/2 hours after water has been added. This time may be reduced by the Architect if hot weather or other conditions causing quick setting occur (8.2.1).
- C. In no case shall the concrete have a free fall sufficient to cause segregation of the aggregate. In general, the limit free fall shall be 2 feet (8.3.3).
- D. Place concrete continuously between scheduled joints or other indicated stop. Where concrete cannot be placed continuously for item, stop at rustication or similar natural break. Concrete containing cold joints between planned joints to be removed to the next lower planned joint and replaced in accordance with the requirements of this paragraph. Obtain approval of Architect for all breaks in continuous placement.
- E. Weather Conditions: Concrete work to comply with the following requirements as applicable:
 1. "Hot Weather Concreting," ACI 305.
 2. "Cold Weather Concreting," ACI 306.
 3. Section 32 05 23.

3.9 CURB FORMED FINISHES

- A. Appearance: Uniform color and texture to match approved Mockup and comply with requirements of ACI 301 for Architectural Concrete.
- B. Formed Surfaces for Curbs:
 1. Rough Form Finish: For formed concrete surfaces not exposed to view in the finish work or by other construction, unless otherwise indicated. This is the concrete surface having texture imparted by form facing material used, with defective areas repaired and patched.
 2. Smooth Form Finish: For formed concrete surfaces exposed to view. This is as-cast concrete surface obtained with selected form facing material, arranged orderly and symmetrically with a minimum of seams. Repair and patch defective areas with fins or other projections removed. When concrete is stable and free standing, and the surface is still workable remove forms; and provide trowel finish on exposed faces. Fill air-hole voids with a cement paste matching color of concrete wall to obtain a smooth troweled finish void of air holes, fins, and imperfections.

- a. A retarder on the form work may be required to allow the surface to be workable and concrete stable and free standing.
- C. Form Re-Use: For smooth form finishes, forms shall not be reused if there is any evidence of surface wear and tear or defect which would impair the quality of the surface. Forms shall be thoroughly cleaned and properly coated before re-use. (Note: Requirements for form release agents are covered in Section 4.4.2).
- D. Sandblast Finish:
 - 1. Provide light sandblast finish to match approved Mockup.
 - 2. Provide sandblast finish on exposed portions of Architectural concrete and surfaces designated on the Concrete Finish Schedule under SCHEDULE below.
 - a. Allow concrete to cure to sufficient strength that it will not be damaged by blasting but not less than seven days.
 - b. Re-work edges to eliminate wide edge mark left by rounding tool.

3.10 PAVING FINISHES

- A. Tolerances: Class 'B', 1/4 inch in 10 feet, or better (11.9.2).
 - 1. Portions of slabs to receive additional paving materials to be Class 'C', 1/4 inch in 2 feet, or better (11.9.3).
- B. Broom Finish: Light broom finish where shown only.
- C. Steel Troweled & Sandblast Finish, Typical. A two-step process:
 - 1. Steel Troweled Finish: Provide steel troweled finish as soon as conditions permit after normal float finishing.
 - a. Re-work edges to eliminate wide edge mark left by rounding tool.
 - b. After finish, allow concrete to cure to sufficient strength that it will not be damaged by blasting but not less than seven days.
 - 2. Sand Blast Finish: Provide light sandblast finish over steel troweling to exposed paving surfaces to match approved mockup.

3.11 FORMED FINISHES

- A. Appearance: Uniform color and texture to match approved Mockup and comply with requirements of ACI 301 for Architectural Concrete.
- B. Schedule of Finishes on Formed Surfaces:
 - 1. Rough Form Finish: For formed concrete surfaces not exposed to view in the finish work or by other construction, unless otherwise indicated. This is the concrete surface having texture imparted by form facing material used, with tie holes and defective areas repaired and patched.
 - 2. Smooth Form Finish: For formed concrete surfaces exposed to view. This is as-cast concrete surface obtained with selected form facing material, arranged orderly and symmetrically with a minimum of seams. Repair and patch defective areas with fins or other projections removed.
 - a. Vibrate concrete or employ other methods to reduce air-hole voids to a minimum.
 - b. While the surface is still workable, fill air-hole voids with a cement paste matching color of concrete wall.
 - c. Do not apply a sack finish.

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- d. When concrete is stable and free standing, and the surface is still workable remove forms; and provide trowel finish on exposed faces. Fill air-hole voids with a cement paste matching color of concrete wall to obtain a smooth steel troweled finish void of air holes, fins, and imperfections.
 - 1) A retarder on the form work maybe required to allow the surface to be workable and concrete stable and free standing.
 - C. Form Re-Use: For smooth form finishes, forms shall not be reused if there is any evidence of surface wear and tear or defect which would impair the quality of the surface. Forms shall be thoroughly cleaned and properly coated before re-use.
 - D. Sandblast Finish: Typical for surfaces exposed to view, unless indicated otherwise on drawings.
 - 1. Provide light sandblast finish to match the approved Mockup.
 - 2. Provide sandblast finish on exposed portions of Architectural Site Concrete and surfaces designated on drawings.
 - 3. Prior to sandblasting, provide a troweled finish on horizontal surfaces.
 - 4. Perform sandblasting in as continuous operation as possible, utilizing the same work crew to provide a finish matching the approved Mockup.
 - 5. Use specified abrasive grit to expose the aggregate and surrounding matrix surfaces to provide a uniform sandblast finish matching the approved Mockup.
 - 6. Use same nozzle person, nozzle, nozzle pressure and blasting technique as used for the approved Mockup.
 - 7. Blast corners and edge of patterns carefully, using backup boards in order to maintain a uniform corner or edge line.
 - 8. Maintain control of abrasive grit and concrete dust in each area of blasting.
 - 9. Remove expended abrasive grit, concrete dust and debris at the end of each day of blasting operations.
 - 10. Protect adjacent surfaces from being eroded, damaged, or discolored by the sandblasting.

3.12 CURING AND PROTECTION

- A. See "Temperature" under ENVIRONMENTAL CONDITIONS in Part 1 above for thermal requirements to be maintained during cure period.
- B. Cure Time and Sequence:
 - 1. Curing Start: Begin immediately after disappearance of water sheen and continue uninterrupted for the required cure period.
 - 2. Cure Period: Not less than 7 days at required temperatures.
 - 3. Early Form Removal: Where forms are removed before full cure period, apply curing materials as specified below.
- C. Coat surfaces not in contact with forms with impervious membrane film consisting of approved liquid sealing compound applied in atomized form after surface water has entirely disappeared, but while surfaces are still moist. Coat formed surfaces if forms are removed before cure period. Apply in accordance with manufacturer's recommendations.
- D. Re-coat surfaces sandblasted before cure period.

3.13 REPAIR OF SURFACE DEFECTS

- A. General:

1. All voids, damaged places, fins, projections, honeycomb areas, and tie-rod holes shall be removed down to sound concrete and shall be repaired immediately after form removed and after a concrete curing compound is applied.
2. If chipping is necessary, the edge shall be perpendicular to the surface and slightly undercut.
3. At areas to be repaired, the surface shall be thoroughly flushed and scrubbed with water just before patching to remove all loose material.
4. The specified bonding agent shall be used for all patching and the specified epoxy adhesive and/or epoxy mortar shall be used for all structural concrete repairs.
5. All patching and repairs shall have prior approval of the Architect as to method and procedure.
6. Tie holes not exposed in completed Work: Thoroughly and liberally coated with a bonding agent and then thoroughly filled with a non-shrink patching mortar.
7. Acceptance: Repairs to be satisfactory to the Architect; redo repair work until accepted; repairs on exposed work may be rejected for aesthetic reasons. If acceptable repairs cannot be achieved, remove defective work and replace with new concrete until accepted.

3.14 CONCRETE FINISH SCHEDULE

A. Provide the following concrete finishes:

1. Paving: Light sand blast.
2. Curbs: Light sand blast.
3. Curb Ramps: Light sand blast.
4. Walls: Light sand blast.

3.15 FIELD QUALITY CONTROL

- #### A. Color additive manufacturer shall furnish and Contractor shall acquire inspection days utilizing manufacturer's technical inspectors to assure compliance with manufacturer's recommendations for installation. Inspect critical steps including consistency of slump, placing, finishing, and curing.
- #### B. The minimum number of Technical Service full time inspection days is as follows:
1. Three days for projects of 2,000 square feet or less. Technical service representative shall be present for the following periods.
 - a. Field Sample: Immediately prior to and during its construction.
 - b. Installation: Immediately prior to and during the installation of one complete area including application of curing compound.
 2. Increase days at a rate of one day for each additional 2,000 square feet.

END OF SECTION

SECTION 32 14 19
STONE WEIRS**PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes: Mortar set granite weir where shown on Landscape Drawings.
- B. Related sections:
 - 1. Mortar: Section 04 05 13.
 - 2. Architectural Site Concrete: Section 32 13 15.
 - 3. Colors, finishes, and textures: Section 09 06 00, SCHEDULE FOR FINISHES and NOTES and LEGENDS on Landscape Drawings (referred to hereinafter as LEGENDS).

1.2 REFERENCES (Latest edition unless otherwise noted)

- A. American Society for Testing and Materials (ASTM):
 - C 615 Granite Dimension Stone.
 - C 1242 Guide for Selection, Design, and Installation of Dimension Stone Anchoring Systems.
- B. National Building Granite Quarries Association (NBGQA), Inc.
Specifications for Architectural Granite.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Product Data: Submit for the following items:
 - 1. Granite data showing compliance with ASTM C 615.
 - 2. Epoxy cement.
- C. Samples: Submit 2 samples of type of proposed stone showing grooves for water flow. Samples to be full size except depth may be reduced as needed to maintain integrity x 20 inches wide. Show two 9-inch wide "teeth".
- D. Shop Drawings: Show location, size, setting methods. Show in detail dowels, and anchors.

1.4 QUALITY CONTROL

- A. All work, methods and materials to be in conformance with recommendations of the NBGQA. Anchoring systems to comply with recommendations of ASTM C 1242.
- B. All setting shall be done by competent masons under adequate supervision.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Loading and Shipment: Carefully pack cut stone to prevent damage during shipment.
- B. Store unit off the ground and protected against staining and other damage.
- C. Replace damaged or rejected units with new materials at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Granite: ASTM C 615. Domestic stone; and approved by Architect.
 - 1. See LEGENDS on Landscape Drawings for basis of bid manufacturer, color, finish and other information.
- B. Mortar: Provide as specified under Section 04 05 13.
- C. Granite Anchors: Stainless steel.
 - 1. Shapes, Plates and Rods: Type 304, ASTM A 167, and ASTM A 276.
 - 2. Granite anchors must have epoxy cement applied into drilled granite and concrete holes.
- D. Epoxy Cement: Two component, 100% solids. Type suitable for application as recommended by manufacturer. Submit technical data for Architect's approval

2.2 FABRICATION

- A. Fabricate stone weirs to shape and dimensions indicated on approved shop drawings. Comply with specified fabrication tolerances.
 - 1. Dress joints (bed and vertical) straight and at 90 degree angle to face, unless otherwise indicated.
- B. Grooves: Cut accurate grooves of uniform width and depth using water jet, router, or similar method which allows directional change without overcuts into adjacent surfaces. Conventional sawing not permitted for cutting grooves.
 - 1. Groove Size: As indicated on drawings.
- C. Joint Width: 1/4 inch plus or minus 1/16 inch.
- D. Cutting for Dowels, Anchors and Cramps: Cut holes and sinkages for dowels, anchors and cramps in accurate locations as indicated on approved setting drawings. Provide lewis holes for all stones that cannot be handled manually or set with cramp.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Substrate: Examine substrate to determine its adequacy to receive work of this Section. Concrete to be fully cured without use of liquid curing compounds detrimental to bond. Bring evidence of inadequate base to the immediate attention of the Architect.
- B. Starting work of this Section constitutes acceptance of substrate.
- C. Do not use units with chips, cracks, stains, or other defects which might be visible in the finished work.

3.2 MORTAR SET STONE WEIRS

- A. Install granite as shown and as detailed on final shop drawings, in compliance with recommendations of the National Building Granite Quarries Association, Inc.
- B. Anchors: Support each stone with both gravity and lateral anchors.
 - 1. Provide minimum four anchors for panels up to 12 sq.ft. and two additional anchors for each additional 8 sq.ft. of surface area.
 - 2. Attach anchors securely to stones and to back-up substrate.
 - 3. Fill anchor holes with mortar.
- C. Granite Cubic: Set in full mortar bed. Set stones on setting buttons as required to maintain joint depth. Fill head joints full.
- D. Joints: See JOINTS below.

3.3 JOINTS

- A. Mortar Joints: Rake out mortar to depths equal to 2-1/2 times their widths but not less than 1/2 inch. Point joints in 3 layers with each of the first and second layers filling approximately 2/5 of joint depth and third layer remaining 1/5. Fully compact each layer and allow to become thumbprint hard before applying next layer. Tool to concave profile.

3.4 CLEANING AND PROTECTION OF PAVER SURFACES

- A. After completion of work, carefully clean surfaces removing all dirt, excess mortar, and stains.

END OF SECTION

**SECTION 32 30 00
SITE IMPROVEMENTS****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Landscape edging.
 - a. Paving Retention Angle Edging.
 - b. Aggregate Mulch Bed Edging.
2. Gravel mow strip.
3. Weed barrier fabric.
4. Planters

B. Related Sections:

1. NOTES and LEGENDS on Landscape Drawings (referred to hereinafter as LEGENDS).
2. Lightweight soil for planters: Section 32 91 18, Imported Topsoil.

1.2 SUBMITTALS**A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA and SAMPLES.****B. Product Data:** For each type of product indicated.**C. Samples:**

1. Landscape edging: 12" long each type.
2. Mow strip aggregate. 1 lb. plastic bag.
3. Weed barrier: 12" square.

1.3 QUALITY ASSURANCE

- A. Mockup: Provide mockup, minimum 8 feet long, of aggregate mow strip with weed barrier and edging not less than 8 feet long. Obtain Architect's approval of mock up before proceeding with work. Accepted mockup to remain as an acceptable standard of workmanship and can be part of completed Work.

PART 2 - PRODUCTS**2.1 MATERIALS****A. Gravel Mow Strip:** As shown and described in LEGEND on Landscape Drawings.**B. Weed Barrier Fabric:** A woven monofilament filtration geotextile with apparent opening size of 70-100 US Standard Sieve. Acceptable products include, but are not limited to, the following:

1. "Carthage 6%" by Carthage Mills.
2. "Geotex" by Propex.

2.2 LANDSCAPE EDGING

- A. Paving Retention Angle Edging: Nominal 2" x 2-1/4" extruded aluminum sections with locking ribs and notched horizontal leg for curving. 6063-T6 alloy. Thickness and profile varies. Vertical Leg: Minimum 0.070 inch thick with hooked top formed to 0.20 thick; minimum 0.116" thick at bottom portion.
 - 2. Horizontal Leg: 0.0625-inch thick with hooked edge; 0.08-inch thick at inner portion. 5/8" and 3/16" diameter staking holes pre-drilled.
 - 3. Finish: Baked acrylic enamel finish, AAMA 2603; black.
- B. Aggregate Mulch Bed Edging: Aluminum devices. Extruded aluminum sections with locking ribs. 6063-T6 alloy. Corrugated straight profile with loops on one side to receive stakes at approximate 2-foot centers.
 - 1. Size: 5-1/2 high x 1/8 thick with 3/16" thick exposed top lip. 16-foot lengths.
 - 2. Line Stakes: Minimum 24 inches long x 0.125 thick, manufacturer's optional heavy-duty devices.
 - 3. Splicing Stakes: Not required. See splicing detail on Landscape Drawings.
 - 4. Finish: Mill finish.
- C. See LEGEND on Landscape Drawings for description of edging and Basis of Design products and manufacturer.

2.3 PLANTERS

- A. Freestanding fiber-reinforced plastic (fiberglass) products with smooth surface texture and acrylic enamel paint finish. See LEGEND on Landscape Drawings for Basis of Design product, and manufacturer.
- B. Color: Approximate color listed below for metal building panel color MP-2 (EWP-6) except metallic sheen not required.
 - 1. EXTC-3 (EWP-6): #KS2C 52162, Bronze.
- C. Physical Properties of Planter Material:
 - 1. Tensile Strength, Ultimate: 12,500 psi.
 - 2. Modulus of Elasticity: 1,020 ksi.
 - 3. Compressive Yield Strength: 21,800 psi.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Excavation: Perform excavation as required for installation of work under this Section.
- B. Compact subgrade as required to finish firm, even surface. Fill and consolidate any dented and depressed areas. Remove any noncompactible or unsuitable material and replace with clean fill.

3.2 INSTALLATION

- A. Gravel Mow Strip:
 - 1. Weed Barrier: Install on compacted subgrade. Lap edges minimum 6 inches. Turn perimeter edges up to within 1 inch of finish grade.

- a. Install gravel Rake to achieve minimum compaction and surface smoothness.
Thickness as indicated on drawings.
- B. Landscape Edging: Install in accurate locations in accordance with approved shop drawings and manufacturer's recommendations; secure with connectors at spacing suitable for conditions but not less than recommended by manufacturer.

END OF SECTION

SECTION 32 39 50
SITE SECURITY EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Security Bollards
 2. Foundation and support design.

1.2 RELATED WORK:

- A. Soils Report: Division 00.
- B. Cast-In-Place Concrete: Section 03 30 01.
- C. Zinc coating and paint finish: Section 05 05 15, HOT DIP GALVANIZING.
- D. Wire Rope Decorative Railing: Section 05 73 16.
- E. Colors, finishes, and textures: Section 09 06 00, SCHEDULE FOR FINISHES and NOTES and, LEGENDS on Landscape Drawings (referred to hereinafter as LEGENDS).
- F. Earthwork: Section 31 20 00.
- G. Paving: Division 32.

1.3 REFERENCES (Latest edition unless otherwise noted)

- A. American Architectural Manufacturers Association (AAMA):
1. 2604 High Performance Organic Coatings on Aluminum Extrusions and Panels; Voluntary Specification, Performance Requirements and Test Procedures for.
- B. American Society for Testing and Materials (ASTM):
1. A53-07 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
- C. Department of State (DOS)
- D. SD-STD-02.01 Test Method for Vehicle Crash Testing of Perimeter Barriers and Gates, Revision A.

1.4 FOUNDATION & SUPPORT DESIGN

- A. Manufacture to design foundations and supporting structures for each type of equipment supplied based on impact requirements and soil type. Include sizes, steel members, concrete strengths and reinforcing.
1. Special shallow foundation design required for some security bollards.

1.5 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Product Data: Include description of product including size, material, finish, and crash rating where applicable.
- C. Shop Drawings:
 - 1. Submit Shop Drawings of fabricated items for acceptance prior to fabrication.
 - 2. Show complete dimensions of site security equipment and associated concrete foundation. Include concrete strength, reinforcing grade, sizes, and placement. Indicate maximum allowable distances between site security equipment and minimum distances from foundation edge.
 - 3. Show shop and erection details including dimensions, sizes, thicknesses, gauges, finishes, joining, attachments, holes, welds, bolts, elevations and relationship of work to adjoining construction, including finished soil grades and finished paving surfaces.
 - 4. Where welded connectors, concrete, or masonry inserts are required to receive Work, show exact locations required.
 - 5. Where items must fit and coordinate with finished surfaces and/or constructed spaces, take measurements at site and not from Drawings.
 - 6. Indicate welded connections using standard AWS A2.4 welding symbols.
 - 7. Furnish accepted Shop Drawings to the trades responsible for installing the connectors or inserts.
- D. Samples:
 - 1. Metal Finish: Minimum 4" x 6" plate with zinc coating and paint finish of proposed color.
- E. Certification: Submit proof of required crash certification for each type of security equipment.
- F. Delegated-Design Submittal: For site security equipment foundations and support indicated to comply with design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 QUALITY ASSURANCE

- A. Installer and Fabricator Qualifications: Workmanship shall be best standard practice of trades and shall be performed by mechanics skilled in type of Work required.
- B. Regulatory Requirements: Meet requirements of applicable laws, codes, and regulations required by authorities having jurisdiction over Work.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Protective Pads: Use protective pads to prevent damage to metal finishes when lifting, handling and shipping.
- B. Handling: Provide adequate support and attachments during handling to prevent structural damage.

PART 2 - PRODUCTS

2.2 SECURITY BOLLARDS

- A. Common Characteristics: See NOTES & LEGENDS on Landscape Drawings for Basis of Design manufacturer, model, Security Rating Class, diameter, height, and finish.
1. Material: Provide as listed on Finish Schedule on Landscape Drawings.
 - a. Carbon steel pipe, ASTM A 53.
 2. Finishes:
 - a. Hot dip galvanized coating after fabrication in accordance with Section 05 05 15, HOT DIP GALVANIZING in addition to powder coat finish.
 - b. Powder Coat Finish: Powder Coat Finish: Custom gray metallic color as selected by Architect and conforming to AAMA 2604.
 3. Security Rating: Class certified by DOS in accordance with SD-STD-02.01; stopping a 15,000 lb. vehicle at speeds as noted.
 4. Configuration: Round with flat cast top; no reflective tape.
- B. Fixed Bollards:
1. Mounting: "Fixed".
 2. Wall Thickness: As required for rating.
- C. Removable Bollards: Provide with mounting sleeve, cover plate, and lifting trolley for removal and transport; manufacturer's standard.
1. Type: Locking and Removable.
 2. Operation: Manually inserted and removed from sleeve; sleeve has cover plate flush with pavement when bollard is removed.
- D. Shallow Foundation Design: Provide special shallow foundation design at designated locations to avoid conflict with underground utilities.

2.3 NON-RATED BOLLARDS

- A. Fixed and removable devices for embedded installation.
- B. Metal: Pipe, carbon steel, ASTM A 53, Schedule 40, galvanized after fabrication with powder coat finish.
1. Finishes: Same as specified above for SECURITY BOLLARDS.
- C. Size: 6-inch diameter x height and embedment shown on drawings.
- D. Cap Style: "Dome"; manufacturer's standard curved profile.
- E. Fixed Bollards:
1. Mounting: "Fixed".
- F. Removable Bollards: Manufacturer's standard sleeve size and depth for specified bollard with hinged lid.
1. Type: Locking and Removable
 - a. Locking: Internal with camlock device operated with special key. Provide 2 keys.
 2. Operation: Manually inserted and removed from sleeve; sleeve has cover plate flush with pavement when bollard is removed.

- G. Basis of Design Manufacturer: See "Notes and Legends" on Landscape Drawings.

2.4 ACCESSORIES

- A. As required for complete installation.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install work of this Section, including foundations and supports, in locations shown, in accordance with manufacturer's recommendations and approved shop drawings.

END OF SECTION

SECTION 32 84 00
LANDSCAPE IRRIGATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes irrigation system complete as shown and as specified.

1.2 QUALITY ASSURANCE:

- A. Permits and Fees: Obtain and pay for all permits required.
- B. Manufacturer's Specifications: Follow Manufacturer's current printed specifications and drawings in all cases where the manufacturers of articles used in the Contract furnish directions covering points not specified or shown in the Drawings.
- C. Ordinances and Regulations: All local, municipal and state laws, codes, and regulations governing or relating to all portions of this work are hereby incorporated into and made a part of these Specifications. Anything contained in these Specifications shall not be construed to conflict with any of the above codes, regulations, or requirements of the same. However, when these Specifications and Drawings call for or describe materials, workmanship, or construction of a better quality, higher standard, or larger size than is required by the above codes and regulations, the provisions of these Specifications and Drawings shall take precedence.
- D. EPA WaterSense Certification:
1. Contractor shall be a WaterSense certified contractor per the requirements of the United States Environmental Protection Agency.
- E. Explanation of Drawings:
1. Due to the scale of the Drawings, it is not possible to indicate all offsets, fittings, sleeves, etc., which may be required. Carefully investigate the conditions affecting all of the work and plan accordingly, and furnish all required fittings. Install system in such a manner to avoid conflicts with planting, utilities, and architectural features.
 2. Do not install the irrigation system as shown on the Drawings when it is obvious in the field that obstructions, grade differences or discrepancies in dimensions exist that might not have been considered in engineering. Bring such obstructions or differences to the attention of the Owner's Representative. In the event this notification is not given, the Contractor shall assume full responsibility for any revision necessary.

1.3 SUBMITTALS

- A. Materials List:
1. Within ten (10) days after receipt of notice to proceed, submit three (3) copies of the complete lists of materials proposed for installation, and obtain the Owner's Representative's written approval thereof before proceeding. Use only accepted materials and items of equipment.
 2. List all materials by manufacturer's name and model number.

B. Manuals:

1. Prior to the final acceptance of the irrigation system, furnish three (3) individually bound Service Manuals to the Owner's Representative for use by the Owner. The manuals shall contain complete enlarged drawings, diagrams and spare parts lists of all equipment installed showing manufacturer's name and address. In addition, each Service Manual shall contain the following:
 - a. Index sheet indicating the Contractor's name, address and phone number.
 - b. Copies of equipment warranties and certificates.
 - c. List of equipment with names, addresses and telephone numbers of all local manufacturer's representatives.
 - d. Complete operating and maintenance instructions in sufficient detail to permit operating personnel to understand, operate and maintain all equipment.

C. Record Drawings:

1. Dimension from two (2) permanent points of reference, building corners, sidewalk, or road intersections, etc., the location of the following items:
 - a. Connection to existing water lines.
 - b. Connection to electrical power.
 - c. Gate valves.
 - d. Routing of sprinkler pressure lines.
 - e. Remote control valves.
 - f. Routing of control valves.
 - g. Quick coupling valves.
 - h. Other related equipment as directed by Owner's Representative.
 - i. All sleeve locations.
2. Deliver as required by Division I

D. Controller Plan:

1. Permanently install one 'bubble diagram' controller plan in each controller housing. The plan shall show the area controlled by each valve and any major permanent structure, such as buildings and roads.
2. These charts to be waterproof and install as accepted by the Owner's Representative at the coverage test of the irrigation system.

E. Establishment Period Material - Supply the following tools to the Owner;

1. Three (3) sets of specialized tools required for removing, disassembling and adjusting each type of sprinkler, valve or other equipment supplied on this project.
2. Two (2) keys for each type of equipment enclosure.
3. Two (2) keys for each automatic controller.
4. Two (2) quick-coupler keys and matching hose swivels.
5. Two (2) five foot valve keys for operation of gate valves.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Furnish and deliver materials in manufacturer's packaging, bearing and original legible labeling.
- B. Handle and store all equipment in accordance with manufacturer's current printed specifications.

1.5 SEQUENCING AND SCHEDULING

- A. Acceptance: Do not install main line trenching prior to acceptance by Owner's Representative of rough grades completed under another Section.
- B. Coordination: Coordinate with the work of other sections to insure the following sequence of events
 - 1. Sleeves and Conduits: Installation of all sleeves and conduits to be located under paving (and through walls) prior to placement of those materials.

1.6 WARRANTY

- A. Provide a written guarantee covering entire system against defects in installation, workmanship, and equipment for a period of one year from date of final acceptance. Make necessary repairs to the system as well as to other work affected by defects in the system during the warranty period. Repairs shall be made at Contractor's sole expense.

1.7 MAINTENANCE

- A. Routine: Inspect and adjust all spray valves and control valves including raising or lowering of spray head heights to accommodate plant growth, to achieve uniform irrigation at all times. Verify correct operating pressure.
- B. Controller: Inspect regularly for power interruption and reset clock as required. Adjust station timing to accommodate changes in plant growth.
- C. Climate Change: Do not run the irrigation system during the rainy season. Set and program automatic controllers in response to seasonal requirements and requirements of newly - planted materials.

PART 2 - PRODUCTS

2.1 GENERAL

- ~~A.~~ Use only new materials of brands and types noted on Drawings or substitutes accepted by Owner's Representative.

2.2 PIPE

- A. Pressure Main Line Pipe and Fittings: All PVC fittings shall bear the manufacturer's trademark name, material designation, size, applicable I.P.S. schedule and NSF seal of approval.
 - 1. PVC pressure rated pipe: ASTM D2241 NSF approved Type I, Grade I, PVC. All pipe must meet Federal Specifications pS-22-70, with an appropriate standard dimension ratio (S.D.R.)
 - 2. PVC scheduled pipe: ASTM D1785 NSF approved Type I, Grade I, PVC. All pipe must meet Federal Specifications PS-21-70.
 - 3. PVC solvent-weld fittings for joining lengths of main line: ASTM D2466 Schedule 40, 1-2, II-I NSF approved.

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4. Solvent cement and primer for PVC solvent-weld pipe and fittings: Type and installation methods prescribed by the manufacturer.
 5. PVC solvent-weld fittings for connections between main lines and valves & appurtenances: ASTM D2464, ASTM D2467 Schedule 80, 1-2, II-I NSF approved.
- B. PVC Non-Pressure Lateral Line Piping and Sleeving:
1. PVC pressure rated pipe: ASTM D2241 NSF approved Type I Grade I, PVC and Federal Specification PS-22-70, with an appropriate standard dimension ratio (S.D.R.).
 2. PVC scheduled pipe: ASTM D1785 NSF approved Type I Grade I, PVC and Federal Specification PS-21-70.
 3. PVC solvent - weld fittings: ASTM D2466 Schedule 40, 1-2, II-I NSF approved.
 4. Flexible PVC: ASTM D-2287 Algae-resistant flexible PVC.

2.3 CONTROLLER

- A. Type: Model No. as shown on Drawings.

2.4 CONTROL WIRES

- A. Type: Communication between controller and the decoders & valves shall be accomplished by a twisted pair of #14 AWG decoder cables for direct burial within a red HDPE. The communication cable shall be manufactured by Paige Electric model #P7350D, or equal.
- B. Splices: 'DBY' by 3M.

2.5 BOXES FOR REMOTE CONTROL VALVES

- A. Type: Rectangular plastic valve box - Ametek, Brooks, Christy or equal.
- B. Color: black.

2.6 ISOLATION VALVES:

- A. Gate valves 3 inches and smaller: 125-pound WSP bronze gate valve with union bonnet, non-rising stem and solid wedge disc.
- B. Box: 10" round plastic, Ametek, Brooks, Christy or equal.
- C. Color: black.

2.7 MISCELLANEOUS INSTALLATION MATERIALS:

- A. Solvent cement and primers for solvent weld joints: Make and type approved by manufacturer(s) of pipe and fittings. Maintain cement proper consistency throughout use.
- B. Pipe joint compound: Do not use on sprinkler inlet port.
- C. Coatings for below grade steel pipe and fittings: Koppers Bitumastic #300-M coal tar epoxy and wrapped with 50-mil polyethylene tape to 6" above finish grade.

2.8 MISCELLANEOUS EQUIPMENT/ACCESSORIES

- A. Sleeves and Conduits: See Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Sleeves and Conduits: Verify that all installed sleeving and conduits are undisturbed and are free of defects or errors introduced by the work of other sections.
- B. Water Pressure: Test and verify that irrigation water supply provided by Plumbing Section of Contract provides level of water pressure specified on Drawings. Notify Owner's Representative if pressure is lower than Pressure noted on plan.
- C. Notification: Submit written notification to Owner's Representative within ten (10) working days of above inspections describing all acceptable and non-acceptable site conditions.

3.2 INSTALLATION

- A. Conduits and Sleeves:
1. Coordination:
 - a. Sleeving will be existing only if installed by others. Inspect as specified above.
 - b. For all other installations, provide conduit and sleeve materials and coordinate installation with other trades.
 2. Extent: Install conduits and sleeves where control wires and pipes pass under paving or through walls. Extend 12 in. beyond edges of paving and walls and cap ends until ready for use.
- B. Excavating and Trenching:
1. Existing Installations: Restore to their original conditions, damaged surfaces and underground installations as a result of the excavations at no cost to University.
 2. Trenches: Dig trenches wide enough to allow a minimum of 6 in. between parallel pipe lines. Provide a minimum cover from finish grade as follows:
 - a. 18 in. Deep: Over pipe on pressure side of irrigation control valve and control wires.
 - b. 12 in. Deep: Over pipe on non-pressure side of irrigation control valve.
 - c. Direct Burial PVC Piping Under Pavement: Provide a minimum of 4 in. of sand backfill on all sides and 24 in. cover to bottom of paving.
- C. Pipe Line Assembly:
1. General:
 - a. Install pipes and fittings in accordance with manufacturer's current printed Specifications.
 - b. Clean all pipes and fittings of dirt, scales and moisture before assembly.
 2. Solvent-Welded Joints for PVC Pipes:
 - a. Solvents: Use solvents and methods specified by pipe manufacturer.
 - b. Curing Period: Minimum of 1 hour before applying any external stress on the piping and at least 24 hours before placing the joint under water pressure.
 3. Threaded Joints for Plastic Pipes:
 - a. Tape: Use Teflon tape on threaded PVC fittings.

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- b. Joining: Use strap-type friction wrench only. Do not use metal-jawed wrench.
 - 4. Laying of Pipe:
 - a. Bedding On-grade: Remove from trench all rocks or clods. Bed pipes in at least 2 in. of soil excavated from trench. Backfill on all sides of piping to provide a uniform bearing.
 - b. Snaking: Snake pipe from side to side of trench bottom to allow for expansion and contraction. Minimum allowance for snaking is one (1) additional ft. per 100 ft. of pipe.
 - c. Moisture Restrictions: Do not lay PVC pipe when there is water in the trench. Do not assemble PVC pipe unless the pipe is perfectly dry.
 - D. Valves: Group valves together, aligned in a row where grouped, and locate in planted areas. Install box flush with finish grade, not necessarily level.
 - E. Control Valves:
 - 1. Install in valve boxes where shown on Drawings and group together where practical. Install box flush with finish grade, not necessarily level.
 - 2. Where two or more valves are installed adjacent to each other, provide at least twelve (12) in. separation. Align boxes in a row.
 - 3. Permanently mark valve box lid with valve number and controller letter.
 - F. Sprinkler Heads: Install as detailed on Drawings.
 - G. Automatic Controller:
 - 1. General: Install per local code and manufacturer's current printed Specifications.
 - 2. Connection to Valves: Connect remote control valves to controller in clockwise sequence to correspond with station setting beginning with Stations 1, 2, 3, etc.
 - 3. Labeling: Affix controller name (i.e., "CONTROLLER A") on inside of controller cabinet door with minimum of 1 in. high permanent letters.
 - 4. Irrigation Diagram: Affix a non-fading copy of irrigation diagram to cabinet door below controller name. Irrigation diagram to be sealed between two plastic sheets, 20 mil. minimum thickness. Use a reduced copy of the Record Drawing, for the irrigation diagram clearly showing all valves operated by the controller, station number, valve size, and type of planting irrigated.
 - F. Control Wiring:
 - 1. General: Install control wires in common trenches with sprinkler mains and laterals wherever possible. Lay to the bottom side of pipe line. Provide looped slack at valves. Snake wires in trench to allow for contraction of wires. Tie wires in bundles at 10 ft. intervals.
 - 2. Extra Length: Provide 24 in. extra control wire at each remote control valve splice to facilitate the removal of the remote control bonnet to finish grade without cutting wires.
 - 3. Spare: Install one unconnected spare control wire running from the controller through each intermediate control valve box.
 - 4. Size: Minimum size of wire is to be determined strictly by the manufacturer's current printed specifications for remote control valves, but not smaller than # 14.
 - 5. Splicing: Crimp control wire splices at remote control valves. Seal with specified splicing materials. In-line splices will be allowed only on runs exceeding 2500 ft.
 - G. Mastic and Tape: Install mastic and tape on all below grade metallic piping. Install per manufacturer's current printed specifications extending mastic and tape to 6 inches above finish grade.

H. Closing of Pipe and Flushing of Lines:

1. Capping: Cap or plug all openings as soon as lines have been installed to prevent entrance of materials that would obstruct the pipe. Leave in place until removal is necessary for completion of installation.
2. Flushing: Thoroughly flush out all water lines before installing heads, valves and other hydrants.

3.3 FIELD QUALITY CONTROL

A. Adjustment of the System:

1. Flush and adjust all sprinkler heads for optimum performance and to prevent overspray onto walks, roadways, and buildings.
2. Set all sprinkler heads set perpendicular to finished grades unless otherwise noted on the Drawings.

B. Testing of Irrigation System:

1. In the presence of the Owner's Representative test all pressure lines under hydrostatic pressure of 125 pounds per square inch, and prove watertight.
2. Sustain pressure in lines for not less than two (2) hours. If leaks develop, repair and repeat test until entire system passes.
3. When the landscape sprinkler system is completed, perform a coverage test in the presence of the Owner's Representative, to determine if the water coverage for planting areas is adequate.
4. Test controllers individually in the presence of the Owner's Representative. Demonstrate that all control valves operate electrically. Provide vehicles and radio equipment as necessary to expedite this process.
5. Demonstrate to Owner's Representative that irrigation scheduling programmed into controller is adequate for plant requirements without causing runoff, and that scheduling capacities of controller are utilized.

3.4 BACKFILL AND COMPACTING

A. General: After system is operating and required tests and reviews have been made, backfill excavations and trenches with clean soil, free of debris.

B. Backfill For All Trenches: Regardless of the type of pipe covered, compact to minimum 95 percent density under pavements, and 85 percent under planted areas.

C. Backfill at Existing Underground Pipes: Use only backfill material which has been screened to eliminate all materials larger than 3/8 in. when backfilling adjacent to existing underground pipe lines.

D. Finishing: Dress off all areas to finish grades.

3.5 MAINTENANCE

A. Refer to Section 02935.

3.6 CLEAN-UP

- A. Clean-up as each portion of work progresses. Remove refuse and excess dirt from the site. Paving shall be broomed or washed down. Repair damages incurred on the work of others and restore to original conditions.

3.7 REVIEWS PRIOR TO ACCEPTANCE:

- A. Notify the Owner's Representative in advance for the following reviews, according to the time indicated:
 - 1. Pre-construction conference - 7 days.
 - 2. Supply line pressure test and control wire installation - 72 hours.
 - 3. Coverage and controller test - 72 hours.
 - 4. Final review - 7 days.
- B. No reviews will commence without record drawings. In the event the Contractor calls for a review without record drawings, without completing previously noted corrections, or without preparing the system for review, he shall be responsible for reimbursing the Owner's Representative at the rate of two and one-half times the normal office hourly rate per hour portal to portal (plus transportation costs) for the inconvenience. No further reviews will be scheduled until this charge has been paid.

3.8 FINAL REVIEW

- A. Operate each system in its entirety for the Owner's Representative at time of final review. Any items deemed not acceptable by the Owner's Representative shall be reworked until installation includes correction of deficiencies as noted by Owner's Representative.
- B. Provide evidence to the Owner's Representative that the Contractor has submitted all accessories and equipment as required before final review can occur.

--- E N D ---

SECTION 32 91 13
PLANTING SOIL PREPARATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Amendment of Planting Area Soil Surfaces.
 - 2. Plant Pit Backfill Mix.
- B. Related Sections:
 - 1. Structural Planting Soil: Section 31 38 00.
 - 2. Operation and Maintenance of Planting: Section 32 01 90.
 - 3. Irrigation Systems: Section 32 84 00.
 - 4. Imported Topsoil: Section 32 91 18.
 - 5. Landscape Grading: Section 32 91 19.
 - 6. Plants: Section 32 93 00.

1.2 REFERENCES (Latest edition unless otherwise noted)

- A. American Society for Testing and Materials (ASTM):
 - 1. D 1557 Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.
- B. United States Department of Agriculture (USDA):
 - 1. Soil Texture Triangle Classification.
 - 2. Handbook No. 60.
- C. Soil Science Society of America, Inc. (SSSA):
 - 1. Methods of Soil Analysis Part 1 – Physical and Mineralogical Methods, 1986.
 - 2. Methods of Soil Analysis Part 3 – Chemical Methods, 1996.

1.3 DEFINITIONS

- A. Acceptance, Acceptable, or Accepted: Acceptance by the Architect in writing.
- B. Excessive Compaction: Planting area soil compaction greater than 75 percent of maximum dry density as determined by ASTM D 1557.

1.4 SYSTEM DESCRIPTION

- A. Soil Mixes, Backfill Mixes, and Amended Planting Area Surface Soil: Topsoil with amendments incorporated uniformly to provide a well-draining, well-aerated, fertile medium for vigorous plant root growth, free of excessive compaction.

1.5 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Product Data:
 - 1. Chemical Additives.
 - 2. Organic Soil Conditioner.
 - 3. Fertilizers.
 - 4. Organic Amendment.
 - 5. Organic Fertilizer.
- C. Test Reports:
 - 1. Laboratory test reports for installed planting area topsoil.
 - 2. Laboratory test report for organic amendment.
- D. Purchase Documentation:
 - 1. Fertilizer Purchase and Delivery Invoices.
 - 2. Chemical Amendment Purchase and Delivery Invoices.

1.6 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies:
 - 1. Meet requirements of applicable laws, codes, and regulations required by authorities having jurisdiction over Work.
 - 2. Provide for inspections and permits required by federal, state and local authorities in furnishing, transporting, and installing materials.
 - 3. Soil supplier to have a minimum of 15 years experience in mixing blended soils of this quality and quantity.
- B. Settlement Mockup: Mockup areas of backfill mix at the specified depths and apply irrigation to induce settlement, if required to help determine the amount of settlement which will be caused by irrigation and rain.

1.7 SITE CONDITIONS

- A. Environmental Requirements:
 - 1. Do not work soil when moisture content is so great that excessive compaction will occur, nor when it is so dry that dust will form in the air or that clods will not break readily.
 - 2. Apply water, if necessary, to bring soil to an optimum moisture content for tilling.
 - 3. Do not work soil when muddy or frozen.
 - 4. Do not apply chemicals if wind conditions will cause hazardous drift to people or property.
- B. Existing Conditions:
 - 1. Prior to Work commencement review and clearly mark in field horizontal and vertical locations of existing public underground utilities and structures with respective utility companies.
 - 2. Prior to Work commencement review and clearly mark in field horizontal and vertical locations of existing private underground utilities and structures with the Owner's Representative.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Organic Amendment: Organic material is to be well-composted humus with the following properties:
1. Humus material shall have an ash content of no less than 8 percent and no more than 20 percent.
 2. The pH of the material shall be between 6 and 7.5.
 3. The salt content shall be less than 10 millimho/cm at 25 degrees C on a saturated paste extract.
 4. Boron content of the saturated extract shall be less than 1.0 part per million
 5. Silicon content (acid-insoluble ash) shall be less than 50 percent.
 6. Calcium carbonate shall not be present if the amendment is to be applied on alkaline soils.
 7. Types of acceptable products are composts, manures, mushroom composts, straw, alfalfa, sludge, peat mosses, etc., low in salts, low in heavy metals, free from weed seeds, free of pathogens and other deleterious materials.
 8. Composted wood products are conditionally acceptable (stable humus must be present). Wood-based products are not acceptable which are based on redwood or cedar.
 9. Sludge-based materials are not acceptable if the soil already has a high level (toxic level) of zinc, copper, or other heavy metals based on soil analysis.
 10. Carbon: nitrogen ratio shall be less than 25:1.
 11. The compost shall be aerobic without malodorous presence of decomposition products.
 12. The maximum particle size shall be 1/2-inch, 80 percent or more shall pass a No. 4 screen.
 13. Maximum total permissible pollutant concentrations in organic amendment in parts per million on a dry-weight basis:

Arsenic:	20
Cadmium:	15
Chromium:	300
Cobalt:	50
Copper:	150
Lead:	150
Mercury:	200
Molybdenum:	10
Nickel:	60
Nickel:	60
Selenium:	100
Silver:	50
Vanadium:	10
Zinc	200

- a. Higher amounts of salinity or boron may be present if the soils are to be pre-leached to reduce the excess or if the plant species will tolerate the salinity and/or boron.

- B. Potential Chemical Amendments Required by Accepted Amendment Program and Backfill Mix:

1. Ground Limestone: Agricultural limestone containing not less than 85 percent of total carbonate, ground to such fineness that 50 percent will pass No. 1 sieve and 90 percent will pass No. 20 sieve.
 2. Dolomite Lime: Agricultural grade mineral soil conditioner containing 35 percent minimum magnesium carbonate and 49 percent minimum calcium carbonate, 100 percent passing No. 65 sieve.
 3. Gypsum: Agricultural grade product containing 80 percent minimum calcium sulfate.
 4. Iron Sulfate (Ferric or Ferrous): Supplied by a commercial fertilizer supplier, containing 20 to 30 percent iron and 35 percent to 40 percent sulfur.
 5. Sulfate of Potash: Agricultural grade containing 50 to 53 percent of water-soluble potash.
 6. Single Superphosphate: Commercial product containing 20 to 25 percent available phosphoric acid.
 7. Ammonium Sulfate: Commercial product containing approximately 21 percent ammonia.
 8. Ammonium Nitrate: Commercial product containing approximately 34 percent ammonia.
 9. Calcium Nitrate: Agricultural grade containing 15-1/2 percent nitrogen.
 10. Urea Formaldehyde: Granular commercial product containing 38 percent nitrogen.
 11. IBDU (Iso Butyldiene Diurea): Commercial product containing 31 percent nitrogen.
 12. Soil Sulfur: Agricultural grade sulfur containing a minimum of 96 percent sulfur.
 13. Silicic Acid Calcium: Commercial grade.
- C. Organic Fertilizer: Pure Black Worm Castings as available from Vermi Technology Unlimited, Orange Lake, FL, 352 591-1111; www.vermitechnology.com.

2.2 MIXES

- A. Preliminary Plant Pit Backfill Mix to Establish Bid (actual quantities contingent on amendment program determined by the Architect based on soil test report):
1. Content:
 - a. 1/2-pound gypsum per cubic yard of dry topsoil.
 - b. 1/5-pound ammonium nitrate (34-0-0) per cubic yard of dry topsoil.
 - c. 1/3-pound potassium sulfate (0-0-50) per cubic yard of dry topsoil.
 - d. 1/4-pound triple superphosphate (0-45-0) per cubic yard of dry topsoil.
 - e. 15-percent organic amendment by volume.
 2. Mixing:
 - a. Blend materials uniformly with dry topsoil in bulk by turning over materials with an end loader.
 - b. Blend materials in a clean area which will not contaminate mix.
 - c. Do not mix in planting areas.
- B. Final Plant Pit Backfill Mix for Installation: Backfill mixes determined by the Architect upon review of the soil test report.
- C. Structural Planting Soil Mix: See Section 31 38 00.

2.3 SOURCE QUALITY CONTROL

- A. Organic Amendment:
1. Send representative sample of organic amendment to Wallace Laboratories in El Segundo, CA; (310) 615-0116, www.bettersoils.com.
 2. Employ the laboratory to test for the specified properties.
 3. Submit laboratory's test report to Architect, with test date less than 2 weeks old, indicating specified properties.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. General: Examine site and verify that conditions are suitable to receive Work and that no defects or errors are present which would cause defective installation of products or cause latent defects in workmanship and function.
- B. Subgrade: Verify that the topsoil is installed at the correct elevation and slope.
- C. Underground Utilities and Structures: Verify that the locations of utilities, structures and other underground items have been clearly marked.
- D. Notification of Unsuitable Conditions: Before proceeding with Work, notify the Owner's Representative in writing of unsuitable conditions and conflicts.

3.2 PREPARATION

- A. Protection of Existing Conditions:
 - 1. Use all reasonable precautions to prevent damage to existing conditions to remain such as structures, utilities, plant materials and walks on or adjacent to the site of the Work.
 - 2. Provide barricades, fences or other barriers to protect existing conditions to remain from damage during construction.
 - 3. Use all reasonable precautions to prevent excessive compaction of planting area soil within or adjacent to the areas of Work.
 - 4. Do not store materials or equipment, permit burning, or operate or park equipment under the branches of existing plants to remain.
 - 5. Submit written notification of damaged plants and structures to the Owner's Representative immediately.
- B. Surface Preparation:
 - 1. Inspect soil surface for sticks, oils, chemicals, plaster, concrete, and other deleterious materials.
 - 2. Do Work required to remove and dispose of the deleterious materials.
- C. Excessively Compacted Areas: Where soil has become excessively compacted. Loosen soil to the depth of the excessive compaction, via a method acceptable to the Architect.

3.3 AMENDMENT OF SOIL SURFACE OF PLANTING AREAS

- A. Preliminary Amendment Program to Establish Bid: Six cubic yards of organic amendment per 1,000 square feet; 8 pounds of potassium sulphate (0-0-50) per 1,000 square feet; 4 pounds of triple superphosphate (0-45-0) per 1,000 square feet; 3 pounds of ammonium nitrate (34-0-0) per 1,000 square feet, 10 pounds of gypsum per 1,000 square feet, and 50 pounds of organic fertilizer per 1,000 square feet.
- B. Final Amendment Program for Installation: Determined by Architect upon review of soil test report.
- C. Amendment Incorporation:
 - 1. Spread dry amendments evenly over surface of dry soil with a drop spreader.

2. Organic amendment and soil must be dry.
3. Uniformly incorporate amendments uniformly within top 6 to 8 inches of soil within a few hours after amendment application.
4. Mechanically incorporate the amendments into the soil via a method that will not excessively compact the soil below incorporated amendments.

3.4 FIELD QUALITY CONTROL

A. Soil Tests to Determine Final Plant Pit Backfill Mix and Final Planting Area Soil Surface Amendment Program for Installation, and Maintenance Period Fertilization Program:

1. Take five 1-pound composite representative samples of installed topsoil from locations determined by the Landscape Architect in the field.
2. Send samples to Wallace Laboratories, El Segundo, CA, (310) 615-0116, www.bettersoils.com.
3. Employ the laboratory to test the soil samples for the following:
 - a. pH measurement in the saturation extract per USDA Handbook No. 60, Method 21.
 - b. Electrical conductivity of the saturation extract per USDA Handbook No. 60, Method 2.
 - c. Sodium absorption ratio of the saturation extract per USDA Handbook No. 60, Method 20b.
 - d. Determination of boron, calcium, copper, iron, magnesium, manganese, molybdenum, phosphorous, potassium, sodium, sulfur, and zinc, via the ammonium bicarbonate DTPA test method.
 - e. Analysis of saturation extract for calcium, magnesium, sodium, boron, chloride, phosphorous, nitrate, and sulfate per USDA Handbook No. 60, Method 2.
 - f. Measurement of following trace metals by the ammonium bicarbonate DTPA extract test method: aluminum, arsenic, cadmium, chromium, cobalt, lead, lithium, nickel, selenium, silver, strontium, tin, and vanadium per SSSA Methods of Soil Analysis Part 3.
 - g. Presence of calcium carbonate and magnesium carbonate.
 - h. Determine soil texture per SSSA Methods of Soil Analysis Part 1.
 - i. Measurement of organic matter content by organic carbon and total nitrogen per SSSA Methods of Soil Analysis Part 3.
 - j. Measurement of exchangeable Ammonium cation per SSSA Methods of Soil Analysis Part 3.
 - k. Determine base Saturation per SSSA Methods of Soil Analysis Part 3.
 - l. Determine cation Exchange Capacity per SSSA Methods of Soil Analysis Part 3.
 - m. Water Infiltration Rate per USDA Handbook No. 60, Method 34b.
4. Employ the laboratory to perform tests in accordance with commonly used methods if a specific method is not indicated.
5. At least 30 days prior to commencement of soil preparation Work, submit to the Architect the laboratory's written soil test report, with a test date less than 2 weeks old, including the laboratory's soil test data; the laboratory's interpretation of nutritional deficiencies, excesses, and potential toxicities; the laboratory's amendment recommendations; and the laboratory's maintenance recommendations.
6. The Architect will determine the final amendment and maintenance programs based on the soil test report which may differ from the soil test report amendment recommendations.

B. Soil Tests for Parasitic Nematodes:

1. Test soils which have been used for agricultural purposes within the prior 12 months for parasitic nematodes.

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2. Soil will be acceptable if the parasitic nematode population is less than 200 per 50 cubic centimeters of soil.
 3. Do not artificially dry soil prior to testing.
 4. Submit written test report to the Architect.
- C. Soil Tests for Herbicide Contamination:
1. Perform a radish/rye grass growth trial on soils suspected of herbicide contamination.
 2. Submit written test report to the Architect.
- D. Soil Mix Composition Verification:
1. Take up to 10 random composite samples of amended soil surface areas and soil mixes at locations and depths designated by the Architect for laboratory testing to verify amendment composition.
 2. Submit composite samples to the same soil testing laboratory used to test the soil as indicated in 3.04.A above.
 3. Employ the laboratory to test soil samples and submit test results to the Architect.
 4. Perform corrective work as recommended by the laboratory soil test reports if directed to do so by the Landscape Architect.
 5. When a laboratory soil test indicates that the soil or soil mixes meet the requirements of the Specifications the Contractor will receive written notification of acceptance from the Architect.

END OF SECTION

SECTION 32 91 18
IMPORTED TOPSOIL**PART 1 - GENERAL****1.1 SUMMARY**

- A. Section Includes:
 - 1. Placement of Imported Topsoil.
 - 2. Bio Retention Soil.
 - 3. Lightweight topsoil for planters.
- B. Related Sections:
 - 1. Temporary Tree & Plant Protection: Section 01 56 39.
 - 2. Earth Moving: Section 31 20 00.
 - 3. Planters: Section 32 30 00.
 - 4. Irrigation Systems: Section 32 84 00.
 - 5. Planting Soil Preparation: Section 32 91 13.
 - 6. Landscape Grading: Section 32 91 19.
 - 7. Turf and Grasses: Section 32 92 00.
 - 8. Plants: Section 32 94 00.

1.2 REFERENCES (Latest edition unless otherwise noted)

- A. American Society for Testing and Materials (ASTM):
 - D 1557 Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ftf-lb/ft³ (2,700 kN-m/m³)). (Modified Proctor).
- B. Environmental Protection Agency (EPA):
 - Method 8015.
 - Method 8020.
- C. Soil Science Society of America, Inc. (SSSA):
 - Methods of Soil Analysis Part 1 – Physical and Mineralogical Methods, 1986.
 - Methods of Soil Analysis Part 3 – Chemical Methods, 1996.
- D. United States Department of Agriculture (USDA):
 - Texture Triangle Classification.
 - Handbook No. 60.

1.3 DEFINITIONS

- A. Subgrade Soil Surface: The soil surface on which topsoil is placed.
- B. Finished Grades: The soil surface grade elevations and contours indicated on the Drawings.
- C. Aesthetic Acceptance of Grades: Acceptance by the Architect in writing of the aesthetic correctness of the contours as observed without a survey instrument. Aesthetic acceptance does not address whether an area drains properly, whether the areas are at the correct elevation, or whether it has been compacted properly.

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- D. Acceptance, Acceptable, or Accepted: Acceptance by the Architect in writing.
 - E. Excessive Compaction: Planting area soil compaction greater than 75 percent of maximum dry density as determined by ASTM D 1557.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Test Reports: Soil test report for imported topsoil, with test date less than 2 weeks old.

1.5 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies:
 - 1. Meet requirements of applicable laws, codes, and regulations required by authorities having jurisdiction over Work.
 - 2. Provide for inspections and permits required by federal, state and local authorities in furnishing, transporting, and installing materials.
- B. Settlement Mockup: Mockup areas of backfill mix at the specified depths and apply irrigation to induce settlement, if required to help determine the amount of settlement which will be caused by irrigation and rain.

1.6 SITE CONDITIONS

- A. Environmental Requirements:
 - 1. Do not work soil when moisture content is so great that excessive compaction will occur, nor when it is so dry that dust will form in the air or that clods will not break readily.
 - 2. Do not work soil when muddy or frozen.
- B. Existing Conditions:
 - 1. Prior to Work commencement review and clearly mark in field horizontal and vertical locations of existing public underground utilities and structures with respective utility companies.
 - 2. Prior to Work commencement review and clearly mark in field horizontal and vertical locations of existing private underground utilities and structures with the Owner's Representative.

1.7 SEQUENCING

- A. Topsoil Placement: When possible, avoid placing topsoil in areas subject to construction vehicle and equipment traffic until traffic ceases, in order to help prevent excessive compaction.

PART 2 - PRODUCTS

2.1 IMPORTED TOPSOIL

- A. General: Topsoil shall be friable and have sufficient structure in order to give good tilth and aeration to the soil. When amended, fertilized, and conditioned, the soil must be friable, be well drained, and be supportive of vigorous plant growth. It must contain low concentrations of inhibitory constituents. Plant growth of dicots and monocots must be at least 80 percent of a known reference soil, free of inhibitory constituents. A soil containing inhibitory constituents will be deemed to be suitable if the inhibitory constituents can be properly counteracted. The soil must have sufficient moisture retention and nutrient retention to avoid excessive frequency of irrigation and frequency of fertilizer application. The soil must be clean and free of excessive gravel, rock, and physical impurities.

1. Deleterious Materials: Free of roots, clods, stones larger than 1 inch in the greatest dimension, pockets of coarse sand, noxious weeds, sticks, lumber, brush, and other debris.
2. Disease-causing Organisms: Free of infestation of nematodes or other undesirable disease-causing organisms such as insects and plant pathogens.
3. Gradation: Sandy loam as classified by the USDA Soil Texture Triangle classification method.
4. Permeability Rate: Hydraulic conductivity rate shall be not less than 1 inch per hour, nor more than 20 inches per hour when tested in accordance with the USDA Handbook, No. 60, Method 34B or other approved methods.
5. Fertility: The range of the essential elemental concentration in soil shall be as follows:

*Ammonium Bicarbonate / DTPA Extraction**Parts per million (mg/kg dry-weight basis)*

Phosphorus:	2.0 – 40.0
Potassium:	40.0 – 220.0
Iron:	2.0 – 35.0
Manganese:	0.3 – 6.0
Zinc:	0.6 – 8.0
Copper:	0.1 – 5.0
Boron:	0.2 – 1.0
Magnesium:	50.0 – 150.0
Sodium:	0 – 100.0
Sulfur:	25.0 – 500.0
Molybdenum:	0.1 – 30.0

6. Acidity: 6.0 – 7.9 soil pH range measured in the saturation extract (Method 21a, USDA Handbook No. 60).
7. Salinity: 0.5 – 2.0 dS/m salinity range measured in the saturation extract (Method 3a, USDA Handbook No. 60). If calcium and if sulfate ions both exceed 20 milliequivalents per liter in the saturation extract, the maximum salinity shall be 4.0 dS/m.
8. Chloride: 150 mg/liter (parts per million) maximum concentration of soluble chloride in the saturation extract (Method 3a, USDA Handbook No. 60).
9. Boron: 1-mg/liter (parts per million) maximum concentration of soluble boron in the saturation extract (Method 3a, USDA Handbook No. 60).
10. Sodium Adsorption Ratio (SAR): Maximum of 3 measured per Method 20b, USDA Handbook No. 60.
11. Soil Organic Matter Content: Sufficient soil organic matter present to impart good physical soil properties, but not be excessive to cause toxicity or cause excessive reduction in the volume of soil due to decomposition or organic matter.
12. Calcium Carbonate Content: No free calcium carbonate (limestone) present.

13. Available Aluminum: Less than 5 parts per million measured with the Ammonium Bicarbonate/DPTA Extraction.
14. Heavy Metals: The maximum permissible elemental concentration in the soil shall not exceed the following:

*Ammonium Bicarbonate / DTPA
Extraction
Parts per million (mg/kg dry-
weight basis)*

Arsenic	2.0
Cadmium	2.0
Chromium	10.0
Cobalt	2.0
Lead	30.0
Mercury	1.0
Nickel	5.0
Selenium	3.0
Silver	0.5
Vanadium	3.0

- B. If the soil pH is between 6.0 and 7.0, the maximum permissible elemental concentration shall be reduced 50 percent. If the soil pH is less than 6.0, the maximum permissible elemental concentration shall be reduced 75 percent. No more than three metals shall be present at 50 percent or more of the above values.
- C. Phytotoxic Constituent, Herbicides, Hydrocarbons, etc.: Total petroleum hydrocarbons shall not exceed 50 mg/kg dry soil measured per the modified EPA Method No. 8015. Total aromatic volatile organic hydrocarbons (benzene, toluene, xylene and ethylbenzene) shall not exceed 2 mg/kg dry soil measured per EPA Method No. 8020.

2.2 BIO RETENTION SOIL

- A. General - Topsoil shall be free of roots, clods, stones larger than 1-inch in the greatest dimension, pockets of coarse sand, noxious weeds, sticks, lumber, brush and other litter. It shall not be infested with nematodes or other undesirable disease-causing organisms such as insects and plant pathogens.
1. Topsoil shall be friable and have sufficient structure in order to give good tilth and aeration to the soil.
- B. Gradation limits - soil shall be a sandy loam. The definition of soil texture shall be the USDA classification scheme. Approximately, based on the non-gravel fraction, clay less than 20% by weight, silt plus two times the concentration of clay over 30% by weight and the concentration of sand plus the concentration of clay over 50% by weight. Gravel over 2 millimeter in diameter shall be less than 20% by weight.
- C. Permeability Rate - Hydraulic conductivity rate shall be not less than 2 inches per hour nor more than 20 inches per hour when tested in accordance with the USDA Handbook Number 60, method 34b or other approved methods.
- D. Fertility - The range of the essential elemental concentration in soil shall be as follows:
- Ammonium Bicarbonate/DTPA Extraction
parts per million (mg/kilogram
dry weight basis)

phosphorus	2 - 40
potassium	40 - 220
iron	2 - 35
manganese	0.3 - 6
zinc	0.6 - 8
copper	0.1 - 5
boron	0.2 - 1
magnesium	50 - 150
sodium	0 - 100
sulfur	25 - 500
molybdenum	0.1 - 2

Soil may need to be amended and conditioned to optimize plant growth. The above listed fertility is for soil selection.

Concentration of nutrients for final acceptance

Ammonium Bicarbonate/DTPA Extraction
parts per million (mg/kilogram
dry weight basis

phosphorus	10 - 40
potassium	100 - 220
iron	24- 35
manganese	0.6 - 6
zinc	1 - 8
copper	0.3 - 5
boron	0.2 - 1
magnesium	50 - 150
sodium	0 - 100
sulfur	25 - 500
molybdenum	0.1 – 2

Acidity - The soil pH range measured in the saturation extract (Method 21a, USDA Handbook Number 60) shall be 6.0 - 7.9.

Chloride - The maximum concentration of soluble chloride in the saturation extract (Method 3a, USDA Handbook Number 60) shall be 150 mg/l (parts per million).

Boron - The maximum concentration of soluble boron in the saturation extract (Method 3a, USDA Handbook Number 60) shall be 1 mg/l (parts per million).

Sodium Adsorption Ratio (SAR) - The maximum SAR shall be 3 measured per Method 20b, USDA Handbook Number 60.

Aluminum – Available aluminum measured with the Ammonium Bicarbonate/DTPA Extraction shall be less than 3 parts per million

Soil Organic Matter Content - Sufficient soil organic matter shall be present to impart good physical soil properties but not be excessive to cause toxicity or cause excessive reduction in the volume of soil due to decomposition of organic matter. The desirable range is 3% to 6%. The carbon:nitrogen ratio should be about 10. A high carbon:nitrogen ratio may indicate the presence of hydrocarbons or non-humified organic matter.

Calcium Carbonate Content - Free calcium carbonate (limestone) shall not be present for acid-loving plants.

Heavy Metals - The maximum permissible elemental concentration in the soil shall not exceed the following concentrations:

Ammonium Bicarbonate/DTPA Extraction	
parts per million (mg/kilogram	
dry weight basis	
arsenic	1
cadmium	1
chromium	10
cobalt	2
lead	30
mercury	1
nickel	5
selenium	3
silver	0.5
vanadium	3

If the soil pH is between 6 and 7, the maximum permissible elemental concentration shall be reduced 50%. If the soil pH is less than 6.0, the maximum permissible elemental concentration shall be reduced 75%. No more than three metals shall be present at 50% or more of the above values.

Phytotoxic constituent, herbicides, hydrocarbons etc. - Germination and growth of monocots and dicots shall not be restricted more than 10%. Total petroleum hydrocarbons shall not exceed 50 mg/kg dry soil measured per the modified EPA Method No. 8015. Total aromatic volatile organic hydrocarbons (benzene, toluene, xylene and ethylbenzene) shall not exceed 0.5 mg/kg dry soil measured per EPA Methods No. 8020.

2.3 LIGHTWEIGHT SOIL FOR PLANTERS

A. Comply with applicable requirements for IMPORTED TOPSOIL above plus the following:

B. Composition:

Grain Size Distribution

clay fraction	0 - 2 %
passing #200 sieve	5-15 %
passing #60 sieve	10-25 %
passing #18 sieve	20-50 %
passing 1/8-inch sieve	55-95 %
passing 3/8-inch sieve	90-100 %

Density

Application Density	0.7 – 1.1 g/cm ³ (44 lbs – 68 lbs/cf)
Saturated Density	1.0 - 1.5 g/cm ³ (62 lbs – 93 lbs/cf)
Dry Density	0.6 -1.1 g/cm ³ (38 lbs – 68 lbs/cf)

Water & Air Management (% vol.)

saturated water capacity	>40
saturated air content	>10
Saturated Hydraulic Conductivity	>0.4 mm/min (>1.0 in/hr)

pH, Lime, and Salt Content	
pH (saturated paste)	5.5 - 7.5
carbonate content	<25 g/l
salts content (water extract)	
Electrical Conductivity (eCe)	<3.0 mmhos/cm
Organics	
OM content	2 – 4 mass %
C/N ratio	<20
Nutrients** (plant available)	
nitrogen (NO ₃)	3 – 15
phosphorus	1 – 7
potassium	6 – 15
calcium	19 – 65
magnesium	3 – 15
sulfur	1 – 3.5
iron	1 - 3
manganese	1 - 3
copper	0.25 – 0.50
boron	0.25 – 0.50
zinc	0.012 – 0.025
CEC Capacity	>6 cmol/kg

C. Compost Fraction:

1. Meet or exceed USEPA Class A standard, 40 CFR 503.13, Tables 1 & 3 (chemical contaminants) and 40 CFR 503.32(a) (pathogens) and/or be permitted in their state to produce Class A material.
2. Meet US Compost Council STA/TMECC criteria or equal for Class I or II stable, mature product.

2.4 SOURCE QUALITY CONTROL

A. Procedure for Sampling Topsoil at Source for Testing to Verify Chemical and Physical Characteristics:

1. Take representative samples from at least 5 locations at topsoil source.
2. Collect soil with clean, stainless steel implements and place it in clean plastic bags or soil sampling bags to prevent contamination.
3. Collect soil samples in a manner and in whatever quantity necessary to ensure that the samples are representative of topsoil.
4. Send soil samples to laboratory for testing, as indicated in Paragraph E below.
5. Submit to the Architect the laboratory's written soil test report, including the laboratory's soil test data; the laboratory's interpretation of nutritional deficiencies, excesses, and potential toxicities; and the laboratory's amendment recommendations.

B. Soil Sample Testing:

1. Send samples to Wallace Laboratories in El Segundo, CA.
2. Employ the laboratory to perform the following tests:
 - a. pH measurement in the saturation extract per USDA Handbook No. 60, Method 21.
 - b. Electrical conductivity of the saturation extract per USDA Handbook No. 60, Method 2.
 - c. Sodium absorption ratio of the saturation extract per USDA Handbook No. 60, Method 20b.

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- d. Determination of boron, calcium, copper, iron, magnesium, manganese, molybdenum, phosphorous, potassium, sodium, sulfur, and zinc, via the ammonium bicarbonate DTPA test method.
 - e. Analysis of saturation extract for calcium, magnesium, sodium, boron, chloride, phosphorous, nitrate, and sulfate per USDA Handbook No. 60, Method 2.
 - f. Measurement of following trace metals by the ammonium bicarbonate DTPA extract test method: aluminum, arsenic, cadmium, chromium, cobalt, lead, lithium, nickel, selenium, silver, strontium, tin, and vanadium per SSSA Methods of Soil Analysis Part 3.
 - g. Presence of calcium carbonate and magnesium carbonate.
 - h. Determine soil texture per SSSA Methods of Soil Analysis Part 1.
 - i. Measurement of organic matter content by organic carbon and total nitrogen per SSSA Methods of Soil Analysis Part 3.
 - j. Measurement of exchangeable Ammonium cation per SSSA Methods of Soil Analysis Part 3.
 - k. Determine base Saturation per SSSA Methods of Soil Analysis Part 3.
 - l. Determine cation Exchange Capacity per SSSA Methods of Soil Analysis Part 3.
 - m. Water Infiltration Rate per USDA Handbook No. 60, Method 34b.
3. Employ the laboratory to perform tests in accordance with commonly used methods if a specific method is not indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. General: Examine site and verify that conditions are suitable to receive Work and that no defects or errors are present which would cause defective installation of products or cause latent defects in workmanship and function.
- B. Verification of Subgrade: Verify that subgrade soil surface has been graded to correct elevations.
- C. Notification: Before proceeding with Work, notify the Resident Engineer in writing of unsuitable conditions and conflicts.

3.2 PREPARATION

- A. Protection:
 1. Use all reasonable precautions to prevent damage to existing conditions to remain such as structures, utilities, irrigation systems, plant materials and paving on or adjacent to the site of the Work.
 2. Provide barricades, fences or other barriers to protect existing conditions to remain from damage during construction.
 3. Use all reasonable precautions to prevent excessive compaction of planting area soil within or adjacent to the areas of Work.
 4. Do not store materials or equipment, permit burning, or operate or park equipment under the branches of existing plants to remain.
 5. Submit written notification of conditions damaged during construction to the Owner's Representative immediately.

-
- B. Cleaning Subgrade Surface: Clear subgrade of surface stones larger than 1 inch, debris, roots, branches, sticks, contaminated soil and other extraneous materials.

3.3 CLEANING TOPSOIL

- A. Cleaning Topsoil: Prior to placement, remove stones, tree and shrub roots, clods, sticks, and other deleterious materials larger than 1 inch diameter.

3.4 TOPSOIL INSTALLATION

- A. Location and Depths: As indicated on the Drawings.
- B. Topsoil Placement:
1. Place topsoil same day that subgrade soil ripping occurs and prior to vehicle or equipment traffic running over the ripped surface.
 2. Place topsoil with equipment of appropriate size for area and in a manner that avoids excessive compaction of the topsoil.
 3. Avoid repeatedly driving equipment in same tracks so that topsoil does not become excessively compacted.
- C. Allowances: Place topsoil to elevations that allow for settlement, addition of soil amendment, and finish grading tolerances.

3.5 TOLERANCES

- A. Finish Grading: See Section 32 91 19.

3.6 PROTECTION OF TOPSOIL

- A. Surface Drainage: Keep topsoil surface sloped so that surface drains.
- B. Compaction and Contamination:
1. Where necessary for traffic to occur on topsoil, protect the topsoil from excessive compaction from vehicular, equipment, and foot traffic by laying down planks, plywood, or other accepted protective devices.
 2. Do not store or stockpile materials on the topsoil.
 3. Where possible, do not allow vehicles to park or drive on topsoil, except equipment being used for soil preparation and finish grading Work.

3.7 REPAIR

- A. Excessively Compacted Topsoil:
1. Mechanically loosen excessively compacted topsoil to the full depth of the excessive compaction via a method acceptable to the Landscape Architect and finish grade the surface smooth to accepted elevations, after loosening the topsoil.
 2. Keep topsoil from being excessively compacted until date of Final Completion.
- B. Erosion Repair:
1. Repair erosion that occurs between topsoil installation and plant or sod installation.

2. Without excessively compacting topsoil, fill eroded areas with topsoil and finish grade surface smooth to accepted elevations.

END OF SECTION

SECTION 32 91 19
LANDSCAPE GRADING**PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Finish Grading of Planting Area Soil Surfaces.

B. Related Sections:

1. Section 01 43 39 – Mockups.
2. Termites: Section 31 31 16 - Termite Control.
3. Topsoil stripping, stockpiling, and rough grading: Section 31 20 00 - Earth Moving Operation and Maintenance of Planting: Section 32 01 90.
4. Structural Planting Soil: Section 31 38 00.
5. Irrigation Systems: Section 32 84 00.
6. Planting Soil Preparation: Section 32 91 13.
7. Imported Topsoil: Section 32 91 18.
8. Lawns: Section 32 92 00 - Turf and Grasses.
9. Plants: Section 32 93 00.

1.2 REFERENCES (Latest edition unless otherwise noted)**A. American Society for Testing and Materials (ASTM):**

D 1557 Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.

1.3 DEFINITIONS

- A. Acceptance, Acceptable, or Accepted: Acceptance by the Landscape Architect in writing.
- B. Finished Grades: The required final soil surface elevations and contours indicated on the Drawings.
- C. Aesthetic Acceptance of Grades: Acceptance by the Landscape Architect in writing of the aesthetic correctness of the contours. Aesthetic acceptance does not address whether an area drains properly, whether the areas are at the correct elevations, or whether it has been compacted properly.
- D. Excessive Compaction: Planting area soil or soil compaction greater than 75 percent maximum dry density as determined by ASTM D 1557.

1.4 QUALITY ASSURANCE**A. Finished Grade Smoothness Mockup:**

1. Prepare a 20-foot by 20-foot area of finish graded soil representing the finished graded surface of the planting areas.

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2. Locate mockup on site in a proposed planting area easily referenced by workers performing finish grading operations.
 3. Protect accepted mockup from physical damage and erosion with fencing, canopies, sandbags or other accepted means until date of Final Completion.
 4. The accepted Mockup shall be the standard by which finish grading will be judged.
- B. Settlement Mockup: Mockup areas of topsoil at the specified depths and apply irrigation to induce settlement, if required to help determine the amount of settlement which will be caused by irrigation and rain.

1.5 SITE CONDITIONS

- A. Environmental Requirements:
1. Do not work soil when moisture content is so great that excessive compaction will occur, nor when it is so dry that dust will form in the air or that clods will not break readily.
 2. Apply water, if necessary, to bring soil to an optimum moisture content for grading.
 3. Do not work soil when muddy or frozen.
- B. Existing Conditions:
1. Prior to Work commencement review and clearly mark in field horizontal and vertical locations of existing public underground utilities and structures with respective utility companies.
 2. Prior to Work commencement review and clearly mark in field horizontal and vertical locations of existing private underground utilities and structures with the Owner's Representative.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. General: Examine site and verify that conditions are suitable for finish grading Work, and that no defects or errors are present which would interfere with or cause incorrect finish grading Work to occur.
- B. Excessive Compaction: Verify that soil in planting areas is not excessively compacted.
- C. Soil Preparation: Verify that soil preparation Work is complete.
- D. Notification of Unsuitable Conditions: Before proceeding with Work, notify the Owner's Representative in writing of unsuitable conditions and conflicts.

3.2 PREPARATION

- A. Protection of Existing Conditions:

1. Use all appropriate precautions to prevent damage to existing conditions to remain such as structures, utilities, irrigation systems, plant materials and paving on or adjacent to the site of the Work.
2. Provide barricades, fences or other barriers to protect existing conditions to remain from damage during construction.
3. Use all appropriate precautions to prevent excessive compaction of planting area soil or soils within or adjacent to the areas of Work.
4. Do not store materials or equipment, permit burning, or operate or park equipment under the branches of existing plants to remain.
5. Submit written notification of conditions damaged during construction to the Owner's Representative immediately.

3.3 FIELD ENGINEERING

- A. General:
1. Establish lines and levels, locate and lay out by instrumentation and similar appropriate means for planting area finish grades.
 2. Provide as many grade stakes and string lines as required to achieve smooth finish grades acceptable to the Landscape Architect with positive surface drainage.
- B. Swale Flow Lines, Bottom of Slopes, Top of Slopes and Grade Breaks: Install grade stakes at maximum 10 feet on center.
- C. High Points and Low Points: Provide grade stakes at high points and low points including top of berms, catch basin rims and area drain rims.

3.4 FINISH GRADING OPERATIONS

- A. General:
1. Grade soil surface with smooth uniform slope between points where elevations are given, and between points where elevations are given and existing grades.
 2. Slope finish grades to drain surface water away from buildings, walks, paving, and other structures unless indicated otherwise.
 3. Slope finish grades to drain surface water to catch basins, area drains or trench drains as shown on the Drawings.
 4. Grade soil surface smooth to be free of high and low areas which will inhibit surface drainage.
 5. Grade the soil surface at the edges of lawn and groundcover areas along paving edges and curbs to an elevation 1 inch below the finished surface of adjacent paving and curbs, unless indicated otherwise.
 6. Hand-rake soil surface using screed boards, string lines and laser levels to achieve smooth surfaces acceptable to the Landscape Architect.
- B. Excessive Compaction:
1. Take precautions to prevent soil from becoming excessively compacted.
 2. Mechanically loosen excessively compacted soil areas to the full depth of excessive compaction.
- C. Equipment: Use equipment and hand tools of appropriate size and type to achieve the sculptural forms, profiles and a smooth soil surface free of high areas, depressions, equipment tracks, and excessive compaction.

- D. Depressions and Loose Material: Fill any depressions, and remove loose material to finish surface true to line and grade, presenting a smooth and unyielding surface.

3.5 TOLERANCES

A. Planting Areas:

1. Grade soil surface to within 0.05-foot of grades indicated on the Drawings, except bring soil surface grades along headers, paving, curbs, and other structures to within 0.01-foot of grades indicated on the Drawings.
2. Transition soil surface grades along paving, curbs, and other structures to areas of less strict tolerance over a 5-foot distance.

B. Wood Chip Mulch and Aggregate Mulch Areas:

1. Grade soil surface to within 0.05-foot of grades indicated on the Drawings, except bring perimeter surface grades along headers, paving, curbs, and other structures to within 0.01-foot of grades indicated on the Drawings.
2. Transition soil surface grades along paving, curbs, and other structures to areas of less strict tolerance over 5-foot distance.

- C. Allowances: Make proper allowances for settlement, spoils from plant pits, and addition of soil amendment.

3.6 ADJUSTING

A. Soil Finished Grade:

1. Provide allowance for 80 hours per crew (total 320 hrs.) of adjustment grading work with a 4-person hand-grading crew to smooth and shape the soil surfaces using hand rakes, shovels, or other hand tools.
2. After the soil surface elevations have been graded to be within the specified tolerances, perform adjustment grading Work under the direction of the Landscape Architect in the field.
3. Do not rely on adjustment grading to bring finished grade elevations to within the specified tolerances.

3.7 FIELD QUALITY CONTROL

A. Aesthetic Acceptance of Grades:

1. Upon completion of finish grading Work, schedule with the Landscape Architect a review to obtain aesthetic acceptance.
2. Provide 3 days advance written notification.
3. Do not commence sodding or other planting Work until receiving aesthetic acceptance.

B. Tests for Excessive Compaction:

1. Where excessive compaction is suspected by Landscape Architect, have Geotechnical Engineer perform nuclear density field tests.
2. Correct excessively compacted soil areas to the depth of the excessive compaction by means and methods acceptable to the Landscape Architect prior to installing plant material.

END OF SECTION

SECTION 32 92 00
TURF AND GRASSES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Sodded lawns.
 - 2. Soil testing.
 - 3. Maintenance.
- B. Related Sections:
 - 1. Earthwork: Section 31 20 00.
 - 2. Operation & Maintenance of Planting: Section 32 01 90.
 - 3. Landscape Irrigation System: Section 32 84 00.
 - 4. Topsoil: 32 91 18.
 - 5. Landscape Grading: Section 32 91 19.
 - 6. Exterior Plants: Section 32 93 00.

1.2 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Product Data:
 - 1. Sod grower's certification for each mixture for sod including sod source, supplier name, contact person, and phone numbers.
 - 2. Fertilizer and other soil amendments.
- C. Soil Test:
 - 1. Soil Analysis: Submit results for review. See QUALITY ASSURANCE below.
 - 2. Recommendations: Submit recommendations for soil amendments for approval.
- D. Contractor Qualifications: Qualification data for installer. See QUALITY ASSURANCE below.
- E. Maintenance Instructions: Recommended annual maintenance procedures to be followed by the Owner at the conclusion of Contractor maintenance period.

1.3 QUALITY ASSURANCE

- A. Installer's Qualifications: Single firm specializing in lawn installation and maintenance with at least five years experience installing projects of comparable size and complexity.
 - 1. Submit reference list of at least five completed representative projects indicating project name, address, telephone number, contract amount, Architect's, and Facilities Manager's name.
 - 2. Landscape Contractors submitting bids shall be pre-qualified before award of contract. Each reference shall be contacted to verify workmanship and general business practices.
 - 3. Contractors found to exhibit unsatisfactory installation, closeout, or warranty procedures will be disqualified.

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4. Contractor shall maintain an experienced full-time supervisor on the Project site during planting operations.
- B. Testing Agency Qualifications: Independent Material Testing Agency with capability to conduct analysis of soil content according to ASTM D-5268-92 and analysis of nutrient content and recommendations for amendments according to local Agricultural Experiment Station guidelines.
 - C. Soil Test: Contractor to provide soil tests for on-site and imported topsoil to be used for all lawn areas. Test to include analysis of organic matter, inorganic matter, (sand, silt, and clay), deleterious material, pH factor, mineral, and plant nutrient content. Report shall state suitability of topsoil for growth of plant material and include recommendations for additional nitrogen, phosphorus, and potash nutrients, limestone, aluminum sulfate, and other soil amendments if required. Mechanical analysis shall include:
 1. Soil pH factor.
 2. Lime deficiency.
 3. Available phosphorus.
 4. Exchangeable potassium.
 5. Calcium.
 6. Magnesium.
 7. Cation exchange capacity.
 8. Percent base saturation.
 - D. Field Quality Assurance:
 1. Acceptance: Acceptable lawn areas shall be uniform, thick, healthy turf, containing no gaps at sod joints and no bare areas in seeded areas in excess of 1 square foot with such areas not comprising more than 2 percent of the total lawn areas, resulting in 98 percent lawn coverage minimum. Unacceptable areas are all areas not showing proper catch or weed infestation at end of maintenance, not less than 60 days, and shall be re-seeded or re-sodded. Determination of acceptance of lawn areas will be made by the Landscape Architect upon request of Contractor.
 2. Protection: Contractor shall protect the work from construction, leaving the area free of depressions, ruts, etc. Contractor shall repair all disturbed areas to the satisfaction of the Owner.
 3. Payment: Payment will not be authorized until the above conditions (Acceptance, Protection, and Submittals) have been met to the satisfaction of the Landscape Architect.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Sod shall be harvested, delivered, and installed within a 24-hour period.
 1. Do not cut or transport sod when moisture content may adversely affect survival.
 2. Protect sod from sun, wind, and dehydration during delivery and storage.
 3. Protect sod from tearing, stretching, dropping and other handling damage during harvesting, delivery, storage, and installation.
- B. Deliver materials other than sod in original, unopened containers showing weight, analysis and name of manufacturer. Store in a manner not to impair effectiveness.

1.5 PROJECT CONDITIONS

- A. Notify Landscape Architect at least seven working days prior to installation of lawn materials.

- B. Verify location and extent of underground utilities. Protect existing utilities, paving, and other facilities from damage caused by lawn installation.
- C. Restrict traffic from lawn areas until grass is established. Erect temporary signs and barriers as required.
- D. Provide necessary watering equipment required for lawn establishment and maintenance period.
- E. Installation shall not occur until fine grading has been approved by Landscape Architect.

1.6 SEQUENCING

- A. Install lawns only after planting and other work affecting ground surface has been completed.
- B. Landscape Irrigation System: Irrigation system to be installed prior to lawn materials.
 - 1. Locate, protect and maintain system during lawn installation.
 - 2. Repair system components damaged by lawn installation at no additional cost to Owner.

1.7 WARRANTY

- A. All work shall be in accordance with the terms of the Paragraph, "Warranty" of FAR clause 52.246-21, including the following supplements:
 - 1. A One Year Turf Warranty will begin on the date that the Government accepts the project or phase for beneficial use and occupancy. The Contractor shall have completed, located, and installed all plants according to the plans and specifications. All turf is expected to be living and in a healthy condition at the time of final inspection.
 - 2. The Contractor will replace any dead turf material immediately. A one year warranty for the turf that was replaced, will begin on the day the work is completed.
 - 3. The Government will re-inspect all turf at the end of the One Year Warranty. The Contractor will replace any dead, missing, or defective turf material immediately. The Warranty will end on the date of this inspection provided the Contractor has complied with the work required by this specification. The Contractor shall also comply with the following requirements:
 - a. Replace dead, missing or defective turf material prior to final inspection.
 - b. Complete remedial measures directed by the Resident Engineer to ensure turf survival.
 - c. Repair damage caused while making turf replacements.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Topsoil: Specified in Section 32 91 18. Where additional topsoil is required, provide in accordance with referenced section. (Fertile, friable, natural, fine sandy clay loam containing at least 2 percent of decayed organic matter (humus), obtained from a well drained, arable site, capable of sustaining vigorous plant growth, and free from subsoil, heavy clay, coarse sand, clods, stones, slag, cinders, plants, roots, sticks, noxious weeds, and other foreign materials.)

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- B. Fertilizer: An approved commercial grade lawn fertilizer containing amounts of nitrogen, phosphorus and potassium required to adjust the soil fertility to a ratio recommended by the local Agricultural Experiment Station based upon the soil test.
1. Fast and slow release nitrogen; one quarter of nitrogen shall be in form of nitrates, 1/4 in form of ammonia salt and 1/2 in form of organic nitrogen.
 2. Phosphorus shall be from super-phosphate, a finely ground phosphate rock containing not less than 18 percent phosphoric acid.
 3. Potassium shall be in the form of sulfate of potash.
 4. Availability of various elements shall conform to standards of the Association of Official Agricultural Chemists.
- C. Lime: ASTM C 602 Class T, agricultural limestone containing not less than 80% of total carbonates, ground so that not less than 99 percent passes a No.8 sieve and not less than 75 percent passes a No.60 sieve.
- D. Sod: Cultivated turfgrass sod, free of weeds and undesirable grasses, machine-cut to supplier's standard width and length and not more than 1-1/2 inch or less than 1 inch thick.
1. Species: St. Augustine Palmetto, *Stenotaphrum secundatum*.
 2. Sod Stakes:
 - a. Softwood, 3/4 inch diameter x 8 inches long, or,
 - b. Steel, tee shaped, 4 inch wide head x 8 inches long.
- E. Water: Clean, fresh, and potable.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Inspection: Finish grading and topsoil specified elsewhere. Begin lawn installation only after finished grading has been approved by Landscape Architect. Examine lawn areas to verify they are ready to receive work under this section. Start of installation constitutes acceptance of work by other trades.
- B. After topsoil has been spread, apply ground agricultural lime if necessary at rate determined by the soil tests to adjust pH of topsoil to no less than 5.0. Distribute ground lime evenly by machine over entire area and incorporate thoroughly into topsoil.
- C. Not less than 7 days after lime (if necessary) has been spread, apply fertilizer and other soil amendments to lawn areas at rates recommended by soil test. Apply by mechanical spreader and incorporate thoroughly into topsoil. Use hand tools for areas inaccessible to mechanical equipment.
- D. Rake and loosen soil to a depth of 4 inches. Remove stones over 1 inch in any dimension and sticks, roots, debris, and extraneous matter.

3.2 SODDING

- A. Sodding Periods:
1. Place sod immediately after preparation of bed and within 24 hours of harvesting.

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2. Place sod between March 15 and October 15 or at other times with prior approval of Landscape Architect.
- B. If soil is dry, dampen with fine mist spray of water. Do not place sod on dry, frozen, or muddy soil, or if sod is dormant.
 - C. Lay sod to form a solid mass with tight-fitted joints. Butt joint ends and sides of sod strips without overlapping edges. Stagger sod to offset joints in adjacent courses. Do not drop, stretch, or tear sod. Remove excess sod to avoid smothering adjacent grass.
 - D. Provide consistent surface with top of sod pad flush with adjacent curb, walk, drain, or other hard surface. Provide smooth transition between sodded and seeded lawns.
 - E. To prevent slippage on slopes of 3 to 1 and greater, peg sod with two stakes per strip.
 - F. As each area is installed, tamp lightly and roll with light lawn roller to ensure good contact with soil, eliminating air pockets, and forming a smooth, even surface without displacing sod.
 - G. Water sod immediately after placement and thoroughly saturate with a fine mist spray. Continue watering, on a daily basis if necessary, to maintain adequate moisture in the root zone during establishment and until acceptance by Landscape Architect.

3.3 RECONDITIONING EXISTING LAWNS

- A. Recondition existing lawn areas where indicated and where damaged by Construction operations, including storage of materials and equipment and movement of construction vehicles.
- B. Provide fertilizer, sod, and soil amendments as specified for new lawns and as required to provide satisfactory reconditioned lawn. Provide topsoil as required to fill low areas and blend with new finished grades.
- C. Cultivate bare and compacted areas thoroughly. Where substantial but thin lawn remains, aerate if compacted, rake or cultivate soil, fertilize, seed, and mulch.
- D. Remove diseased, weed infested, or unsatisfactory lawn areas. Do not bury into soil. Remove soil contaminated by Contractor's operations, including oil and fuel drippings, stone, gravel, concrete spoils, and other construction debris.
- E. Provide same maintenance for reconditioned lawns as new lawns specified below.

3.4 CLEANING AND PROTECTION

- A. Perform cleaning during installation and maintenance of lawn work. Provide final cleaning prior to final acceptance. Remove all excess materials, debris, and equipment from the site. Sweep and wash paved surfaces affected by lawn installation.
- B. Protect all lawn work from construction, leaving the area free of depressions, ruts, and defects. Maintain protection during installation and maintenance periods. Repair all disturbed areas to the satisfaction of the Landscape Architect.

3.5 MAINTENANCE

- A. See Section 32 01 90 – Operation and Maintenance of Planting.

END OF SECTION

SECTION 32 93 00
PLANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Trees.
 - 2. Shrubs.
 - 3. Ground Cover.
 - 4. Shredded Pine Needle Mulch.
 - 5. Tree Stakes.
 - 6. Root Ball Anchor Kit
 - 7. Related Materials.
- B. Related Sections:
 - 1. Operation and Maintenance of Planting: Section 32 01 90.
 - 2. Irrigation Systems: Section 32 84 00.
 - 3. Planting Soil Preparation: Section 32 91 13.
 - 4. Topsoil: Section 32 91 18.
 - 5. Landscape Grading: Section 32 91 19.
 - 6. Turf and Grasses: Section 32 92 00.

1.2 REFERENCES (Latest edition unless otherwise noted)

- A. American Nursery & Landscape Association (ANLA).
- B. American National Standards Institute (ANSI):
 - 1. Z60.1 American Standard for Nursery Stock
- C. American Society for Testing and Materials (ASTM):
 - 1. D 1557 Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.
- D. International Code of Botanical Nomenclature (ICBN).
- E. International Code of Nomenclature of Cultivated Plants (ICNCP).

1.3 DEFINITIONS

- A. Plant Height: Measurement of main body height, not measurement to top branch tip.
- B. Plant Spread: Measurement of main body diameter, not measurement from branch tip to tip.
- C. Caliper: Trunk diameter measured at a point 6 inches above natural ground surface for trees up to 4 inches in caliper, and measured at a point 12 inches above natural ground surface for trees over 4 inches in caliper.
- D. Acceptance, Acceptable, or Accepted: Acceptance by the Architect in writing.

- E. Excessive Compaction: Planting area soil compaction greater than 75 percent of maximum dry density as determined by ASTM D 1557.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Product Data:
 - 1. Fertilizer.
- C. Samples:
 - 1. Shredded Pine Needle Mulch — 1/2-pound bag.
- D. Plant Material Photographs:
 - 1. At least 14 days prior to submittal of plant material location data, submit three color photographs each of representative plants of each type of plant material.
 - 2. Include a measuring rod in each photograph to clearly indicate plant heights.
- E. Plant Material Location Data: Quantities and sizes of each plant material type at each nursery or other place of growth, and address, phone number, and contact person for each nursery or other place of growth.
- F. Manufacturer's Instructions: Root ball anchor kit installation instructions, for informational purposes.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Meet requirements of applicable laws, codes, and regulations required by authorities having jurisdiction over Work.
 - 2. Provide for inspections and permits required by federal, state and local authorities in furnishing, transporting, and installing materials.
- B. Installer's Qualifications: Single firm specializing in landscape work with a minimum of five years experience installing projects of comparable size and complexity.
 - 1. Submit reference list of at least five completed representative projects indicating project name, address, telephone number, contract amount, Architect's, and Facilities Manager's name.
 - 2. Landscape Contractors submitting bids shall be pre-qualified before award of contract. Each reference shall be contacted to verify workmanship and general business practices.
 - 3. Contractors found to exhibit unsatisfactory installation, closeout, or warranty procedures will be disqualified.
 - 4. Contractor shall maintain an experienced full-time supervisor on the Project site during planting operations.
- C. Tree Stake System Mockups:
 - 1. Prepare one Mockup of wood pole tree staking system.
 - 2. Prepare one Mockup of root ball anchor kit support system.
 - 3. Construct Mockup using specified materials.
 - 4. Accepted Mockup shall be project standard by which Work will be judged.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Handling Plants:
 - 1. Do not lift or handle container plants by tops, stems or trunks.
 - 2. Do not bind or handle plants with wire or rope.
 - 3. Pad trunk and branches where hoisting cables or straps contact.
- B. Anti-Desiccant:
 - 1. Spray plant material in full leaf immediately before transporting with anti-desiccant.
 - 2. Meet requirements of anti-desiccant manufacturer's current printed application instructions.
- C. Digging Plants: Dig ball and burlap plants with firm, natural balls of earth of diameter meeting or exceeding requirements of ANSI Z60.1 and of sufficient depth as required to include the fibrous and feeding roots.
- D. Plant Storage Prior to Installation:
 - 1. Protect plant root balls from sun and drying winds.
 - 2. Keep root balls moist.
 - 3. Keep sun-sensitive plants shaded.
 - 4. Anchor plants to prevent damage from strong winds.

1.7 SITE CONDITIONS

- A. Environmental Requirements: Protect plant material being stored on site from sun and drying winds.
- B. Existing Conditions:
 - 1. Prior to Work commencement, review and clearly mark in field horizontal and vertical locations of public existing underground utilities and structures with respective utility companies.
 - 2. Prior to Work commencement, review and clearly mark in field horizontal and vertical locations of private underground utilities and structures with the Architect and Owner.

1.8 WARRANTY

- A. All work shall be in accordance with the terms of the Paragraph, "Warranty" of FAR clause 52.246-21, including the following supplements:
 - 1. A One Year Plant Warranty will begin on the date that the Government accepts the project or phase for beneficial use and occupancy. The Contractor shall have completed, located, and installed all plants according to the plans and specifications. All plants is expected to be living and in a healthy condition at the time of final inspection.
 - 2. The Contractor will replace any dead plant material immediately. A one year warranty for the plants that were replaced will begin on the day the work is completed.
 - 3. Replacement of relocated plants, that the Contractor did not supply, is not required unless they die from improper handling and care during transplanting. Loss through Contractor negligence requires replacement in kind and size.
 - 4. The Government will re-inspect all plants at the end of the One Year Warranty. The Contractor will replace any dead, missing, or defective plant material immediately. The Warranty will end on the date of this inspection provided the Contractor has complied with the work required by this specification. The Contractor shall also comply with the following requirements:

- a. Replace dead, missing or defective plant material prior to final inspection.
- b. Mulch and weed plant beds and saucers. Just prior to this inspection, treat these areas to a second application of approved pre-emergent herbicide.
- c. From plants having been installed for one year, remove stakes, guy wires and any required tree wrappings.
- d. Complete remedial measures directed by the Resident Engineer to ensure plant survival.
- e. Repair damage caused while making plant replacements.

1.9 MAINTENANCE

- A. Maintenance Service: Refer to Section 32 01 90.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

- A. Plant Material: Accepted substitute plants shall be true to species and variety and shall meet requirements of this Section except that plants larger than specified may be used, if accepted by the Architect, and at no additional cost to the Owner.

2.2 MATERIALS

- A. General Plant Requirements:
 - 1. Growing Practices: Nursery grown in accordance with best horticultural industry practices.
 - 2. Nomenclature: Plant nomenclature shall meet requirements of ICBN and ICNCP.
 - 3. Climatic Growing Conditions: Grown under climatic conditions similar to those of project for at least two years unless otherwise accepted by the Arborist.
 - 4. Container Growth Limitations: Container stock excluding annuals shall have been grown in the containers in which delivered for at least six months, but not over two years.
 - 5. Root Ball Size: Meet or exceed requirements of ANSI Z60.1.
 - 6. Branching: Structurally strong, able to stand upright without stakes or guys on a windless day; exceptionally heavy, symmetrical, tightly knit, so trained or favored in development and appearance as to be superior in form, number of branches, compactness and symmetry.
 - 7. Vigor: Sound, healthy and vigorous, well branched and densely foliated when in leaf.
 - 8. Disease and Pests: Free of disease, insect pests, eggs, or larvae.
 - 9. Root System: Healthy well-developed root systems, free of kinked, circling, girdling and center roots, root-bound condition and cracked or broken root balls.
 - 10. Plant Size: Measure plants when branches are in their normal upright position.
 - 11. Pruning: Do not prune, thin or shape plants before delivery without acceptance by the Arborist and the Architect.
 - 12. Unacceptable Conditions: Multiple leaders, unless specified or accepted by Architect, damaged or crooked leaders, bark abrasions, sunscald, disfiguring knots, or fresh cuts of limbs over 3/4-inch diameter which have not completely callused.
- B. Organic Fertilizer for Trees and Shrubs: Pure Black Worm Castings.
- C. Water: Clean, fresh, potable and free of toxic elements.

- D. Wood Chip Mulch: Shredded hardwood bark, 1/2-inch maximum length, free of soil, rocks, toxic materials, and other debris.
- E. Shredded Pine Needle Mulch:
- F. Anti-Desiccant: Commercially available spray protective coating, designed to reduce plant transpiration loss, which produces a moisture retarding barrier not removable by rain or snow.
- G. Root Ball Anchor Kit: Provide for trees in tree grates only. 3 anchors per root ball. Galvanized aircraft cable with "duckbill" earth anchor on bottom and D-ring on top and nylon fabric tensioning strap. All metal zinc coated.
 - 1. Small (#40 size duckbill with 1/16" diameter cable) for trees up to 3" in diameter.
 - 2. Medium (#68 size duckbill with 1/8" diameter cable) for trees up to 6" in diameter.
- H. Staking Line: Flat woven polypropylene woven material; 3/4 inch wide; 900 lb test strength; green color. Metal wire not permitted.
- I. Stakes: Sound hardwood, cross sectional dimension as indicated below with one end pointed.
 - 1. 2-1/2 inches diameter (preferred), or
 - 2. 2-1/2 x 2-1/2 inches square.
 - 3. Length: 8 feet.

2.3 MIXES

- A. Plant Pit Backfill: Refer to Section 32 91 13.
- B. Structural Planting Soil Mix: Refer to Section 31 38 00.

2.4 SOURCE QUALITY CONTROL

- A. Advanced Tree Procurement:
 - 1. Within 60 days of award of Contract, notify Architect in writing of the availability or lack thereof of the specified plant material.
 - 2. Procure trees and arrange for contract growing as required to ensure that plant material is available in the quantities and sizes specified, and of the quality specified, at time of installation.
 - 3. Verify plant branching requirements with Architect prior to contract growing.
 - 4. Landscape Architect will review advanced procured trees prior to initial purchase and at end of the first growing season.
 - 5. Prior to delivery of advanced procured plant material to site, coordinate and schedule a final review of the plant material at the place of growth.
 - 6. Review and acceptance of the advance-procured plant material at the place of growth does not cancel the right of the Architect to reject plant material at the site, if damage or unacceptable conditions are found that were not detected at the place of growth.
- B. Plant Material Review and Tagging:
 - 1. Trees will be reviewed, photographed and tagged using irremovable tags by the Architect at the nursery, or other place of growth prior to delivery of trees to site.
 - 2. At the Architect's discretion, shrubs may or may not be reviewed, photographed, and tagged by the Architect at the nursery or other place of growth.
 - 3. Tagging of plant material at the nursery or place of growth does not affect the right of the Architect to reject plant material at the site, if damage or unacceptable conditions are

found that were not detected at the nursery or place of growth, or in the submitted photographs.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. General: Examine site and verify that conditions are suitable to receive Work and that no defects or errors are present which would cause defective installation of products or cause latent defects in workmanship and function.
- B. Finish Grading and Soil Preparation: Verify that finish grading and soil preparation Work is complete.
- C. Verification Surface Drainage: Verify positive surface drainage of planted areas.
- D. Notification: Before proceeding with Work, notify the Owner's Representative in writing of unsuitable conditions.

3.2 PREPARATION

- A. Protection of Existing Conditions:
 - 1. Use all reasonable precautions to prevent damage to existing conditions to remain such as structures, utilities, plant materials and walks on or adjacent to the site of the Work.
 - 2. Provide barricades, fences or other barriers to protect existing conditions to remain from damage during construction.
 - 3. Use all reasonable precautions to prevent excessive compaction of planting area soil within or adjacent to the areas of Work.
 - 4. Do not store materials or equipment, permit burning, or operate or park equipment under the branches of existing plants to remain.
 - 5. Submit written notification of damaged plants and structures to the Owner's Representative immediately.

3.3 SUBSURFACE OBSTRUCTIONS

- A. Plant Pit Excavation:
 - 1. If rock, underground utilities, structures, tree roots or other obstructions are encountered in the excavation of plant pits, alternate locations may be accepted by the Landscape Architect.
 - 2. Submit written notification of encountered obstructions to the Architect immediately.
- B. Irrigation Piping: Reroute around the plant root balls.

3.4 PLANT LAYOUT

- A. Trees:
 - 1. Stake location of trees where indicated on Drawings.
 - 2. Scale tree locations where no dimensions are given.

3. Drive a 3-foot long wood lath stake at each tree location and mark each tree type with different color survey tape.
4. Contact the Architect to review locations in field prior to excavating plant pits and installing irrigation.
5. Do not excavate plant pits or install irrigation until the Architect has accepted plant locations.

3.5 EXCAVATION OF TREE AND SHRUB PLANT PITS

A. Equipment:

1. Excavate pits with a back-hoe or hand digging.
2. Do not use an auger.

B. Dimensions:

1. Excavate plant pits to size and shape indicated on the Drawings.
2. Where not indicated on the Drawings, excavate plant pits to a depth equal to the root ball height minus the amount needed to allow for settlement and to install the root balls at the specified elevation relative to adjacent finished grade.
3. Install top of plant root balls 1 inch above adjacent finished grade, or higher if required to allow for settlement, except where indicated otherwise.
4. Excavate pits to a diameter which is 2 times the root ball diameter, except where indicated otherwise on the Drawings.
5. Center plant pits on plant locations, unless indicated otherwise.
6. Where plant pits can not be excavated to specified dimensions nor centered on plants due to obstructions such as paving, walls, curbs, or other structures excavate pits in directions without obstructions until pit volume equals the specified plant pit volume, except where indicated otherwise.
7. Do not undercut adjacent obstructions unless accepted by the Architect.
8. Excavate plant pit sides along adjacent elements such as paving, walls, curbs, and other structures at a 45 degree angle sloping away from the bottom surfaces of the adjacent elements, except where indicated otherwise.

3.6 PLANTING AND BACKFILL OPERATIONS

A. General: Install plant material in accordance with recommendations of ANLA.

B. Protection of Plants Prior to Installation:

1. Protect plant root balls from sun or drying winds.
2. Keep root balls of plants that cannot be planted immediately upon delivery in the shade, well-protected and well-watered.

C. Removal of Containers:

1. Remove canned stock carefully after cans have been cut on two sides with accepted cutter.
2. Do not use spade to cut containers.

D. Root Ball Scarification:

1. After removing plant from container, scarify side of root ball to prevent root-bound condition.
2. Loosen root ball soil surface to depth of 1/8-inch to 1/4-inch without damaging roots or breaking root ball.

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- E. Cutting Circling Roots:
1. If circling roots are encountered at root ball sides, notify the Landscape Architect for field review by the Arborist.
 2. Upon the Arborist's acceptance, cut roots on 4 sides of root ball 90 degrees apart at no additional cost to the Owner.
 3. Use a 4-inch wide sharp sterilized straight blade.
 4. Cut roots by pushing spade or knife down sides of root ball 90 degrees to root ball surface and 2 inches into root ball.
 5. Keep spade or knife sharp to cut roots cleanly.
- F. Plant Placement:
1. Handling plant carefully; set plant root ball on pit bottom centered on accepted horizontal location.
 2. Install plant root ball vertically so that top of root ball is 1/2-inch to 1-1/2-inch above adjacent finished grade after settlement except where indicated otherwise.
- G. Removal of Root Ball Wrapping Materials: Remove and dispose of burlap, nylon cord, wire baskets, twine and other materials prior to backfilling.
- H. Backfill Mix Placement:
1. Place mix carefully as not to damage the plant root ball, trunk, branches, or foliage.
 2. Fill pit until top of backfill mix is even with top of root ball.
- I. Backfill Mix Settlement:
1. After backfill mix has been placed, settle mix by watering evenly.
 2. Fill settled backfill mix areas with additional backfill mix as required to bring it even with top of root ball.
 3. Continue filling settled areas and drenching with water until settlement stops.
- J. Settled Plant Adjustment: Raise plant root balls which settle so that tops of root balls are at the specified elevation relative to adjacent finished grade.
- K. Organic Fertilizer for Trees and Shrubs:
1. After backfill settlement and plant adjustment work, uniformly spread organic fertilizer over the surface of the root ball and backfill mix at the rate of ½ pound for each inch of tree caliper and at the rate of ½ pound for each shrub.
 2. After application, uniformly sprinkle surface of plant pits and root balls with 2 inches of water.

3.7 PINE NEEDLE MULCH

- A. Depth:
1. Install a 2-inch depth continuous mulch layer over plant watering basins and shrub areas, except where indicated otherwise.
 2. Install 2-inch depth continuous mulch layer over ground cover areas, except where indicated otherwise.
- B. Surface: Rake mulch surface smooth.
- C. Woody Plant Stems: Hold mulch 1 inch away from woody plant stems so that mulch does not touch stems.

3.8 TREE PROTECTION

- A. Trees with Underground Obstacles: Install trees using specified "Root Ball Anchor Kit" in accordance with manufacturer's instructions.
 - 1. Prior to placing root ball, install "duckbill" anchors in bottom of pit, driving into soil with drive rod until only the cable loops remain exposed. Load lock anchors so anchor becomes perpendicular to the cable.
 - 2. Place root ball in pit. Make sure anchor loops and D-ring remain exposed.
 - 3. Lace tensioning strap through D-rings and over root ball in triangular form as described by manufacturer; engage tensioner and tighten. Use special lacing configuration for small or week root balls as described by manufacturer; finish tensioning as described above.
- B. Trees Without Underground Obstacles:
 - 1. Immediately after planting, stake, guy and protect trees.
 - 2. Orientation: Install stakes on the prevailing wind side of trees.
 - 3. Stake System Installation: Use "T" system with two vertical stakes and staking line.
 - a. Install in accordance with manufacturer's current printed instructions, and the accepted Mockup.
 - b. Install stakes deeper than the minimum recommended by the manufacturer if necessary to anchor the tree adequately.
 - c. Install separate staking line for each stake; wrap tree and stake in figure 8 pattern; attach to stake with corrosion resistant screws.
 - 4. Trunks shall be inspected and approved. Inspect for infestation, trunk deformity, damage, or improper pruning. Take corrective measures in accordance with recommendations of ANLA.
- C. Protect completed installation from damage until work can be reviewed for initial acceptance by Landscape Architect.

3.9 FIELD QUALITY CONTROL

- A. Architect's Review of Tree and Shrub Layout and Plant Orientation:
 - 1. Schedule Architect to review staked tree and shrub locations in the field to determine specific locations for each plant, and to determine orientation for each plant.
 - 2. Do not excavate plant pits or install local irrigation lines until plant locations are accepted.

END OF SECTION