100% Construction Documents
FOR
CITY OF FREDERICKSBURG

RIVERFRONT PARK

Submitted July 17, 2019
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SECTION 012200 - UNIT PRICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for unit prices.

B. Related Requirements:

1. Section 012100 "Allowances" for procedures for using unit prices to adjust quantity allowances.
2. Section 012600 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.
3. Section 014000 "Quality Requirements" for field testing by an independent testing agency.

1.3 DEFINITIONS

A. Unit price is an amount incorporated into the Agreement, applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

1.4 PROCEDURES

A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, overhead, and profit.

B. Measurement and Payment: See individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.

C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.

D. List of Unit Prices: A schedule of unit prices is included in Part 3. Specification Sections referenced in the Part 3 "Schedule of Unit Prices" Article contain requirements for materials described under each unit price.
PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

A. Unit Price No. 1: Removal of unsatisfactory soil and replacement with satisfactory soil material.
   1. Description: Unsatisfactory soil excavation and disposal off-site and replacement with satisfactory fill material or engineered fill from off-site, as required, in accordance with Section 312000 "Earth Moving."
   2. Unit of Measurement: Cubic yard of soil excavated, based on in-place surveys of volume before and after removal.

B. Unit Price No. 2: Fine Grading of soils.
   1. Description: All work necessary to bring the subgrade material into the final shape and compacted condition prescribed in the contract documents
   2. Unit of Measurement: Square yard of soil graded to finish grade.

C. Unit Price No. 3: Brick Paver Assembly including sub-base.
   1. Description: The placement of brick unit pavers including sub-base and setting bed, as required, in accordance with Section 321400 "Unit Paving" and detail 3 on sheet L-601.
   2. Unit of Measurement: Square foot of brick pavers installed including sub-base.

D. Unit Price No. 4: Granite Curb including Setting Bed.
   1. Description: Installation of Granite Curb including mortar setting in accordance with Section 321400 "Unit Paving" and detail 5 on sheet L-601.
   2. Unit of Measurement: Linear Feet of Granite Curb installed.

E. Unit Price No. 5: Top soil imported and placed.
   1. Description: Top soil imported and placed in accordance with Section 329100 "Planting Soil."
   2. Unit of Measurement: Cubic Yards of topsoil placed.

F. Unit Price No. 6: Meadow Plantings
   1. Description: Purchase, installation, maintenance and warranty for meadow plantings, in accordance with Section 329200 "Lawns & Grasses."
   2. Unit of Measurement: Square Yards of finished plantings, including warranty.

G. Unit Price No. 7: Sod
   1. Description: Installation of sod including preparation, maintenance and warranty in accordance with 329200 "Lawns & Grasses."
   2. Unit of Measurement: Square Yards.

H. Unit Price No. 8: Curb & Gutter
UNIT PRICES

1. Description: Cast in Place Concrete Curb and Gutter in accordance with City Design Standards Manual and 033000 “Cast-in-Place Concrete.”
2. Unit of Measurement: Linear Feet.

I. Unit Price No. 9: Asphalt overlay per City Street DSM
   1. Description: Asphalt overlay per City Design Standards Manual, in accordance with Section 321216 ”Asphalt Paving.”
   2. Unit of Measurement: Square Yards.

J. Unit Price No. 10: Concrete Sidewalk Assembly per City DSM
   1. Description: Concrete Sidewalk Assembly in accordance with City Design Standards Manual and Section 321313 ”Concrete Paving.”
   2. Unit of Measurement: Square Feet.

K. Unit Price No. 11: Pole Lights
   1. Description: Poles and Luminaires for bases installed in base contract in accordance with Section 265600 ”Exterior Lighting Luminaires.”
   2. Unit of Measurement: Each.

L. Unit Price No. 12: Sign Columns
   1. Description: Cor-Ten Sign Columns in accordance with Section 055001 ”Cor-Ten Site Walls.”
   2. Unit of Measurement: Each.

END OF SECTION 012200
SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY
   A. Section includes administrative and procedural requirements for alternates.

1.2 DEFINITIONS
   A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

   1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
   2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.3 PROCEDURES
   A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

      1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

   B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated revisions to alternates.

   C. Execute accepted alternates under the same conditions as other work of the Contract.

   D. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.
PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. ADD ALTERNATE #1: Stage
   1. Base Bid: Concrete Slab as indicated on Sheet L-101 and as specified in Division 32 Section "Concrete Paving" – Concrete Paving – Type 2.
   2. Alternate: Stage with stairs, ramps, cable enclosure, handrails and guardrails as indicated on Sheets L-101A, L-617, L-618, and L-619 and as specified in Division 32 Section "Concrete Paving" – Concrete Paving – Type 2, Division 05 Section "Decorative Metal Railings," and Section "Metal Fabrications".

B. ADD ALTERNATE #2: Pole Lights
   1. Base Bid: No lights; light pole bases installed and covered with Footing-Post Attachments as indicated in Detail 6A on Sheet L-638 and as specified in Division 05 Section "Metal Fabrications".
   2. Alternate: Light Fixture – Type 1 - as indicated in Detail 7 on Sheet L-641 “Details – Furniture” and as specified in Division 26 Section "Exterior Lighting Luminaires”.
   3. Provide Unit Prices for work under this Alternate. See Division 01 Section “Unit Prices” and Bid Form.

C. ADD ALTERNATE #3: Sign Columns
   2. Alternate: Cor-Ten Sign Columns as indicated on Sheet L-606 and Division 05 Section “Cor-Ten Site Walls”.
   3. Provide Unit Prices for work under this Alternate. See Division 01 Section “Unit Prices” and Bid Form.

D. ADD ALTERNATE #4: Fence
   1. Base Bid: No Type 2 Fencing.
   2. Alternate: Provide Type 2 Fencing as indicated on Sheet L-101 – “Materials Plan” and in Details 4,5 and 6 on Sheet L-643 – “Details – Furniture” and as specified in Division 05 – “Decorative Metal Railings”.

E. ADD ALTERNATE #5: Extended Warranty for Meadow Planting
   1. Base Bid: One-Year of Warranty as indicated in Division 32 Section “Meadow Planting.”
   2. Alternate: One additional year of Warranty under the same terms and condition as indicated in Division 32 Section “Meadow Planting” for a total of two years of warranty.

END OF SECTION 012300
SECTION 024116 - STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Demolition and removal of existing site improvements.
   2. Abandoning in-place below-grade construction.
   3. Disconnecting, capping or sealing, and abandoning in-place site utilities.
   4. Salvaging items for reuse by Owner.

B. Related Requirements:
   1. Section 024119 "Selective Demolition" for partial demolition of buildings, structures, and site improvements.
   2. Section 311000 "Site Clearing" for site clearing and removal of above- and below-grade site improvements not part of building demolition.

1.2 DEFINITIONS

A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged.

B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and store for later reinstallation. Include fasteners or brackets needed for reattachment elsewhere.

1.3 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

   1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.4 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.

   1. Inspect and discuss condition of construction to be demolished.
   2. Review structural load limitations of existing structures.
   3. Review procedures for noise control and dust control.
4. Review items to be salvaged and returned to Owner.

1.5 FIELD CONDITIONS

A. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

   1. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

B. On-site storage or sale of removed items or materials is not permitted.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

2.2 SOIL MATERIALS

A. Satisfactory Soils: Comply with requirements in Section 312000 "Earth Moving."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

B. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

C. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.

3.2 PREPARATION

A. Salvaged Items: Comply with the following:

   1. Clean salvaged items of dirt and demolition debris.
   2. Store items in a secure area until delivery to Owner or reinstallation.
3. Protect items from damage during and storage.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Utilities to be Disconnected: Locate, identify, disconnect, and seal or cap off utilities to be demolished.
   1. Arrange to shut off utilities with utility companies.
   2. If removal, relocation, or abandonment of utility services will affect adjacent occupied buildings, then provide temporary utilities that bypass buildings and structures to be demolished and that maintain continuity of service to other buildings and structures.
   3. Cut off pipe or conduit a minimum of 24 inches below grade. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing according to requirements of authorities having jurisdiction.
   4. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.4 PROTECTION

A. Existing Utilities to Remain: Maintain utility services to remain and protect from damage during demolition operations.

3.5 DEMOLITION, GENERAL

A. General: Demolish indicated site improvements completely. Use methods required to complete the Work within limitations of governing regulations.

B. Site Access and Temporary Controls: Conduct building demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

   1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed trafficways if required by authorities having jurisdiction.
   2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

C. Explosives: Use of explosives is not permitted.

3.6 SITE RESTORATION

A. Below-Grade Areas: Completely fill below-grade areas and voids resulting from building demolition operations with satisfactory soil materials according to backfill requirements in Section 312000 "Earth Moving."
B. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades.

3.7 REPAIRS

A. Promptly repair damage to adjacent infrastructure caused by demolition operations.

3.8 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Do not burn demolished materials.

3.9 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by building demolition operations. Return adjacent areas to condition existing before building demolition operations began.

1. Clean roadways of debris caused by debris transport.

END OF SECTION 024116
SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Demolition and removal of selected site elements.
2. Salvage of existing items to be reused or recycled.

B. Related Requirements:

1. Section 015639 "Temporary Tree and Plant Protection" for temporary protection of existing trees and plants that are affected by selective demolition.
2. Section 017300 "Execution" for cutting and patching procedures.
3. Section 311000 "Site Clearing" for site clearing and removal of above- and below-grade improvements not part of selective demolition.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.

B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.

C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.
B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 INFORMATIONAL SUBMITTALS

A. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by demolition operations. Comply with Section 013233 "Photographic Documentation." Submit before Work begins.

1.6 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

1.7 FIELD CONDITIONS

A. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

B. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

C. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

D. Storage or sale of removed items or materials on-site is not permitted.

E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

C. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video.
   1. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.
   2. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations.

B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

C. Removed and Salvaged Items:
   1. Clean salvaged items.
   2. Pack or crate items after cleaning. Identify contents of containers.
   3. Store items in a secure area until delivery to Owner.
   4. Transport items to Owner's storage area designated by Owner.
   5. Protect items from damage during transport and storage.

D. Removed and Reinstalled Items:
   1. Clean and repair items to functional condition adequate for intended reuse.
   2. Pack or crate items after cleaning and repairing. Identify contents of containers.
   3. Protect items from damage during transport and storage.
   4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.3 PIPED UTILITY DEMOLITION

A. Disconnect, demolish, and remove piped utility systems, equipment, and components indicated to be removed.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
2. Piping to Be Abandoned in Place: Drain piping. Fill abandoned piping with flowable fill, and cap or plug piping with same or compatible piping material.

B. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.4 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.

B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.

C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn demolished materials.

3.6 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.
SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Cast-in-place concrete, including formwork, reinforcement, concrete materials, anchorages, mixture design, placement procedures, and finishes.

B. Related Requirements:
   1. Section 312000 "Earth Moving" for excavation.
   2. Section 321313 "Concrete Paving" for concrete pavement and decorative concrete pavement and walks.

1.2 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, and slag cement subject to compliance with requirements.

B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Design Mixtures: For each concrete mixture.

C. Shop Drawings:
   1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
      a. Location of construction joints is subject to approval of the Architect.
   2. Steel Reinforcement
      a. Include placing drawings that detail fabrication, bending, and placement.
      b. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, tie spacing, and supports for concrete reinforcement.
1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs Project personnel qualified as an ACI-certified Flatwork Technician and Finisher and a supervisor who is a certified ACI Flatwork Concrete Finisher/Technician or an ACI Concrete Flatwork Technician.

B. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

1. Manufacturer certified in accordance with NRMCA’s “Certification of Ready Mixed Concrete Production Facilities.”

C. Mockups: Cast concrete slab-on-ground and formed-surface panels to demonstrate typical joints, surface finish, texture, tolerances, floor treatments, and standard of workmanship.

1. Build panel approximately 100 sq. ft. for slab-on-ground and 50 sq. ft. for formed surface in the location indicated or, if not indicated, as directed by Architect.

2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

D. Color: Site stairs and stage color to match Concrete Paving-Type 1 color (See Section 312313-Concrete Paving).

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with ASTM C94/C94M and ACI 301.

1.7 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1.

B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. As-Cast Surface Form-Facing Material:

1. Provide continuous, true, and smooth concrete surfaces.

2. Furnish in largest practicable sizes to minimize number of joints.

B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.

1. Provide lumber dressed on at least two edges and one side for tight fit.
C. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.


2.2 STEEL REINFORCEMENT

A. Steel reinforcement, except epoxy coated reinforcement, shall be provided in accordance with Section 223 of the VDOT Road and Bridge Specifications, 2016 Edition with 2017 and 2018 Supplements.

B. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.

C. Epoxy-Coated Reinforcing Bars:

1. Steel Bars: ASTM A615/A615M, Grade 60, deformed bars.

2. Epoxy Coating: ASTM A775/A775M with less than 2 percent damaged coating in each 12-inch bar length.

D. Epoxy-Coated Welded-Wire Reinforcement: ASTM A884/A884M, Class A coated, Type 1, deformed steel.

E. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.


2.3 CONCRETE MATERIALS

A. Concrete materials shall be provided in accordance with Section 217 of the VDOT Road and Bridge Specifications, 2016 Edition with 2017 and 2018 Supplements.

B. Integral Color: To match Type 1 Paving (Section 312313-Concrete Paving)

2.4 ADMIXTURES

A. Admixtures shall be provided in accordance with Section 215 of the VDOT Road and Bridge Specifications, 2016 Edition with 2017 and 2018 Supplements, and on the VDOT Approved Materials List.

2.5 FIBER REINFORCEMENT

A. Synthetic Micro-Fiber: Monofilament polypropylene micro-fibers engineered and designed for use in concrete, complying with ASTM C 1116/C 1116M, Type III, 1 to 2-1/4 inches long.
2.6 CURING MATERIALS

A. Curing materials shall be provided in accordance with Section 220 of the VDOT Road and Bridge Specifications, 2016 Edition with 2017 and 2018 Supplements.

2.7 RELATED MATERIALS


B. Adhesive Anchoring: Where directed on the plans, or as directed by the Engineer, post-installed anchors shall be anchored to concrete cured a minimum of 28-days using the following:

1. Hilti HIT-HY 200 Epoxy Adhesive Anchoring System
2. Approved Equivalent

2.8 CONCRETE MIXTURES

A. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash: 30 percent by mass.
2. Slag Cement: 50 percent by mass.

B. Admixtures: Use admixtures in accordance with Section 215 of the VDOT Road and Bridge Specifications, 2016 Edition with 2017 and 2018 Supplements, and with manufacturer's written instructions.

C. Proportion all materials and mix designs in accordance with Section 217 of the VDOT Road and Bridge Specifications, 2016 Edition with 2017 and 2018 Supplements.

1. Foundation and drilled shaft concrete shall conform to VDOT Class A4 General and include:
   a. Synthetic Micro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate as noted in the plans, but not less than 1.5 lb/cu. yd.
2. Walls, slabs, beams, and all other concrete shall conform to VDOT Class A4 General.

2.9 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.10 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use. Select fasteners for type, grade, and class required.

B. Post-Installed Anchors: Chemical anchors

1. ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; and washers.
   a. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

C. Stainless Steel Rods and Nuts: Annealed stainless steel threaded rods, ASTM F593; with hex nuts, ASTM F594; and flat washers; Alloy Group 1.
   1. Minimum yield strength, 45 ksi

PART 3 - EXECUTION

3.1 INSTALLATION OF FORMWORK
   A. Comply with ACI 301.
   B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
   C. Chamfer exterior corners and edges of permanently exposed concrete.

3.2 INSTALLATION OF EMBEDDED ITEMS
   A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.
      1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.3 INSTALLATION OF STEEL REINFORCEMENT
   A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.

3.4 JOINTS
   A. Construct joints true to line, with faces perpendicular to surface plane of concrete.
   B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.
      1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
   C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:
      1. Grooved Joints: Form control joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of control joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
      2. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action does
not tear, abrade, or otherwise damage surface and before concrete develops random cracks.

D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.
2. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

3.5 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.

1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.

B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.

C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect in writing, but not to exceed the amount indicated on the concrete delivery ticket.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301, but not to exceed the amount indicated on the concrete delivery ticket.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

3.6 FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:

1. ACI 301 Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.
   a. Patch voids larger than 1-1/2 inches wide or 1/2 inch deep.
   b. Remove projections larger than 1 inch.
   c. Tie holes do not require patching.
   d. Surface Tolerance: ACI 117 Class D.
   e. Apply to concrete surfaces not exposed to public view.

2. ACI 301 Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.
   a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
b. Remove projections larger than 1/4 inch.
c. Patch tie holes.
d. Surface Tolerance: ACI 117 Class B.
e. Locations: Apply to concrete surfaces exposed to public view.

B. Related Unformed Surfaces:

1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a color and texture matching adjacent formed surfaces.
2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.7 FINISHING SLABS

A. Comply with ACI 302.1R recommendations for screeding, restaightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and locations indicated on Drawings.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.
2. Coordinate required final finish with Architect before application.

3.8 CONCRETE CURING

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

1. Comply with ACI 301 and ACI 306.1 for cold weather protection during curing.
2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply in accordance with manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Curing Formed Surfaces: Comply with ACI 308.1 as follows:

1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
2. Cure concrete containing color pigments in accordance with color pigment manufacturer's instructions.
3. If forms remain during curing period, moist cure after loosening forms.
4. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:

   a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
   b. Continuous Sprinkling: Maintain concrete surface continuously wet.
   c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.
e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.

1) Reccoat areas subject to heavy rainfall within three hours after initial application.
2) Maintain continuity of coating and repair damage during curing period.

D. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:

1. Begin curing immediately after finishing concrete.

3.9 CONCRETE SURFACE REPAIRS

1. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

3.10 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.

B. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

1. Testing agency shall immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
2. Testing agency shall report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.
3. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

END OF SECTION 033000
SECTION 044313 - SANDSTONE BENCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Extraction of existing historic Aquia sandstone foundation
   2. Field cutting and finishing of extracted Aquia sandstone.
   3. Stone masonry adhered to concrete CMU backup.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each variety of stone accessory, and manufactured product.

B. Samples for Initial Selection: For colored mortar.
   1. Color to be selected by Landscape Architect.
   2. Cleaned stone.
   3. Cleaned stone with penetrating breathable sealant.

C. Samples for Verification: submit samples of the following:
   1. Each type of sand used for pointing mortar.
      a. For blended sands, provide samples of each component and blend.
      b. Identify sources, both supplier and quarry, of each type of sand
   2. Extracted, cleaned, and finished stone.

D. Shop Drawings: For creating sandstone benches using existing excavated stones.
   1. Indicate stones to be used and how they will be cut.

E. Process of Extraction of Sandstone from existing historic building foundation. For each phase of the process, provide detailed description of materials, methods, equipment, and sequence of operations to be used for each phase of the work, including protection of surrounding foundation materials.

F. Mortar
   1. Mortar Mix.
   2. Include methods for keeping pointing mortar damp during curing period.
1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For machine operators who will be extracting the sandstone, field supervisors and patching compound manufacturer.

B. Material Test Reports:
   1. Sealant Compatibility and Adhesion Test Report: From sealant manufacturer, indicating that sealants will not stain or damage stone. Include interpretation of test results and recommendations for primers and substrate preparation needed for adhesion.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs experienced stonemasons and stone fitters.

B. Flat Blade Backhoe Operator Qualifications: A qualified operator with three (3) years' experience extracting and moving historic material.

C. Test cleaning compound and penetrating breathable sealant on stone before installing any stone veneer.

D. Historic Fabric: The existing historic fabric that is to remain is an integral part of the structure’s historic significance. As such, the Contractor must use extreme care and exercise special caution to conserve, preserve, and protect the existing structure and its fabric.

   1. Contractor shall not use methods of removal or construction that will result in the loss of detail or material to the extant historic fabric not indicated to be removed.
   2. Contractor shall develop new methods and techniques where necessary to accomplish the goals of historic preservation.
   3. The Contractor must at all times during performance of the Work provide supervision adequate for the protection of extant historic materials to remain. The Landscape Architect shall have the authority and right, but not the duty, to stop the Work if he/she observes Work underway that jeopardizes extant historic fabric that is to remain.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Sealant Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for compatibility and adhesion testing according to sealant manufacturer's standard testing methods, Samples of materials that will contact or affect joint sealants.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

B. Store aggregates where grading and other required characteristics can be maintained, and contamination avoided.

C. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, in a dry location, or in covered weatherproof dispensing silos.
1.9 FIELD CONDITIONS

A. Protection of Stone Masonry: During construction, cover tops of benches with waterproof sheeting at end of each day’s work. Cover partially completed stone masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down both sides, and hold cover securely in place.

B. Stain Prevention: Immediately remove mortar and soil to prevent them from staining stone masonry face.

1. Protect base of walls from rain-splashed mud and mortar splatter, using coverings spread on the ground and over the wall surface.

C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace stone masonry damaged by frost or freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until masonry has dried, but not less than seven days after completing cleaning.


1.10 COORDINATION

A. Advise installers of other work about specific requirements for placement of flashing and similar items to be built into stone masonry.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Mortar Materials: Obtain mortar ingredients of uniform quality for each cementitious component from single manufacturer and each aggregate from single source or producer.

2.2 AQUIA SANDSTONE

A. Sources: Subject to compliance with requirements, provide the Aquia Sandstone extracted from historic foundation on project site as indicated on the drawings.

B. Size and Shape: select or cut stones to meet the requirements of the drawings. Select the minimum amount of stone blocks necessary to complete the work.

2.3 CMU

A. 8”x8”x16” Regular Stretcher.
2.4 MORTAR MATERIALS

A. Masonry Pointing Mortar: Factory-mixed cementitious product that is custom manufactured for pointing mortar based on pre-construction testing and conservator’s mortar recipe.

B. Portland Cement: ASTM C 150, Type I.
   1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C 114.

C. Hydrated Lime: ASTM C 207, Type S.

D. Mortar Sand: ASTM C 144, unless otherwise indicated.
   1. Color: Provide natural sand based on Owner’s testing.
   2. For pointing mortar, provide sand with rounded edges.
   3. Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands, if necessary, to achieve suitable match.

E. Water: Potable.

F. Mortars for Setting Masonry: Mortars specified hereinafter shall comply with ASTM C 270, "Standard Specification for Mortar for Unit Masonry." Type "N" Mortar strength, in general, shall be consistent with a low standard deviation, and a 28-day cure compressive strength of a minimum of 750 psi and a maximum of 1799 psi. Mortar mixes may change and may require adjustment before and during construction in accordance with preconstruction conformance testing, field testing, and evaluation thereof by Landscape Architect.

2.5 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene or PVC.

B. Weep Products:
   1. Round Plastic Tubing: Medium-density polyethylene, 3/8-inch (10mm) OD by the thickness of the stone masonry.

2.6 MASONRY CLEANERS

A. General purpose, non-etching acidic cleaner for the removal of rust, mud, atmospheric dirt and other stains without altering the surface texture.

B. Manufacturers: Subject to compliance with requirements, provide products from the following:
   1. Sure Klean Light Duty Concrete Cleaner by Prosoco.
   2. Or approved Equal.

2.7 MASONRY WEATHER SEAL

A. Clear drying, water-based silicone emulsion for weatherproofing porous masonry materials.

B. Manufacturers: Subject to compliance with requirements, provide products from the following:
   1. Sure Klean Blok-Guard & Graffiti Control II by Prosoco.
   2. Or approved Equal.
2.8 FABRICATION

A. General: Fabricate stone units in sizes and shapes required to comply with requirements indicated.

B. Select excavated stone to produce pieces of thickness, size, and shape indicated, including details on Drawings.
   1. Shape stone specified with sawed beds, to be laid in two-course, pattern indicated in the drawings

C. Dress joints (bed and vertical) straight and at right angle to face unless otherwise indicated. Shape beds to fit supports.

D. Carefully inspect stone after excavation for compliance with requirements for appearance, material, and fabrication. Replace defective units before using.
   1. Clean all stone to remove surface dirt and rust stains and iron particles.

E. Gage backs of stones for adhered veneer if more than 81 sq. in. in area.

F. Thickness of Stone: Provide thickness indicated, but not less than 6 inches.

2.9 MORTAR MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in the form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

   1. Mortar for Setting Stone: Type N.
   2. Mortar for Pointing Stone: Type N.

D. Mortar for Scratch Coat over Unit Masonry: 1 part portland cement, 1 part lime, 7 parts loose damp sand, and enough water to produce a workable consistency.

E. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.
   1. Pigments shall not exceed 10 percent of Portland cement by weight.
   2. Pigments shall not exceed 5 percent of mortar cement by weight.
   3. Mix to match Landscape Architect's approved sample.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces indicated to receive stone masonry, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of stone masonry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean dirty or stained stone surfaces by removing soil, stains, and foreign materials before setting. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.

3.3 EXTRACTING STONE FROM EXISTING FOUNDATION, RESETTING IN BENCH

A. Remove stone to be reused in bench from existing foundation without damaging surrounding stone.

B. Support and protect remaining stonework that surrounds the removal area. Maintain adjoining construction in an undamaged condition.

C. Remove in an undamaged condition as many whole stone units as is necessary for the work
   1. Remove mortar, loose particles, and soil from the stone by cleaning with general cleaner above.
   2. Store stone for use off the ground, on skids, and protected until ready for use in bench.

D. Do not allow face bedding of stone. Before setting, inspect to verify that each stone has been cut so that when it is set in the final position, natural bedding planes are essentially horizontal.

E. If cutting is required, use a motor-driven saw designed to cut stone with clean, sharp, unchipped edges. Finish edges to blend with appearance of edges of existing stone.
   1. Maintain joint width.
   2. Use setting buttons or shims if necessary to set stone accurately spaced with uniform joints.

F. Set existing stone with completely filled bed, head, and collar joints. Butter vertical joints for full width before setting and set units in full bed of mortar unless otherwise indicated.
   1. Tool exposed mortar joints.
   2. Rake out mortar used for laying stone before mortar sets and point new mortar joints.
   3. When mortar is sufficiently hard to support units, remove shims and other devices interfering with the pointing of joints.

G. Arrange stones with color and size variations uniformly dispersed for an evenly blended appearance.

H. Set stone to comply with requirements indicated on Drawings. Set stone accurately in locations indicated, with edges and faces aligned according to established relationships and indicated tolerances.
I. Maintain uniform joint widths, except for variations due to different stone sizes and where minor variations are required to maintain bond alignment if any.

J. Provide sealant joints of widths and at locations indicated.
   1. Keep sealant joints free of mortar and other rigid materials.
   2. Sealing joints are specified in Section 079200 "Joint Sealants."

K. Install embedded weep holes where indicated.

L. Place weep holes in joints where moisture may accumulate, and as indicated in the drawings.

3.4 POINTING

A. Prepare stone-joint surfaces for pointing with mortar by removing dust and mortar particles. Where setting mortar was removed to depths greater than surrounding areas, apply pointing mortar in layers not more than 3/8 inch (10 mm) deep until a uniform depth is formed.

B. Point stone joints by placing and compacting pointing mortar in layers of not more than 3/8 inch (10 mm) deep. Compact each layer thoroughly and allow to it become thumbprint hard before applying next layer.

C. Tool joints, when pointing mortar is thumbprint hard, with a smooth jointing tool to produce the following joint profile:
   1. Joint Profile: Concave.

3.5 ADJUSTING AND CLEANING

A. Remove and replace stone masonry of the following description:
   1. Broken, chipped, stained, or otherwise damaged stone. Stone may be repaired if methods and results are approved by Landscape Architect.
   2. Defective joints.
   3. Stone masonry not matching approved samples and mockups.
   4. Stone masonry not complying with other requirements indicated.

B. Replace in a manner that results in stone masonry matching approved samples and mockups, complying with other requirements, and showing no evidence of replacement.

C. In-Progress Cleaning: Clean stone masonry as work progresses. Remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water, spray applied at low pressure:
   1. Clean stone masonry with proprietary acidic cleaner applied according to manufacturer's written instructions.

E. Fill excavated area with soil to original grade.
3.6 EXCESS MATERIALS AND WASTE

A. Excess Stone: Stack excess stone where directed by Owner for Owner's use.

B. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other waste, and legally dispose of off Owner's property.

END OF SECTION 044313
SECTION 055000 – METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Cable Enclosure
   2. Footing-Post Attachment

B. Products furnished, but not installed, under this Section include the following:
   1. Expansion bolts.

1.2 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers’ written instructions to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

A. Product Data: For Shop primers.

1.4 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls, floor slabs, decks, and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
2.2 FASTENERS

A. Post-Installed Anchors: Torque-controlled expansion anchors.

2.3 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

2.4 METAL CABLE ENCLOSURE

A. Fabricate from plate of thickness indicated below:
   1. Thickness: 3/8 inch
   2. Color: Grey to match concrete. Color to be selected by Landscape Architect.

2.5 FOOTING-POST ATTACHMENT

A. Fabricate from plate of thickness indicated below:
1. Thickness: 1/4 inch
2. Color: Grey to match concrete. Color to be selected by Landscape Architect.

2.6 GENERAL FINISH REQUIREMENTS

A. Finish metal fabrications after assembly.

B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.7 SHOP FINISHING

A. Surface Preparation:
   1. Cleaning of Ferrous Metals shall be done in compliance with Steel Structures Painting Council (SSPC) SP6 Commercial Blast Cleaning or as indicated in Schedule of Coating Systems below.

B. Shop Applied Coatings:
   1. Exterior Metal members shall be primed with one coat of Tnemec Series 90-97 Tnemec Zinc primer as indicated in Schedule below. If a factory finish or complete system application is desired, then apply the intermediate and finish coats of Tnemec as listed in the coating schedule.
   2. Apply materials at film thickness specified by methods recommended by manufacturer in compliance with SSPC PA-1.
   3. Allow each coat of paint to dry thoroughly before applying succeeding coats.
   4. Make finish topcoats smooth, uniform in color, and free of laps, runs, dry spray, over-spray, and skipped or missed areas.
   5. Environmental conditions shall be in compliance with coating manufacturer's printed instructions.
   6. Field Touch-up shop applied coatings that are damaged during handling, and shipping, or from stacking and erection of members at the jobsite.

C. Schedule of Coating Systems:
   1. Surface Preparation: SSPC SP6 Commercial Blast Cleaning
   2. Shop/Field Primer Coat: Tnemec Series 90-97 Tneme-Zinc
      a. Dry Film Thickness: 2.5 to 3.5 mils
   3. First Coat: Series 161-color Tneme-Fascure
      a. Dry film Thickness: 3.0-5.0 mils
   4. Finish Coat: Tnemec Series Fluoronar Semi Gloss
      a. Dry Film Thickness: 2.5-3.0 mils
   5. Total Dry Film Thickness 8.0 to 11.5 mils

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
3.2 INSTALLATION OF CABLE ENCLOSURE AND FOOTING-POST ATTACHMENT


B. Install to completely cover cables.

C. Install plumb and square as shown on the drawings.

3.3 REPAIRS

A. Touchup Painting:

1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

   a. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

END OF SECTION 055000
SECTION 055001 - COR-TEN SITE WALLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Entry Wall – Site Wall 5
2. Retaining Wall - Site Wall 8
3. Sign Column – Site Walls 6, 7, 9

B. Related Sections:

1. Section 033000 "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Mortar Mix
2. Custom metal fabricator qualifications including examples of similar work.

B. Shop Drawings: Take field measurements of all surfaces to receive metal fabrications. Show fabrication and installation of metal components based on field measurements. Include plans, elevations, sections, component details, corner conditions and attachments to other Work.

1. For installed metal fabrications indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
2. No work shall be fabricated until shop drawings for the work have been reviewed by the Landscape Architect.

C. Samples for Verification: For each type of exposed finish required, prepared on components indicated below and of same thickness and metal indicated for the Work. If finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.

1. Wall: 4-inch x 4-inch x full thickness.
1.4 INFORMATIONAL SUBMITTALS
   A. Mill Certificates: Signed by manufacturers certifying that products furnished comply with requirements.

1.5 PROJECT CONDITIONS
   A. Field Measurements: Verify actual locations of walls, footings, and other construction contiguous with metal fabrications by field measurements before fabrication.

1.6 COORDINATION
   A. Coordinate installation of anchorages for casting or setting into concrete. Furnish setting drawings, templates, and directions for installing anchorages, galvanized expansion anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 METALS, GENERAL
   A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.2 FERROUS METALS
   A. Cor-Ten Steel Sheet, Strip, and Plate: “Cor-Ten A” self-weathering steel as manufactured by United States Steel, Pittsburgh PA, ASTM A 242, Type 1

2.3 FASTENERS
   A. General: Unless otherwise indicated, provide galvanized-steel expansion anchors for exterior use. Select fasteners for type, grade, and class required.
      1. Provide galvanized-steel fasteners for fastening Cor-Ten steel.
   B. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

2.4 MISCELLANEOUS MATERIALS
   A. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa).
2.5  FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
   5. Use welding materials that provide similar corrosion resistance and color match to Cor-Ten 'self-weathering steel' plates.
   6. All exposed welds for Cor-Ten steel should be prepared by power grinding or by blast cleaning according to SSPC-SP 3-63 “No. 3 Power Tool Cleaning” or SSPC-SP 6.63 “No. 6 Commercial Blast Cleaning” to remove welding flux, slag and spatter. Care should be used when grinding to avoid formation of a heat-scale which will retard the weathering process.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

2.6  FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal fabrications after assembly.

C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.
2.7 STEEL FINISHES

A. Cor-Ten Steel: standard factory “bare” finish.

B. Color Plate: High Performance Coating
   1. Color: with Silk Grey RAL 7044

2.8 SIGN COLUMN LETTER PLATE

A. Material: Cor-Ten steel

B. Thickness: 3/8 inch

C. Lettering:
   1. Font: Gotham Bold
   2. Height: 8 inches
   3. Special Mounting required for letters R, O, P, and A.

2.9 SHOP FINISHED COLOR PLATE – site wall 5 only

A. SCHEDULE OF COATING SYSTEMS
   1. Surface Preparation: SSPC SP6 Commercial Blast Cleaning
   2. Shop/Field Primer Coat: Tnemec Series 90-97 Tneme-Zinc
      a. Dry Film Thickness: 2.5 to 3.5 mils
   3. First Coat: Series 161-color Tneme-Fascure
      a. Dry film Thickness: 3.0-5.0 mils
   4. Finish Coat: Tnemec Series Fluoronar Semi Gloss
      a. Dry Film Thickness: 2.5-3.0 mils
   5. Total Dry Film Thickness 8.0 to 11.5 mils

2.10 WATERPROOFING, PAINTING

A. Provide either of the following waterproofing methods for Cor-Ten Steel below finished grade that come in contact with soil.
   1. A two-coat baked system consisting of 0.2 to 0.25 mils of a rust-inhibitive primer such as an epoxy chromate followed by a top coat of synthetic-resin paint such as a polyester, acrylic or alkyd applied to a total dry film-thickness of 1.0 mils.
   2. A one-coat system consisting of a high-quality air-drying rust-inhibitive shop-primer which is applied to a nominal dry-film thickness of 1.5 to 2 mils.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with the following requirements:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
   5. Use welding materials that provide similar corrosion resistance and color match to Cor-Ten 'self-weathering steel' plates.
   6. All exposed welds for Cor-Ten steel should be prepared by power grinding or by blast cleaning according to SSPC-SP 3-63 “No. 3 Power Tool Cleaning” or SSPC-SP 6.63 “No. 6 Commercial Blast Cleaning” to remove welding flux, slag and spatter. Care should be used when grinding to avoid formation of a heat-scale which will retard the weathering process.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 FINISHING: In compliance with finish manufacturer's written instructions.

A. Appearance of Finished Work: Noticeable variations in appearance of abutting or adjacent pieces are not acceptable. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast and approved by the Landscape Architect.

B. Surface Preparation
   1. Cleaning of Ferrous Metals shall be done in compliance with Steel Structures Painting Council (SPC) SP6 Commercial Blast Cleaning or as indicated in Schedule of Coating Systems below.
   2. Shop Applied Coatings:
      a. Prime with one coat of Tnemic Series 90-97 Tnemic Zinc primer as indicated in Schedule below. Apply the intermediate and finish coats of Tnemec as listed in the coating schedule.
      b. Apply materials at film thickness specified by methods recommended by manufacturer in compliance with SSPC PA-1.
      c. Allow each coat of paint to dry thoroughly before applying succeeding coats
      d. Make finish topcoats smooth, uniform in color, and free of laps, runs, dry spray, overspray and skipped or missed areas.
      e. Environmental conditions shall be in compliance with coating manufacturer's printed instructions.
      f. Field Touch-up shop applied coatings that tare damaged during handling, and shipping, or from stacking and erection of members at the jobsite.

3.3 PROTECTION
A. Protect finishes of metal components from damage during construction period with temporary protective coverings approved by metal components manufacturer. Remove protective coverings at the time of Substantial Completion.

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

3.4 ADJUSTING AND CLEANING

A. Touchup: Immediately after erection, clean field welds, bolted connections, and abraded areas.

B. Cor-Ten Steel Surfaces:

1. Final cleaning: Any foreign materials which adhere to the steel after it has been erected and which would inhibit formation of the oxide should be removed as soon as practical. Where contaminants are difficult to remove by hand, the affected areas should be cleaned in accordance with SSPC-SP 3-63 "No. 3 Power Tool Cleaning", or SSPC-SP 7-63 "No. 7 Brush-Off Blast Cleaning", or SSPC-SP 1-63 "No. 1 Solvent Cleaning", except that no acid solutions be used. Care should be exercised when power cleaning to avoid heat scale formation which will retard the weathering process.
SECTION 057300 - DECORATIVE METAL RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Stainless-steel decorative railings with stainless-steel, wire-rope guard infill. Type 1 and 2.
   2. Stainless-steel railings and removable guardrails.

B. Related Sections:
   1. Division 03 Section “Cast-in-Place Concrete” for foundations

1.2 DEFINITIONS

A. Railings: Guards, handrails, and similar devices used for protection of occupants at open-sided floor areas, pedestrian guidance and support, visual separation, or wall protection.

1.3 PERFORMANCE REQUIREMENTS

A. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.4 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on laboratory mockups. Payment for these services will be made by Contractor. Retesting of products that fail to meet specified requirements shall be done at Contractor’s expense.

   1. Build laboratory mockups at testing agency facility; use personnel, materials, and methods of construction that will be used at Project site.
   2. Test railings according to ASTM E 894 and ASTM E 935.
   3. Notify Landscape Architect seven working days in advance of the dates and times when laboratory mockups will be tested.

1.5 ACTION SUBMITTALS

A. Product Data: For the following:

   1. Manufacturer’s product lines of railings assembled from standard components.
   2. Grout, anchoring cement.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Samples for Initial Selection: For products involving selection of mechanical finishes.
D. Samples for Verification: For each type of exposed finish required.
   1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
   2. Fittings and brackets.
   3. Welded connections.
   4. Assembled Samples of railing systems, made from full-size components, including top rail, post, handrail, and infill. Show method of finishing members at intersections. Samples need not be full height.

E. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified professional engineer.

B. Welding certificates.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

D. Preconstruction test reports.

1.7 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of railing from single source from single manufacturer.

B. Product Options: Information on Drawings and in Specifications establishes requirements for system's aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including structural analysis, preconstruction testing, field testing, and in-service performance.
   1. Do not modify intended aesthetic effects, as judged solely by Landscape Architect, except with Landscape Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Landscape Architect for review.

C. Product Options: Drawings indicate size, profiles, and dimensional requirements of railings and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
   1. Do not modify intended aesthetic effects, as judged solely by Landscape Architect, except with Landscape Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Landscape Architect for review.

D. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.6, "Structural Welding Code - Stainless Steel."

E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
   1. Build mockups as shown on Drawings.
2. Build mockups for each form and finish of railing consisting of two posts, top rail, infill area, and anchorage system components that are full height and are not less than 24 inches in length.

3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

F. Preinstallation Conference: Conduct conference at Project site.

1.8 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication and indicate measurements on Shop Drawings.

1.9 COORDINATION AND SCHEDULING

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not suit structural performance requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers for Rails: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Stainless-Steel Decorative Railings:
   a. Architectural Metal Works.
   b. Blum, Julius & Co., Inc.
   c. Wagner, R & B, Inc.; a division of the Wagner Companies.

2.2 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
2.3 STAINLESS STEEL

A. Rails and posts: ASTM A 554, Grade MT 316L.
   1. Size: 2” x 2” square
   2. Thickness: 3/8”

B. Square Sleeve
   1. Size: 2-1/4” x 2-1/4” x 10-1/8”
   2. Thickness: 3/8”

2.4 CABLES AND FASTENERS

A. General: Provide the following:
   1. Stainless-Steel Cables and Fasteners: Type 316 stainless-steel
   2. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

B. Cables:
   1. Acceptable Manufacturer: Subject to compliance with requirements, provide cables from Jakob Rope Systems, Contact information:
      a. 955 NW 17th Ave.
         Unit B;
         Delray Beach, FL 33445
         Toll Free Tel: 866-215-1421
         Tel: 561-330-6502
         Fax: 561-220-6508
         Email: info@jakob-usa.com
         Web: www.jakob-usa.com

C. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

D. Fasteners for Interconnecting Railing Components:
   1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.
   2. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.
   3. Provide square or hex socket flat-head machine screws for exposed fasteners unless otherwise indicated.

2.5 MISCELLANEOUS MATERIALS

A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
B. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

1. Water-Resistant Product: At exterior locations provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.6 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, anchorage and approved shop drawings, but not less than that required to support structural loads.

B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate. Locate weep holes in inconspicuous locations.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with welded connections unless otherwise indicated.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.
4. At exposed connections, finish exposed welds to comply with NOMMA’s “Voluntary Joint Finish Standards” for Type 1 welds: no evidence of a welded joint.

I. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer’s standard splicing method.

J. Form changes in direction as follows:

1. As detailed.
K. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

L. Close exposed ends of hollow railing members with prefabricated end fittings.

M. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

2.7 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM’s “Metal Finishes Manual for Architectural and Metal Products” for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.

C. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.8 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Dull Satin Finish: No. 6.

C. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.

2. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).

3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (5 mm in 3 m).

C. Adjust railings before anchoring to ensure matching alignment at abutting joints.
D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.2 RAILING CONNECTIONS

A. Nonwelded Connections: Where indicated on the drawings, use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.

B. Welded Connections: Where indicated on the drawings, use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches (50 mm) beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches (150 mm) of post.

3.3 ANCHORING POSTS

A. Install posts directly into concrete foundations as indicated on the drawings.

B. Concrete should be sloped away from post as indicated on the drawings.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Contractor will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports. Payment for these services will be made by Contractor.

B. Extent and Testing Methodology: Testing agency will randomly select completed railing assemblies for testing that are representative of different railing designs and conditions in the completed Work. Railings will be tested according to ASTM E 894 and ASTM E 935 for compliance with performance requirements.

C. Remove and replace railings where test results indicate that they do not comply with specified requirements unless they can be repaired in a manner satisfactory to Landscape Architect and will comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.5 CLEANING

A. Clean stainless steel by washing thoroughly with clean water and soap, rinsing with clean water, and wiping dry.
3.6 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

END OF SECTION 057300
SECTION 061064– WOOD PLATFORMS AND STEPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes materials, labor, tools and equipment necessary for the installation of
   1. Wood Platforms
   2. Wooden Steps

B. Related Sections:
   1. Section 311000 – Site Clearing
   2. Section 312000 – Earth Moving for subgrade

1.2 DEFINITIONS

A. Boards: Lumber of less than two inches (2") nominal (38mm actual) in thickness and two
   inches (2") nominal (38 mm actual) or greater in width.

B. Dimension Lumber: Lumber of two inches (2") nominal (38mm actual) or greater but less than
   Five inches (5") nominal (114 mm actual) in least dimension.

C. Timber: Lumber of five inches (5") nominal (114 mm actual or greater in least dimension.

D. Lumber grading agencies, and the abbreviations used to reference them, include the following:
   2. NLGA: National Lumber Grades Authority.
   3. RIS: Redwood Inspection Service.
   5. WCLIB: West Coast Lumber Inspection Bureau.

1.3 ACTION SUBMITTALS

A. Product Data: For preservative-treated wood products.
   1. For preservative-treated wood products. Include chemical treatment manufacturer's
      written instructions for handling, storing, installing, and finishing treated material.

B. Shop Drawings for all wood platforms. See plans for design intent.

1.4 INFORMATIONAL SUBMITTALS

A. Material Certificates:
1. For lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by ALSC's Board of Review.

2. For preservative-treated wood products. Indicate type of preservative used and net amount of preservative retained. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

B. Certificates of Inspection: Issued by lumber grading agency for exposed wood products not marked with grade stamp.

C. Evaluation Reports: For the following, from ICC-ES:
   1. Preservative-treated wood products.
   2. Earth Anchoring Screws.
   3. Decking fasteners.

D. Product Information for Earth Anchors, including Installation references

1.5 QUALITY ASSURANCE

A. Lumber Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.

B. Installer Qualifications: A qualified installer who employs experienced stonemasons and stone fitters with a minimum of ten (10) years documented experience.

C. Source Limitations: Obtain each type of unit paver and setting material from single source with resources to provide materials and products of consistent quality in appearance and physical properties.

D. Mockups: Build mockup to verify selections and to demonstrate aesthetic effects and set quality standards for materials and execution.

   1. Mock-up shall be the full width of any portion of the platform and at least five (5) feet in length, including at least one (1) end joist with anchoring screws.
   2. Step mock-up shall be the full width of the path and at least five (5) feet in length, including at least one (1) end joist with anchoring screws.
   3. Approved mockups may become part of the completed Work if sized and located for that purposed and approved by the Director's Representative.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials under cover and protected from weather and contact with damp or wet surfaces. Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.
2.1 GENERAL LUMBER

A. Comply with DOC PS 20 and with grading rules of lumber grading agencies certified by ALSC's Board of Review as applicable. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by ALSC's Board of Review.

1. Provide certificates of grade compliance issued by grading agency.
2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry wood products.
3. Provide dressed lumber, S4S, unless otherwise indicated.

2.2 DECKING

A. Board Decking: 1" x 4" boards, with one face free of planer skip, machine burn, and torn or chipped grain.

1. Species: Kebony– produced from FSC®-certified Pinus Radata
2. Grade Characteristics:
   a. Clear
   b. Straight grained and parallel cut
   c. No decay, incipient decay, honeycomb, knot holes, shakes, splits, or wante.
   d. No discoloration
   e. Hardness rating: Brinell Hardness Rating of 41 N/mm² EN 1534
   f. Swelling: Dry to wet in tangential direction – 4%
   g. Size: 1" x 4"

3. Contact Information – Sales Representative:
   Pine River Group
   812 South Riverside Avenue
   St. Clair, MI  48079
   Phone: 1-855-230-5656
   Email: info@pinerivergroup.com

B. Preparation: Pre-drill holes for anchors and screws and pre-cut lumber lengths for decking.

2.3 STEPS

A. Step: 9" x 9" timber; 9-foot lengths, with two adjacent faces free of planer skip, machine burn, and torn or chipped grain

B. Material: Pressure treated Southern Yellow Pine

2.4 PRESSURE TREATED LUMBER
A. Lumber designated for Ground Contact.

B. Preservative Treatment

1. Pressure treat boards and dimension lumber with waterborne preservative according to AWPA U1; Use Category UC4a for items in contact with the ground.
2. Pressure treat timber with waterborne preservative according to AWPA U1; Use Category UC4a.
4. Do not use chemicals containing arsenic or chromium.
5. Usually retain one of first two paragraphs below.
7. After treatment, redry dimension lumber to 19 percent maximum moisture content.
8. Mark treated wood with treatment quality mark of an inspection agency approved by ALSC's Board of Review.
9. For items indicated to receive a stained or natural finish, omit marking and provide certificates of treatment compliance issued by inspection agency.

C. Application: Treat items indicated on Drawings.

2.5 CONNECTIONS AND ANCHORS

A. Screws: Type 316 Stainless Steel

B. Post Base: connection between the post and concrete foundation

1. PBS66 Post Base
2. Contact Information:
   a. Simpson Strong-Tie
      Sales: 800-999-5099
      Website: www.strongtie.com
      Email: from website
3. Length: As indicated on the plans
4. Material: 12-gauge galvanized steel
5. Load Capacity: 350 lbs. in loose medium to fine sand.

C. Joist Hangers
1. HUS26 from Simpson Strong-Tie, or equal.
2. Sixteen (16) gauge.
3. Finish: ZMAX.

D. Use Simpson Strong-Tie 1/4" x 1-1/2" Strong-Drive SDS Heavy-Duty Connector screws Anchors for Wood Steps: 26" removable earth anchoring screws.
1. PW26 “Penetrator” with hex head from American Earth Anchors (stock number: NSN4030-01-528-5749), or equal.
2. Contact:
   a. 20 Grove Street; Franklin, MA 02038
      Phone: 866-520-8511
      Email: info@americanea.com
3. 2. Length: Twenty-six (26”).
5. 4. Load Capacity: 350 lbs. in loose medium to fine sand.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of projections and substances detrimental to application.
   1. Remove rocks or other obstructions larger than one inch (1”) from subgrade.

B. Measure and pre-cut lengths; pre-drill holes for connections to required diameter and depth.

3.3 INSTALLATION, GENERAL

A. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit work to other construction; scribe and cope as needed for accurate fit.

B. Comply with approved shop drawings.

C. Framing Standard: Comply with AF&PA WCD1 unless otherwise indicated.

D. Secure decking to joist with Type 316 stainless steel screws.

E. Do not splice structural members between supports unless otherwise indicated.

F. Provide blocking and framing as indicated and as required to support facing materials.

G. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of members or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

H. Apply copper naphthenate field treatment to comply with AWPA M4, to cut surfaces of preservative-treated lumber.

I. Securely attach exterior rough carpentry work to substrate by anchoring and fastening as indicated.
J. Select fasteners of sizes indicated that do not fully penetrate members where opposite side is exposed to view. Make tight connections between members. Install fasteners without splitting wood; do not countersink nail heads unless otherwise indicated.

K. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced and with adjacent rows staggered.

END OF SECTION 061064
SECTION 129300 – SITE FURNISHINGS – BENCHES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. Bench – Type 1, Type 2
   2. Curve Bench – 'A', 'B', 'C'.

B. Related Sections:
   1. Section 033000 – Cast-In-Place Concrete for foundations
   2. Section 310000 - Earth Moving for excavation for installing concrete footings
   3. Section 311000 – Site Clearing

C. References

1.2 SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: For site furnishings. Use same designations indicated on Drawings.

C. Closeout submittals
   1. Maintenance Data: For all pieces

1.3 Sample Maintenance Forms: For all pieces

1.4 PRE-INSTALLATION MEETING:

A. Prior to installation of any materials, conduct a pre-installation meeting to discuss the scope of work and review installation requirements. The pre-installation meeting shall be attended by all parties involved in the installation of the material.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle materials in a manner which will insure the preservation of their quality and fitness for the Work.

B. Deliver materials to site in Manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and Manufacturer.

C. The materials shall be stored in accordance with Manufacturer's instructions. The materials shall be protected from damage and out of direct sunlight and precipitation.
D. The materials shall be delivered, unloaded and installed in a manner to prevent damage.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 BENCH - TYPE 1 AND TYPE 2

A. Acceptable Manufacturer: ID Metalco,
1. Contact:
   info@idmetalco.com
   t. 760.690.8557
   toll free: 877.690.7755
   fax: 760.282.7082

   Or equal, approved by the Landscape Architect

B. Type 1 – Ideas L bench
1. Products: Subject to compliance with requirements, provide the following:
   a. Ideas L
   b. Length: 2890 mm
   c. Type: With backrest attached to one side
   d. Wood: Teak (3)

C. Type 2 – Ideas L bench
1. Products: Subject to compliance with requirements, provide the following:
   a. Ideas L
   b. Length: 2890 mm
   c. Type: With No backrest
   d. Wood: Teak (3)

2. Finish for metal components: Cor-ten Steel

2.2 CURVE BENCH

A. Acceptable Manufacturer: Streetlife

B. Contact:

   Email: streetlife@streetlifeamerica.com
   Philadelphia, PA
   Telephone -215 247 0148
Or equal, approved by the Landscape Architect

C. Specifications
   
1. Model: Rough & Ready Curve (R&R-C-200-60 / R&R-C-200-60-Ext)
2. Dimensions: 24” wide x 18” high in indicated lengths
3. Wood Seat: Untreated FSC 100% Lorro Gamela hardwood
4. Wood Mounting: in radial comb-system
5. Feet: Open U-shaped in Cor-Ten Steel
6. Support rails: set of two radial comb-profiles in Cor-Ten Steel

2.3 EXAMINATION
   
A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

2.4 INSTALLATION, GENERAL
   
A. Comply with manufacturer’s written installation instructions unless more stringent requirements are indicated. Complete field assembly of site furnishings where required.

B. Unless otherwise indicated, install site furnishings after paving has been completed.

C. Install site furnishings level, plumb, true, and securely anchored at locations, and in the manner indicated on Drawings.

D. Post Setting: Set cast-in support posts in concrete footing with smooth top, shaped slightly to shed water. Protect portion of posts above footing from concrete splatter. Verify that posts are set plumb or at correct angle and are aligned and at correct height and spacing. Hold posts in position during placement and finishing operations until concrete is sufficiently cured.

END OF SECTION 129300
SECTION 129301 – SITE FURNISHINGS – FABRICATED PLAY EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. Parkour 4.
   2. Twisted Net.
   3. Stilts.

B. Related Sections:
   1. Section 033000 – Cast-In-Place Concrete for foundations.
   2. Section 310000 – Earth Moving for excavation for installing concrete footings.
   3. Section 311000 – Site Clearing.
   5. Section 321244 – Engineered Wood Fiber Surfacing.

1.2 SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: For site furnishings. Use same designations indicated on Drawings.

C. Closeout submittals
   1. Maintenance Data: For all pieces

1.3 Sample Maintenance Forms: For all pieces

1.4 PRE-INSTALLATION MEETING:

A. Prior to installation of any materials, conduct a pre-installation meeting to discuss the scope of work and review installation requirements. The pre-installation meeting shall be attended by all parties involved in the installation of the material.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle materials in a manner which will insure the preservation of their quality and fitness for the Work.

B. Deliver materials to site in Manufacturer’s original, unopened containers and packaging, with labels clearly identifying product name and Manufacturer.
C. The materials shall be stored in accordance with Manufacturer’s instructions. The materials shall be protected from damage and out of direct sunlight and precipitation.

D. The materials shall be delivered, unloaded and installed in a manner to prevent damage.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. For Parkour 4
      a. Rope sections: two (2) each of the three rope segments.
   2. For Stilts:
      a. Connections: six (6) of each
   3. Water Lily Balance posts with Rope
      a. Rope: two - ropes plus connections to poles
      b. Lily tops: four (4)

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

A. Kompan
   1. Contact:
      821 Grand Avenue Parkway
      Pflugerville, TX 78660
      Phone: 1 (800) 426-9788
      USSales@KOMPAN.COM
   2. Equal, approved by the Landscape Architect

2.2 PARKOUR 4 – ‘Robina series’ (2/L-631)

A. Products: Subject to compliance with requirements, provide the following:
   1. Kompan (USSales@KOMPAN.COM)
   2. Product Number NRO854-1001
   3. Wood: Natural

2.3 STILTS – ‘Robina series’ (1/L-631)

A. Products: Subject to compliance with requirements, provide the following:
   1. Kompan (USSales@KOMPAN.COM)
   2. Product Number NRO806-0601
   3. Wood: Natural
   4. Height: 3’7”

2.4 TWISTED NET – ‘Robina series’ (4/L-631)

A. Products: Subject to compliance with requirements, provide the following:
1. Kompan (USSales@KOMPAN.COM)
2. Product Number NRO8
3. Wood: Natural
4. Height: 6’10”

2.5 WATER LILY BALANCE POSTS with ROPE– ‘Robina series’ (3/L-631)
A. Products: Subject to compliance with requirements, provide the following:
1. Kompan (USSales@KOMPAN.COM)
2. Product Number NRO832-0903
3. Wood: Natural
4. Height: 3’11”
5. Color for lily pads: brown

2.6 LOG SCRAMBLE ‘A’, ‘B’, and ‘C’
A. Product: Subject to compliance with requirements, provide the following:
1. Log Scrambles by Columbia Cascade
2. Contact Information
   a. Columbia Cascade Company
      1300 S.W. Sixth Avenue, Suite 310
      Portland, Oregon 99720-3464
      Phone: 503-223-1157
      Fax: 503-223-4530
      Web: www.timberform.com
3. Classic Timberform
   a. Model No 4500-305-W1
   b. Model No 4500-304-W1
   c. Model No 4500-302-W1

PART 3 - EXECUTION

3.1 EXAMINATION
A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance of the Work.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL
A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of site furnishings where required.
B. Unless otherwise indicated, install site furnishings after paving has been completed.
C. Install site furnishings level, plumb, true, and securely anchored at locations, and in the manner indicated on Drawings.
D. Post Setting: Set cast-in support posts in concrete footing with smooth top, shaped slightly to shed water. Protect portion of posts above footing from concrete splatter. Verify that posts are set plumb or at correct angle and are aligned and at correct height and spacing. Hold posts in position during placement and finishing operations until concrete is sufficiently cured.
SECTION 129302 – SITE FURNISHINGS – CUSTOM LOG, TIMBER AND LOOSE BOULDER

PART 1 - GENERAL

1.1 SUMMARY

A. The intent is to create a natural log, large enough to be stable to be cut to shape with the approval of the Landscape Architect and used in combination with the boulders and all appropriate and necessary hidden hardware to create natural log or stone benches and site features as indicated in the drawings.

B. Section includes:

1. Custom Log and Boulder Bench.
2. Custom Timber Bench.
3. Custom Bollard
5. Loose Boulders.

C. Related Sections:

1. Section 033000 – Cast-In-Place Concrete for foundations
2. Section 312000 – Earth Moving for excavation for installing concrete footings
3. Section 321816 – Playground Protective Surfacing
4. Section 321313 – Concrete Paving
5. Section 321400 – Unit Paving

1.2 SUBMITTALS

A. Product sources to be approved by the Landscape Architect before harvesting and certified on site.

B. Written approval for wood and stone from lot holders.

C. Process for extracting, finishing and placement of Aquia Creek sandstone bench from existing below grade foundation.

D. Photographs:

1. Trees: Submit photographs of trees to be harvested, as requested by the Landscape Architect, prior to Observation, as listed under Quality Assurance, below. Photographs shall include a person holding a clearly-marked measuring rod next to plants. Photographs shall exhibit the size, growth habit, and general visual quality of trees. Photographs of dense clusters of plants, in which one plant is not distinguishable from another, are not acceptable. Digital photographs submitted via email are acceptable.

2. Boulders: Submit photographs of stones to be purchased, as requested by the Landscape Architect, prior to Observation, as listed under Quality Assurance, below. Photographs shall include a clearly-marked measuring rod next to stones. Photographs shall exhibit the size, and general visual quality of stones. Photographs of piles of stones, in which one stone is not distinguishable from another, are not acceptable. Digital photographs submitted via email are acceptable.
E. Closeout submittals

1. Source and Maintenance Data: For boulders and logs.

1.3 QUALITY ASSURANCE

A. Observation: Landscape Architect may observe trees either at place of growth or at site before installing for compliance with requirements for genus, species, variety, size, and quality. Landscape Architect retains right to observe trees further for size and condition, including insects, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected logs immediately from Project site.

1. Notify Landscape Architect of sources of trees to be harvested seven days in advance of delivery to site. No trees are to be harvested before approval of the Landscape Architect.

B. Observation: Landscape Architect may observe at place of purchase before installing for compliance with size and visual requirements to reject unsatisfactory or defective material at any time during progress of work. Remove rejected stones immediately from Project site.

C. Testing: Test soil compaction under boulders to achieve 95% Proctor test using ASTM D698 and AASHTO T99.

1.4 PRE-INSTALLATION MEETING:

A. Prior to installation of any materials, conduct a pre-installation meeting to discuss the scope of work and review installation requirements. The pre-installation meeting shall be attended by all parties involved in the installation of the material.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle materials in a manner which will insure the preservation of their quality and fitness for the Work.

B. Deliver materials to site in Manufacturer’s original, unopened containers and packaging, with labels clearly identifying product name and Manufacturer.

C. The materials shall be stored in accordance with Manufacturer’s instructions. The materials shall be protected from damage and out of direct sunlight and precipitation

D. The materials shall be delivered, unloaded and installed in a manner to prevent damage.

1.6 MAINTENANCE PLAN

A. Submit maintenance plan for the care of the wooden logs.
PART 2 - PRODUCTS

2.1 LOGS

A. Natural Logs stripped of all bark

B. Sources: Remove trees only from approved sources with written permission of lot holder.

C. Quality:
   1. Trees removed for use as installed logs should be free from damage by insects, disease or rot.

D. Dimensions:
   1. Cut to lengths and diameters shown on the drawings
   2. Cut branches 24" from trunk before bringing to the site for further cutting to be done with the approval of the Landscape Architect

E. Wood:
   1. Wood should have a Janka Hardness Rating of greater than 1000
   2. Examples of Acceptable species
      a. Robinia pseudoacacia (Black Locust)
      b. Gleditsia triacanthos (Honey Locust)
      c. Acer saccharum (Hard / Sugar Maple)
      d. Quercus alba (White Oak)
      e. Fagus grandifolia (American Beech)
      f. Quercus rubra (Northern Red Oak)
      g. Betula alleghaniensis (Yellow Birch)
      h. Fraxinus pennsylvanica (Green Ash)
      i. Fraxinus Americana (White Ash)
      j. Juglans nigra (Black Walnut)
      k. Pinus palustris (Yellow Heart Pine)
      l. Larix spp (Larch)
      m. Gymnocladus dioicus (Kentucky Coffee Tree)

2.2 GENERAL LUMBER

A. Comply with DOC PS 20 and with grading rules of lumber grading agencies certified by ALSC's Board of Review as applicable. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by ALSC's Board of Review.

   1. Provide certificates of grade compliance issued by grading agency.
   2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry wood products.
   3. Provide dressed lumber, S4S, unless otherwise indicated.

2.3 WOOD FOR TIMBER BENCHES:
A. Pressure Treated Pine Timbers

1. Lumber designated for Ground Contact.
2. Preservative Treatment
   a. Pressure treat boards and dimension lumber with waterborne preservative according to AWPA U1; Use Category UC4a for items in contact with the ground.
   b. Pressure treat timber with waterborne preservative according to AWPA U1; Use Category UC4a.
   c. Preservative Chemicals: Acceptable to authorities having jurisdiction.
   d. Do not use chemicals containing arsenic or chromium.
   e. Usually retain one of first two paragraphs below.
   g. After treatment, redry dimension lumber to 19 percent maximum moisture content.
   h. Mark treated wood with treatment quality mark of an inspection agency approved by ALSC's Board of Review.
   i. For items indicated to receive a stained or natural finish, omit marking and provide certificates of treatment compliance issued by inspection agency.

B. Application: Treat items indicated on Drawings.

C. Wood: Pressure Treated Pine Timbers

D. Dimensions: 8 inches x 8 inches x 8 feet

2.4 NETTING

A. Product: Subject to compliance with requirements, provide the following"

1. Braided Rope and assemblies by InCord
   a. Contact Information:
      InCord
      226 Upton Road
      Colchester, CT  06415
      Phone 860-537-1414
      Website: https://incord.com
      Virginia Representative: Robin Ritz, 860-537-7393 (robinr@incord.com)

2. Style: Braided Twelve Strand Rope
   a. Fiber Dyneema Ultra High Molecular Weight Polyethylene (UHMWPE)
   b. Model # RDNB050SL
   c. Rope Diameter: 1/2 inch
   d. Average Maximum Strength: 27,500lbs
   e. Minimum Strength: 24800 lbs
   f. Weight per 100 ft: 6.4 lb
   g. Specific Gravity: .98
   h. Melting Point: 296 degrees F
   i. UV Stabilized
   j. Color: Silver

3. Style: Netform
   a. Reinforced Rope:
1) Outer Layer: Polyester Fiber Braided Steel Wire
2) Inner Core: Polypropylene
3) Diameter: 18 mm (.71 inch)
4) Weight: .29 lb/ft
5) Tensile Strength: 60 kN
6) UV: Resistant (250 kLY)
7) Color: Black

b. Shackle Assembly: Stainless Steel with Shackle (InCord)

2.5 BOLLARD

A. Custom Square wood bollard with all faces free of planer skip, machine burn, and torn or chipped grain.

1. Species: Black Locust (Robinia Pseudoacacia)
2. Grade Characteristics:
   a. Clear.
   b. Straight grained and parallel cut.
   c. No decay, incipient decay, honeycomb, knot holes, shakes, splits, or wante.
   d. No discoloration.
   e. Finish: Weathered.
   f. Weight: Specific gravity of 0.66 (Basic) / 0.77 (12% MC) to 1.08. Air dried weight shall be 48 lbs per cubic foot.
   g. Hardness rating: Janka Hardness Rating of 1,700 lbf (7,560 N) with air-dried decking and 12% moisture content.

3. Size: 5 inches x 5 inches.
4. Height: 30 inches.
5. Top: Tapered as indicated on the drawings.

B. Metal Base

1. Grade 316L Stainless Steel.
2. Dull Satin Finish No. 6.
3. Thickness: 3/8 inch
4. Shape and dimensions: As indicated on the drawings.

C. Accessories

1. Bolts
   a. Grade 316L Stainless Steel
   b. Diameter: 3/8 inch
   c. Length: as indicated on the drawings

2. Base Plate
   a. Grade 316L Stainless Steel
   b. Thickness: 3/8 inch
   c. Dimensions: as indicated on the drawings
2.6 WOOD BEAMS

A. Board Decking: 4" x 10" boards, with one face free of planer skip, machine burn, and torn or chipped grain.

1. Species: Black Locust (Robinia Pseudoacacia)
2. Grade Characteristics:
   a. Clear
   b. Straight grained and parallel cut
   c. No decay, incipient decay, honeycomb, knot holes, shakes, splits, or wante.
   d. No discoloration
   e. Finish: Weathered.
   f. Weight: Specific gravity of 0.66 (Basic) / 0.77 (12% MC) to 1.08. Air dried weight shall be 48 lbs per cubic foot.
   g. Hardness rating: Janka Hardness Rating of 1,700 lb f (7,560 N) with air-dried decking and 12% moisture content.
   h. Size: 4 inches x 10 inches

B. Preparation: Pre-drill holes for anchors and screws and pre-cut lumber lengths for decking.

2.7 BOULDERS

A. Specifications

1. Shaping: Boulders are to be shaped per drawings
2. Boulder Dimensions per drawings.
3. Stone type/color: Similar in character to those found regionally along the Rappahannock River

B. Source: Subject to compliance with requirements, provide boulder supplied by:

1. Marshall Stone
   Route 220
   19730 Virgil H. Goode Highway
   Rocky Mount, VA 24151
   Phone 540-483-2737

2.8 MISCELLANEOUS

A. Anchors

1. Boulder to boulder
2. Log to boulder
   a. Dowel:
      1) Galvanized Steel
      2) 24" long; 1.5" diameter

3. Timber Bench
   a. Cor-ten Plates: 3.4 inches
   b. Anchors: 26" removable earth anchoring screws
1) PE36 “Penetrator” with hex head from American Earth Anchors (stock number: NSN 4030-01-528-5749), or equal.

20 Grove Street; Franklin, MA 02038
Phone: 866-520-8511
Email: info@americanea.com Website: www.americanea.com

2) Length: Thirty-six (36”)
3) Material: Aircraft-quality cast aluminum 356 alloy, heat-treated to T6 specification
   c. Anchor Bolts: 1-inch diameter x 6-inch galvanized hex

4. Log Walk and Net
   a. Plate: 3/8-inch Stainless steel
   b. Dowels: 1.5-inch diameter x 17 inch length stainless steel

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance of the Work.
   B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL
   A. Locate and install per drawings.
   B. Unless otherwise indicated, install site furnishings after paving has been completed.
   C. Install site furnishings securely anchored at locations, and in the manner indicated on Drawings.
   D. Boulders and logs, individually and in combination, must be set securely with no motion possible.
   E. Ground beneath the boulders must achieve minimum Proctor compaction of 95%.
   F. Anchor Setting: Set anchors in concrete footing with smooth top, shaped slightly to shed water. Protect portion of posts above footing from concrete splatter. Verify that posts are set plumb or at correct angle and are aligned and at correct height and spacing. Hold posts in position during placement and finishing operations until concrete is sufficiently cured.

END OF SECTION 129302
SECTION 129303 – SITE FURNISHINGS – MISCELLANEOUS FABRICATED

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. Picnic Table
   2. Bike Rack
   3. Litter Receptacle
   4. Shade Structure

B. Related Sections:
   1. Section 033000 – Cast-In-Place Concrete for foundations
   2. Section 310000 – Earth Moving for excavation for installing concrete footings
   3. Section 311000 – Site Clearing
   4. Section 321100 – Decomposed Granite
   5. Section 321313 – Concrete Paving
   6. Section 321816 – Playground Protective Surfacing

1.2 SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: For site furnishings. Use same designations indicated on Drawings.

C. Closeout submittals
   1. Maintenance Data: For all pieces.

D. Sample Maintenance Forms: For all pieces.

1.3 QUALITY ASSURANCE:

A. Contractor Qualifications: Five (5) years’ experience with steel erection and general construction techniques to install shade structures.

1.4 PRE-INSTALLATION MEETING:

A. Prior to installation of any materials, conduct a pre-installation meeting to discuss the scope of work and review installation requirements. The pre-installation meeting shall be attended by all parties involved in the installation of the material.
1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle materials in a manner which will insure the preservation of their quality and fitness for the Work.

B. Deliver materials to site in Manufacturer’s original, unopened containers and packaging, with labels clearly identifying product name and Manufacturer.

C. The materials shall be stored in accordance with Manufacturer’s instructions. The materials shall be protected from damage and out of direct sunlight and precipitation.

D. The materials shall be delivered, unloaded and installed in a manner to prevent damage.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Picnic Table
   a. one (1) extra bench

2. Bike Rack
   a. one (1) extra bike rack
   b. 2 wooden cross pieces

3. Litter Receptacles
   a. One (1) additional litter receptacle
   b. Liners for Litter Receptacle: four (4) additional liners

4. Shade Structure
   a. 

PART 2 - PRODUCTS

2.1 PICNIC TABLE

A. Acceptable Manufacturer: ID Metalco

B. Contact:
   email: info@idmetalco.com
   telephone. 760.690.8557
   toll free: 877.690.7755
   fax: 760.282.7082

   Local Representative: Pyramid Lighting Group
   227 W. 29th Street, 12th floor
   New York, NY 10001
   914-699-1996

   Or equal, approved by the Landscape Architect

C. Table dimensions: 430mmH x 621mmW x 2000mmL

D. Bench dimensions: 420mmH x 464mmW x 2000mmL
E. Metal: Cor-ten Steel

F. Wood: teak (3)
   1. FSC – Forest Stewardship Council Certificate
   2. pigmented vegetable oil saturation treatment coat

G. Model: Pic Bull

2.2 BIKE RACK

A. Acceptable Manufacturer: Streetlife

B. Contact:
   Email: streetlife@streetlifeamerica.com
   Philadelphia, PA
   Telephone -215 247 0148

   Or equal, approved by the Landscape Architect

C. Specifications
   1. Model: Solid
   2. Top Beam: 28"
   3. Untreated FSC hardwood
   4. Mounting: in ground
   5. Height: 30" above ground
   6. Finish for metal components: Cor-ten Steel

2.3 LITTER RECEPTACLE

A. Acceptable Manufacturer: ID Metalco

B. Contact:
   email: info@idmetalco.com
   telephone. 760.690.8557
toll free: 877.690.7755
   fax: 760.282.7082

   Local Representative: Pyramid Lighting Group
   227 W. 29th Street, 12th floor
   New York, NY 10001
   914-699-1996

   Or equal, approved by the Landscape Architect

C. Specifications
   1. Model: Lys
   2. Volume: 50 liters
   3. Mounting: fixed
2.4 SHADE STRUCTURE (2)

A. Long lead: Product is typically shipped 8-12 weeks from the time the order (signed TSP proposal) and deposit are received and accepted. The TSP powder-coating option adds about two weeks to the production schedule.

B. Acceptable Manufacturer: Tensil Shade Products

C. Contact:

525 East Roger Road
Tucson, AZ 85705 USA
Phone: 520-903-0414
Email: info@tensilesashadeproducts.com

Or equal, approved by the Landscape Architect

D. Specifications

1. Model: Visor

2. Canopy:
   a. Fabric: knitted fire-retardant High-Density-Poly-Ethylene
   b. Shade factor: ranging from 66-97%
   c. Warranty: 10-year UV warranty from the fabric manufacturer
   d. Edge: perimeter-edged with a layer of tough, acrylic covered polyester webbing, and sewn with GoreTex thread
   e. All canopy connection and tensioning hardware is stainless steel.
   f. Color: White

3. Frames:
   a. Material: frames are made from carbon steel pipe
   b. Finish: Mill finish, for painting or powder-coating, is standard
      1) 2-part polyurethane paint be applied after steel erection in field
   c. Strength: engineered for Wind Exposure C, at 90 mph (3 second gust) by ASCE 7-05, equivalent to 115 mph (ultimate 3 second gust) by ASCE 7-10
   d. Strength: engineered for Wind Exposure C, at 130 mph (3 second gust) by ASCE 7-05, equivalent to 165 mph (ultimate 3 second gust) by ASCE 7-10.

E. Additional Requirements:

1. Foundation: requires a site-specific foundation to be designed by a locally licensed Structural Engineer.
2. Available Assistance: offers an on-site Installation Advisor and telephone support
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of site furnishings where required.

B. Unless otherwise indicated, install site furnishings after paving has been completed.

C. Install site furnishings level, plumb, true, and securely anchored at locations, and in the manner indicated on Drawings.

D. Post Setting: Set cast-in support posts in concrete footing with smooth top, shaped slightly to shed water. Protect portion of posts above footing from concrete splatter. Verify that posts are set plumb or at correct angle and are aligned and at correct height and spacing. Hold posts in position during placement and finishing operations until concrete is sufficiently cured.

END OF SECTION 129300
SECTION 129304 – WOOD AND CONCRETE SITE WALLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes all labor, material and equipment necessary for the on-site fabrication and installation of custom site walls.

B. The custom furniture manufacturer (hereafter referred to as “Contractor”) shall be responsible for the detailing, fabrication, and supply of the Work specified herein, some or all of which may be subcontracted to others meeting the qualification requirements of 1.4. The intent of this specification is to establish an undivided, single-source responsibility of the Contractor for all of the foregoing functions.

C. Contractor’s Work shall include, but not be limited to, the supply (including shipment), fabrication – on and off site - of the following items:

1. Seat Wall – Site Wall – Type 1, 2, 3, 4
2. Seat Wall – Platform Bench – A, B1, B2
3. Stage Seat Wall – Site Wall 4

D. Related Requirements:

1. Section 311000 – Site Clearing
2. Section 312000 – Earth Moving
3. Section 033000 – Cast-in-Place Concrete
4. Section 321313 – Concrete Paving

1.2 SUBMITTALS

A. Shop Drawings: For all wall types listed in this section.

B. Material samples: Provide samples to Landscape Architect for review.
   1. Wood slats: a 6” long piece of *Robinia pseudoacacia* (Black Locust) wood.

C. Color samples: Concrete color additives. Color to match concrete paving color selected by Landscape Architect

D. Material certificates:
   1. *Robinia pseudoacacia* (Black Locust) wood.
   2. Stainless steel hardware verifying that steel is Type 316.

1.3 QUALITY ASSURANCE AND CONTROL

A. All elements of each product shall be provided from a single Manufacturer for the entire project.
B. Qualifications: Fabrication of custom site walls is limited to firms with proven experience in fabrication and construction of similar PIP concrete, steel, and wood outdoor furnishings. Firms must meet the following minimum requirements:

1. At least ten (10) years’ experience in the successful fabrication of PIP concrete outdoor forms, and custom furniture pieces.
2. At least five (5) similar custom PIP concrete forms.
3. Subcontractor must have successfully similar concrete formed material (as determined by the Landscape Architect) and provide the Landscape Architect with the project name, site address and contact information for reference where the units were installed.

C. Prototypes:

1. Contractor shall provide a prototype of one of the wood and concrete site walls for approval by the Landscape Architect.
2. Expense: The cost of the approval process and all costs associated with fabricating the prototype are included in the bid price.
3. Disposition: Approved prototype may be incorporated into the final Work. Rejected materials must be demolished completely and legally disposed of offsite.

1.4 PRE-INSTALLATION MEETING:

A. Prior to installation of any materials, conduct a pre-installation meeting to discuss the scope of work and review installation requirements. The pre-installation meeting shall be attended by all parties involved in the installation of the material.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle materials in a manner which will insure the preservation of their quality and fitness for the Work.

B. Deliver materials to site in Manufacturer’s original, unopened containers and packaging, with labels clearly identifying product name and Manufacturer.

C. The materials shall be stored in accordance with manufacturer’s instructions.

D. Protect materials from weather by covering with waterproof sheeting, securely anchored. Take all necessary precautions to protect all items from moisture, chipping, cracking, or other damage throughout the construction process. Damaged units will not be allowed to remain and should any damaged units be found in constructed work, such units shall be demolished and removed from the site immediately and replaced with new formed units, and the Contractor shall assume all expenses incurred.

E. At the work site, all components of the site walls shall be placed out of the way of traffic and other construction activities, until the actual time of installation.

F. Installed walls should be wrapped or padded or otherwise protected during subsequent construction activity such that no damage can occur.
1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products in this specification and are packaged with protective covering for storage and identified with labels describing contents.

1. Wooden Replacement Slats: No fewer than one dozen full-size units.

PART 2 - PRODUCTS

2.1 CONCRETE

A. Cementitious Materials

1. Portland Cement, ASTM C 150, Type 1
2. Plasticizers, slag, fly ash, or other products replacing portions of the Portland Cement shall not exceed 20% of the Portland cement volume and shall not be calcium chloride based.

B. Normal Weight Aggregates: ASTM C 33, graded.

1. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.


D. Proportion normal-weight concrete mixture as follows:

1. Minimum Comprehensive Strength: 4000 psi minimum at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.45.
3. Slump Limit: 4".

E. Base:

1. Cast in sections as indicated on the drawings.
2. Finish: Unfinished
3. Reinforcement: Steel bar framework
5. Cure:
   a. Evaporation control and wet curing as per ACI 308R-01.
   b. Do not use curing compounds or air entrainment

F. Concrete Color: to match color and source selected by Landscape Architect under Section 321313 – Concrete Paving.

2.2 WOOD SLAT TOP

A. Type:

1. 2” x 4” wood slats
2. Species: Kebony– produced from FSC®-certified Pinus Radata
3. Grade Characteristics:
a. Clear
b. Straight grained and parallel cut
c. No decay, incipient decay, honeycomb, knot holes, shakes, splits, or wante.
d. No discoloration
e. Hardness rating: Brinell Hardness Rating of 41 N/mm² EN 1534
f. Swelling: Dry to wet in tangential direction – 4%
g. Size: 1” x 4”

4. Contact Information – Sales Representative:
Pine River Group
812 South Riverside Avenue
St. Clair, MI  48079
Phone: 1-855-230-5656
Email: info@pinerivergroup.com

5. 1/4” Chamfer on all exterior edges. See drawings
6. Preparation: Pre-drill holes for anchors and screws.

2.3 CONNECTIONS:

A. Stainless Steel: Type 316 stainless steel (marine grade) for all connections. Grind smooth all exposed cut edges. See drawings for sizes and dimensions.
   1. Stainless steel flat bars
   2. Stainless steel anchors
   3. Square stainless-steel tubes – Grind smooth all exposed cuts edges
   4. Wood screws.

2.4 JOINTS:

A. Placement: Locate joints per contract drawings.

B. Type: As indicated in the drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FORMWORK

A. General: Comply with Division 03 Section "Cast-in-Place Concrete" for formwork, embedded items, and shoring and reshoring.
B. Forms shall be smooth and true to provide even planed surfaces.

C. Forms shall be set to contain the force of the pour without bulging.

D. Fabricate forms to result in cast-in-place concrete that complies with ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

   1. In addition to ACI 117, comply with the following tolerances: <Insert tolerances>.

E. 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. Kerf wood rustications, keyways, reglets, recesses, and the like, for easy removal.

   1. Seal form joints and penetrations at form ties with form joint tape or form joint sealant to prevent cement paste leakage.
   2. Do not use rust-stained steel form-facing material.

F. Chamfer exterior corners and edges of cast-in-place concrete.

G. Coat contact surfaces of chamfer strips with sealer before placing reinforcement, anchoring devices, and embedded items.

H. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

I. Re-tighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

J. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

K. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and attach securely to prevent deflection and maintain stability of liners during concreting. Prevent form liners from sagging and stretching in hot weather. Seal joints of form liners and form liner accessories to prevent mortar leaks. Coat form liner with form-release agent.

3.3 REINFORCEMENT AND INSERTS

A. General: Comply with Division 03 Section "Cast-in-Place Concrete" for fabricating and installing steel reinforcement. Securely fasten steel reinforcement and wire ties against shifting during concrete placement.

B. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

3.4 REMOVING AND REUSING FORMS

A. Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.

   1. Schedule form removal to maintain surface appearance that matches approved mockups.
B. Leave formwork for slabs, and other structural elements that support weight of concrete in place until concrete has achieved 28-day design compressive strength. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

C. Clean and repair surfaces of forms to be reused in the Work. Do not use split, frayed, delaminated, or otherwise damaged form-facing material. Apply new form-release agent.

D. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for cast-in-place concrete surfaces.

3.5 JOINTS

A. Construction Joints: Install construction joints true to line with faces perpendicular to surface plane of cast-in-place concrete so strength and appearance of concrete are not impaired, at locations indicated or as approved by Landscape Architect.
   1. Place joints as indicated.
   2. Form joints as indicated. Align construction joint within rustications attached to form-facing material.
   3. Space vertical joints in walls as indicated on the drawings

B. Contraction Joints: Form weakened-plane contraction joints true to line with faces perpendicular to surface plane of cast-in-place concrete so strength and appearance of concrete are not impaired, at locations indicated or as approved by Landscape Architect.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, form-release agent, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Landscape Architect.

C. Deposit concrete continuously between construction joints. Deposit concrete to avoid segregation.
   1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
   2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 303.1.
   3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. Do not permit vibrators to contact forms.

D. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
   1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
   2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
   3. Do not use calcium chloride, salt, or other materials containing antifreeze agents.
4. Do not use chemical accelerators unless otherwise specified and approved in design mixtures.

E. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.7 FINISHES, GENERAL

A. Concrete Finish: Match Landscape Architect's design reference sample, identified and described as indicated, to satisfaction of Landscape Architect.

B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces.

1. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

C. Maintain uniformity of special finishes over construction joints unless otherwise indicated.

3.8 AS-CAST FORMED FINISHES

A. Broom finish to match description in Concrete Paving Specification.

3.9 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with ACI 301 for hot-weather protection during curing.

B. Begin curing cast-in-place concrete immediately after applying as-cast formed finishes to concrete. Cure according to ACI 308.1, by one or a combination of the following methods that will not mottle, discolor, or stain concrete:

1. Moisture Curing: Keep exposed surfaces of cast-in-place concrete continuously moist for no fewer than seven days with the following materials:
   a. Water.
   b. Continuous water-fog spray.
   c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for no fewer than
seven days. Immediately repair any holes or tears during curing period; use cover material and waterproof tape.

3. Curing Compound: Mist concrete surfaces with water. Apply curing compound uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.10 FIELD QUALITY CONTROL

A. General: Comply with field quality-control requirements in Division 03 Section "Cast-in-Place Concrete."

3.11 REPAIRS, PROTECTION, AND CLEANING

A. Repair and cure damaged finished surfaces of cast-in-place concrete when approved by Landscape Architect. Match repairs to color, texture, and uniformity of surrounding surfaces and to repairs on approved mockups.

1. Remove and replace cast-in-place concrete that cannot be repaired and cured to Landscape Architect's approval.

B. Protect corners, edges, and surfaces of cast-in-place concrete and wood slats from damage; use guards and barricades.

C. Protect cast-in-place concrete and wood slats from staining, laitance, and contamination during remainder of construction period.

D. Clean cast-in-place concrete and wood surfaces after finish treatment to remove stains, markings, dust, and debris.

E. Wash and rinse surfaces according to concrete finish applicator's written instructions. Protect other Work from staining or damage due to cleaning operations.

1. Do not use cleaning materials or processes that could change the appearance of cast-in-place concrete finishes.

END OF SECTION 029301
SECTION 221113 - FACILITY WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary
      Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
   A. This Section includes water-distribution piping and related components outside the building for
      water service.
   B. Utility-furnished products include water meters that will be furnished to the site, ready for
      installation.

1.3 DEFINITIONS
   A. PVC: Polyvinyl chloride plastic.

1.4 ACTION SUBMITTALS
   A. Product Data: For each type of product indicated.
   B. Shop Drawings: Detail precast concrete vault assemblies and indicate dimensions, method of
      field assembly, and components.

1.5 INFORMATIONAL SUBMITTALS
   A. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS
   A. Operation and Maintenance Data: For water valves and specialties to include in emergency,
      operation, and maintenance manuals.

1.7 QUALITY ASSURANCE
   A. Regulatory Requirements:
1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:

1. Ensure that valves are dry and internally protected against rust and corrosion.
2. Protect valves against damage to threaded ends and flange faces.
3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. During Storage: Use precautions for valves, including fire hydrants, according to the following:

1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

E. Protect stored piping from moisture and dirt. Elevate above grade.

F. Protect flanges, fittings, and specialties from moisture and dirt.

G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.9 PROJECT CONDITIONS

A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of service.
2. Do not proceed with interruption of water-distribution service without Owner's written permission.
1.10 COORDINATION

A. Coordinate connection to water main with utility company.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372.

2.2 COPPER TUBE AND FITTINGS

A. Soft Copper Tube: ASTM B 88, Type K, water tube, annealed temper.

B. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.

C. Copper Unions:
   1. MSS SP-123.
   4. Solder-joint or threaded ends.

2.3 PVC PIPE AND FITTINGS

A. PVC, Schedule 40 Pipe: ASTM D 1785.
   1. PVC, Schedule 40 Socket Fittings: ASTM D 2466.

B. PVC, Schedule 80 Pipe: ASTM D 1785.
   1. PVC, Schedule 80 Socket Fittings: ASTM D 2467.
   2. PVC, Schedule 80 Threaded Fittings: ASTM D 2464.

2.4 JOINING MATERIALS

A. Brazing Filler Metals: AWS A5.8, BCuP Series.

B. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
2.5 PIPING SPECIALTIES

A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.6 CORPORATION VALVES

A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following: City of Fredericksburg Utilities Department Approved Products.

B. Service-Saddle Assemblies: Comply with AWWA C800. Include saddle and valve compatible with tapping machine.
   1. Service Saddle: Copper alloy with seal and AWWA C800, threaded outlet for corporation valve.
   2. Corporation Valve: Bronze body and ground-key plug, with AWWA C800, threaded inlet and outlet matching service piping material.

C. Service Boxes for Curb Valves: Similar to AWWA M44 requirements for cast-iron valve boxes. Include cast-iron telescoping top section of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over curb valve and with a barrel approximately 3 inches in diameter.
   1. Shutoff Rods: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve.

2.7 WATER METERS

A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following: City of Fredericksburg Utilities Department Approved Products.

B. Displacement-Type Water Meters:
   1. Description: With bronze main case.
      b. Registration: Flow in gallons.

2.8 BACKFLOW PREVENTERS

A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following: City of Fredericksburg Utilities Department Approved Products.
2.9 WATER METER BOXES

A. Description: Cast-iron body and double cover for disc-type water meter, with lettering "WATER METER" in top cover; and with separate inner cover; air space between covers; and slotted, open-bottom base section of length to fit over service piping.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Refer to Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 VALVE APPLICATIONS

A. General Application: Use mechanical-joint-end valves for NPS 3 and larger underground installation. Use threaded- or flanged-end valves for installation in vaults. Use UL/FMG, nonrising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for NPS 2 and smaller installation.

3.3 PIPING INSTALLATION

A. Water-Main Connection: Arrange with utility company for tap of size and in location indicated in water main.

B. Water-Main Connection: Tap water main according to requirements of water utility company and of size and in location indicated.

C. Make connections NPS 2 and smaller with drilling machine according to the following:

1. Install service-saddle assemblies and corporation valves in size, quantity, and arrangement required by utility company standards.
2. Install service-saddle assemblies on water-service pipe to be tapped. Position outlets for corporation valves.
3. Use drilling machine compatible with service-saddle assemblies and corporation valves. Drill hole in main. Remove drilling machine and connect water-service piping.
4. Install corporation valves into service-saddle assemblies.
5. Install manifold for multiple taps in water main.
6. Install curb valve in water-service piping with head pointing up and with service box.

D. Install PVC, AWWA pipe according to ASTM F 645 and AWWA M23.

E. Bury piping with depth of cover over top at least 36 inches, with top at least 12 inches blow level of maximum frost penetration for the area.

F. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.
3.4 JOINT CONSTRUCTION

A. Make pipe joints according to the following:

1. Copper-Tubing, Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools and procedures recommended by pressure-seal-fitting manufacturer. Leave insertion marks on pipe after assembly.
2. PVC Piping Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139 and pipe manufacturer's written instructions.

3.5 ANCHORAGE INSTALLATION

A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:

1. Concrete thrust blocks.
2. Locking mechanical joints.
4. Bolted flanged joints.
5. Pipe clamps and tie rods.

B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:


C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.6 VALVE INSTALLATION

A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.

B. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.

C. UL/FMG, Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.

D. UL/FMG, Valves Other Than Gate Valves: Comply with NFPA 24.

E. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.

3.7 WATER METER INSTALLATION

A. Install water meters, piping, and specialties according to utility company's written instructions.
B. Water Meters: Install displacement-type water meters, NPS 2 and smaller, in meter boxes with shutoff valves on water meter inlets. Include valves on water meter outlets and valved bypass around meters unless prohibited by authorities having jurisdiction.

3.8 BACKFLOW PREVENTER INSTALLATION

A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.

B. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding from backflow discharge.

C. Do not install bypass piping around backflow preventers.

3.9 WATER METER BOX INSTALLATION

A. Install water meter boxes in paved areas flush with surface.

B. Install water meter boxes in grass or earth areas with top 2 inches above surface.

3.10 PROTECTIVE ENCLOSURE INSTALLATION

A. Install concrete base level and with top approximately 2 inches above grade.

B. Install protective enclosure over valves and equipment.

C. Anchor protective enclosure to concrete base.

3.11 CONNECTIONS

A. Connect water-distribution piping to existing water main. Use service clamp and corporation valve.

B. Connect water-distribution piping to interior domestic water piping.

3.12 FIELD QUALITY CONTROL

A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.

1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig. Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints.
Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

C. Prepare reports of testing activities.

3.13 IDENTIFICATION

A. Install continuous underground detectable warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Section 312000 "Earth Moving."

3.14 CLEANING

A. Clean and disinfect water-distribution piping as follows:

1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:
   a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
   b. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
   c. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.

B. Prepare reports of purging and disinfecting activities.

END OF SECTION 221113
SECTION 221313 - FACILITY SANITARY SEWERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. PVC pipe and fittings.
   2. Nonpressure-type transition couplings.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Pipe and fittings.
   2. Non-pressure and pressure couplings

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of pipe and fitting.

B. Field quality-control reports.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle manholes according to manufacturer's written rigging instructions.
1.6 FIELD CONDITIONS

A. Interruption of Existing Sanitary Sewerage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of service.
2. Do not proceed with interruption of service without Owner's written permission.

PART 2 - PRODUCTS

2.1 PVC PIPE AND FITTINGS

A. PVC Type PSM Sewer Piping:

1. Pipe: ASTM D 3034, SDR 26, PVC Type PSM sewer pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM D 3034, PVC with bell ends.

2.2 NONPRESSURE-TYPE TRANSITION COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling; for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and include corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:

1. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.

C. Shielded, Flexible Couplings:

1. Description: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

D. Nonpressure-Type, Rigid Couplings:

1. Description: ASTM C 1461, sleeve-type, reducing- or transition-type mechanical coupling; molded from ASTM C 1440, TPE material; with corrosion-resistant-metal tension band and tightening mechanism on each end.

2.3 BACKWATER VALVES

A. PVC Backwater Valves:

1. Description: Horizontal type; with PVC body, PVC removable cover, and PVC swing check valve.
2.4 CLEANOUTS

A. PVC Cleanouts:
   1. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.

B. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

C. Install gravity-flow, nonpressure, drainage piping according to the following:
   1. Install PVC Type PSM sewer piping according to ASTM D 2321 and ASTM F 1668.

D. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure, drainage piping according to the following:
   1. Join PVC Type PSM sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasket joints.

3.4 BACKWATER VALVE INSTALLATION

A. Install horizontal-type backwater valves in piping manholes or pits.

3.5 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts, and use cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
1. Use Heavy-Duty, top-loading classification cleanouts in all areas.

B. Set cleanout frames and covers in earth in cast-in-place-concrete block, 12 by 12 by 12 inches deep. Set with tops flush with surrounding grade.

C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.6 CONNECTIONS

A. Make connections to existing piping and underground manholes.

1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye fitting plus 6-inch overlap with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.

2. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

3.7 IDENTIFICATION

A. Comply with requirements in Section 312000 "Earth Moving" for underground utility identification devices. Arrange for installation of green warning tapes directly over piping and at outside edges of underground manholes.

1. Use warning tape or detectable warning tape over ferrous piping.

2. Use detectable warning tape over nonferrous piping and over edges of underground manholes.

3.8 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate report for each system inspection.

2. Defects requiring correction include the following:

   a. Alignment: Less than full diameter of inside of pipe is visible between structures.

   b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.

   c. Damage: Crushed, broken, cracked, or otherwise damaged piping.

   d. Infiltration: Water leakage into piping.

   e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to requirements of authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.
5. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:
   a. Fill sewer piping with water. Test with pressure of at least 10-foot head of water, and maintain such pressure without leakage for at least 15 minutes.
   b. Close openings in system and fill with water.
   c. Purge air and refill with water.
   d. Disconnect water supply.
   e. Test and inspect joints for leaks.

6. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
   a. Test plastic gravity sewer piping according to ASTM F 1417.
   b. Test concrete gravity sewer piping according to ASTM C 1628.

7. Manholes: Perform hydraulic test according to ASTM C 969.

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.9 CLEANING

A. Clean dirt and superfluous material from interior of piping. Flush with potable water prior to substantial completion.

END OF SECTION 221313
SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal conduits and fittings, including GRC and PVC-coated steel conduit.
2. Rigid nonmetallic duct.
3. Flexible nonmetallic duct.
4. Duct accessories.
5. Fiberglass handholes and boxes with polymer concrete frame and cover.

1.3 DEFINITIONS

A. Direct Buried: Duct or a duct bank that is buried in the ground, without any additional casing materials such as concrete.

B. Duct: A single duct or multiple ducts. Duct may be either installed singly or as component of a duct bank.

C. Duct Bank:

1. Two or more ducts installed in parallel, with or without additional casing materials.
2. Multiple duct banks.

D. GRC: Galvanized rigid (steel) conduit. Also known as RGS conduit.

E. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include duct-bank materials, including spacers and miscellaneous components.
2. Include duct, conduits, and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
3. Include accessories for handholes, boxes.
4. Include underground-line warning tape.
B. Shop Drawings:

1. Factory-Fabricated Handholes and Boxes Other Than Precast Concrete:
   a. Include dimensioned plans, sections, and elevations, and fabrication and installation details.
   b. Include duct entry provisions, including locations and duct sizes.
   c. Include cover design.
   d. Include grounding details.
   e. Include dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND FITTINGS

A. GRC: Comply with ANSI C80.1 and UL 6.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. Allied Tube & Conduit; a part of Atkore International.
   2. Southwire Company.
   3. Thomas & Betts Corporation; A Member of the ABB Group.
   4. Or approved equal.

C. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.

2.2 RIGID NONMETALLIC DUCT

A. Underground Plastic Utilities Duct: Type EPC-80-PVC and Type EPC-40-PVC RNC, complying with NEMA TC 2 and UL 651, with matching fittings complying with NEMA TC 3 by same manufacturer as duct.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. ARNCO Corp.
   2. Beck Manufacturing.
   3. IPEX USA LLC.
   4. Or approved equal.
C. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.

D. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 FLEXIBLE NONMETALLIC DUCTS

A. HDPE Duct: Type EPEC-80 HDPE, complying with NEMA TC 7 and UL 651A.

1. <Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. ARNCO Corp.
   b. Carlon; a brand of Thomas & Betts Corporation.
   d. Or approved equal.

2. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.

2.4 DUCT ACCESSORIES

A. Duct Spacers: Factory-fabricated, rigid, PVC interlocking spacers; sized for type and size of duct with which used, and selected to provide minimum duct spacing indicated while supporting duct during concreting or backfilling.

1. <Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Allied Tube & Conduit; a part of Atkore International.
   b. Carlon; a brand of Thomas & Betts Corporation.
   c. IPEX USA LLC.
   d. Or approved equal.

B. Underground-Line Warning Tape: Comply with requirements for underground-line warning tape specified in Section 260553 "Identification for Electrical Systems."

2.5 FIBERGLASS HANDHOLES AND BOXES WITH POLYMER CONCRETE FRAME AND COVER

A. Description: Sheet-molded, fiberglass-reinforced, polyester resin enclosure joined to polymer concrete top ring or frame.

B. <Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. Armorcast Products Company.
   2. Oldcastle Enclosure Solutions.
3. **Quazite: Hubbell Power Systems, Inc.**
4. Or approved equal.


D. Color: Gray.

E. Configuration: Units shall be designed for flush burial and have open bottom unless otherwise indicated.

F. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.

G. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

H. Cover Legend: Molded lettering, "ELECTRIC."

I. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.

J. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering duct for secure, fixed installation in enclosure wall.

K. Handholes 12 inches wide by 24 inches long and larger shall have factory-installed inserts for cable racks and pulling-in irons.

### 2.6 UTILITY STRUCTURE ACCESSORIES

A. Accessories for Utility Structures: Utility equipment and accessory items used for utility structure access and utility support, listed and labeled for intended use and application.

B. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:

1. **Quazite: Hubbell Power Systems, Inc.**
2. **Underground Devices, Inc.**
3. Or approved equal.

C. Duct-Sealing Compound: Nonhardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F. Capable of withstanding temperature of 300 deg F without slump and adhering to clean surfaces of plastic ducts, metallic conduit, conduit and duct coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.

D. Cover Hooks: Light duty, designed for lifts less than 60 lbf. Two required.
2.7 SOURCE QUALITY CONTROL

A. Nonconcrete Handhole and Pull-Box Prototype Test: Test prototypes of boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Tests of materials shall be performed by an independent testing agency.
2. Strength tests of complete boxes and covers shall be by an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
3. Testing machine pressure gages shall have current calibration certification, complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate layout and installation of duct, duct bank, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field. Notify Architect if there is a conflict between areas of excavation and existing structures or archaeological sites to remain.

B. Coordinate elevations of duct and duct-bank entrances into handholes and boxes with final locations and profiles of duct and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct and duct bank will drain to handholes, and as approved by Architect.

C. Clear and grub vegetation to be removed, and protect vegetation to remain according to Section 311000 "Site Clearing." Remove and stockpile topsoil for reapplication according to Section 311000 "Site Clearing."

3.2 UNDERGROUND DUCT APPLICATION

A. Duct for Electrical Feeders 600 V and Less: Type EPC-40-PVC RNC, direct-buried unless otherwise indicated.

B. Duct for Electrical Branch Circuits: Type EPC-40-PVC RNC, direct-buried unless otherwise indicated.

C. Bored Underground Duct: Type EPEC-80-HDPE unless otherwise indicated.

D. Underground Ducts Crossing Walks and Driveways: Type EPC-40 PVC RNC, encased in reinforced concrete.

E. Stub-ups: Concrete-encased GRC.
3.3 UNDERGROUND ENCLOSURE APPLICATION

A. Handholes and Boxes for 600 V and Less:
   1. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Fiberglass enclosures with polymer concrete frame and cover, SCTE 77, Tier 15 structural load rating.
   2. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Heavy-duty fiberglass units with polymer concrete frame and cover, SCTE 77, Tier 8 structural load rating.
   3. Units Subject to Light-Duty Pedestrian Traffic Only: Fiberglass enclosures with polyester concrete frame and cover, structurally tested according to SCTE 77 with 3000-lbf vertical loading.
   4. Cover design load shall not exceed the design load of the handhole or box.

3.4 EARTHWORK

A. Excavation and Backfill: Comply with Section 312000 "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restoration: Replace area immediately after backfilling is completed or after construction vehicle traffic in immediate area is complete.

C. Restore surface features at areas disturbed by excavation, and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

D. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Section 329200 "Turf and Grasses" and Section 329300 "Plants."

E. Cut and patch existing pavement in the path of underground duct, duct bank, and underground structures according to "Cutting and Patching" Article in Section 017300 "Execution."

3.5 DUCT AND DUCT-BANK INSTALLATION

A. Where indicated on Drawings, install duct, spacers, and accessories into the duct-bank configuration shown. Duct installation requirements in this Section also apply to duct bank.

B. Install duct according to NEMA TCB 2.

C. Slope: Pitch duct a minimum slope of 1:300 down toward handholes and away from buildings and equipment.

D. Manufactured sweep bends in "Curves and Bends" Paragraph below are available in various radii up to 25 feet (7.5 m) for 4- and 5-inch (100- and 125-mm) duct, although a 48-inch (1200-mm) radius is the largest regularly stocked. To minimize pulling tensions, specify the largest radius possible, consistent with other Project requirements. See the Evaluations. Coordinate with Drawings.
E. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches, both horizontally and vertically, at other locations unless otherwise indicated.

1. Duct shall have maximum of two 90 degree bends or the total of all bends shall be no more 180 degrees between pull points.

F. Joints: Use solvent-cemented joints in duct and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent duct do not lie in same plane.

G. End Bell Entrances to Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches o.c. for 5-inch duct, and vary proportionately for other duct sizes.

1. Begin change from regular spacing to end-bell spacing 10 feet from the end bell, without reducing duct slope and without forming a trap in the line.
2. Expansion and Deflection Fittings: Install an expansion and deflection fitting in each duct in the area of disturbed earth adjacent to handhole. Install an expansion fitting near the center of all straight line direct-buried duct with calculated expansion of more than 3/4 inch.
3. Grout end bells into structure walls from both sides to provide watertight entrances.

H. Terminator Entrances to Polymer Concrete Handholes: Use manufactured, cast-in-place duct terminators, with entrances into structure spaced approximately 6 inches o.c. for 4-inch duct, and vary proportionately for other duct sizes.

1. Begin change from regular spacing to terminator spacing 10 feet from the terminator, without reducing duct line slope and without forming a trap in the line.
2. Expansion and Deflection Fittings: Install an expansion and deflection fitting in each duct in the area of disturbed earth adjacent to handhole. Install an expansion fitting near the center of all straight line duct with calculated expansion of more than 3/4 inch.

I. Building Wall Penetrations: Make a transition from underground duct to GRC at least 10 feet outside the building wall, without reducing duct line slope away from the building and without forming a trap in the line. Use fittings manufactured for RNC-to-GRC transition. Install GRC penetrations of building walls as specified in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

J. Sealing: Provide temporary closure at terminations of duct with pulled cables. Seal spare duct at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.


L. Direct-Buried Duct and Duct Bank:

1. Excavate trench bottom to provide firm and uniform support for duct. Comply with requirements in Section 312000 "Earth Moving" for preparation of trench bottoms for pipes less than 6 inches in nominal diameter.
2. Width: Excavate trench 12 inches wider than duct on each side.
3. Width: Excavate trench 3 inches wider than duct on each side.
4. Depth: Install top of duct at least 36 inches below finished grade unless otherwise indicated.
5. Set elevation of bottom of duct bank below frost line.
6. Support ducts on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
7. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than four spacers per 20 feet of duct. Place spacers within 24 inches of duct ends. Stagger spacers approximately 6 inches between tiers. Secure spacers to earth and to ducts to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
8. Install duct with a minimum of 3 inches between ducts for like services and 6 inches between power and communications duct.
10. Install manufactured GRC elbows for stub-ups, at building entrances, and at changes of direction in duct.
   a. Couple RNC duct to GRC with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
   b. Stub-ups to Outdoor Equipment: Extend concrete-encased GRC horizontally a minimum of 60 inches from edge of base. Install insulated grounding bushings on terminations at equipment.
      1) Stub-ups shall be minimum 4 inches above finished floor and minimum 3 inches from conduit side to edge of slab.
   c. Stub-ups to Indoor Equipment: Extend concrete-encased GRC horizontally a minimum of 60 inches from edge of wall. Install insulated grounding bushings on terminations at equipment.
      1) Stub-ups shall be minimum 4 inches above finished floor and no less than 3 inches from conduit side to edge of slab.
11. After installing first tier of duct, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand place backfill to 4 inches over duct and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction. Comply with requirements in Section 312000 "Earth Moving" for installation of backfill materials.
   a. Place minimum 3 inches of sand as a bed for duct. Place sand to a minimum of 6 inches above top level of duct.
   b. Place minimum 6 inches of engineered fill above concrete encasement of duct.
3.6   INSTALLATION OF HANDBOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of duct, and seal joint between box and extension as recommended by manufacturer.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas and trafficways, set cover flush with finished grade. Set covers of other handholes 1 inch above finished grade.

D. Install handholes and boxes with bottom below frost line, 24 inches below grade.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.

F. Field cut openings for duct according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

G. For enclosures installed in asphalt paving and concrete and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on compacted earth.

   1. Concrete: 3000 psi, 28-day strength, complying with Section 033000 "Cast-in-Place Concrete," with a troweled finish.
   2. Dimensions: 10 inches wide by 12 inches deep.

3.7   GROUNDING

A. Ground underground ducts and utility structures according to the latest adopted version of the National Electrical Code (NFPA 70)

3.8   FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

   1. Demonstrate capability and compliance with requirements on completion of installation of underground duct, duct bank, and utility structures.
   2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide a minimum 12-inch-long mandrel equal to duct size minus 1/4 inch. If obstructions are indicated, remove obstructions and retest.

B. Correct deficiencies and retest as specified above to demonstrate compliance.

C. Prepare test and inspection reports.

3.9 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of duct until duct cleaner indicates that duct is clear of dirt and debris. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

END OF SECTION 260543
SECTION 26 56 00 – EXTERIOR LIGHTING LUMINAIRE

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. The work required under this Section shall conform to the requirements of "Division 01, General Requirements," "Conditions of the Contract" and "Supplementary Conditions." Specific attention is called to the "Division 26 Operation and Maintenance of Electrical Systems" located in Section 26 01 00.

1.2 SECTION INCLUDES

A. Provide the lighting and accessories as shown on the contract documents and as specified herein. The specifications in this section shall apply to the light fixtures specified by the Lighting Designer.

B. Refer to architectural drawings for dimensions and details. Check and verify dimensions and details on drawings before proceeding with the Work. Report any inconsistencies or discrepancies at once to the Architect or Construction Manager. Should it appear that the Work intended is not sufficiently detailed or explained in the drawings or the specifications, apply to the Architect or Construction Manager for further drawings or explanations, as may be necessary. Conform to these explanations in the work. If any question arises about the true meaning of the drawing or specifications, refer the matter to the Architect or Construction Manager, whose decision is final and conclusive. Under no circumstances shall any request for extra compensation be honored where the basis of the claim is such a clarification by the Construction Manager, Owner or Architect. In any case submit a bid, or proceed on any Work with uncertainty. The intention of this specification and the accompanying or applicable drawing is to provide a job complete in every respect. Contractor is responsible for this result.

1.3 RELATED SECTIONS

A. Division 26 General Requirements – Section 260000.

B. Low-Voltage Electrical Power Conductors and Cables – Section 260519

C. Raceway and Boxes for Electrical Systems – Section 260533

D. Testing – Section 260594

1.4 DEFINITIONS

A. Specifier: Design team consisting of representatives of Lighting Designer, Architect, Electrical Engineer, and Owner/ User.

B. CCT: Correlated color temperature.
C. CRI: Color-rendering index.

D. HID: High-intensity discharge.

E. LER: Luminaire efficacy rating.

F. Luminaire: Complete lighting fixture, including ballast or driver housing if provided.

G. LED: Lighting Emitting Diode

H. BF: Ballast Factor

I. CFL: Compact Fluorescent lamp

J. LM-79: Electrical and Photometric measurements applied to LED luminaires and sources.

K. LM-80: Lumen Depreciation test method applied to LED luminaires and sources.

1.5 SUBMITTALS

A. Product Data: For each type of luminaire, arranged in order of fixture designation. Include and clearly identify data on features, accessories, finishes, and the following

1. Complete luminaire lists of luminaires proposed to be used.
2. Submit manufacturer
3. Manufacturer’s cut sheet or shop drawing/illustrations
4. Manufacturer’s complete model and specification number
5. Voltage
6. Ballast or Driver specifications and manufacturer for each luminaire
7. Lamp specifications and manufacturer for each luminaire
8. Photometric data, in IESNA format, based on laboratory tests by a qualified independent testing agency of each lighting fixture type, outfitted with lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.
9. Warranty

B. Shop Drawings

1. Supply complete manufacturers line drawing showing scaled dimensions, weights, methods of assembly, components, features, and accessories. Include all wiring diagrams and means of installation.
2. Shop drawings for non-standard product are required for fixture approval and must be submitted as part of submittal. Cut sheets for manufacturer and system approval prior to submission of complete shop drawing are not acceptable.
3. Fixture submittals may be submitted electronically in compliance with project submittal specifications.

C. Formatting

1. Fixture submittals shall be furnished in a single complete submittal containing all fixture types for project to include clearly outlined fixture type, fixture manufacturer, fixture model...
D. Samples

1. It shall be the responsibility of the Contractor to provide sample fixture(s) as indicated in LIGHTING FIXTURE SPECIFICATIONS. When samples are called for the manufacturer shall provide working samples complete with lamp, ballast or driver.

2. Conditions for mock-up of individual luminaire types shall be indicated in LIGHTING FIXTURE SPECIFICATIONS on a per luminaire type. Contractor is responsible to provide sample fixture as indicated.

3. The sample(s) shall be shipped to a location that is determined by the Architect. Shipping and return shipping costs shall be provided as part of the contract.

4. The purpose of the sample is to review manufacturing techniques, detailing, lamping and scale. Sample fixtures must be approved prior to fabrication of fixtures for the project. Minor modifications, if any, shall be considered part of these Specifications and shall be accomplished with no additional cost to the Owner.

5. Sample fixtures may not be used on the project.

E. Substitutions

1. Should the Contractor wish to have considered products other than those specified, the items must be submitted in written project bid RFI (Request for Information) (21) Twenty One days in advance of the bid. Failure to submit within that deadline constitutes a guarantee that the specified products shall be supplied.

2. Substitute fixtures shall be submitted with current photometric certified test data from an independent testing laboratory of the substitute fixture and the specified fixture.

3. Within seven days after the submittal, the Contractor will be prepared to submit one sample unit of each proposed substitute item. Samples will include proper lamps, accessories, cord, and plug for operation on 120V. Failure to comply with these requirements will require the Contractor to supply the specified item only.

4. The party responsible for Specification of luminaire (Lighting Designer, Architect, Engineer, etc.) shall be the sole judge of determining whether the substitution complies with the specifications and shall reserve the right to disqualify any candidate.

5. Alternate Manufacturers: Alternate manufacturers than those listed in the fixture schedule may be considered provided all of the following conditions are met. Compliance with conditions listed below must be in writing and attested to by fixture manufacturer.
   a. Demonstrates fixture performance is equal or improved.
   b. Meets aesthetic considerations as established by the Architect / Owner / Lighting Designer.
   c. The cost to Owner is reduced. Shown in a per line item side by side of specified product cost and proposed alternate cost with pricing certified by fixture manufacturers or their designated Manufacturer’s Representatives.
   d. Improves delivery schedule.

6. Substitutions shall only be considered on a per line item method and not as a complete luminaire package.

F. Procurement:

1. Contractor must show, in writing, that the selected Electrical Distributor has received factory and/or factory representative pricing for this project and has ability to procure
specified product.

2. Electrical Distributor must hold account in good standing with all specified manufacturers or be capable of opening such an account within time frame of project.

G. Contract Closeout Submittals:

1. Operating and Maintenance Manual with the following data:
   a. Product data submittals.
   b. Wiring diagrams (as required).
   c. Installation instructions (for other than lay-in type fixtures).
   d. Parts lists.

H. Review:

1. Luminaire submittals shall be reviewed (2) two times per type. Additional reviews shall be at the expense of the Electrical Contractor and may not be charged against project budget. Reviews shall be conducted upon written acknowledgement of these conditions as Senior hourly labor rates for Lighting Designer, Architect, Electrical Engineer.

1.6 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with NFPA 70.

E. FMG Compliance: Lighting fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FMG.

F. The mock-up installation shall closely conform to the conditions of the actual installation as to: height, distance from ceiling, number and type of lamps, material, color, etc. The Contractor shall submit a written description of each proposed mock-up with drawings in order to obtain the Specifier’s approval prior to commencement of each mock-up. The purpose of the mock-up will be to study the general appearance and performance of the intended lighting systems. At the time, certain minimal test variations may be requested as to lamp location, lamp type, reflector shape, color and etc. Final modifications, if any, shall be considered a part of these Specifications and shall be accomplished with no additional cost to the Owner.

G. Experience: Manufacturer(s) shall have no less than five (5) years experience in design and
manufacture of lighting fixtures of the type and quality shown, unless otherwise indicated in specifications.

H. LED lighting must be provided with independent testing for LM-79 and LM-80 standards.

1.7 REFERENCE STANDARDS

A. Lighting fixtures shall be designed, manufactured, tested and installed in compliance with the following standards

1. NFPA 70 National Electrical Code
2. Underwriters’ Laboratories (UL)
3. Illuminating Engineering Society (IES)
4. ANSI C62 and C82
5. FCC Part 18, Subpart C
6. ASHRAE/IESNA 90.1
7. FDA Food Code

1.8 MANUFACTURER BEST PRACTICES

A. After receipt of order and prior to fabrication fixture manufacturer shall issue a letter to Specifier stating best practices and products that meet specification intent. This shall include evolution of lamping, LED, optics, photometry and fixture performance.

1. This is to allow for improvements in technology during the period between the award and manufacturing. LED technology, specifically, is rapidly improving and likely could exceed the specifications.
2. Manufacturer to offer, at no additional cost, solutions that meet the design intent as alternates to the base design prior to fabrication.

a. LED lighting could include:

   1) Improved (lower) wattage for same light output
   2) Improved (higher) lumen output for same wattage
   3) New fixture series in product line
   4) Improved color consistency and binning
   5) To be determined by manufacturer.

3. Submittal of letter does not imply approval of alternate product. Base product approved during standard submittal process shall still be available if desired.

B. LED correlated color temperature (CCT) shall have a tolerance of +/- 50 degree Kelvin from base CCT listed in product specification. Tolerance shall be across full product supplied. All Luminaires with continuous installation greater than 8’ shall also be subject to visual inspection for color or output shift.

1.9 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Luminaires and their component elements shall be delivered to the job site factory-assembled and wired to the greatest extent practical, in strict accordance with the approved shop
drawings, samples, certificates and catalog cuts, and shall be handled in a careful manner to avoid damage.

B. Exposed finished shall be protected during manufacture, transport, storage and handling. Delivered materials shall be identical to the approved samples. Materials which become damaged shall be repaired and/or replaced as directed.

1.10 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: 10% but not less than 6 of each type of lamp.
2. Ballasts: 5% but not less than 1 of each type of ballast.
3. LED Luminaries: 10% but not less than 2 of each LED downlight module and 4 of each unique length of LED channel.
4. LED power supply: 5% but not less than 1 of each type of driver.
5. LED lighting control box: minimum (1) spare per type.
6. Plastic Diffusers and Lenses: 10% but not less than 1 of each type of diffuser, lens, or baffle.
7. Globes and Guards: 5% but not less than one of each type of globe or guard.

1.11 PRICING

A. Contractor to provide unit line item pricing for each fixture type listed. Pricing to be valid for (1) One Year from award of contract and allow for removal or addition of fixtures in official project changes.

B. Pricing shall have a cap of 10% unit cost increase through project duration, after (1) one year.

PART 2 PRODUCTS

2.1 GENERAL

A. Provide materials, equipment, accessories and workmanship for the Work of this Section conforming to the highest commercial standards, as specified and indicated on the drawings. Make luminaire parts and components not specifically identified or indicated on the drawings, of materials most appropriate to their use or function, and resistant to corrosion and to thermal and mechanical stresses encountered in the normal application and function of the luminaire.

B. Named manufacturers, when listed in the luminaire schedule, are representative of an adequate level of quality and reputation, and are allowed to submit a product, provided that they are capable of satisfying the provision of the specifications in every aspect. This does not mean that any standard product provided by the manufacturer is automatically qualified.

2.2 FIXTURES AND LAMPS

A. Fixtures shall be provided as specified herein and as indicated on the drawings. Fixtures shall be complete with all required lamps, sockets, wiring, glassware, reflectors, hangers,
fittings, plaster frames, etc., necessary for a complete installation.

1. All fixtures shall be cleaned and have all lamps at the time of final acceptance of the building. All burned-out lamps shall be replaced at the time of final acceptance of building.

2. All fixtures specified herein scheduled and/or detailed on the drawings, shall conform to the standards and bear the label of the Underwriters’ Laboratories, Inc. Prior to the application of any finish, all metal parts of all fixtures shall be protected by a rust inhibiting process approved by the Architect. The rust inhibiting process shall be chemical. No type of sprayed, painted, or dipped primer may be used as the basic rust inhibitor. Any fixtures and/or parts of any fixtures which shall have begun to show signs of rusting or corroding at the time of completion of the job shall be removed and replaced by properly protected metal parts, subject to the approval of the Architect, and this shall be done before a final certificate of acceptance will be issued.

3. Where required, fixtures shall be furnished complete with internal wiring and ballasts. All joints and splices within the fixture housing shall be made as specified in Section 260519. Substitute material will not be acceptable.

4. All fixtures provided for this project shall be designed and rated by the fixture manufacturer for the intended application and for the location installed. All fixtures provided for this project shall be UL listed for the intended application and for the location installed. All fixtures exposed to outdoor weather conditions shall be suitable for outdoor weather conditions. All fixtures exposed to outside ambient temperatures shall be designed and rated for operation throughout the entire range of temperatures between the minimum and maximum outside ambient temperatures for this project. All fixtures exposed to damp locations, including but not limited to parking structure areas, shall be of damp rated construction. All fixtures shall be in accordance with the requirements of the Local Code Authority and the National Electrical Code. The requirements of this paragraph shall be in addition to all the other requirements of this specification. The requirements of the specification shall be in addition to the requirements indicated in the lighting fixture schedule. All fixtures shall meet these requirements whether specifically indicated in the lighting fixture schedule or not. It shall be the responsibility of the fixture manufacturer to provide all necessary accessories and modifications to the fixtures specified to meet these requirements. Catalog numbers of fixtures in the fixture schedule are intended to establish manufacturer, type, quality, aesthetic appearance, and lighting characteristics of the fixtures and do not necessarily indicate all the requirements of the specifications.

5. All pole mounted parking lot light fixtures shall be full cut-off type.

B. Provide the proper fixture type for the type of ceiling or wall construction in which the fixture is to be installed. Regardless of fixture numbers given in the fixture schedule, the fixtures supplied shall have the proper trim, frames, mounting devices and configuration and accessories necessary to be properly installed in the building construction. Catalog numbers of fixtures in the fixture schedule are to establish a type of fixture and not to determine a method of mounting.

C. The ballasts for all fluorescent and high intensity discharge fixtures, unless otherwise noted in luminaire specifications, shall be Class "P" energy saving CBM approved, thermally protected. Ballasts shall be General Electric, Advance, Universal, Motorola, Thomas, Valmount or EBT.

1. Fluorescent ballasts shall be high-frequency (above 20 kHz) electronic, energy saving, high power factor (95% minimum), "A" sound rated, programmed start, universal voltage, and Type "P" automatic reset type. Ballasts shall generate less than 15% total harmonic distortion with a lamp current crest factor less than 1.7 and a ballast factor of .87 or
greater. Ballasts shall operate as a parallel circuit, sustain variations of +/- 10% of
voltage and frequency with no damage to the ballasts, tolerate operation in ambient
temperatures up to 105 degrees F without damage, and operate with no visible flicker
(less than 3% flicker index). Compact fluorescent ballasts shall be similar to above with
lamp shutdown circuitry for end of lamp life protection, plenum rated, and instant on.

2. Ballasts shall be compatible for lamp type specified and shall be provided in quantity per
fixture to perform the switching requirements indicated on the drawings.

3. All ballasts located in fixtures exposed to freezing temperatures shall be rated for zero
degree operation. This shall include but not be limited to truck docks, site lighting and
roof mounted fixtures.

4. All lighting ballasts shall have a two year manufacturer's warranty for all parts and labor.

5. Where dimming is specified, dimming ballasts shall meet the above ballast requirements
in addition to proper dimming characteristics for the specific lamp and fixture type.

6. Power input to a 277-volt fluorescent ballast for two 32-watt F32T8 lamps shall not
 exceed 58 watts when tested per ANSI C82.2.

7. Ballasts for 3-tube fluorescent fixtures shall power three 32-watt F32T8 lamps. Power
input shall not exceed 86 watts when tested per ANSI C82.2.

8. Ballasts for fixtures located in remote or difficult to access locations shall have separate
ballasts remotely mounted from fixture. Remote ballasts shall be mounted in fully
accessible locations. Light fixtures mounted outside on the skin of the building shall have
remote ballasts mounted nearby in accessible ceiling plenum area or other accessible
area. All ballasts located within environmental air plenums shall be rated for such a
location.

D. All incandescent lamps shall be General Electric, Philips, or Osram Sylvania 120 volt, inside
frosted lamps, except where lamps are indicated on the lighting fixture schedule.

E. All fluorescent lamps shall be energy-saving 32-watt F32T8 3500K unless indicated
otherwise in the lighting fixture schedule. Fluorescent type (tube and compact) lamp color
rendering index (CRI) shall be a minimum of 82 unless otherwise noted by the Lighting
Consultant.

F. Fixtures shall be air handling type with provisions for air supply and return through the side
slots and heat removal through the lamp cavity unless otherwise noted. The heat extract
openings shall have sufficient area to limit the return air pressure drop to a maximum of 0.05" w.g. with 40 CFM flowing through the lighting fixture lamp cavity and the heat removal
openings. Fixtures shall be compatible with the slot diffusers, with and without crossover
ducts, specified in Division 23 under Section 23 37 00. Fixtures shall have louvered outlets
on top of the fixture and combination light and dust trap air slots at the door frame end to
provide return air flow through the lamp cavity. Each four foot side slot shall have an integral
hinged air control damper blade to be used as a shut-off device or pattern controller. The
fixture shall be designed to direct the supply air horizontally at the ceiling away from the
lighting fixture. The contractor shall adjust the hinged air control dampers appropriately for
proper return air balancing. The Division 26 electrical contractor shall coordinate with the
Division 23 mechanical contractor to determine which light fixtures to close and which light
fixtures to open the hinged air control damper blade. Typically, all light fixtures within
enclosed perimeter office areas or within 15 feet of the perimeter wall for open office areas
will have their hinged air control dampers closed to disable the return air function of the light
fixture when combination supply and return air perimeter slot diffusers are used along the
perimeter wall.

G. The lighting fixture manufacturer shall submit certified test data listing the return air
performance of the fixture with return air flowing only through the lamp cavity and with return
air flowing through the lamp cavity and the two side slot openings. See Section 26 00 10 for
H. All fixtures in elevator machine rooms, electrical rooms, telephone rooms, and equipment rooms shall have wire guards.

I. Supply ten (10) loose exit signs to owner at completion of project. Contractor shall use these where fire marshal instructs to add exit signs during inspection at no additional cost to owner.

J. All lighting fixtures in areas where there is exposed food, clean equipment, utensils, linens, or unwrapped single service and single use articles shall be lensed or provided with shatter resistant lamps in compliance with the most current FDA Food Code and other adopted codes.

K. New and existing indoor (non-dwelling unit) fluorescent light fixtures utilizing double ended lamps and ballasts within the area of work shall include required NEC ballast disconnect internal to fixture and be accessible to qualified persons. Disconnect shall be UL Listed with two mating finger safe halves disconnecting simultaneously all ballast supply conductors including the ground.

L. Solid State Lighting / Light Emitting Diode (LED) Lamps and Luminaires

1. General:
   a. Luminaire manufacturer shall have a minimum of (5) years experience in the manufacture and design of LED products and systems and no less than one hundred (100) North American installations.
   b. All components, peripheral devices and control software are to be provided by and shall be the responsibility of a single entity. All components shall perform successfully as a complete system and shall operate as described in Lighting Designer’s Control Narrative documents or Lighting Fixture Schedule.
   c. Include all components necessary for a complete installation. Provide all power supplies, synchronizers, data cables, and data terminators for a complete working system.

2. Replacement and Spares
   a. Manufacture shall provide written guarantee of the following:
      1) Manufacture will keep record of original bin for each LED module and have replacement modules from the same bin available for three (3) years after date of installation.
      2) Manufacturer will keep an inventory of replacement parts (source assembly, power and control components).
      3) Manufacturer’s LED system will not become obsolete for ten (10) years: Manufacturer will provide exact replacement parts, or provide upgraded parts that are design to fit into the original luminaire and provide equivalent distribution and lumen output to the original, without any negative consequences.

   b. All parts of system shall replaceable in field. Manufacturer shall provide written guarantee of the following:
1) Manufacturer has in place a written recycling and re-used program, and will accept returned product and/or components for recycling or re-use.

2) Manufacturer will properly dispose of non-recyclable components that are deemed harmful to the environment.

c. System shall carry a full warranty for five (5) years. Manufacturer shall be responsible for cost of labor not exceed $50 per individual part, and cost of shipping, to replace any component of the system that fails within 2 years of installation.

3. Products and Components – Performance

a. Manufacturer shall ensure that products undergo and successfully meet appropriate design and manufacturability testing including Design FMEA, Process FMEA, Environmental Engineering Considerations and Laboratory Tests, IEC standards and UL/CE testing.

b. All LED luminaires shall be subjected to the following JEDEC Reliability Tests for Lead-free Semiconductors: HTOL, RTOL, LTOL, PTMCL, TMSK, Mechanical Shock, Variable Vibration Frequency, SHR, Autoclave.

c. All LED components shall be mercury and lead-free.


e. LEDs shall comply with IESNA LM-80- Standards for Lumen Maintenance of LED Lighting Products.

f. White LEDs shall have a rated source life of 50,000 hours under normal operating conditions. RGB LEDs shall have a rated source life of 100,000 hours. LED “rated source life” is defined as the time when a minimum of 70% of initial lumen output remains.

g. Luminaire assembly shall include a method of dissipating heat so as to not degrade life of source, electronic equipment, or lenses. LED luminaires housing shall be designed to transfer heat from LED board to the outside environment. Luminaire housing shall have no negative impact on life of components.

h. Manufacturer shall supply in writing a range of permissible operating temperatures in which system will perform optimally.

i. For wet and damp use, the LED-based luminaire itself shall be sealed, rated, and tested for appropriate environmental conditions, not accomplished by using an additional housing or enclosure. Such protection shall have no negative impact on rated life of source or components, or if so, such reductions shall be explicitly brought to the attention of the designer.

j. Manufacturer shall be able to provide supporting documentation of the product meeting third party regulatory compliance.

k. All LED luminaires (100% of each lot) shall undergo a minimum twenty-four (24) hour burn-in during manufacturing, prior to shipping.

l. Manufacturer shall provide Luminaire Efficacy (lm/W), total luminous flux (lumens), luminous intensity (candela) chromaticity coordinates, CCT and CRI, optical performance, polar diagrams, and relevant lumiance and illuminance photometric data. Provide data in IES file format in accordance with IES LM-79-2008, based on test results from an independent Nationally Recognized Testing Laboratory.

m. Power / data supply shall have the following:

1) Supply outputs shall have current limiting protection.

2) Supply shall provide miss-wiring protection.

3) Supply shall have power factor correction.

4) Supply shall provide connections that are conduit-ready or clamp-style
connections in case of low-voltage wiring.
5) Supply shall come with a housing that meets a minimum IP20 rating for dry location installation unless located in a damp or wet location.
6) Supply shall be UL listed for Class 1 or Class 2 wiring.

PART 3 EXECUTION

3.1 INSTALLATION

A. Recessed lay in type lighting fixtures shall be installed in the lay in type ceiling in such a manner that the lens or louver housing may be easily opened and so that the fixtures may be removed and relocated without forcing the fixtures or changing the grid system tie wires. The electrical subcontractor shall coordinate with the ceiling subcontractor before the ceiling grid is installed to assure a mutually satisfactory installation of ceiling and light fixtures, which will permit the fixtures to be relocated at a future date. Refer to specification Section 26 00 10 for seismic restraint requirements.

B. Lighting Fixtures shall be set level, plumb, and square with ceilings and walls. Install lamps in each fixture.

C. Connect wiring according to Division 26 Section “Conductors and Cables”.

3.2 SUPPORTS

A. Recessed downlight lighting fixtures (LED, incandescent, compact fluorescent, metal halide, etc.) installed in lay in type ceilings shall be supported by means of hanger bars extending across the main ceiling support members supported by wires at all four corners. Fluorescent lighting fixtures (1’x1’, 1’x4’, 2’x2’, 2’x4’, etc.) shall be supported independently of the ceiling grid by wires on all four corners. The four wires shall be independent to the structure above. All other type fixtures in lay in type ceilings shall have the outlet box rigidly supported from the building structural system. In addition, each fixture shall be supported independently of the ceiling grid and all other MEP equipment by support wires connected to the building structure. Provide removable clips to securely fasten light fixtures in place to the ceiling construction; however, support shall be via tie wires. In addition to above support methods, all Local Code Authority requirements shall be adhered to. Support means and methods shall be in accordance with manufacturer’s recommendations and the Local Code Authority seismic requirements and wind loading.

3.3 CLEANING

A. All fixtures shall be cleaned of dirt, debris, and tape inside and outside and left in a clean condition at the end of the construction work.

3.4 SAMPLES

A. Provide samples of each fixture type as requested by the architect.

3.5 COORDINATION

A. The Contractors shall coordinate the control of all light fixtures with the lighting controls.
indicated in the Automatic Temperature Control System specification section.

END OF SECTION  265600
### General Notes

1. Should the contractor wish to have products other than those specified considered, the items must be submitted (14) days in advance of the bid. Failure to submit within that deadline constitutes a guarantee that the specified products will be supplied.

2. Contractor shall provide a complete list of all lamps which will be furnished on the project. This list shall be organized alphabetically by luminaire type indicated on the luminaire schedule, and include the manufacturer and exact model ordering code of each lamp.

3. Contractor shall provide extra materials as described with a minimum of 1 for each category: 10 for every 100 of lamps/1 for every 100 of plastic diffusers, lenses, ballasts, and LED power supplies/1 for every 20 of globes and guards/1 for every 40 of LED luminaires including full light engine assembly and power supply/1 LED lighting control box. List of spare materials to be included in submittal documentation.

4. All emergency and exit lighting shall be designed and specified by the electrical engineer.

5. Confirm with architect the exact mounting height aff.

6. Contractor must provide unit pricing to the architect. For each fixture type complete with all accessories and lamp.

### Architectural Lighting Luminaire Schedule

<table>
<thead>
<tr>
<th>Fixture Type</th>
<th>Description</th>
<th>Item</th>
<th>Manufacturer</th>
<th>Catalog Number</th>
<th>System Watts</th>
<th>Volts</th>
<th>Finish</th>
<th>Aper. Size</th>
<th>Mounting</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>KX1</td>
<td>Post with Angled Arm Mounted Suspended Pathway Luminaire</td>
<td>Fixture</td>
<td>NERI</td>
<td>LIGHT 21 SUJ-211L-02-1-P2-02</td>
<td>27W</td>
<td>270V</td>
<td>BY EE</td>
<td>NA</td>
<td>X</td>
<td>+ STRUCTURA TO INCLUDE COURTESY POWER RECEPACTACLE ON EACH POLE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lamp</td>
<td>NERI</td>
<td>3000K, 70+ CRI LED</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Power Supply</td>
<td>NERI</td>
<td>0-10V DIM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pole</td>
<td>STRUCTURA</td>
<td>ALBA-14-52-S2-CT-A1-MOD TO INCLUDE POWER RECEPACTACLE</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
DESCRIPTION:
Circular light fixture in cast and sheet aluminium for suspended mounting. The lower frame is tilting for access to auxiliary and optic compartment. Electrical components are mounted on easily removable plate. Optic system with refractive lens in polycarbonate (UV resistant) with also function of screen. Light source with LED module (power led’s), combined to a internal large heat sink in aluminium for optimal control of temperature and self regulating power rated for a operative life of over 80,000 hours (15 years). The Light 21, require low-maintenance due to Leds sources and IP66, and is ideally for illuminating urban streets, cycle paths or pedestrian walkways. The suggested height of installation from 11.5’ to 16.5’.

LIGHT 21
LED Source - Comfort range - Contemporary
Voltage = 120-277V, 50/60 Hz

EPA = 0.484 ft²
Weight = 17.63 lb
Height (A) = 11’ - 1/8”
Diameter (Ø) = 1’ - 9 3/4”

- No maintenance is required, except a periodic cleaning of the screen from dust.
- Painting: colour of RAL range.
- Shock resistance of screen:IK10
- Chromatic Rendering Index: CRI>70.
- Lumen output: from 2,500 to 4,500 lm
- Light source: power leds.
- Protection rating: IP66 (Optic).
- Protection rating: IP43
- Operating temp.: -22°F°+104°F° (-30°C +40°C).
- Estimated life: 80,000 hours (L85 - Ta 25°C).
- Estimate life :B10 at 80,000 hours.
- Heat sink in aluminium extruded for an optimal control of temperature with electronic sensor on LED plate for the control of over tempatures.
- Electronic ballast with self-diagnostic functions and monitoring of over temperatures.
- Lumen output: from 2,500 to 4,500 lm
- Colour temperature: 3,000K or 4,000K
- Chromatic Rendering Index: CRI>70.
- Estimated life: 80,000 hours (L85 - Ta 25°C).

TECHNICAL DATA:
Construction:
- Upper frame shaped and a visor in aluminium sheet.
- Lower frame ring in aluminium for the support of the Led module and screen.
- Suitable for wet location (IP 66).
Materials:
- Die-cast aluminium (ASTM B179-82)
- Sheet aluminium
- Hot galvanized steel
- Screen in acrylic frosted (shock resistance IK06).
- Brass and stainless steel screws.
Finish:
- Standard colour is dark grey NERI type.
- Information about paint steps used on this product in specific technical sheet.
Fastening:
- Suspended installation with threaded tube (Ω 3/4” - UNI 338;ISO 228/1).
Operation and maintenance:
- Follow the instructions for operation and maintenance.
- No maintenance is required, except a periodic cleaning of the screen from dust.
On demand features:
- Painting: colour of RAL range.
- Information about paint steps used on this product in specific technical sheet.

SPECIFICATIONS:
Mounting Series Optic system CCT Lumen output Driver function
SU = Suspended 213L = Series with flat screen 02 = type III Very Short
09 = type V Short
1 = 3,000K
3 = 4,000K
P2 = 2,500 lm
P4 = 3,500 lm
P6 = 4,500 lm
02 = 1-10V + NCL
06 = DALI + NCL
14 = 6 hours aut. flux red. + NCL
71 = Manual dimming

CONFIGURATION TABLES:

3,000 K - Colour temperature

<table>
<thead>
<tr>
<th>Code</th>
<th>lm output</th>
<th>Watt</th>
<th>lm/W</th>
</tr>
</thead>
<tbody>
<tr>
<td>1P2</td>
<td>2,500</td>
<td>27</td>
<td>93</td>
</tr>
<tr>
<td>1P4</td>
<td>3,500</td>
<td>39</td>
<td>90</td>
</tr>
<tr>
<td>1P6</td>
<td>4,500</td>
<td>53</td>
<td>85</td>
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4,000 K - Colour temperature

<table>
<thead>
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<th>Code</th>
<th>lm output</th>
<th>Watt</th>
<th>lm/W</th>
</tr>
</thead>
<tbody>
<tr>
<td>3P2</td>
<td>2,500</td>
<td>26</td>
<td>96</td>
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<tr>
<td>3P4</td>
<td>3,500</td>
<td>36</td>
<td>97</td>
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<tr>
<td>3P6</td>
<td>4,500</td>
<td>48</td>
<td>94</td>
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</table>

Configuration of driver functions

<table>
<thead>
<tr>
<th>Code</th>
<th>Driver function</th>
</tr>
</thead>
<tbody>
<tr>
<td>02</td>
<td>1-10V control + constant flux control (1-10V + NCL)</td>
</tr>
<tr>
<td>06</td>
<td>DALI control + constant flux control (DALI + NCL)</td>
</tr>
<tr>
<td>14</td>
<td>6 hours aut. flux reduction -30% + constant flux control (6H NVL + NCL)</td>
</tr>
<tr>
<td>71</td>
<td>Optional: Internal manual dimming control allowing up to 50% light reduction. Setup by qualified operator and with powerline disconnected,</td>
</tr>
</tbody>
</table>

Note:
- NCL: constant flux control is standard with all driver functions.
LIGHT 21
LED Source - Comfort range
Contemporary

PHOTOMETRIC VALUE
LM-79 test and reports are performed in accordance with IESNA standards.

Luminaire Classification System (LCS)

<table>
<thead>
<tr>
<th>LCS Zone</th>
<th>Angles</th>
<th>% Lamp</th>
<th>% Lum</th>
</tr>
</thead>
<tbody>
<tr>
<td>FL</td>
<td>0° - 30°</td>
<td>7.6%</td>
<td>11.9%</td>
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<tr>
<td>FM</td>
<td>30° - 60°</td>
<td>40.6%</td>
<td>41.6%</td>
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<tr>
<td>FH</td>
<td>60° - 80°</td>
<td>15.6%</td>
<td>15.9%</td>
</tr>
<tr>
<td>FYH</td>
<td>80° - 100°</td>
<td>8.6%</td>
<td>8.4%</td>
</tr>
<tr>
<td>BL</td>
<td>0° - 30°</td>
<td>5.9%</td>
<td>6.7%</td>
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<tr>
<td>BM</td>
<td>30° - 60°</td>
<td>7.8%</td>
<td>8.4%</td>
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<tr>
<td>BH</td>
<td>60° - 80°</td>
<td>5.9%</td>
<td>6.2%</td>
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<tr>
<td>BVH</td>
<td>80° - 90°</td>
<td>1.4%</td>
<td>1.5%</td>
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<tr>
<td>UL</td>
<td>90° - 100°</td>
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<td>UH</td>
<td>100° - 180°</td>
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<td>1.5%</td>
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<tr>
<td>Totals</td>
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<td>97.7%</td>
<td>100%</td>
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<td>P2 - BUG: B1 U0 G1</td>
<td></td>
<td></td>
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<tr>
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<tr>
<td>P6 - BUG: B1 U0 G1</td>
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Luminaire Classification System (LCS)

<table>
<thead>
<tr>
<th>LCS Zone</th>
<th>Angles</th>
<th>% Lamp</th>
<th>% Lum</th>
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<tbody>
<tr>
<td>FL</td>
<td>0° - 30°</td>
<td>11.9%</td>
<td>12.5%</td>
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<tr>
<td>FM</td>
<td>30° - 60°</td>
<td>29.7%</td>
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<tr>
<td>FH</td>
<td>60° - 80°</td>
<td>5.9%</td>
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<td>FYM</td>
<td>80° - 90°</td>
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<td>BL</td>
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<td>BM</td>
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<td>BH</td>
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<td>BVH</td>
<td>80° - 90°</td>
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<td>0.1%</td>
</tr>
<tr>
<td>UL</td>
<td>90° - 100°</td>
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<td>100%</td>
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<td>P6 - BUG: B2 U0 G0</td>
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Fredericksburg Riverfront Park

Type KX1

CM KLING + ASSOCIATES INC

NERI

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Company shall reserve the right at any time and from time to time to modify the specifications or features or to discontinue the sale of any products.

NERI North America Inc. • 1835 NW 112th Ave, Suite 176 • Miami, FL 33172 • T 786.315.4367 • F 786.257.1336

DESCRIPTION:
Circular shaped light fixture for suspended installation on bracket, with body in die cast and sheet aluminium. Tilting lower frame for acces to auxiliary and optic compartment. Electrical components on removable plate. Optic system asymmetric with refractive lens in polycarbonate extraclear (UV resistant), with drop shaped screen in frosted acrylic to low glare. Light source with LED module (power led's), combined to a internal large heat sink in aluminium for optimal control of temperature and self regulating power rated for a operative life of over 80,000 hours (15 years). The Light 21, require low-maintenance due to Leds sources and IP66, and is ideally for illuminating urban streets, cycle paths or pedestrian walkways. The suggested height of installation from 11.5' to 16.5'.

LIGHT 21
LED Source - Comfort range - Heritage
Voltage = 120-277V, 50/60 Hz
EPA = 0.575 ft²
Weight = 20.0 lb (9.0 Kg)
Height = 1' - 4 1/2"
Diameter = 1' - 9 3/4"

Compliance:
UL Standard 1598 CSA C22.2 no.250.0-8
MODEL:
code sample: SU211L021P202

SPECIFICATIONS:
Construction:
- Upper frame shaped and a visor in aluminium sheet.
- Lower frame ring in aluminium for the support of the Led module and screen.
- Suitable for wet location (IP 66).

Materials:
- Die-cast aluminium (ASTM B179-82)
- Sheet aluminium
- Hot galvanized steel
- Screen in acrylic frosted (shock resistance IK06).
- Brass and stainless steel screws.

Finish:
- Standard colour is dark grey NERI type.
- Information about paint steps used on this product in specific technical sheet.

Fastening:
- Suspended installation with threaded tube (G 3/4" - UNI 338;ISO 228/1).

Operation and maintenance:
- Follow the instructions for operation and maintenance.
- No maintenance is required, except a periodic cleaning of the screen from dust.

TECHNICAL DATA:
Electrical:
- Voltage:120-277V (universal)
- Rated power: from 26W to 53W
- Frequency: 50/60Hz.
- Potectionrating: IP43
- Operating temp.: -22F°+104F°(-30°C +40°C).
- Electronic ballast with self-diagnostic functions and monitoring of over temperatures.
- Estimate life: 810 at 80,000 hours.
- Chromatic Rendering Index: CRI>70.
- Colour temperature: 3.000K or 4.000K
- Lumen output: from 2.500 to 4.500 lm
- Light source: power leds.
- Protection rating(IP66 (Optic).
- Heat sink in aluminium extruded for an optimal control of temperature with electronic sensor on LED plate for the control of over temperatures.
- Refractive lens in PC ( UV resistant ).
- IES classification: cat off.
- Shock resistance of screen:IK10

On demand features:
- Painting/colour of RAL range.
- Information about paint steps used on this product in specific technical sheet.

CONFIGURATION TABLES:
Configuration tables of luminous fluxes:
The efficacy (lm/W) on table refers to the complete system.

<table>
<thead>
<tr>
<th>Code</th>
<th>lm output</th>
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<td>1P4</td>
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<tr>
<td>3P6</td>
<td>4,500</td>
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Configuration of driver functions:

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<th>Code</th>
<th>Driver function</th>
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<tbody>
<tr>
<td>02</td>
<td>1-10V control + constant flux control (1-10V + NCL)</td>
</tr>
<tr>
<td>06</td>
<td>DALI control + constant flux control (DALI + NCL)</td>
</tr>
<tr>
<td>14</td>
<td>6 hours aut. flux reduction -30% + constant flux control (6H NVL + NCL)</td>
</tr>
<tr>
<td>71</td>
<td>Internal manual dimming control allowing up to 50% light reduction. Setup by qualified operator and with powerline disconnected.</td>
</tr>
</tbody>
</table>

Note:
- NCL: constant flux control is standard with all driver functions.
LIGHT 21
LED Source - Comfort range
Contemporary

PHOTOMETRIC VALUE
LM-79 test and reports are performed in accordance with IESNA standards.

OPTIC NLG 02 - Type III Short
Full Cutoff

OPTIC NLG 06 - Type V Short
Full Cutoff

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Alba 10’ – 16’ Double Wood Upright Pole

**FIXTURE MOUNTING:** Fixtures mount either by 2 3/8”, 2 7/8”, 3 1/2”, or 4” diameter by 4” tall tenon or casted arm for pendant lighting fixtures. Consult factory for other tenon sizes. Luminaires shall be provided by others.

**ELECTRICAL:** A 5/16” -18 grounding point is provided on the steel pole base. Wireway access is provided through a NEC compliant handhole with a flush, gasketed cover plate.

**FINISHES AND MATERIALS:** Woods are finished with a low VOC waterborne matte exterior finish containing UV and mildew inhibitors. All steel parts are polyester powder coat painted.

**HARDWARE:** Fasteners are stainless steel. Anchor bolt kits are hot dip galvanized.
**ORDERING GUIDE:** EXAMPLE: ALBA-12-S3-C5-T3004-STD

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<td>ALBA</td>
<td>Series</td>
<td>Wood Finish</td>
<td>Metal Finish</td>
<td>Fixture Mounting</td>
<td>Special</td>
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<td>10</td>
<td>12</td>
<td>14</td>
<td>16</td>
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<td>12'</td>
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<td>T3124</td>
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Designed by Aubrilam

Product specification sheets subject to change.
metal finishes

C1 - Bone White
C2 - Light Silver
C3 - Light Grey
C4 - Speckled Silver
C5 - Slate
C6 - Bronze
C7 - Jet Black

All colors are polyester powder coat paint. Custom color or RAL color available by request that meet AAMA 2604 standard.
wood finishes

All colors are shown on Accoya® wood. Finishes are a four step application of stain and clear matte top coat. UV inhibitors and mildewcides are included providing superior longevity.

made with:

Accoya® and the Trimarque Device are registered trademarks owned by Titan Wood Limited, a wholly owned subsidiary of Accsys Technologies PLC, and may not be used or reproduced without written permission.
**FIXTURE TYPE:** Alba 10’ – 16’ Double Wood Upright Pole

**PROJECT NAME:**

**SPECIFICATIONS:**

**HOUSING:** Solid wood pole is assembled through glulam construction and precision machined using CNC technology. An electrical raceway is provided inside the upright for wiring. Laminations measure no more than 2” in thickness. Adhesive complies with ASTM D-2559 glulam construction specifications for extreme exposed weather conditions, is waterproof and rated for wet or dry use exposure.

Glulam wood shaft is fastened to steel pole base welded to a 1/2” thick aluminum anchor bolt base. Anchor bolt kit includes (4) 3/4” hot dip galvanized anchor bolts and fasteners and ridged concrete pour template.

**FIXTURE MOUNTING:** Fixtures mount either by 2 3/8”, 2 7/8”, 3 1/2”, or 4” diameter by 4” tall tenon or casted arm for pendant lighting fixtures. Consult factory for other tenon sizes. Luminaires shall be provided by others.

**ELECTRICAL:** A 5/16” – 18 grounding point is provided on the steel pole base. Wireway access is provided through a NEC compliant handhole with a flush, gasketed cover plate.

**FINISHES AND MATERIALS:** Woods are finished with a low VOC waterborne matte exterior finish containing UV and mildew inhibitors. All steel parts are polyester powder coat painted.

**HARDWARE:** Fasteners are stainless steel. Anchor bolt kits are hot dip galvanized.

Glulam solid wood and steel pole available in 10’ – 16’ lengths. Tenon adapters and arm bracket mounts are available for luminaire mounting.

**FEATURES:**

- Steel pole base with flush handhole cover held with countersunk stainless steel fasteners with steel upright ties.
- Straight, solid glulam wood pole
**ORDERING GUIDE:**

**EXAMPLE:** ALBA-12-S3-C5-T3004-STD

<table>
<thead>
<tr>
<th>1</th>
<th>Series</th>
<th>3</th>
<th>Wood Finish</th>
<th>5</th>
<th>Fixture Mounting</th>
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<tr>
<td>ALBA</td>
<td>Alba</td>
<td>S*</td>
<td>See color options on finishes technical sheet</td>
<td>Tenon</td>
<td>2 3/8” x 4” Tenon</td>
</tr>
<tr>
<td>2</td>
<td>Height</td>
<td>4</td>
<td>Metal Finish</td>
<td>T2384</td>
<td>2 7/8” x 4” Tenon</td>
</tr>
<tr>
<td>10</td>
<td>16’</td>
<td>C*</td>
<td>See color options on finishes technical sheet</td>
<td>T2784</td>
<td>3 1/2” x 4” Tenon</td>
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<tr>
<td>12</td>
<td>14’</td>
<td>CSM</td>
<td>Custom Color</td>
<td>T3124</td>
<td>4” x 4” Tenon</td>
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<tr>
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<td>16’</td>
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<td>Specify Tenon</td>
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<tr>
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<td>16’</td>
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<table>
<thead>
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<th>6</th>
<th>Arm Mount</th>
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<tbody>
<tr>
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<tr>
<td>MOD</td>
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</table>

Designed by Aubrilam

Product specification sheets subject to change.
metal finishes

C1 - Bone White
C2 - Light Silver
C3 - Light Grey
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C5 - Slate
C6 - Bronze
C7 - Jet Black

All colors are polyester powder coat paint. Custom color or RAL color available by request that meet AAMA 2604 standard.
wood finishes

All colors are shown on Accoya® wood. Finishes are a four step application of stain and clear matte top coat. UV inhibitors and mildewcides are included providing superior longevity.

S1 - Garapa
S2 - Teak
S3 - Cumaru
S4 - Ipe
S5 - Jarrah
S6 - Mahogany
S7 - Ebony
S8 - Weathered Grey

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SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Requirements:
   1. Section 329300 “Exterior Plants” for Disposition of Existing Trees indicated on L-300 of the drawings.

1.2 SUMMARY

A. Section Includes:
   1. Protecting existing vegetation to remain.
   2. Removing existing vegetation.
   3. Clearing and grubbing.
   4. Stripping and stockpiling topsoil.
   5. Stripping and stockpiling rock.
   6. Removing above- and below-grade site improvements.
   7. Disconnecting, capping or sealing, and removing site utilities.
   8. Temporary erosion and sedimentation control.

1.3 DEFINITIONS

A. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.

B. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects larger than 2 inches in diameter; and free of weeds, roots, toxic materials, or other nonsoil materials.

C. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and indicated on Drawings.

D. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
1.5 MATERIAL OWNERSHIP

A. Except for materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.6 INFORMATIONAL SUBMITTALS

A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.

1. Use sufficiently detailed photographs or video recordings.
2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plant designated to remain.

B. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.7 FIELD CONDITIONS

A. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

B. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
1. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

C. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.

D. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

E. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.

F. Tree- and Plant-Protection Zones: Protect according to the Drawings

G. Soil Stripping, Handling, and Stockpiling: Perform only when the soil is dry or slightly moist.
PART 2 - PRODUCTS

2.1 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "Earth Moving."
   1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

A. Review Project Record Documents of existing condition provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

B. Protect and maintain benchmarks and survey control points from disturbance during construction.

C. Verify that trees, shrubs, and other vegetation to remain or to be relocated have been flagged and that protection zones have been identified and enclosed.

D. Protect existing site improvements to remain from damage during construction.
   1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. As required to obtain a Construction General Permit, a SWPPP has been prepared for this project. The SWPPP is incorporated in the Project Manual and is intended to control waterborne pollutant discharges in stormwater by some combination of interception, filtration and containment. The SWPPP requires that all land disturbing activities and associated pollution prevention measures be documented, inspected and maintained throughout the construction phase of the project until final stabilization is achieved, and a Notice of Termination has been sent to VDEQ.

B. An Erosion and Sediment Control (E&S) Control plan has been developed for this project. The approved E&S Control plans are incorporated into the SWPPP and shall be followed as part of the procedure for complying with the SWPPP.

C. This SWPPP is provided as a courtesy to the contractor. Any updates to this SWPPP required by the Virginia Department of Environmental Quality or the City of Virginia Beach shall be made by the Contractor.
D. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.

E. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

F. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

G. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

H. The Contractor is responsible for adhering to the requirements of this SWPPP and any subsequent updates throughout construction.

3.3 TREE AND PLANT PROTECTION

A. Protect trees and plants remaining on-site.

B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations.

3.4 EXISTING UTILITIES

A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed.
   1. Arrange with utility companies to shut off indicated utilities.

B. Locate, identify, and disconnect utilities indicated to be abandoned in place.

C. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others, unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
   1. Notify Owner not less than two days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without Owner's written permission.

D. Excavate for and remove underground utilities indicated to be removed.

3.5 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
   1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
2. Grind down stumps and remove roots larger than 2 inches in diameter, obstructions, and debris to a depth of 18 inches below exposed subgrade.
3. Use only hand methods or air spade for grubbing within protection zones.
4. Chip removed tree branches and dispose of off-site.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Stockpile topsoil away from edge of excavations without intermixing with subsoil or other materials. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.

1. Limit height of topsoil stockpiles to 144 inches.
2. Do not stockpile topsoil within protection zones.
3. Dispose of surplus topsoil. Surplus topsoil that does not meet the soil specifications or that which exceeds quantity indicated to be stockpiled or reused.

3.7 STOCKPILING ROCK

A. Remove from area indicated on Drawings rip rap that measure more than 6 inches across in least two dimensions. Do not include excavated or crushed rock.

1. Separate or wash off non-rock materials from rocks, including soil, clay lumps, gravel, and other objects larger than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.

B. Stockpile rock away from edge of excavations without intermixing with other materials. Cover to prevent windblown debris from accumulating among rocks.

1. Limit height of rock stockpiles to 36 inches.
2. Do not stockpile rock within protection zones.
3. Dispose of surplus rock. Surplus rock is that which exceeds quantity indicated to be stockpiled or reused.

3.8 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.9 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.
   1. Do not allow demolished materials to accumulate on-site.
   2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials, and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION 311000
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Excavating and filling for rough grading the Site.
   2. Preparing subgrades for walks, pavements, turf, grasses and plants.
   3. Excavating and backfilling for buildings and structures.
   4. Subbase course for concrete walks and pavements.
   5. Subbase course and base course for asphalt paving.
   6. Excavating and backfilling trenches for utilities and pits for buried utility structures.

B. Related Requirements:
   1. Section 033000 "Cast-in-Place Concrete" for granular course if placed over vapor retarder and beneath the slab-on-grade.
   2. Section 311000 "Site Clearing" for site stripping, grubbing, stripping topsoil, and removal of above- and below-grade improvements and utilities.
   3. Section 329200 "Turf and Grasses" for finish grading in turf and grass areas, including preparing and placing planting soil for turf areas.
   4. Section 329300 "Plants" for finish grading in planting areas and tree and shrub pit excavation and planting.

1.3 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
   1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
   2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
E. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
2. Bulk Excavation: Excavation more than 10 feet in width and more than 30 feet in length.
3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

F. Fill: Soil materials used to raise existing grades.

G. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

H. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

I. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

J. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following manufactured products required:
   1. Geotextiles.
   2. Warning tapes.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:
   1. Classification according to ASTM D 2487.
   2. Laboratory compaction curve according to ASTM D 698.

C. Preexcavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth-moving operations. Submit before earth moving begins.
1.6 QUALITY ASSURANCE

A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

1.7 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Improvements on Adjoining Property: Do not proceed with work on adjoining property unless written direction is obtained from Owner.

C. Utility Locator Service: Notify "Miss Utility" for area where Project is located before beginning earth-moving operations.

D. Do not commence earth-moving operations until temporary site fencing and erosion- and sedimentation-control measures specified in Section 311000 "Site Clearing" are in place.

E. Do not commence earth-moving operations until plant-protection measures specified in Section 015639 "Temporary Tree and Plant Protection" are in place.

F. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impounding of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

G. Do not direct vehicle or equipment exhaust towards protection zones.

H. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
B. Satisfactory Soils: Soil Classification CL, ML, SC, SM, SP, SW, GC, GM, GP or GW according to ASTM D 2487 or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: Soils that do not meet the definition for Satisfactory Soils.
   1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; meeting VDOT 21A or 21B gradation requirements.

E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 294/D 2940M; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.

F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.

H. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and zero to 5 percent passing a No. 8 sieve.

I. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and zero to 5 percent passing a No. 4 sieve.

J. Sand: ASTM C 33/C 33M; fine aggregate.

K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 GEOTEXTILES

A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
   1. Survivability: Class 2; AASHTO M 288.
   2. Survivability: As follows:
      a. Grab Tensile Strength: 157 lbf; ASTM D 4632.
      b. Sewn Seam Strength: 142 lbf; ASTM D 4632.
      c. Tear Strength: 56 lbf; ASTM D 4533.
d. Puncture Strength: 56 lbf; ASTM D 4833.

3. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
4. Permittivity: 0.2 per second, minimum; ASTM D 4491.
5. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2; AASHTO M 288.
2. Survivability: As follows:
   a. Grab Tensile Strength: 247 lbf; ASTM D 4632.
   b. Sewn Seam Strength: 222 lbf; ASTM D 4632.
   c. Tear Strength: 90 lbf; ASTM D 4533.
   d. Puncture Strength: 90 lbf; ASTM D 4833.

3. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
4. Permittivity: 0.02 per second, minimum; ASTM D 4491.
5. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

2.3 ACCESSORIES

A. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:

2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth-moving operations.

B. Protect planting areas from over compaction.

C. Protect and maintain erosion and sedimentation controls during earth-moving operations.
D. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
   1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

C. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others.

3.3 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
   1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.4 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
   1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
   2. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.

B. Excavations at Edges of Tree- and Plant-Protection Zones:
   1. Excavate by hand or with an air spade to indicated lines, cross sections, elevations, and subgrades. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.5 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.6 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.

   1. Clearance: 12 inches each side of pipe or conduit.

B. Trench Bottoms: Excavate trenches 6 inches deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.

C. Trenches in Tree- and Plant-Protection Zones:

   1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
   2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.
   3. Cut and protect roots.

3.7 SUBGRADE INSPECTION

A. Notify Architect when excavations have reached required subgrade.

B. If Architect determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

   1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
   2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.8 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Architect.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

3.9 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.10 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for Record Documents.
3. Testing and inspecting underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring, bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.11 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Section 033000 "Cast-in-Place Concrete."
D. Backfill voids with satisfactory soil while removing shoring and bracing.

E. Initial Backfill:
   1. Soil Backfill: Place and compact initial backfill of subbase material, free of particles larger than 1 inch in any dimension, to a height of 6 inches over the pipe or conduit.
      a. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

F. Final Backfill:
   1. Soil Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.

G. Warning Tape: Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.12 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:
   1. Under grass and planted areas, engineered soil material.
   2. Under walks and pavements, use satisfactory soil material.
   3. Under steps and ramps, use engineered fill.
   4. Under building slabs, use engineered fill.
   5. Under footings and foundations, use engineered fill.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.13 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
   1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
   2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified density.
3.14 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 6 inches in loose depth for material compacted by heavy compaction equipment and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:

1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.
2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 92 percent.
3. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 85 percent.
4. For utility trenches, compact each layer of initial and final backfill soil material at 95 percent.

3.15 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:

1. Turf or Unpaved Areas: Plus or minus 1 inch.
2. Walks: Plus or minus 1 inch.
3. Pavements: Plus or minus 1/2 inch.

3.16 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:

1. Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
2. Place base course material over subbase course under hot-mix asphalt pavement.
3. Shape subbase course and base course to required crown elevations and cross-slope grades.
4. Place subbase course and base course 6 inches or less in compacted thickness in a single layer.
5. Place subbase course and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
6. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.17 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

C. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.18 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

   1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

   1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.19 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.
END OF SECTION 312000
SECTION 321216 - ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Cold milling of existing asphalt pavement.
   2. Hot-mix asphalt patching.
   3. Hot-mix asphalt paving.
   4. Hot-mix asphalt overlay.
   5. Asphalt surface treatments.

B. Related Requirements:
   1. Section 024119 "Selective Demolition" for demolition and removal of existing asphalt pavement.
   2. Section 312000 "Earth Moving" for subgrade preparation, fill material, separation geotextiles, unbound-aggregate subbase and base courses, and aggregate pavement shoulders.
   3. Section 321313 "Concrete Paving" for concrete pavement and for separate concrete curbs, gutters, and driveway aprons.
   4. Section 321373 "Concrete Paving Joint Sealants" for joint sealants and fillers at pavement terminations.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include technical data and tested physical and performance properties.
   2. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Material Certificates: For each paving material. Include statement that mixes containing recycled materials will perform equal to mixes produced from all new materials.
C. Material Test Reports: For each paving material, by a qualified testing agency.
D. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by the Virginia Department of Transportation (VDOT).
B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated.
C. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of the VDOT Road and Bridge Specifications for asphalt paving
   1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:
   1. Prime Coat: Minimum surface temperature of 60 deg F.
   2. Tack Coat: Minimum surface temperature of 60 deg F.
   4. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
   5. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. General: Use materials and gradations that have performed satisfactorily in previous installations.
   A. Coarse Aggregate: In accordance with VDOT Road and Bridge Specifications.
   B. Fine Aggregate: In accordance with VDOT Road and Bridge Specifications.
   C. Mineral Filler: In accordance with VDOT Road and Bridge Specifications.

2.2 ASPHALT MATERIALS

A. Asphalt Binder: In accordance with VDOT Road and Bridge Specifications.
B. Asphalt Cement: In accordance with VDOT Road and Bridge Specifications.

C. Emulsified Asphalt Prime Coat: In accordance with VDOT Road and Bridge Specifications.

D. Tack Coat: In accordance with VDOT Road and Bridge Specifications.

E. Water: Potable.

2.3 AUXILIARY MATERIALS

A. Herbicide: Commercial chemical for weed control, registered by the EPA, and not classified as "restricted use" for locations and conditions of application. Provide in granular, liquid, or wettable powder form.

B. Sand: ASTM D 1073 or AASHTO M 29, Grade No. 2 or No. 3.

C. Paving Geotextile: AASHTO M 288 paving fabric; nonwoven polypropylene; resistant to chemical attack, rot, and mildew; and specifically designed for paving applications.

D. Joint Sealant: ASTM D 6690, Type II or III, hot-applied, single-component, polymer-modified bituminous sealant.

2.4 MIXES

A. Hot-Mix Asphalt: Dense-graded, hot-laid, hot-mix asphalt plant mixes approved by VDOT.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to begin paving.

B. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protection: Provide protective materials, procedures, and worker training to prevent asphalt materials from spilling, coating, or building up on curbs, driveway aprons, manholes, and other surfaces adjacent to the Work.

B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.

2. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

3.3 COLD MILLING

A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.

1. Mill to a depth of 1-1/2 inches.
2. Mill to a uniform finished surface free of excessive gouges, grooves, and ridges.
3. Control rate of milling to prevent tearing of existing asphalt course.
4. Repair or replace curbs, driveway aprons, manholes, and other construction damaged during cold milling.
5. Excavate and trim unbound-aggregate base course, if encountered, and keep material separate from milled hot-mix asphalt.
6. Patch surface depressions deeper than 1 inch after milling, before wearing course is laid.
7. Keep milled pavement surface free of loose material and dust.
8. Do not allow milled materials to accumulate on-site.

3.4 PATCHING

A. Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

B. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseat concrete pieces firmly.

1. Undersealing: Pump hot undersealing asphalt under rocking slab until slab is stabilized or, if necessary, crack slab into pieces and roll to reseat pieces firmly.
2. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Recompact existing unbound-aggregate base course to form new subgrade.

C. Tack Coat: Before placing patch material, apply tack coat uniformly to vertical asphalt surfaces abutting the patch. Apply at a rate of 0.05 to 0.15 gal./sq. yd..

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

D. Placing Patch Material: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.
3.5 REPAIRS

A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch in existing pavements.
   1. Install leveling wedges in compacted lifts not exceeding 3 inches thick.

B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/4 inch.
   1. Clean cracks and joints in existing hot-mix asphalt pavement.
   2. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.
   3. Use hot-applied joint sealant to seal cracks and joints more than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.

3.6 SURFACE PREPARATION

A. Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.
   1. Mix herbicide with prime coat if formulated by manufacturer for that purpose.

C. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd..
   1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
   2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.7 PAVING GEOTEXTILE INSTALLATION

A. Apply tack coat uniformly to existing pavement surfaces at a rate of 0.20 to 0.30 gal./sq. yd..

B. Place paving geotextile promptly according to manufacturer's written instructions. Broom or roll geotextile smooth and free of wrinkles and folds. Overlap longitudinal joints 4 inches and transverse joints 6 inches.

C. Protect paving geotextile from traffic and other damage, and place hot-mix asphalt overlay the same day.
3.8 PLACING HOT-MIX ASPHALT

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Place hot-mix asphalt base course in number of lifts and thicknesses permitted by the VDOT Road and Bridge Specification.
2. Spread mix at a minimum temperature of 250 deg F.
3. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
4. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.

1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Overlap mix placement about 1 to 1-1/2 inches from strip to strip to ensure proper compaction of mix along longitudinal joints.
2. Complete a section of asphalt base course before placing asphalt surface course.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.9 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.
2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
3. Offset transverse joints, in successive courses, a minimum of 24 inches.
4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AIMS-22, for both "Ending a Lane" and "Resumption of Paving Operations."
5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.10 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.
1. Complete compaction before mix temperature cools to 185 deg F.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density: 96 percent of reference laboratory density according to ASTM D 6927, but not less than 94 percent or greater than 100 percent.
2. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041/D 2041M, but not less than 90 percent or greater than 96 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.11 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:

1. Base Course: Plus or minus 1/2 inch.
2. Surface Course: Plus 1/4 inch, no minus.

B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:

1. Base Course: 1/4 inch.
2. Surface Course: 1/8 inch.
3.12 SURFACE TREATMENTS

A. Fog Seals: Apply fog seal at a rate of 0.10 to 0.15 gal./sq. yd. to existing asphalt pavement and allow to cure. With fine sand, lightly dust areas receiving excess fog seal.

B. Slurry Seals: Apply slurry coat in a uniform thickness according to ASTM D 3910 and allow to cure.
   1. Roll slurry seal to remove ridges and provide a uniform, smooth surface.

3.13 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549/D 3549M.

C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

D. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979/D 979M.
   1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041/D 2041M, and compacted according to job-mix specifications.
   2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726/D 2726M.
      a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than three cores taken.
      b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726/D 2726M.

E. Replace and compact hot-mix asphalt where core tests were taken.

F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.14 WASTE HANDLING

A. General: Handle asphalt-paving waste according to state and local regulations.

END OF SECTION 321216
SECTION 321244 – ENGINEERED WOOD FIBER SURFACING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes providing all material, labor, tools and equipment for the installation of Engineered Wood Fiber Surfacing as shown in the Contract Documents and as specified in this section including subgrade preparation and installation by certified installers.

1.2 SYSTEM DESCRIPTION

A. Engineered Wood Fiber Surfacing: A recreational surface manufactured from 100 percent pre-consumer recovered wood. It is designed to reduce injuries on playgrounds and provide a stable resilient surface for trails. Tested according to ASTM methods to ensure compliance with ADA, ASTM, CPSC, and CSA standards for playground surfacing.

B. Geotextile Fabric: Placed both below and above aggregate drainage material to create a weed barrier and to prevent the aggregate from mixing with the subsurface and the engineered wood fiber.

1.3 RELATED SECTIONS

1. Section 033000 – Cast in Place Concrete.

1.4 SUBMITTALS

A. Comply with Section 013300 - Submittal Procedures.

B. Product Data: Submit manufacturer's product data, including installation instructions, ASTM F 1292 test results, ASTM F1951 Accessibility test results, ASTM F2075 test results, and IPEMA Certificates of Compliance where applicable.

C. Samples: Submit manufacturer's samples of each specified material.

D. Maintenance Instructions: Submit manufacturer's maintenance instructions for playground surfacing.

E. Warranty: Submit manufacturer's standard warranty.

F. References: Submit at least 3 customers that have been using the product for at least 3 years.

1.5 REFERENCES


C. ASTM D 3776 – Standard Test Methods for Mass Per Unit Area (Weight) of Fabric.


1.6 QUALITY ASSURANCE AND CONTROL

A. Manufacturer Qualifications:

1. Member of International Play Equipment Manufacturer’s Association (IPEMA).
2. Sales Representatives trained by National Playground Safety Institute (NPSI).

B. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by surfacing manufacturer as experienced and with sufficient trained staff to install manufacturer’s products according to specified requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer. Deliver engineered wood fiber playground surfacing to site in bulk.

B. Storage: Store materials in a clean, dry area in accordance with manufacturer's instructions. Store engineered wood fiber playground surfacing to prevent contamination.
C. Handling: Protect materials during handling and installation to prevent damage. Handle engineered wood fiber playground surfacing to prevent contamination.

1.8 WARRANTY

A. Warranty Covers Playground Surfacing for Following Periods:
   1. Engineered Wood Fiber Playground Surfacing: 15-20 years.

PART 2 - PRODUCTS

2.1 ENIGINEERED WOOD FIBER

A. Basis of Design Manufacturer or Approve Equal

B. Surfacing:
   1. Engineered Wood Fiber Playground Surfacing: WOODCARPET
   2. Composition: Engineered wood fiber. No chemical treatments or additives.
   3. Compliance: Meet or exceed CPSC guidelines for impact attenuation.
   4. Recycled Content: 100 percent pre-consumer recovered materials.
   8. Coefficient of Permeability, ASTM D 2434: Greater than 0.6 cm/s.
   10. Moisture Absorption: Maximum of 150 percent by weight.
   11. Moisture Content: 25 to 60 percent by weight.
   12. Density: 15 to 24 pounds per cubic foot.
   14. IPEMA Certification: 8 inch thickness.

C. Drainage Fabric:
   1. Composition: nonwoven geotextile filter fabric of staple fibers that is formed into a random network, needle punched and heat-set for dimensional stability.
   2. Recycled content: N/A.
   3. Size: 5 feet wide x 300 feet long. / 1.5 m wide x 91.4 m Long
   4. Weight, ASTM D5261 Min. 3.5 ounces per square yard
   5. Grab Tensile Strength: ASTM D4632 0.45 kN / 57 lbs
   6. Grab Tensile Elongation: 50%
   7. CBR Puncture: ASTM D6241 .064kN / 145 lbs
   8. UV Resistance: ASTM D4355 70% @500 hrs
   9. Trapezoidal Tear : ASTM D4533 0.13kN / 29 lbs
   10. Permittivity ASTM D4491 2.20 sec
   11. Water Flow Rate: " " 6112 lpm/m 150 gpm/ft
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive playground surfacing. Notify Architect if areas are not acceptable. Do not begin installation until unacceptable conditions have been corrected.

3.2 INSTALLATION

A. WOODCARPET Aggregate System 1.

1. Review project plans and verify that playground equipment use zones, clearances, and reach ranges will comply with ASTM F1487 sections 8, 9, and 10, and with CAN/CSA-Z614 sections 14 and 15.
2. Prepare sub-grade as specified in Section 312000. Ensure that site drainage is routed away from or around the playground area. Grade subsoil to a 2 percent grade toward the drainpipe.
3. Install playground equipment in accordance with manufacturer’s instructions at locations indicated on the drawings.
4. Geotextile Fabric:
5. Lap seams a minimum of 10 inches or a minimum of 5 inches if a double bead of exterior grade construction adhesive is applied to lap.
6. Place seams parallel to direction of slides and travel of swings.
7. Install drainage piping and aggregate drainage material as specified in Section 334600.
8. Install concrete curb around the play area edge.
10. Engineered Wood Fiber Playground Surfacing:
   a. Place wood fiber surfacing to a minimum depth of 8 inches after compaction for play equipment under 4 feet high and to a minimum depth of 12 inches after compaction for play equipment over 4 feet high.
   b. Place wood fiber surfacing in 4" lifts.
   c. Use mechanical equipment to uniformly compact and level material.

END OF SECTION 321244
SECTION 321313 - CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes Concrete Paving Including the Following:
   1. Driveways.
   2. Curbs and gutters.
   3. Walks.
   4. Wheel Stops.

B. Related Requirements:
   1. Section 033000 "Cast-in-Place Concrete" for general building applications of concrete.
   2. Section 321373 "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within concrete paving and in joints between concrete paving and asphalt paving or adjacent construction.
   3. Section 321723 "Pavement Markings."

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash, slag cement, and other pozzolans.

B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer of stamped detectable warnings and ready-mix concrete manufacturer.
B. Material Certificates: For the following, from manufacturer:

1. Cementitious materials.
2. Steel reinforcement and reinforcement accessories.
3. Fiber reinforcement.
4. Admixtures.
5. Curing compounds.
7. Bonding agent or epoxy adhesive.
8. Joint fillers.

C. Material Test Reports: For each of the following:

1. Aggregates: Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.

D. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA’s "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").

B. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockups of full-thickness sections of concrete paving to demonstrate typical joints; surface finish, texture, and color; curing; and standard of workmanship.
2. Build mockups of concrete paving in the location and of the size indicated or, if not indicated, build mockups where directed by Architect and not less than 96 inches by 96 inches.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified independent testing agency to perform preconstruction testing on concrete paving mixtures.
1.8 FIELD CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

B. Cold-Weather Concrete Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:

1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
2. Do not use frozen materials or materials containing ice or snow.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

C. Hot-Weather Concrete Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover steel reinforcement with water-soaked burlap, so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 unless otherwise indicated.

2.2 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.

1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less. Do not use notched and bent forms.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.
2.3 STEEL REINFORCEMENT


B. Epoxy-Coated Reinforcing Bars: ASTM A 775/A 775M or ASTM A 934/A 934M; with ASTM A 615/A 615M, Grade 60 deformed bars.

C. Epoxy-Coated-Steel Wire: ASTM A 884/A 884M, Class A; coated, [plain] [deformed].

D. Epoxy-Coated, Joint Dowel Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60 plain-steel bars.

E. Tie Bars: ASTM A 615/A 615M, Grade 60; deformed.

F. Hook Bolts: ASTM A 307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

G. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded-wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI’s "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:

1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

H. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.

2.4 CONCRETE MATERIALS

A. Cementitious Materials: In accordance with VDOT Road and Bridge Specifications.

B. Normal-Weight Aggregates: In accordance with VDOT Road and Bridge Specifications.

C. Exposed Aggregate: In accordance with VDOT Road and Bridge Specifications.

D. Air-Entraining Admixture: ASTM C 260/C 260M.

E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material and in accordance with VDOT Road and Bridge Specifications.

F. Water: Potable and complying with ASTM C 94/C 94M.
2.5 FIBER REINFORCEMENT

A. Synthetic Micro-Fiber: Monofilament polypropylene micro-fibers engineered and designed for use in concrete, complying with ASTM C 1116/C 1116M, Type III, 1 to 2-1/4 inches long.

2.6 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.
B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
C. Water: Potable.
D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.

2.7 RELATED MATERIALS

A. Joint Fillers: ASTM D 1751, asphalt-saturated cellulosic fiber in preformed strips.
B. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.
C. Epoxy-Bonding Adhesive: ASTM C 881/C 881M, two-component epoxy resin capable of humid curing and bonding to damp surfaces; of class suitable for application temperature, of grade complying with requirements, and of the following types:
   1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.8 TACTILE WARNING SURFACING, GENERAL

A. Accessibility Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for tactile warning surfaces.
   1. For tactile warning surfaces composed of multiple units, provide units that when installed provide consistent side-to-side and end-to-end dome spacing that complies with requirements.

2.9 DETECTABLE WARNING TILES

A. Cast-in-Place Detectable Warning Tiles: Accessible truncated-dome detectable warning tiles configured for setting flush in new concrete walkway surfaces, with slip-resistant surface treatment on domes and field of tile.
B. Surface-Applied Detectable Warning Tiles: Accessible truncated-dome detectable warning concrete tiles configured for surface application on existing concrete walkway surfaces, with slip-resistant surface treatment on domes, field of tile, and beveled outside edges.

2.10 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.

1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that comply with or exceed requirements.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash or Pozzolan: 25 percent.
2. Slag Cement: 40 percent.
3. Combined Fly Ash or Pozzolan, and Slag Cement: 40 percent, with fly ash or pozzolan not exceeding 25 percent.

C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement in accordance with VDOT Road and Bridge Specifications:

D. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

E. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

F. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate.

2.11 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M. Furnish batch certificates for each batch discharged and used in the Work.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For concrete batches of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For concrete batches larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

2.12 WHEEL STOPS

A. Concrete Wheel Stops: Precast, steel-reinforced, air-entrained concrete, 4000-psi minimum compressive strength, 6 inches high by 9 inches wide by 84 inches long. Provide chamfered corners, transverse drainage slots on underside, and a minimum of two factory-formed or drilled vertical holes through wheel stop for anchoring to substrate.

1. Surface Appearance: Free of pockets, sand streaks, honeycombs, and other obvious defects. Corners shall be uniform, straight, and sharp.
2. Surface Sealer: Manufacturer's standard salt-resistant, clear sealer, applied at precasting location.
3. Mounting Hardware: Galvanized-steel spike or dowel, 5/8-inch diameter, 24-inch minimum length.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.

1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph.
2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch according to requirements in Section 312000 "Earth Moving."

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.
3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT INSTALLATION

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded-wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

E. Zinc-Coated Reinforcement: Use galvanized-steel wire ties to fasten zinc-coated reinforcement. Repair cut and damaged zinc coatings with zinc repair material.

F. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M.

G. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

3.5 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
2. Provide tie bars at sides of paving strips where indicated.
3. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
4. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.

1. Locate expansion joints at intervals of 50 feet unless otherwise indicated.
2. Extend joint fillers full width and depth of joint.
3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows: to match jointing of existing adjacent concrete paving:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving-tool marks on concrete surfaces.
   a. Tolerance: Ensure that grooved joints are within 3 inches either way from centers of dowels.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
   a. Tolerance: Ensure that sawed joints are within 3 inches either way from centers of dowels.
3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.
3.6 CONCRETE PLACEMENT

A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.

B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.

F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
   1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement dowels and joint devices.

H. Screed paving surface with a straightedge and strike off.

I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleedwater appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

J. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.

K. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.
   1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

3.7 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true
planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. **Burlap Finish**: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
2. **Medium-to-Fine-Textured Broom Finish**: Draw a soft-bristle broom across float-finished concrete surface, perpendicular to line of traffic, to provide a uniform, fine-line texture.
3. **Medium-to-Coarse-Textured Broom Finish**: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.

### 3.8 DETECTABLE WARNING INSTALLATION

**A. Cast-in-Place Detectable Warning Tiles**: Form blockouts in concrete for installation of tiles. Screed surface of concrete where tiles are to be installed to elevation, so that edges of installed tiles will be flush with surrounding concrete paving. Embed tiles in fresh concrete immediately after screeding concrete surface.

**B. Stamped Detectable Warnings**: Install stamped detectable warnings as part of a continuous concrete paving placement and according to stamp-mat manufacturer's written instructions.

1. **Before using stamp mats**, verify that the vent holes are unobstructed.
2. **Apply liquid release agent** to the concrete surface and the stamp mat.
3. **Stamping**: While initially finished concrete is plastic, accurately align and place stamp mats in sequence. Uniformly load, gently vibrate, and press mats into concrete to produce imprint pattern on concrete surface. Load and tamp mats directly perpendicular to the stamp-mat surface to prevent distortion in shape of domes. Press and tamp until mortar begins to come through all of the vent holes. Gently remove stamp mats.
4. **Trimming**: After 24 hours, cut off the tips of mortar formed by the vent holes.
5. **Remove residual release agent** according to manufacturer's written instructions, but no fewer than three days after stamping concrete. High-pressure-wash surface and joint patterns, taking care not to damage stamped concrete. Control, collect, and legally dispose of runoff.

### 3.9 CONCRETE PROTECTION AND CURING

**A. General**: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

**B. Comply with ACI 306.1** for cold-weather protection.

**C. Evaporation Retarder**: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

**D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.**
E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
   a. Water.
   b. Continuous water-fog spray.
   c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period, using cover material and waterproof tape.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

3.10 WHEEL STOP INSTALLATION

A. Securely anchor wheel stops to pavement with hardware in each preformed vertical hole in wheel stop as recommended in writing by manufacturer. Recess head of hardware beneath top of wheel stop.

3.11 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 and as follows:

1. Elevation: 3/4 inch.
3. Surface: Gap below 10-feet-long; unleveled straightedge not to exceed 1/2 inch.
4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches of tie bar.
5. Lateral Alignment and Spacing of Dowels: 1 inch.
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches of dowel.
8. Joint Spacing: 3 inches.

3.12 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
B. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

C. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

D. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

E. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.

F. Concrete paving will be considered defective if it does not pass tests and inspections.

G. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

H. Prepare test and inspection reports.

3.13 REPAIR AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.

B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313
SECTION 321314 - CONCRETE PAVEMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Concrete Paving – Type 1 – Broom Finish
   2. Concrete Paving – Type 2 – Exposed Aggregate Finish

B. Related Sections:
   1. Division 03 Section "Cast-in-Place Concrete" for general building applications of concrete, site stairs and stage.
   2. Division 32 Section "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within concrete paving and in joints between concrete paving and asphalt paving or adjacent construction.

1.2 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Initial Selection: For each type of product, ingredient, or admixture requiring color selection.
   1. Exposed Aggregate 5-lb Sample of each mix.
   2. Integral Color: Samples of Scofield Color:
      a. Porcelain Gray - 3987
      b. Spring Beige – 5130
      c. Cool Grey – 1266

C. Other Action Submittals:
   1. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified installer of exposed aggregate surfacing, ready-mix concrete manufacturer and testing agency.

B. Material Certificates: For the following, from manufacturer:
   1. Cementitious materials.
   2. Steel reinforcement and reinforcement accessories.
   3. Admixtures.
4. Curing compounds.
5. Applied finish materials.

C. Material Test Reports: For each of the following:
   1. Aggregates: Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.

D. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
   1. Manufacturer certified according to NRMCA’s ”Certification of Ready Mixed Concrete Production Facilities” (Quality Control Manual - Section 3, ”Plant Certification Checklist”).

B. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
   1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

C. Concrete Testing Service: Engage a qualified testing agency to perform material evaluation tests and to design concrete mixtures.

D. ACI Publications: Comply with ACI 301 (ACI 301M) unless otherwise indicated.

E. Mockups: Build mockups of exposed aggregate and concrete paving to verify selections of color and retardant type made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Build mockups of full-thickness sections of concrete paving to demonstrate typical joints; surface finish, texture, and color; curing; and standard of workmanship.
   2. Build mockups of concrete paving in the location and of the size indicated or, if not indicated, build mockups where directed by Landscape Architect and not less than 96 inches (2400 mm) by 96 inches (2400 mm).
   3. Mockup should include four (4) combinations of Scofield retardant and color:
      a. Lithocast 15 with Spring Beige
      b. Lithocast 15 with Porcelain Gray
      c. Lithocast 50 with Spring Beige
      d. Lithocast 50 with Porcelain Gray
      e. Include topcoat of Repello FPS.
   4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Landscape Architect specifically approves such deviations in writing.

F. Preinstallation Conference: Conduct conference at Project site.
   1. Review methods and procedures related to concrete paving, including but not limited to, the following:
      a. Concrete mixture design.
      b. Quality control of concrete materials and concrete paving construction practices.
      c. Scheduling with respect to the installation of other site materials.
2. Require representatives of each entity directly concerned with concrete paving to attend, including the following:
   a. Contractor's superintendent.
   b. Independent testing agency responsible for concrete design mixtures.
   c. Concrete paving subcontractor.

1.6 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.1 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
   1. Use flexible or uniformly curved forms for curves with a radius of 100 feet (30.5 m) or less to maintain smooth, continuous curves.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.2 STEEL REINFORCEMENT


B. Epoxy-Coated, Joint Dowel Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel bars.

C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:
   1. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

D. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.

2.3 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source throughout Project:
   1. Portland Cement: ASTM C 150, white Portland cement Type II.

1. Maximum Coarse-Aggregate Size: 3/4 inch (19 mm) nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Exposed Aggregate: Selected, hard, and durable; washed; free of materials with deleterious reactivity to cement or that cause staining; from a single source, with gap-graded coarse aggregate as follows:
   1. Aggregate Sizes: 3/8” nominal.
   2. Aggregate Source, Shape, and Color:
   3. Aggregate Shape, and Color: Rounded, multicolored (Grey, Brown, Blue, Red) stone
   4. Stone type: Delaware River Jacks
   5. Aggregate Source: NJ Gravel & Sand Co:
      a. 1661 Hwy 34 South
         Wall, NJ 07719
         Phone: 732-410-7172
         Email: info@njgravelsand.com
      b. Or approved equal.

D. Water: Potable and complying with ASTM C 94/C 94M.


F. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
   1. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.

G. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, nonfading, and resistant to lime and other alkalis.
   1. Manufacturers: Subject to compliance with requirements,
      a. Scofield, L. M. Company
         Telephone: 800-800-9900
         Website: www.scofield.com
      b. Or approved equal.
   2. Type 1 Colors – based on mock-ups:
      a. Porcelain Gray 3987
      b. Spring Beige 5130
      c. Cool Grey 1266
   3. Type 2 Colors – based on mock-ups:
      a. Porcelain Gray 3987
      b. Spring Beige 5130

2.4 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) dry.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.
E. Retardant for Exposed Aggregate: Lithocast Surface Retarder
   1. Manufacturer: L.M. Scofield Company
      Telephone 800-800-9900
      Website: www.scofield.com
   2. To be selected at mockup stage between:
      a. Lithocast Surface Retarder 15
      b. Lithocast Surface Retarder 50

F. Curing Paper:
   1. Nonstaining, waterproof paper, consisting of two layers of kraft paper cemented together and reinforced with fibber and complying with ASTM C 171

2.5 PROTECTIVE LAYER

A. Manufacturers: Subject to compliance with requirements,
   1. Manufacturer: L.M. Scofield Company
   2. Telephone: 800-800-9900
   3. Website: www.scofield.com

B. Repello FPS: Breatheable non-film forming surface treatment
   1. Blend of inorganic fluorinated polysiloxane polymer
   2. Low odor water based
   3. Exterior and UV light stable
   4. Colorless
   5. Use and store according to manufacturer's directions.

2.6 RELATED MATERIALS

A. Joint Fillers: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork in preformed strips as designated on the drawings.

B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

C. Epoxy Bonding Adhesive: ASTM C 881/C 881M, two-component epoxy resin capable of humid curing and bonding to damp surfaces; of class suitable for application temperature, of grade complying with requirements, and of the following types:
   1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.7 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301 (ACI 301M), for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.
   1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.

B. Proportion mixtures to provide normal-weight concrete with the following properties:
2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.45.
3. Slump Limit: 4 inches (100 mm), plus or minus 1 inch (25 mm).

C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
   1. Air Content: 5 percent plus or minus 1.5 percent for 3/4-inch (19-mm) nominal maximum aggregate size.

D. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

E. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
   1. Use water-reducing and retarding admixtures when required by high temperatures, low humidity, or other adverse placement conditions and when they do not affect the effectiveness of the color, retardant or sealant

F. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.0 lb/cu. yd. (0.60 kg/cu. m).

G. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.8 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M. Furnish batch certificates for each batch discharged and used in the Work.

   1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.

   1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph (5 km/h).
   2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes).
   3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of \( \frac{1}{2} \) inch (13 mm) according to requirements in Division 31 Section "Earth Moving."

C. Proceed with installation only after inspection and approval by Landscape Architect and unsatisfactory conditions have been corrected.
3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

E. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M.

3.5 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.

2. Provide tie bars at sides of paving strips where indicated.

3. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
1. Locate expansion joints at intervals of 50 feet (15.25 m) unless otherwise indicated.
2. Extend joint fillers full width and depth of joint.
3. Terminate joint filler not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished surface if joint sealant is indicated.
4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Control Joints: Form weakened-plane control joints, sectioning concrete into areas as indicated on the drawings. Construct control joints for a depth equal to at least one-fourth of the concrete thickness, as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch (6-mm) radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving-tool marks on concrete surfaces.
   a. Tolerance: Ensure that grooved joints are within 3 inches (75 mm) either way from centers of dowels.
   b. Tolerance: Ensure that sawed joints are within 3 inches (75 mm) either way from centers of dowels.
2. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch (6-mm) radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.
B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.
C. Remove organic materials from the subbase surface and steel reinforcement before placing concrete.
D. Moisten subbase to provide a uniform dampened condition at time concrete is placed.
E. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
F. Comply with ACI 301 (ACI 301M) requirements for measuring, mixing, transporting, and placing concrete.
G. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.
H. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

I. Consolidate concrete according to ACI 301 (ACI 301M) by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
   1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement dowels and joint devices.

J. Screed paving surface with a straightedge and strike off.

K. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

L. Cold-Weather Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
   1. When air temperature has fallen to or is expected to fall below 40 deg F (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.
   2. Do not use frozen materials or materials containing ice or snow.
   3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

M. Hot-Weather Placement: Comply with ACI 301 (ACI 301M) and as follows when hot-weather conditions exist:
   1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
   2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
   3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.7 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
   1. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.
3.8 SPECIAL FINISHES

A. Paving Type 1 - Monolithic Exposed-Aggregate Finish: Expose coarse aggregate in paving surface as follows:
   1. Immediately after float finishing, spray-apply chemical surface retarder to paving according to manufacturer's written instructions.
   2. Finish, remove retarder and expose aggregate according to manufacturer’s written instructions.

3.9 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by moisture curing moisture-retaining-cover curing or a combination of these as follows:
   1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
      a. Water.
      b. Continuous water-fog spray.
      c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.
   2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm) and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period using cover material and waterproof tape.

3.10 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 and as follows:
   1. Must meet grades of adjoining surfaces smooth and level.
   2. Elevation: 3/4 inch (19 mm).
   3. Thickness: Plus 3/8 inch (10 mm), minus 1/4 inch (6 mm).
   4. Surface: Gap below 10-foot- (3-m-) long, unleveled straightedge not to exceed 1/2 inch (13 mm).
   5. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches (13 mm per 300 mm) of tie bar.
   6. Lateral Alignment and Spacing of Dowels: 1 inch (25 mm).
   7. Vertical Alignment of Dowels: 1/4 inch (6 mm).
   8. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches (6 mm per 300 mm) of dowel.
   9. Joint Spacing: 3 inches (75 mm) with approval from the Landscape Architect.
10. Contraction Joint Depth: Plus 1/4 inch (6 mm), no minus.
11. Joint Width: Plus 1/8 inch (3 mm), no minus.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
   1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. (76 cu. M) or fraction thereof of each concrete mixture placed each day.
      a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
   2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
   3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
   4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when it is 80 deg F (27 deg C) and above, and one test for each composite sample.
   5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
   6. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days and two specimens at 28 days.
      a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).

D. Test results shall be reported in writing to Landscape Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Landscape Architect but will not be used as sole basis for approval or rejection of concrete.

F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Landscape Architect.

G. Concrete paving will be considered defective if it does not pass tests and inspections.

H. Additional testing and inspecting, at Contractor’s expense, will be performed to determine compliance of replaced or additional work with specified requirements.
I. Prepare test and inspection reports.

3.12 REPAIRS AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Landscape Architect.

B. Drill test cores, where directed by Landscape Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with Portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321314
SECTION 321373 - CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY
   A. Section Includes:
      1. Cold-applied joint sealants.
      2. Hot-applied joint sealants.
      4. Primers.

1.2 ACTION SUBMITTALS
   A. Product Data: For each type of product.
   B. Paving-Joint-Sealant Schedule: Include the following information:
      1. Joint-sealant application, joint location, and designation.
      2. Joint-sealant manufacturer and product name.

1.3 INFORMATIONAL SUBMITTALS
   A. Qualification Data: For Installer.
   B. Product Certificates: For each type of joint sealant and accessory.

1.4 QUALITY ASSURANCE
   A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
   B. Product Testing: Test joint sealants using a qualified testing agency.

1.5 FIELD CONDITIONS
   A. Do not proceed with installation of joint sealants under the following conditions:
      1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
      2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

2.2 COLD-APPLIED JOINT SEALANTS

A. Single-Component, Nonsag, Silicone Joint Sealant: ASTM D5893/D5893M, Type NS.
B. Single-Component, Self-Leveling, Silicone Joint Sealant: ASTM D5893/D5893M, Type SL.
C. Multicomponent, Nonsag, Urethane, Elastomeric Joint Sealant: ASTM C920, Type M, Grade NS, Class 25, for Use T.
D. Single Component, Pourable, Urethane, Elastomeric Joint Sealant: ASTM C920, Type S, Grade P, Class 25, for Use T.
E. Multicomponent, Pourable, Urethane, Elastomeric Joint Sealant: ASTM C920, Type M, Grade P, Class 25, for Use T.

2.3 HOT-APPLIED JOINT SEALANTS

B. Hot-Applied, Single-Component Joint Sealant: ASTM D6690, Type I or Type II.
C. Hot-Applied, Single-Component Joint Sealant: ASTM D6690, Type I, II, or III.
D. Hot-Applied, Single-Component Joint Sealant: ASTM D6690, Type IV.

2.4 JOINT-SEALANT BACKER MATERIALS

A. Joint-Sealant Backer Materials: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by joint-sealant manufacturer, based on field experience and laboratory testing.
B. Round Backer Rods for Cold- and Hot-Applied Joint Sealants: ASTM D5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

C. Round Backer Rods for Cold-Applied Joint Sealants: ASTM D5249, Type 3, of diameter and density required to control joint-sealant depth and prevent bottom-side adhesion of sealant.

D. Backer Strips for Cold- and Hot-Applied Joint Sealants: ASTM D5249; Type 2; of thickness and width required to control joint-sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

2.5 PRIMERS

A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Before installing joint sealants, clean out joints immediately to comply with joint-sealant manufacturer's written instructions.

   1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION OF JOINT SEALANTS

A. Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.
B. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions.

C. Install joint-sealant backings to support joint sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of joint-sealant backings.
2. Do not stretch, twist, puncture, or tear joint-sealant backings.
3. Remove absorbent joint-sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install joint sealants immediately following backing installation, using proven techniques that comply with the following:

1. Place joint sealants so they fully contact joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants according to the following requirements to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint:

1. Remove excess joint sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.

F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.

3.4 CLEANING AND PROTECTION

A. Clean off excess joint sealant as the Work progresses, by methods and with cleaning materials approved in writing by joint-sealant manufacturers.

B. Protect joint sealants, during and after curing period, from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations in repaired areas are indistinguishable from the original work.

END OF SECTION 321373
SECTION 321400 - UNIT PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Brick pavers set sand cement setting beds.
   2. Granite pavers set in mortar setting beds.
   5. Detectable Warning Pavers.
   6. PVC edge restraints.

B. Related Sections:
   1. Division 09 Section "Stone Flooring" for dimension stone paving.

1.2 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Submit to latex-additive manufacturer, for testing as indicated below, samples of paving materials that will contact or affect mortar and grout that contain latex additives.
   1. Use manufacturer's standard test methods to determine whether mortar and grout materials will obtain optimum adhesion with, and will be nonstaining to, installed pavers and other materials constituting paver installation.

1.3 ACTION SUBMITTALS

A. Product Data: For materials other than water and aggregates.

B. Product Data: For the following:
   1. Pavers.
   2. New cobble to match existing
   3. Mortar and grout materials.
   4. Stone curbs
   5. Edge restraints.

C. Sieve Analyses: For aggregate setting-bed materials, according to ASTM C 136.

D. Samples for Initial Selection: For the following:
   1. Brick pavers.
   2. Detectable warning pavers
   3. Granite sample for stone steps, curbs and pavers.
   4. New Granite Cobble to match existing.
   5. Joint materials involving color selection.

E. Samples for Verification:
   1. Full-size units of each type of unit paver indicated. Assemble no fewer than five Samples of each type of unit on suitable backing and grout joints.
2. Joint materials.
3. Detectible warning pavers
4. Exposed edge restraints.
5. Stone curb.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of unit paver, joint material, and setting material from single source with resources to provide materials and products of consistent quality in appearance and physical properties.

B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

C. Preinstallation Conference: Conduct conference at Project site.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store pavers on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained, and contamination avoided.

D. Store liquids in tightly closed containers protected from freezing.

E. Store asphalt cement and other bituminous materials in tightly closed containers.

1.6 PROJECT CONDITIONS

A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.

PART 2 - PRODUCTS

2.1 BRICK PAVERS

A. Regional Materials: Provide brick pavers that have been manufactured within 500 miles (800 km) of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.
B. Brick Pavers: Provide brick without frogs or cores in surfaces exposed to view in the completed Work.
   1. Manufacturer:
      a. Watsontown Brick Company
         PO Box 68, Route 405
         Watsontown, PA 17777-0068
         www.watsontownbrick.com
         Phone: 1-800-538-2040 or 1-570-538-2555
   2. Thickness: 2-1/4 inches.
   3. Face Size: 4 x 8 inches (3 5/8 by 7 5/8 inches).
   5. Or approved equal.

C. Efflorescence: Brick shall be rated "not effloresced" when tested according to ASTM C 67.

2.2 CURB WALL

A. Granite curb wall: from granite complying with ASTM C 615.
   1. Products: Subject to compliance with requirements, provide the following supplied by:
      a. The North Carolina Granite Corp.
         PO Box 151
         Mount Airy, NC 27030
         1.800.227.6242
         sales@ncgranite.com
   2. “Virginia Mist” (product number 090)
   3. Finish: Thermal
   4. Thickness: 6 inches unless otherwise indicated.
   5. Length: 4’
   6. Face Size: As indicated.

2.3 DETECTABLE WARNING PAVERS

A. Square detectable warning pavers made from recycled content
   1. Products: Subject to compliance with requirements, provide the following supplied by:
      a. Hanover Architectural Products
         5000 Hanover Road
         Hanover, PA 17331
         Email: info@hanoverpavers.com
         Phone: 800-462-4242
   2. Prest Paver
      b. Finish: Tudor.
      c. Size: 24” x 24” x 2.5”.

2.4 STONE PAVERS

A. Granite Pavers: Rectangular pavers made from granite complying with ASTM C 615.
1. Products: Subject to compliance with requirements, provide the following, supplied by:
   a. The North Carolina Granite Corp.
      PO Box 151
      Mount Airy, NC 27030
      1.800.227.6242
      sales@ncgranite.com
      Or approved equal.
   2. “Virginia Mist” (product number 090)
   3. Finish: 35% split and 65% thermal
   4. Thickness: Two (2) inches unless otherwise indicated.
   5. Face Size: 6 by 18 inches

B. Granite Pavers: Irregular square cobble pavers made from granite complying with ASTM C 615.

   1. Products: Subject to compliance with requirements, provide the following, supplied by:
      a. The North Carolina Granite Corp.
         PO Box 151
         Mount Airy, NC 27030
         1.800.227.6242
         sales@ncgranite.com
         Or approved equal.
      2. “Virginia Mist” (product number 090).
      3. Finish: split
      4. Size: range to match existing historic cobble.

2.5 GRANITE CURB

A. Granite Curb: Rectangular block made from granite complying with ASTM C 615.

   1. Products: Subject to compliance with requirements, provide the following, supplied by:
      a. The North Carolina Granite Corp.
         PO Box 151
         Mount Airy, NC 27030
         1.800.227.6242
         sales@ncgranite.com
         Or approved equal.
      2. “Virginia Mist” (product number 090).
      5. Curb lengths: 4 foot.

2.6 EDGE RESTRAINTS

A. Plastic Edge Restraints on aggregate base:
   1. Manufacturer's standard triangular PVC extrusions designed to serve as edge restraints for unit pavers.
   2. Dimensions: 1-3/4 inches (45 mm) high by 3-1/2 inches (89 mm) wide.
   3. Type: rigid type for straight edges and flexible type for curved edges.
5. Stakes: 3/8-inch (9.5-mm) diameter by 12-inch- (300-mm-) long steel spikes.

2.7 ACCESSORIES


2.8 AGGREGATE SETTING-BED MATERIALS

A. Graded Aggregate for Subbase: Sound, crushed stone or gravel complying with requirements in Division 31 Section "Earth Moving" for subbase material.

B. Sand for Joints: Fine, sharp, washed, natural silica sand or crushed stone with 100 percent passing No. 16 (1.18-mm) sieve and no more than 10 percent passing No. 200 (0.075-mm) sieve.
   1. Provide sand of color needed to produce required joint color.

2.9 MORTAR SETTING-BED MATERIALS

A. Portland Cement: ASTM C 150, Type I or Type II.

B. Hydrated Lime: ASTM C 207, Type S.

C. Sand: ASTM C 144.

D. Water: Potable.

E. Reinforcing Wire Fabric: Galvanized, welded wire fabric, 6"x6"; 6 gauge in diameter; comply with ASTM A 185/A 185M and ASTM A 82/A 82M except for minimum wire size.

2.10 SAND CEMENT

A. Masonry Cement – AASHO M-150 Type II.

B. Sand – Fine aggregate for mortar shall meet the requirements of the AASHO Standard Specification for “Aggregate for Masonry Mortar” M-45 and shall be clean and free of salt.

2.11 GROUT

A. Sand-Portland Cement Grout: ANSI A108.10, composed of white or gray cement and white or colored aggregate as required to produce color indicated.
   1. Colored Mortar Pigments for Grout: Natural and synthetic iron and chromium oxides, compounded for use in mortar and grout mixes. Use only pigments that have proved, through testing and experience, to be satisfactory for use in Portland cement grout.

B. Epoxy sealant for joints for granite pavers at water feature

C. Grout Colors: As selected by Landscape Architect from manufacturer's full range.

D. Water: Water for mixing shall be potable, clean, and free from oil, acids, salts, and other deleterious matter.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas indicated to receive paving, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Where pavers are to be installed over waterproofing, examine waterproofing installation, with waterproofing Installer present, for protection from paving operations, including areas where waterproofing system is turned up or flashed against vertical surfaces.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove substances from concrete substrates that could impair mortar bond, including curing and sealing compounds, form oil, and laitance.

B. Sweep concrete substrates to remove dirt, dust, debris, and loose particles.

C. Proof-roll prepared subgrade according to requirements in Division 31 Section "Earth Moving" to identify soft pockets and areas of excess yielding. Proceed with unit paver installation only after deficient subgrades have been corrected and are ready to receive subbase and base course for unit pavers.

3.3 INSTALLATION, GENERAL

A. Do not use unit pavers with chips, cracks, voids, discolorations, or other defects that might be visible or cause staining in finished work.

B. Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.

C. Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.

D. Handle protective-coated brick pavers to prevent coated surfaces from contacting backs or edges of other units. If, despite these precautions, coating does contact bonding surfaces of brick, remove coating from bonding surfaces before setting brick.

E. Joint Pattern: As indicated.

F. Tolerances: Do not exceed 1/8 inch (3 mm) unit-to-unit offset from flush (lippage) nor 1/8 inch in 10 feet (3 mm in 3 m) from level, or indicated slope, for finished surface of paving.

G. Expansion and Control Joints: Provide cork joint filler at locations and of widths indicated.

H. Provide edge restraints as indicated. Install edge restraints before placing unit pavers.
   1. Install edge restraints to comply with manufacturer's written instructions. Install stakes at intervals required to hold edge restraints in place during and after unit paver installation.
2. Where pavers set in mortar bed are indicated as edge restraints for pavers set in aggregate setting bed, install pavers set in mortar and allow mortar to cure before placing aggregate setting bed and remainder of pavers. Cut off mortar bed at a steep angle so it will not interfere with aggregate setting bed.

3. Where pavers embedded in concrete are indicated as edge restraints for pavers set in aggregate setting bed, install pavers embedded in concrete and allow concrete to cure before placing aggregate setting bed and remainder of pavers. Hold top of concrete below aggregate setting bed.

4. Where pavers set in mortar bed are indicated for steps constructed adjacent to pavers set in aggregate setting bed, install steps and allow mortar to cure before placing aggregate setting bed and remainder of pavers. Cut off mortar bed at a steep angle so it will not interfere with aggregate setting bed.

3.4 AGGREGATE SETTING-BED APPLICATIONS

A. Compact soil subgrade uniformly to at least 95 percent of ASTM D 1557 laboratory density.

B. Proof-roll prepared subgrade to identify soft pockets and areas of excess yielding. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Landscape Architect and replace with compacted backfill or fill as directed.

C. For Brick Pavers
   1. Mixture: Sand-cement bedding course shall consist of sand and Portland Cement in the proportion of 1-part cement and 4 parts sand by weight, mixed dry until the mass is of uniform color. Mixing must be carried out at an approved batch mix plant. The contractor must furnish a batch ticket with each load, stating the correct batched weights of each material. Hand mixing will not be permitted unless approved by the City Engineer.
   2. The bedding course shall be placed and shaped upon the prepared soils base so that its furnished depth shall not be less than 4 inches.
   3. The bedding shall be shaped to a true surface, parallel with surface of finished brick walkway, by means of template, and the bed shall be struck off until proper alignment is secured. The contractor shall coordinate his work so that the area of bedding course placed and rolled in any workday shall be scheduled so that no bedding course remains at the end of the day without the brick course placed.
   4. The City may require the contractor to compact the bedding course in addition to shaping it with a template.
   5. After final shaping, the bedding shall not be disturbed prior to laying the brick.
   6. Preformed bituminous fiber expansion joint material shall be furnished in areas as shown on the plans and cost to be included in price for placement of brick in order to place joint sealer. Joint sealers are to be placed as per plans and specifications.
   7. The brick shall be laid in successive coursed with the better face or wire-cut side upward.
   8. Each and every course of brick shall be laid true and even and brought to grade by use of wooden mallets or similar tools. No course shall deviate from a straight line more than 2 inches in 30 feet. Brick laying shall take place in a continuous sequence and shall follow the completion of the bedding within 50 feet.
   9. Immediately after placement of brick, brick surfaces shall be swept and inspected. Any imperfect brick as determined by the City Engineer shall be lifted out and reset.
   10. Cutting Brick - Required cutting of bricks shall be accomplished with a mason’s saw using a diamond blade or broken by brick hammer on an approved straight and even edge.
   11. Sand Filler - Joints shall be thoroughly chocked with a clean white fine grained silica sand.
   12. The sand filler shall be brought up flush with surface or bricks. After filling, bricks shall be swept clean and carefully watered to saturate the joint filler, care being exercised not to
displace filler form the joints. Any joints to which do not remain flush with brick surfaces shall be rechocked and watered, particular attention shall be paid to small section of cut brick necessary to fit manholes, light poles, water meters, tree planters, and any other obstructions within the sidewalk area.

13. **Clean Up** - The contractor shall remove from the roadway and sidewalk all excavated material, debris, and dirt as rapidly as the completion of the repair work proceeds and in no case will it be permissible for this material to remain as an obstruction or safety hazard overnight.

14. **Roofing Felt** - 15# roofing felt shall be placed as per plans between building and expansion material with top edge being flush with top of ½ inch expansion material and under sand-cement filler, 3 feet from building (top of expansion material).

15. **Meter Barrels** - Any existing water meter barrels that may have to be adjusted to match elevation of new brick sidewalks shall be completed by the contractor and the cost shall be included in the bid price for the removal of existing concrete sidewalk and replacement with the brick sidewalks.

D. Place sand-cement base, compact by tamping with plate vibrator to 100 percent of ASTM D 1557 maximum laboratory density, and screed to depth indicated.

E. Place leveling course and screed to a thickness of 1 to 1-1/2 inches (25 to 38 mm), taking care that moisture content remains constant and density is loose and uniform until pavers are set and compacted.

F. Treat leveling course with herbicide to inhibit growth of grass and weeds.

G. Set pavers hand-tight, with a maximum joint width of 1/8 inch (1.5 mm, being careful not to disturb leveling base. If pavers have spacer bars, place pavers hand tight against spacer bars. Use string lines to keep straight lines. Fill gaps between units that exceed 3/8 inch (10 mm) resize adjacent stones and adjust to maintain the required joint width. Use pieces cut to fit from full-size unit pavers.

H. Vibrate pavers into leveling course with a low-amplitude plate vibrator capable of a 3500- to 5000-lbf (16- to 22-kN) compaction force at 80 to 90 Hz. Use vibrator with neoprene mat on face of plate or other means as needed to prevent cracking and chipping of pavers. Perform at least three passes across paving with vibrator.
   1. Compact pavers when there is sufficient surface to accommodate operation of vibrator, leaving at least 36 inches (900 mm) of uncompacted pavers adjacent to temporary edges.
   2. Before ending each day's work, compact installed concrete pavers except for 36-inch (900 mm) width of uncompacted pavers adjacent to temporary edges (laying faces).
   3. As work progresses to perimeter of installation, compact installed pavers that are adjacent to permanent edges unless they are within 36 inches (90 mm) of laying face.
   4. Before ending each day's work and when rain interrupts work, cover pavers that have not been compacted and cover leveling course on which pavers have not been placed with non-staining plastic sheets to protect them from rain.

I. Spread dry sand and fill joints immediately after vibrating pavers into leveling course. Vibrate pavers and add sand until joints are completely filled, then remove excess sand. Leave a slight surplus of sand on the surface for joint filling.

J. Do not allow traffic on installed pavers until sand has been vibrated into joints.

K. Repeat joint-filling process 30 days later.
3.5 MORTAR SETTING-BED APPLICATIONS

A. Saturate concrete subbase with clean water several hours before placing setting bed. Remove surface water about one hour before placing setting bed.

B. Apply mortar bed over bond coat; spread and screed mortar bed to uniform thickness at subgrade elevations required for accurate setting of pavers to finished grades indicated.

C. Mix and place only that amount of mortar bed that can be covered with pavers before initial set. Before placing pavers, cut back, bevel edge, and remove and discard setting-bed material that has reached initial set.

D. Place pavers before initial set of cement occurs. Immediately before placing pavers on mortar bed, apply uniform 1/16-inch- (1.5-mm-) thick bond coat to mortar bed or to back of each paver with a flat trowel.

E. Tamp or beat pavers with a wooden block or rubber mallet to obtain full contact with setting bed and to bring finished surfaces within indicated tolerances. Set each paver in a single operation before initial set of mortar; do not return to areas already set or disturb pavers for purposes of realigning finished surfaces or adjusting joints.

F. Spaced Joint Widths: Provide 3/8-inch (10-mm) nominal joint width with variations not exceeding plus or minus 1/16 inch (1.5 mm).

G. Grouted Joints: Grout paver joints complying with ANSI A108.10.

H. Grout joints as soon as possible after initial set of setting bed.
   1. Force grout into joints, taking care not to smear grout on adjoining surfaces.
   2. Clean pavers as grouting progresses by dry brushing or rubbing with dry burlap to remove smears before tooling joints.
   3. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
   4. If tooling squeezes grout from joints, remove excess grout and smears by dry brushing or rubbing with dry burlap and tool joints again to produce a uniform appearance.

I. Cure grout by maintaining in a damp condition for seven days unless otherwise recommended by grout or liquid-latex manufacturer.

3.6 REPAIRING, POINTING, AND CLEANING

A. Remove and replace unit pavers that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment and with no evidence of replacement.

B. Pointing: During tooling of joints, enlarge voids or holes and completely fill with grout. Point joints at sealant joints to provide a neat, uniform appearance, properly prepared for sealant application.

C. Cleaning: Remove excess grout from exposed paver surfaces; wash and scrub clean.
   1. Remove temporary protective coating as recommended by coating manufacturer and as acceptable to paver and grout manufacturers.
   2. Do not allow protective coating to enter floor drains. Trap, collect, and remove coating material.
SECTION 321401 - UNIT PAVING – RECYCLED COBBLE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   Cleaning, sorting and transporting historic cobble, currently property of the City of Fredericksburg, VA.
   1. Recycled Granite Cobble set in aggregate setting beds.
   2. New Cobble to match existing.

B. Related Sections:
   1. Division 32 Section "Concrete Paving" for concrete base under unit pavers.
   2. Division 32 Section "Unit paving" – for new granite pavers to make up any deficiency in the number of historic cobble pavers and for edge restraints.

1.2 ACTION SUBMITTALS

A. Plan for the sorting cleaning and transporting of exiting historic cobble located at: The City of Fredericksburg Public Works; 1000 Tyler Street and owned by the City of Fredericksburg.

B. Calculations for the square footage of existing historic cobble and the amount of new, if any, required to complete the planned design, per drawings.

C. Samples for Initial Selection: For the following:
   1. Historic paver – fully cleaned and prepared for reinstallation
   2. New pavers – if required to fill deficiency in historic recycled pavers
   4. Exposed edge restraints involving color selection.

D. Samples for Verification:
   1. Full-size units of new cobble to match historic indicated. Assemble no fewer than five Samples of each type of unit on suitable backing and grout joints.

1.3 QUALITY ASSURANCE

A. Source Limitations:
   1. Used pavers shall come from historic cobble currently stockpiled at the City of Fredericksburg Public Works; 1000 Tyler Street and owned by the City of Fredericksburg.
   2. Obtain matching new unit paver, as well as joint material, and setting material from single source with resources to provide materials and products of consistent quality in appearance and physical properties.

B. Mockups: Build mockups from a mix of historic and new pavers to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

   1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
C. Preinstallation Conference: Conduct conference on project site.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store pavers on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained, and contamination avoided.

D. Store liquids in tightly closed containers protected from freezing.

E. Store asphalt cement and other bituminous materials in tightly closed containers.

1.5 PROJECT CONDITIONS

A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.

B. Weather Limitations for Mortar and Grout:
   2. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602. Provide artificial shade and windbreaks and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 deg F (38 deg C) and higher.
      a. When ambient temperature exceeds 100 deg F (38 deg C), or when wind velocity exceeds 8 mph (13 km/h) and ambient temperature exceeds 90 deg F (32 deg C), set pavers within 1 minute of spreading setting-bed mortar.

PART 2 - PRODUCTS

2.1 HISTORIC COBBLE TO BE RECYCLED

A. All historic cobble stored by the City of Fredericksburg at the City of Fredericksburg Public Works; 1000 Tyler Street shall be used for areas designated as Recycled Granite Cobble Pavers (owner furnished).

2.2 NEW GRANITE COBBLE PAVERS:

A. Products: Subject to compliance with requirements, provide the following,
   1. “Virginia Mist” (product number 090)
   2. Supplied by:
      a. The North Carolina Granite Corp.
         PO Box 151
         Mount Airy, NC 27030
2.3 EDGE RESTRAINTS: Refer to 321400 – Unit Paving.

2.4 ACCESSORIES: Refer to 321400 – Unit Paving.

2.5 SETTING-BED MATERIALS: Refer to 321400 – Unit Paving.

2.6 SORTING, CLEANING, TESTING AND TRANSPORT OF EXISTING HISTORIC COBBLE

   A. Select historic granite cobbles from the stockpile that are whole and useable with size and finish of approved samples.
   B. Separate cobbles from all dirt and debris, including, but not limited to, soil, debris, and cement
   C. Test cobbles for soundness.
   D. Clean cobbles of all dirt, and stains to a finish of original granite.
   E. Palletize and transport to project site by means that do not mar the aesthetics or soundness of the cobble.

2.7 PREPARATION

   A. Remove substances from concrete substrates that could impair mortar bond, including curing and sealing compounds, form oil, and laitance.
   B. Sweep concrete substrates to remove dirt, dust, debris, and loose particles.
   C. Proof-roll prepared subgrade according to requirements in Division 31 Section "Earth Moving" to identify soft pockets and areas of excess yielding. Proceed with unit paver installation only after deficient subgrades have been corrected and are ready to receive subbase and base course for unit pavers.

2.8 INSTALLATION, GENERAL

   A. Use only Recycled Granite Cobble with that have been approved by the Landscape Architect or their representative for inclusion in the work.
   B. If there are not enough square footage of historic cobble for the design, mix with approved new cobbles in proportion to the percentage of the whole so that they are evenly distributed.
   C. For area indicated for Recycled Granite Cobble, use the Recycled Granite Cobble detail in the drawings even if new pavers are required to complete the area.
   D. Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.
E. Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.

F. Joint Pattern: As shown.

G. Tolerances: Do not exceed 1/32-inch (0.8-mm) unit-to-unit offset from flush (lippage) nor 1/8 inch in 10 feet (3 mm in 3 m) from level, or indicated slope, for finished surface of paving.

H. Expansion and Control Joints: Refer to 321400 – Unit Paving.

I. Provide edge restraints as indicated and in Refer to 321400 – Unit Paving.

2.9 AGGREGATE SETTING-BED APPLICATIONS

A. Compact soil subgrade uniformly to at least 95 percent of ASTM D 698 laboratory density.

B. Proof-roll prepared subgrade to identify soft pockets and areas of excess yielding. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Landscape Architect and replace with compacted backfill or fill as directed.

C. Place aggregate subbase and base, compact to 100 percent of ASTM D 1557 maximum laboratory density, and screed to depth indicated.

D. Place drainage geotextile over compacted base course, overlapping ends and edges at least 12 inches (300 mm).

E. Place leveling course and screed to a thickness of 1 to 1-1/2 inches (25 to 38 mm), taking care that moisture content remains constant and density is loose and uniform until pavers are set and compacted.

F. Set string lines for finished grade for pavers.

G. Vibrate pavers into leveling course with a low-amplitude plate vibrator capable of a 3500- to 5000-lbf (16- to 22-kN) compaction force at 80 to 90 Hz. Use vibrator with neoprene mat on face of plate or other means as needed to prevent cracking and chipping of pavers. Perform at least three passes across paving with vibrator.

1. Compact pavers when there is sufficient surface to accommodate operation of vibrator, leaving at least 36 inches (900 mm) of uncompacted pavers adjacent to temporary edges.

2. Before ending each day's work, compact installed concrete pavers except for 36-inch (900 mm) width of uncompacted pavers adjacent to temporary edges (laying faces).

3. As work progresses to perimeter of installation, compact installed pavers that are adjacent to permanent edges unless they are within 36 inches (90 mm) of laying face.

4. Before ending each day's work and when rain interrupts work, cover pavers that have not been compacted and covering leveling course on which pavers have not been placed with non-staining plastic sheets to protect them from rain.

H. Spread dry sand and fill joints immediately after vibrating pavers into leveling course. Vibrate pavers and add sand until joints are completely filled, then remove excess sand. Leave a slight surplus of sand on the surface for joint filling.

I. Do not allow traffic on installed pavers until sand has been vibrated into joints.
J. Repeat joint-filling process 30 days later.

2.10 REPAIRING, POINTING, AND CLEANING

A. Remove and replace unit pavers that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment and with no evidence of replacement.

B. Reset areas that have settled unevenly.

END OF SECTION 321400
SECTION 321540 – STABILIZED DECOMPOSED GRANITE SURFACING

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes: Naturally occurring decomposed granite and crushed stone surfacing as shown on Drawings and specified herein. Include sub-grade, edging and related accessories.

1.2 REFERENCES


1.3 ACTION SUBMITTALS

A. Shop Drawings: Submit plan layout of all decomposed granite surfacing areas and detail drawings showing the various components of the surfacing system, including subbase and edging.

B. Product Data: Manufacturer’s literature completely describing all components of the decomposed granite surfacing system, including:
   1. Preparation instructions and recommendations.
   2. Installation methods and application procedures.
   3. Manufacturer’s product data sheet.
   4. Manufacturer’s Material Safety Data Sheet.

C. Base Course gradation indicating that the product meets specifications.

D. Stabilized crushed aggregate gradation indicating that the product meets specifications.

E. Samples for Verification
   1. Submit samples of each of the following:
      a. Three (3) pound sample of each type and color of decomposed granite surfacing material.
      b. Edging material, each type not less than 12” long.

F. Certification
   1. Manufacturer and Installer Qualifications.

1.4 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing Work of this Section with minimum 25 years documented experience.
B. Single Source Responsibility: Obtain each type of decomposed granite surfacing from single manufacturer.

C. Mock Up: Provide a mock-up for evaluation of surface preparation, installation techniques and quality of application.
   1. Install a twenty (20) square foot minimum of decomposed granite surfacing, including subbase course and edging, at location approved by Landscape Architect.
   2. Do not proceed with remaining work until installation of decomposed granite surfacing is approved by Landscape Architect.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Bagged Materials: Accept delivery of materials only in unopened and undamaged containers bearing the brand name and manufacturer’s identification.

B. Bulk Materials: Each load of decomposed granite surfacing material arriving at the job site in bulk shall be accompanied by a delivery ticket containing the following minimum information.
   1. Quarry of origin.
   2. Amount, weight and type of material.
   3. Brand name and manufacturer’s identification.

C. Protect decomposed granite surfacing materials from contamination until ready for installation. Store under cover.

1.6 PROJECT CONDITIONS

A. Ensure that the subgrade and base are properly graded and compacted to required specifications.

B. Surfaces to receive decomposed granite surfacing shall be frost free and free of oil or any other foreign matter, which may impair the proper installation of the surfacing system.

C. Do not install decomposed granite surfacing when subbase course is muddy or saturated with standing water.

D. Perform work in dry weather when subgrade is sufficiently stable to be properly compacted.

E. Protect all nearby surfaces, plants and structures from possible contamination from materials or damage by equipment.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

A. Manufacturer: Provide “Organic-Lock” stabilized pathway aggregate surfacing system by the following:
2.2 STABILIZED DECOMPOSED GRANITE SURFACING MATERIALS

A. Decomposed Granite and Crushed Stone Aggregate: Provide high quality materials consisting of sound, angular, durable stone particles, free from clay lumps, organic materials, frozen materials, or other deleterious substances.

B. Gradation: Manufacturer’s standard mix of well-graded materials in accordance with ASTM C136. Blends of coarse sand and rock dust are not acceptable.

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C. Color: “Platinum Granite”

2.3 ORGANIC-LOCK BINDER

A. Binder to be ‘Organic Lock’.

B. Patented powdered organic binder designed to be blended with crushed aggregate.

C. Product to have 100% naturally occurring materials.

2.4 SUBBASE COURSE MATERIALS


1. Road Base Material: Also know as road rock, road gravel, aggregate base, AB, asphalt base and ¾” minus.
2.5 ACCESSORIES

A. Water: Clean and potable, free from contaminants that would be deleterious to the decomposed granite surfacing.

B. Steel Edging: 3/16-inch thick x 4-inch deep with overlapping joints.
   1. Stakes 3/16-inch x 16-inch long x ¾-inch wide at top tapering to point at bottom, locate at 36-inch on center maximum.

C. Herbicide: Commercial chemical for weed control, registered by th EPA, and not classified as "restricted use" for locations and conditions of application. Application of the herbicide shall pose no short or long term health threats to the installer or the general public.

PART 3- EXECUTION

3.1 MANUFACTURER’S DIRECTION

A. The instructions below refer to a product that has been pre-blended with the aggregate and contains optimal moisture content. Adhere to the manufacturer’s Installation Guidelines.

3.2 EXAMINATION

A. Examine areas and conditions under which Work of the Section will be performed. Notify Landscape Architect of unsatisfactory preparation before proceeding.

B. Correct conditions detrimental to timely and proper completion of Work.

C. Do not proceed until unsatisfactory conditions are corrected.

D. Lay out work prior to the commencement of installation for Landscape Architect approval and do not commence work until approval has been received.

3.3 PREPARATION

A. Excavation: Excavate to depth required so edges of decomposed granite surfacing will match adjacent grades and have a maximum cross-slope of 2 percent. Ensure edges and bottom of excavation are in a smooth and even line.

B. Subgrade Preparation: Plow, Harrow and mix the entire surface of the in-place subgrade to a depth of at least 6-inches and meet finish grade as noted on the plans. After the material has been thoroughly mixed, the subgrade shall be brought to line and grade and compacted to 95% of the maximum laboratory dry density as determined by the Modified Proctor Density test.

C. Herbicide: Apply herbicide per manufacturer’s written instructions. Limit the application to the area to receive decomposed granite surfacing.
D. Base Course Preparation: Place the subbase coarse aggregate free from ridges, depressions or hollows to approved depth. Rake and compact to 95% Standard Proctor Density. Depending on the method of compaction, the installation of base material may require separate lifts.

E. Install in dry conditions and temperatures above 40 degrees Fahrenheit. Wet and cold conditions slow down the curing/drying process.

3.4 WATERSHED MANAGEMENT

A. Crowns and/or cross-slopes must be incorporated into the compacted base material. Follow the details in the drawings.
   1. If the slope is 2% or lower, a crown should be incorporated into the pathway.
   2. If the slope is greater than 2%, incorporate a cross-slope.

3.5 INSTALLATION

A. Steel Edging: Install edging flush with the top of the decomposed granite surfacing. Provide sufficient stakes to secure edging in place during and after decomposed granite surfacing material installation.

B. Subgrade: Proof-roll the subgrade with heavy pneumatic-tired equipment to locate unstable areas and to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
   1. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Landscape Architect, and replace with compacted backfill or fill as directed.
   2. The surface of the completed subgrade shall be bladed to a smooth and uniform texture.
   3. The finished subgrade shall be uniform and free from deleterious debris such as organic materials, nails, stones and loose soil.

C. Subbase: Install aggregate subbase to a compacted depth of 4- to 6-inches minimum for pedestrian traffic, and 8- to 12-inches minimum for vehicular traffic in accordance with manufacturer’s recommendations. Install the subbase in multiple 3- to 4-inch lifts, and compact to a minimum 95% Modified Proctor Density.

D. Compaction: Compact each lift of the subgrade, subbase and final finish decomposed granite surfacing materials with a one-ton double or single static drum roller, or equivalent making 4-6 passes. In small areas that are difficult to access with compaction equipment, hand tamping may be performed with multiple passes to achieve the required density.
   1. Lightly spray surface area following compaction. Do not disturb aggregate surface with spray action.

3.6 INSTALLATION OF DECOMPOSED GRANITE SURFACING

A. Spread decomposed granite surfacing material in 3- to 4-inch lifts. Spread the pathway mix evenly and smoothly before compacting. Allow for 20-25% compaction. Screed if possible.
B. Wet the mix to ensure water has penetrated the full depth of the decomposed granite surfacing material, and roll each lift to form a uniform, smooth surface. Compact each lift to a minimum 95% Modified Proctor Density.

1. Note: Vibratory compaction is acceptable for the base material but generally not suitable for Organic-Lock blended aggregate as it risks disassociating the bonds of the stabilized aggregate or allowing the fines and moisture to migrate to the surface, causing the surface to take on a smooth, concrete-like appearance. Organic-Lock Blended Aggregates should be compacted using a single or double drum static roller wherever possible. For tight spaces that are not accessible by drum rollers, a hand tamper is recommended, however, in certain circumstances, a vibratory or plate tamper can be used where the installer deems it to be more effective.

2. Provided the moisture content of the Organic-Lock blended aggregate is adequate, additional hydration should not be necessary. On dry, sunny days, however, the surface layer may start to dry out while installing, in which case, a light misting would be appropriate to prevent surface cracks from appearing during compaction. Refer to the Organic-Lock Installation Guidelines Brochure for more information.

C. Grade and smooth to the required elevation, compact final lift with 1-ton double or single static drum roller.

D. Minimum Compacted Thickness:
   1. Pedestrian Paths: 3-inches.
   2. Vehicular Drives and Roadways: 4-inches.

E. Surface shall follow grades per plans.

F. Apply a light spray to the surface of the material to live a clean appearance. Apply water until the water begins to run-off.

G. Completed surface shall be of consistent quality and shall not have depressions of humps greater than 1/4-inch in 10-feet.

H. Do not allow any traffic on the newly installed pathway until fully cured.

3.7 INSTALLATION TOLERANCES

   1. Subbase Course: Plus or minus ½-inch.
   2. Surface Course: Plus ¼-inch, no minus.

B. Decomposed Granite Surfacing Smoothness: Produce a surface smoothness within ¼-inch tolerance when measured with a 10-foot straightedge.
   1. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowed variance from the template is ¼-inch.

3.8 REPAIRS

A. Excavate the damaged area and scarify exposed surface.
B. Pre-blend the replacement crushed shone aggregate material with Organic-Lock at 28 34 lbs/imperial ton. Apply the material to the excavated area and compact.

C. Thoroughly water the material to achieve 8-10% moisture content.

D. Allow the newly installed aggregate to cure, but not completely dry out before re-compacting the material, insuring that the final grade, slope and crown are maintained.

3.9 CLEAN-UP AND PROTECTION

A. Thoroughly clean all areas where work has occurred. Remove from site excess material, debris and rubbish.

B. Take all precautions necessary to protect completed work until Substantial Completion of project.

END OF SECTION 321540
SECTION 321723 - PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes painted markings applied to asphalt and concrete pavement.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include technical data and tested physical and performance properties.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of Virginia Department of Transportation (VDOT) for pavement-marking work.

1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for alkyd materials 55 deg F for water-based materials, and not exceeding 95 deg F.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design".
2.2 PAVEMENT-MARKING PAINT

A. Pavement-Marking Paint:
   1. Pavement markings in shall consist of Thermoplastic Pavement Marking Material (Type B, Class I or II), in accordance with the VDOT Road and Bridge Specification, section 246.

   2. Color: As indicated.

B. Glass Beads: In accordance with VDOT Road and Bridge Specification, section 246.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that pavement is dry and in suitable condition to begin pavement marking according to manufacturer's written instructions.

B. Proceed with pavement marking only after unsatisfactory conditions have been corrected.

3.2 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow paving to age for a minimum of 30 days before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

   1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to pavement. Mask an extended area beyond edges of each stencil to prevent paint application beyond stencil. Apply paint so that it cannot run beneath stencil.

   2. Broadcast glass beads uniformly into wet markings at a rate of 6 lb/gal.

3.3 PROTECTING AND CLEANING

A. Protect pavement markings from damage and wear during remainder of construction period.

B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 321723
SECTION 321813 – SYNTHETIC TURF SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes the following:
   1. A synthetic turf system consisting of fibers, tufted into a dual layer backing of woven fabric with a secondary backing as standard with the manufacturer.
   2. Written Warranty.
   3. Testing of system to comply with specified requirements.
   4. Foam Playground Safety Pad

B. Related Sections:
   1. Division 31 Section “Earth Moving” or preparing subgrades and base course.

1.3 REFERENCES

A. Comply with applicable requirements of the following standard test methods. Where these standards conflict with other specific requirements, the most restrictive requirement shall govern.
      F1292 - Standard Specification for Impact Attenuation of Surfacing Materials within the Use Zone of Playground Equipment
      F355 Shock Absorbing Properties of Playing Surface Systems and Materials
      F1015 Relative Abrasiveness of Synthetic Turf Playing Surfaces
      F1551 Comprehensive Characterization of Synthetic Turf Playing Surfaces and Materials

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples:
   1. Synthetic Grass Blades on Backing.
   2. Playground Shock Pad.
   3. Foam Nailer.

C. Shop Drawings.
   1. Provide a detailed drawing showing any details of construction which deviate from the plans and specifications

D. Qualification Data: For installer.
E. Test Reports: For the following, from a qualified testing agency, indicating compliance with critical fall height requirements.

1.5 QUALITY ASSURANCE

A. Manufacturers/Installers Experience:
   1. The synthetic turf installer/manufacturer shall have the experience of at least thirty (30) acceptable installations of synthetic turf play areas in the United States within the past five (5) years of tufted, mono-fiber grass-like fabric that are infilled with sand.

B. The Turf Contractor shall employ only qualified, experienced supervisors and technicians skilled in the installation of the specified system.

C. Turf Contractor shall meet the following criteria:
   1. Have proper license, in good standing, and have never had a license revoked.
   2. Have not had a Surety or Bonding Company finish work on any contract within the last five (5) years.
   3. Have not been disqualified or barred from performing work for any public Owner or other contracting entity.
   4. Turf Installation contractor shall be certified by Turf manufacturer to install the turf system.

D. Turf Manufacturer’s representative is required to be on-site during placement of drainage base construction to verify acceptability of stone placed to support turf system.

E. Testing Agency Qualifications: An independent agency qualified according to ANSI Z34.1 for testing indicated.

F. Source Limitations: Obtain surface system materials, including primers and binders, through one source from a single manufacturer.
   1. Provide secondary materials including adhesives, primers, and repair materials of type and from source recommended by manufacturer of playground surface system materials.

G. Turf system shall have been independently tested to drain 6”-7” per hour through system and out laterally;

H. Critical Fall Height rating / shock absorbing properties should comply with highest standard safety features recommended by federal, state and local agencies.

1.6 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit system installation to be performed according to manufacturers’ written instructions and warranty requirements.

1.7 COORDINATION

A. Coordinate installation of surface systems with installation of storm sub-drainage systems per drawings.
1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Remnants of installed turf a minimum of 3 pieces larger than 8’ x 10’ shall be preserved for the Owner’s use in emergency repairs. Part of the remaining stock shall be placed in a location to allow UV exposure equal to the field to maintain color match.

PART 2 - PRODUCTS

2.1 SYNTHETIC GRASS FIBER SYSTEM

A. SYNLawn
   1. Color/Style: SYN Augustine X47.

B. Standard Products as listed are a requirement of the Work. Modifications to the assembly as published in the manufacturers materials is not permitted.

2.2 SAFETY PAD

A. ProdTeK Padding Playground Safety Pad
   1. 2” thick pad minimum. A thicker pad of 4” may be required if play equipment fall ratings dictate. Playground pad to be water permeable.

2.3 ACCESSORIES

A. Edgings:
   1. Composite lumber nailer for securing turf in-place.
   2. Heavy-duty foam curb designed to be non-protruding when installed, for connecting units and securing turf in-place.

2.4 MAINTENANCE EQUIPMENT

A. Provide a pull-behind groomer for turf upkeep, or as recommended by manufacturer.
   1. Broom bristles used during original installation or in subsequent maintenance shall be made of nylon materials only. Metal bristles shall not be used.

PART 3 - EXECUTION

3.1 PREPARATION

A. The installation shall be performed in full compliance with approved shop drawings.

B. Only factory-trained technicians skilled in the installation of synthetic turf systems shall undertake the placement of the system.
C. The surface to receive the synthetic turf shall be verified by the Synthetic Turf Installer as ready for the installation of the synthetic turf system and must be perfectly clean as installation commences and shall be maintained in that condition throughout the process.

3.2 INSTALLATION

A. The completed base and adjacent curbs/perimeter nailer shall be inspected by the Engineer or Sitework Contractor. Based upon the Contractor's inspection of the topographical survey, the Sitework Contractor shall fine-grade the base suitably, including properly rolling and compacting the base to achieve a surface planarity within ¼" in 10-feet (+0, -¼").

B. The Installer Superintendent shall thoroughly inspect all synthetic turf materials delivered to the site both for quality and quantity to assure that the entire installation shall have sufficient material to maintain proper mixing ratios.

C. Synthetic turf shall be loose-laid across the play area, stretched, and attached to the perimeter edge detail. Synthetic Turf shall be of sufficient length to permit full cross-field installation. No head or cross seams will be allowed.

D. All seams shall be flat, tight, and permanent with no separation or fraying. Play area seams shall be sewn using double-lock stitch with cord recommended by the Manufacturer. Play area seams will also be glued (if applicable) to seaming tape. Seaming tape is to be constructed of high tenacity coated, polyolefin. All main fabric seams shall be transverse to the play area direction; i.e., run perpendicularly across the ellipse.

E. Infill materials shall be properly applied per the Manufacturer's standard. The synthetic turf shall be raked and brushed properly as the mixture is applied. The infill material shall be installed to a settled depth of approximately 1 inches. The infill materials can only be applied when the synthetic turf fabric is dry.

1. Portable equipment shall be utilized to fully work-in the infill to all edges of the turf including curbs and nailer edges, per manufacturer's standard installation procedures.

3.3 CERTIFICATION

A. G-max testing: Prior to final acceptance, provide and submit written results for G-max testing on the installed surface in accordance with ASTM - 355 Method A, subject to the approval of the Owner and Landscape Architect. If measurement thresholds (minimum and maximum) as specified herein are not met, Contractor shall solicit recommendations from the manufacturer, make recommendations, and perform corrective measures as approved by Landscape Architect.

3.4 CLEAN UP

A. Synthetic Turf Contractor shall provide the labor, supplies, and equipment, as necessary, for final cleaning of surfaces and installed items.

B. The Synthetic Turf Contractor shall keep the area clean throughout the project and clear of debris.

C. Surfaces, recesses, enclosures, etc., shall be cleaned as necessary to leave the work area in a clean, immaculate condition ready for immediate occupancy and use by the Owner.
3.5 PROTECTION

A. Prevent traffic over system for not less than 48 hours after installation.

3.6 DEMONSTRATION AND TRAINING

A. Provide a schedule for required maintenance, listing of banned products for play area, and hands-on demonstration covering all aspects of maintenance and upkeep of the synthetic turf installation.

B. Re-inspect the field areas and make necessary repairs, if any, after one month of use. Check for infill displacement and tears in any seams, and correct deficiencies noted.

END OF SECTION 321813
SECTION 321816 – POURED IN PLACE RUBBER

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. PIP Rubber Safety Surfacing with cushion layer.
2. Play Sand.

1.3 DEFINITIONS

A. Definitions in ASTM F 2223 apply to Work of this Section.

B. Critical Height: Standard measure of shock attenuation according to ASTM F 2223; same as "critical fall height" in ASTM F 1292. According to ASTM F 1292, this approximates "the maximum fall height from which a life-threatening head injury would not be expected to occur."

C. SBR: Styrene-butadiene rubber.

D. Unitary Surfacing: A protective surfacing of one or more material components bound together to form a continuous surface; same as "unitary system" in ASTM F 2223.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For each type of protective surfacing.

1. Include plans, sections, placement details, and attachment to substrates.
2. Include accessories and edge terminations.
3. Include patterns made by varying colors of surfacing and details of graphics.
4. Include fall heights and use zones for equipment and structures specified in Section 129300 - SITE FURNISHINGS – Playground coordinated with the critical heights for protective surfacing including cushion layer.

C. Samples for Initial Selection: For each type and color of exposed finish.

D. Samples for Verification: For each type and color of protective surfacing and exposed finish.
1. Unitary, Seamless Surfacing: Minimum 6 by 6 inches (150 by 150 mm).
2. Edging: 6 inches (150 mm) long by full width and cross section.
3. Drainage/Separation Geotextile: Minimum 12 by 12 inches (300 by 300 mm).
1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and testing agency.
B. Product Certificates: For each type of unitary surfacing product.
C. Field quality-control reports.
D. Sample Warranty: For manufacturer’s special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For playground protective surfacing to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
B. Mockups: Build mockups to verify selections made under Sample submittals and to set quality standards for materials and execution.
   1. Build mockups for protective surfacing including accessories.
      a. Size: 48 inches (1200 mm) by 48 inches (1200 mm).
      b. Mockup must include connection between two colors at the tightest radius.
   2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.8 WARRANTY

A. Special Warranty: Manufacturer and Installer agree to repair or replace components of protective surfacing that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Reduction in impact attenuation as measured by reduction of critical fall height.
      b. Deterioration of protective surfacing and other materials beyond normal weathering.
      c. Separation at joints.
   2. Warranty Period: Five years from date of Substantial Completion.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain protective surfacing materials from single source from single manufacturer.

   1. Provide geosynthetic accessories of each type from source recommended by manufacturer of protective surfacing materials.

2.2 PERFORMANCE REQUIREMENTS

A. Impact Attenuation: Critical fall height tested according to ASTM F 1292.

B. Accessibility Standard: Minimum surfacing performance according to ASTM F 1951.

2.3 PIP RUBBER SURFACING (Detail 6, Sheet L-601)

A. Description: Manufacturer's standard, site-mixed and applied, cushion and wearing course material in thickness as required, tested for impact attenuation according to ASTM F 1292 and for accessibility according to ASTM F 1951.

   1. PebbleFlex 2.0, manufactured by Landscape Structures
   2. Contact local representative:
      a. Sparks@Play, LLC
         3705 Crondall Lane
         Owings Mills, MD  21117
         410-356-4151

B. Materials:

   1. Wearing Course (top layer)
      a. Aliphatic thermoplastic polyurethane Pebbles and Pebble Flex 2.0 aliphatic polyurethane Binder
   2. Impact layer (cushion layer)
      a. Select SBR rubber strands of not more than 1" in length
   3. Matrix to be UV stable, porous and resistant to abrasion.
   4. Critical Height: As determined by the equipment indicated on the Drawings
   5. Primer/Adhesive: Manufacturer's standard primer and weather-resistant, moisture-cured polyurethane adhesive suitable for unit, substrate, and location.

C. Color: PebbleFlex 2.0 colors are:

   1. Type A – Blend of 50% “Orange” (large pebbles) and 50% “Red” (small pebbles).
   2. Type B – Blend of 50% “Orange” (large pebbles), 25% “Tan” (small pebbles) and 25% “Cream” (small pebbles).
   3. Type C – Blend of 50% “Cream” (small pebbles), 25% “Tan” (large pebbles) and 25% “White” (large pebbles).

D. Design: Provide as indicated on Drawings.
2.4 LOOSE-FILL ACCESSORIES

A. Edging: Anchored-in-place, weather-resistant containment barrier designed to minimize sharp edges, protrusions, and tripping hazards; formed by interconnected, modular units.

1. Metal Units: Steel fabricated with radiused exposed edges and finished with PVC coating, straight, right-angled corner and curved units, in manufacturer's standard sizes.

2. Anchor Stakes: Manufacturer's standard, of corrosion-resistant-coated metal or noncorrodible material, designed to be nonprotruding when installed, for connecting units and securing in-place.

2.5 GEOSYNTHETIC ACCESSORIES

A. Drainage/Separation Geotextile: Nonwoven, needle-punched geotextile, manufactured for drainage applications and made from polyolefins or polyesters; with the following minimum properties:

1. Weight: 4 oz./sq. yd. (136 g/sq. m) ASTM D 5261.

2. Water Flow Rate: 150 gpm/sq. ft. (102 L/s per sq. m according to ASTM D 4491)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for subgrade elevations, slope, and drainage and for other conditions affecting performance of the Work.

1. Verify that substrates are sound and without high spots, ridges, holes, and depressions.

3.2 PREPARATION

A. Prepare substrates to receive surfacing products according to protective surfacing manufacturer's written instructions.

B. Proof-roll prepared subgrade according to requirements in Division 31 Section "Earth Moving" to identify soft pockets and areas of excess yielding. Proceed with installation only after deficient subgrades have been corrected and are ready to receive aggregate subbase.

C. Compacted crushed stone: Minimum depth is 4 inches. Compact the base to 95 percent proctor. Slope the base at 1/8 – ¼ inch per foot to accommodate proper drainage. Surface drains and/or weep holes are required at the top surface of the aggregate per manufacturer's instructions for aggregate base layer.

3.3 INSTALLATION OF GEOSYNTHETIC ACCESSORIES

A. Install geosynthetic accessories before edging and according to playground surface system manufacturer's and geosynthetic manufacturer's written instructions and in a manner that cannot become a tripping hazard.
1. Drainage/Separation Geotextile: Completely cover area beneath protective surfacing, overlapping geotextile sides and edges with manufacturer’s standard treatment for seams.

3.4 INSTALLATION OF SEAMLESS SURFACING

A. Thickness: The total depth of the surface shall be installed in strict accordance and conformity to the manufacturer’s drawings and these specification requirements. Surface thickness will vary in the impact layer. The thickness of the impact layer will be installed according to the fall heights of the play equipment. These requirements must be verified in the field prior to starting the installation of the impact layer.

B. Impact Cushion Layer:
1. The impact layer is to be made of rubber. The SBR rubber is to be a strand of not more than 1 inch in length.
2. The manufacturer’s minimum depth or greater shall be installed as required by the fall heights required by the playground equipment that exists or is to be installed and to meet the test results of the finished surface as expressly required within this specification.
3. For surrounding curbing, prime the vertical surface of the curb using the SPR Binder. Mix one fifty-pound bag of SBR buffings with 8.14 pounds of aromatic poly binder so that the buffings are covered evenly. Spread the mix and trowel to the appropriate depth. Let cure per manufacturer’s instructions.
4. Mix and apply components of seamless surfacing according to manufacturer’s written instructions to produce uniform, monolithic, and impact-attenuating protective surfacing of required overall thickness.

C. Top Layer:
1. The overall thickness shall be no less than 3/8 inch and be composed of PebbleFlex 2.0 material with an aliphatic polyurethane binder supplied by the manufacturer.
2. Mixing and Finishing
   a. Dry mix 100 pounds of PebbleFlex 2.0 Pebbles (50 large/50 small) in a mortar mixer. After thorough mixing, add 15 pounds of Binder to the dry Pebbles in the mortar mixer, Mix thoroughly so that each pebble is covered evenly. Dump the mix onto the surface and spread it at a minimum thickness as indicated on the drawings, keeping the surface as level as possible. Hand or power trowel using a solution of soapy water to spray the surface of the trowel. This will allow easier manipulation of the trowel. Let the surface set for 72 hours.
   b. High wear areas: Under all high wear areas, such as under slides and swings increase the Pebble Flex 2.0 layer to ½ inch.
   c. Large Areas: all areas in excess of 1,800 square feet, or areas that require adjacent color pours due to designs, shall have this work done in strict accordance with the manufacturer’s installation requirements with adjacent poured layer surface being flush throughout. The installer shall employ proper techniques to ensure that no gaps or separation will occur. All cold joints must be coated with binder prior to the application of the adjacent layer.
   d. Design: Where colored pattern is required, place colored, design material as soon as previously placed material is sufficiently cured, using primer or adhesive if required by manufacturer’s written instructions.
3. Edge Treatment: As indicated on Drawings. Fully adhere edges to substrate with full coverage of substrate. Maintain fully cushioned thickness required to comply with performance requirements.
3.5 INSTALLATION OF LOOSE-FILL SURFACING

A. Apply components of loose-fill surfacing according to manufacturer's written instructions to produce a uniform surface.

B. Edging: Place and permanently secure edging in place and attach units to each other.

C. Loose Fill: Place loose-fill materials to required depth after installation of playground equipment support posts and foundations.

D. Grading: Uniformly grade loose fill to an even surface free from irregularities.

E. Compaction: After initial grading, mechanically compact loose fill before finish grading.

F. Finish Grading: Hand rake to a uniformly smooth finished surface and to required elevations.

3.6 FIELD QUALITY CONTROL

A. Testing Agency Engage a qualified testing agency to perform tests.

B. Perform the following tests with the assistance of a factory-authorized service representative:

1. Perform "Installed Surface Performance Test" according to ASTM F 1292 for each protective surfacing type and thickness in each playground area.

C. Playground protective surfacing will be considered defective if it does not pass tests.

D. Prepare test reports.

3.7 PROTECTION

A. Prevent traffic over seamless surfacing for not less than 48 hours after installation.

END OF SECTION 321816
SECTION 328400 - PLANTING IRRIGATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes automatic irrigation system with supplementary items necessary to complete installation, including labor, equipment, materials, and competent supervision.

B. Water source to be municipal.

1.2 RELATED DIVISIONS

A. REMAINDER OF DIVISION 32 - EXTERIOR IMPROVEMENTS

B. DIVISION 03 - CONCRETE

C. DIVISION 22 - PLUMBING

D. DIVISION 26 - ELECTRICAL

E. DIVISION 31 - EARTHWORK

F. DIVISION 33 - UTILITIES

1.3 PERMITS AND INSPECTIONS

A. Obtain and pay for permits and arrange inspections required for Work of this section.

B. Furnish copies of applicable permits and approval notices to Owner’s Representative prior to requesting final payment.

1.4 QUALITY ASSURANCE

A. Visit site prior to formulating Bid.

B. Installer Qualifications: Minimum three (3) years’ experience installing systems of this scope and type.

C. Ensure competent English-speaking irrigation foreman is on site when irrigation work is in progress. Designate foreman by name, in writing, to Owner’s Representative. Provide foreman’s telephone mobile/pager phone numbers.

   1. Should dominant language of crew be other than English, Foreman must be fluent in that language.

D. Include first two years winterization and following spring start-up services.
1.5 QUALITY CONTROL

A. Applicable requirements of accepted Standards and Codes, in effect at Date of Issue of Contract Documents, apply to Work of this section, including, but not necessarily limited to following:

1. American Society for Testing and Materials (ASTM)
2. Uniform Plumbing Code (UPC)
3. National Electrical Code (NEC)
4. National Sanitary Foundation (NSF)
5. American Society of Irrigation Consultants (ASIC)
6. Irrigation Association (IA)
7. Plastic Pipe and Fittings Association (PPFA)

1.6 TESTS

A. Perform tests in presence of Owner’s Representative.

1. See applicable paragraphs under PART 3 - EXECUTION, this Section.

1.7 SUBMITTALS

A. Product data: Submit each item in this Article according to the Conditions of the Contract and Section 01 3300. Electronic PDF format is preferred. Otherwise, submit six (6) sets of data sheets. Originals or first-generation copies are acceptable. Faxed sheets and copies of faxes are not acceptable.

1. Controller including decoders
2. Flow Sensor
3. Rain Sensor
4. Valves
   a. Master Valve
   b. Automatic Remote Control Valves (RCV)
   c. RCV Drip Assemblies
   d. Manual, including Drain
   e. Quick-coupling, including Keys and Swivel Hose Els
5. Sprinkler Heads and Nozzles, all types
6. Drip Tubing and Fittings
7. Root Watering Systems
8. Valve and Splice Boxes
9. PVC Pipe and Fittings
10. Solvent Primer and Cement
11. Low Voltage Communication Wire and Control Wire
12. Below-grade Electrical Splice Waterproofing Materials and Methods
13. Trench Marking Tape

B. SUBMITTAL data sheets shall be annotated to be project-specific relating to: model; size; pressure-rating; configuration; options; operating characteristics (voltage, etc.). Submittals not so marked will be returned without action. Data sheets may be down-loaded from Manufacturers’ web sites provided they include pertinent technical information.

C. Field Test Reports. Mainline hydrostatic pressure test results.

D. Maintenance and Operating (M&O) Instruction Manuals. See paragraph 1.10, C., below.
1.8 DELIVERY, HANDLING, AND STORAGE

A. Procure, pack, ship, deliver, receive, handle, store, and prepare and install materials and equipment in such manner as to protect from damage due to weather, jobsite activities, vandalism, thievery, or other cause.

B. Coordinate on-site material storage with Owner’s Representative.

1.9 WARRANTY

A. Guaranty labor and material for new Work two (2) years from date of acceptance.

1.10 MAINTENANCE AND OPERATING INSTRUCTIONS

A. Following Punch List completion, perform “walk-through” of completed system and include in bid an allowance for additional four (4) hours instruction of Owner maintenance personnel. Coordinate demonstration and instruction with Owner’s Representative. Use Record Documents and Maintenance and Operating Manual as basis of instruction.

B. Not later than forty-five (45) days following completion of work and prior to application for acceptance and final payment, submit to Owner’s Representative, two (2), 3-ring binders titled MAINTENANCE AND OPERATING INSTRUCTIONS FOR THE FREDERICKSBURG WATERFRONT PARK IRRIGATION SYSTEM. Request digital files of final Irrigation Plans and Details from Architect for use in generating “AS-BUILTS”. Include following in each binder:

1. Cover Sheet indicating installing Contractor name, address, phone and fax numbers, e-mail address, and Dates of Warranty.
2. One (1) Half-scale Blackline copy of APPROVED Record Drawings (“AS-BUILTS”).
3. One (1) Set of APPROVED submittals of above-listed irrigation system equipment.
4. Suggested Operating Schedule indicating Controller program required (Zone run times in minutes per day and days per week) to provide desired amount of water to each area under local, mid-summer, “no-rain”, conditions.
5. Description of procedures to be followed for Winterization and Spring Start-up of system.

C. In addition to M&O Binders, provide:
1. Electronic file of Record Document Drawings (“AS-BUILTS”) in format/version required by Owner.

1.11 EXTRA STOCK AND SPARE PARTS

A. At walk-through, deliver following items, new and unused, in original packaging, to Owner’s Representative with Packing List. Insert copy of signed Packing List into M & O Manuals.

1. Two (2) Q.C.V. Keys with Swivel Hose Ells.
2. Two (2) Q.C.V. Cover Keys.
3. Two (2) formed and welded 1/2” diameter welded-wire valve keys, 30” long, for operating small in-ground manual valves and automatic valve flow-controls, Weather*matic #907, or equivalent by Buckner.
4. Two (2) Controller cabinet keys.
5. Two (2) nut-drivers for valve and splice box lid bolts.
PART 2 - PRODUCTS

2.1 GENERAL

A. Provide new materials conforming to applicable standards. Conflicts between or among Standards and Documents will be addressed by Architect upon written request. Generate Request for Information (RFI) form.

2.2 IRRIGATION EQUIPMENT

A. Basis-of-Design Products: Subject to compliance with requirements, provide:

5. Remote Control Zone Valves (Drip): XCZ Series, sizes and models per plan, manufactured by Rain Bird Corporation, Tucson, AZ.
6. Drip Tubing: Model XFS-CV, pressure-compensating drip tubing with integral check valve, with matching 17mm barbed insert fittings, manufactured by Rain Bird Sprinkler Mfg. Corp., Tucson, AZ, or equal by Netafim USA, Fresno, CA.
7. Tree Root Watering System: Model RWS-M-B-C-1402 Series with integral 0.5 GPM bubbler and check valve, and RWS Sand Sock, manufactured by Rain Bird Corporation, Tucson, AZ.
8. Turf Rotors: 5000 Plus Series, 5006+SAMSS, 6” pop-up height with SAM feature and stainless steel riser, manufactured by Rain Bird Corporation, Tucson, AZ.
11. Quick-Coupling Valves: Model 44NP by Rain Bird with matching Keys and Swivel-hose ells for connection to ¾” hose.
12. Isolation and Manual Shut-Off Valves: PVC, Safety Block, full-port model, 150 PSI working pressure; Single Union, manufactured by DURA Plastic Products, Beaumont, CA., or comparable products by one of the following:
   a. SPEARS manufacturing
   b. NIBCO
14. Control Wire and Wire Splice Waterproofing: Low Voltage (24Vac) Wire: Type PE, UL Labeled, #14 AWG, single, solid conductor, sprinkler wire, P7079D, manufactured by Paige Electric Corporation. Color-code as follows:
   a. Valve power: RED
   b. Valve common: WHITE
c. Electrical Wire Waterproofing: Gel-filled insulator tube, with non-hardening gel and snap-cover, rated to 600 Volts: DBY-6 or DBR-6 manufactured by 3M Company, Electrical Products Division, Austin, TX.

15. PVC pipe, fittings, and primer and solvent cement. Pipe and fittings marked by manufacturer with ASTM designations and pressure rating, and free from cracks, blisters, dents, or other damage.

a. Mainlines and laterals:

   (1) Pipe: SCH-40 PVC, ASTM D-1784, ASTM D-1785, solvent-weld joints, manufactured by Cresline Plastic Pipe Co., Inc., or comparable products by one of the following:
       (a) J-M Manufacturing Company, Inc.
       (b) Silver-Line Plastics.

   (2) Fittings: SCH-40, solvent-weld, or threaded to match equipment, ASTM D-1784, ASTM D-2466, manufactured by LASCO Fittings, Inc., or comparable products by one of the following:
       (a) DURA Plastic Products, Inc.
       (b) SPEARS Manufacturing.

b. PVC primer and solvent:

   (1) Primer: F-656, NSF and UPC labeled, manufactured by Christy’s, or comparable products by one of the following:
       (a) Hercules
       (b) Weld-On.

   (2) Solvent Cement: ASTM D-2564, NSF and UPC labeled, manufactured by Christy’s, or comparable products by one of the following:
       (a) Hercules
       (b) Weld-On.


17. Valve boxes: VB Series, Model, high-density polyethylene (HDPE) with bolt-down “T” type black lids. Provide matching extensions. Splice boxes: Nominal 10” diameter or 12” square, 12” deep with extensions, manufactured by Rain Bird Sprinkler Mfg. Corp., Tucson, AZ, or comparable products by:

   a. Carson Industries, Specification Grade, Glendora, CA.


19. Trench Marking Tape: Detectable, solid aluminum foil core running full length and width of tape, and encased in protective, high visibility, color coded, inert plastic jacket, manufactured by Christy’s, Seton, or approved substitution. Provide 2” width blue tape with “Caution Water Line Buried Below”.

PART 3 - EXECUTION

3.1 GENERAL

A. Visit site prior to formulating a Bid. Become familiar with site conditions at time of Bid.

B. Examine Contract Documents. If discrepancies affecting Work of this Section are noted, bring to attention of Architect in writing. Generate Request for Information (RFI).

C. Insure placement of sleeves as construction progresses.
D. Make field measurements for installation of Work noting relationship of irrigation work to that of others. Coordinate with other trades (landscaping, concrete, waterproofing, electrical, mechanical, and other trades). Lay-out project essentially as indicated on Irrigation Plans, making adjustments for variations in planting bed lines and job conditions. Refer to applicable Landscape, Architectural, Structural, Mechanical, and Electrical Drawings for work in areas involved.

E. Coordinate installation with General Superintendent and Owner’s representative.

F. Protect tree root systems and other landscaping, walls, footings, foundations, waterproofing system, drainage system, site electrical system, and other site utilities and features, from damage due to Work of this Section. Report damage to work of other trade(s) to Owner’s Representative immediately. Arrange or make repairs.

G. Complete Work in stages. Once begun, complete section without undo delay. Do not leave project unmanned unless progress is delayed by job conditions or weather. Project Superintendent and Irrigation Foreman must agree relating to leaving project unmanned.

3.2 SYSTEM LAYOUT, EXCAVATION, BACKFILL, AND PIPE INSTALLATION

A. Locate, identify, and mark existing and new below-grade utilities including site-lighting electrical wire paths and drainage systems.

B. Piping installation:

1. Use mechanical or hand trenching method as conditions indicate. If mechanical, excavate with minimum-width trencher chain. Employ open-trench method. Use of vibratory plow not permitted. Excavate to depth of within 1” of pipe invert, provided suitable base, i.e., no sharp edges or rocks over ½” in diameter available. If trench bed is unacceptable, excavate to 1” below invert and provide clean fill base on which to lay pipe. Use open trenching, boring, and hand-excavation, as situation warrants. Regardless of which method of pipe installation is used, manually “pot-hole” (dig test pit) at existing utilities to be crossed to determine actual location and depth. Exercise caution to avoid damage to tree root systems, plant materials, waterproofing, utilities, site lighting, and drainage system. Rerouting may be required.

2. Cut plastic pipe square and true with hand saw or pipe-cutting tool. Remove burrs. Make solvent-weld joints in accordance with manufacturer’s recommendations relating to preparation, temperature, humidity, and cure-time. Ensure proper application of primer and solvent. Do not apply excess of primer or solvent. Wipe excess solvent from each made connection. Allow connections to cure in accordance with solvent manufacturer’s recommendations. Ensure no stress to pipe connections where belled-ends, couplings, or fitting shoulders bear on trench bed.

C. Following approval of Owner’s Representative, existing work to remain may be cut, drilled, bored, bored beneath, altered, removed, or removed and replaced, as necessary for installation of Work. Repair or replace existing work so disturbed in such manner as to render it complete, whole, and equal to adjacent undisturbed areas in finish and quality.

D. Below-grade low voltage valve wiring: Lay in same trench, and at same invert, as mainline. See paragraph below.

E. Backfilling: Initial 6” of backfill: Containing no foreign matter, no frozen or deleterious materials, and no rock larger than ½” diameter. Carefully place fill material around pipe and wire to depth.
of 6” above pipe and hand-tamp. Remainder of backfill, consisting of excavated materials less rock larger than ¾” diameter, frozen materials, or foreign or deleterious matter: lay-up in maximum 6’ lifts and mechanically tamp to compaction to match that of surrounding undisturbed area. Trench settling will not be tolerated. Upper 6” to 8” of backfill: Topsoil quality and containing no foreign material or trenching spoils. Record pipe and wire locations daily on field-kept Record Drawings.

3.3 CONTROLLER INSTALLATION

A. Coordinate final location and primary power in field. Install, wire, ground, and test in accordance with Manufacturers’ recommendations.

B. Provide Conduit(s) to soil.

3.4 FLOW SENSOR – MASTER VALVE INSTALLATION

A. Install, wire, and test in accordance with Manufacturers’ recommendations.

B. See also Detail on Drawings.

3.5 SPRINKLER INSTALLATION

A. Set perpendicular to finish grade. Maintain 4” space from cap to nearest hardscape. Re-plumb at completion of installation and during warranty period.

B. See also Details on Drawings.

3.6 DRIP TUBING INSTALLATION

A. Install PVC drip header 8”-12” below finish grade. Install drip tubing approximately 4” below finish grade. Staple tubing at maximum 10’ intervals and at all changes of directions.

B. See also Details on Drawings.

3.7 TREE ROOT WATERING SYSTEM

A. Place number of units per plan spaced evenly around root ball. Provide sand sock and fill unit with ½” washed gravel.

B. See also Details on Drawings.

3.8 LOW VOLTAGE CONTROL WIRE INSTALLATION

A. Lay wire along-side, and at same invert as irrigation mainline piping. Ensure pipe does not bear directly on wires. Provide additional slack at changes of direction. Wiring shall at no time be installed taut. Maintain color scheme throughout installation.
1. Splices: Waterproof splices and permit only in valve boxes or splice boxes, i.e., no direct-buried splices between boxes.

2. Provide surge suppression on 2-wire path per manufacturer’s recommendations.

3.9 AUTOMATIC VALVE INSTALLATION

A. Set in valve boxes with adjusting handle and solenoid vertical-up. Provide line-size isolation ball valve at inlet of each zone valve. Wiring shall be of sufficient length to permit decoder and solenoid to be brought to surface. Coil extra wire neatly in valve box. Provide filter fabric and 4” washed gravel under valve and splice boxes. Bring gravel neatly to pipe invert. Do not cover system components.

3.10 MANUAL AND QUICK-COUPLING VALVE INSTALLATION

A. Locate where indicated. Provide access.

B. See also Details on drawings

3.11 TEST, CHECK, START-UP, AND ADJUST

A. Mainline Hydrostatic Leak Test: Flush, vent, cap, and test new portions of mainline for leaks from Point of Connection (POC) to RCV assemblies: Test Pressure: 150 PSI; Time: 2 hrs. Allowable pressure drop: Not-to-exceed 5 PSI. Provide pump and necessary equipment to accomplish test. Make repairs and re-test until acceptable results obtained. Backfilling may be done prior to pressure test at Contractor option. Pressure test may be done from source to closed isolation zone valves and may be done in sections. Hydrostatic test results shall be witnessed and signed-off by Owner’s Representative. Laterals: Test at system normal operating pressure. Make repairs and re-test until acceptable results obtained.

B. Flushing: After piping, valves, and sprinkler connection piping are in place and connected, but prior to installation of sprinklers, flush piping under full head of water until discharge runs clear and clean. Install sprinkler internals and proceed to adjust system.

C. Adjustment: Fully OPEN manual valves and automatic valve flow-controls. Activate Satellite and adjust valve flow controls and sprinkler heads for optimum performance and to prevent over-spray onto walks, pavement, windows, and structures. Adjustments may include changes in nozzle sizes, and/or degrees of arc, and/or distance of throw. Overthrow onto walks, buildings, and windows not permissible.

D. Programming: Program controller to provide the desired weekly amount of water to the various plant types for typical mid-summer conditions. Adjust run times and start times as needed to optimize watering. Utilize Flow Management to minimize the water window and maximize use of the designed flow capacity.

E. Request Punch List after system has been operated through minimum three (3) complete automatic “test” cycles and Contractor-noted deficiencies have been corrected.

F. Coverage Test: Following completion of Punch List items, perform coverage test in presence of Owner’s Representative. Coordinate “walk-through” and demonstration with Owner’s Representative and maintenance personnel.
3.12 CLEAN-UP

A. At completion of Work, remove leftover irrigation-related materials, debris, and equipment from site and dispose of in safe and legal manner.

B. Leave site in at least as neat and clean a condition as when irrigation installation was begun.

3.13 CLOSE-OUT

A. Refer also to DIVISION I - GENERAL REQUIREMENTS, Section 01 7700.

B. At completion of demonstration walk-through and instruction of Owner personnel, and prior to application for final payment, ensure that following are complete:

1. Permits required for Work of this Section: Signed-off by appropriate party(s) and furnished to Owner’s Representative.
4. Record Document (“AS-BUILT”) drawings: APPROVED and included in Maintenance & Operating Manuals with other required items.
5. Maintenance & Operating Manuals: APPROVED and delivered to Owner’s Representative.

END OF SECTION 328400
SECTION 329100 - PLANTING SOIL

PART 1 - GENERAL

1.1 GENERAL REFERENCE

A. The work of this Section is integral with the whole of the Contract Documents and is not intended to be interpreted outside that context.

1.2 DESCRIPTION OF WORK

A. This Section specifies administrative and procedural requirements for planting soil including, but not limited to, the following:
   1. Planting soil components material acquisition.
   2. Testing and analysis for specification conformance.
   3. Inspection and testing of subgrade for preparation of subgrade.
   4. Preparation of planting soil mixes and testing for conformance and quality control.
   5. Preparation of Mock-up of Planter Bed.
   6. Preparation of Mock-up of trees in decomposed granite (Sand-Based Structural Soil).
   7. Installation and placement of planting soils.
   8. Compaction of planting soils.
   10. Coordination with other contractors.
   11. Clean-up.
   12. Project-close out and Warranty.

B. References to other Sections are given that would duplicate provisions in this Section.

1.3 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to all Sections. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all.

1.4 RELATED WORK UNDER OTHER SECTIONS

A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that directly relate to work of this Section include, but are not limited to:
   1. Section 312000, Earth Moving, Part 3 Execution. Execution stipulations for Earthwork apply to Execution under the Planting Soil System Section.
   2. Section 321540 – Stabilized Decomposed Granite Surfacing
3. Section 328400 – Planting Irrigation
4. Section 329200 - Lawns and Grasses
5. Section 329201 – Meadow Planting
6. Section 321300 – Exterior Plants

1.5 DEFINITIONS

A. Definitions/References:

1. Finish Grade: Elevation of finished surface of planting soil after settlement.
2. Planting Soils for Soil Profiles: Soil produced off-site from off-site sources by homogeneously blending mineral soils or sand with mature and stable organic compost to produce specified planting soil blends.
3. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing planting soils.
4. Contractor: The Contractor performing the work specified herein.
5. ASA: American Society of Agronomy
8. Final Acceptance: Final Acceptance shall be the day on which the project is 100% complete and accepted by the Landscape Architect and Owner, including “Punch List” items. Maintenance and Warranty work shall commence at Final Acceptance.

B. Testing/Testing Agency

1. Refer to this Section, 1.7.

1.6 QUALITY ASSURANCE

A. Testing Laboratory Qualifications: An independent laboratory, recognized by the State Department of Agriculture that has, and must be able to demonstrate that they have, the experience and capability to conduct the testing indicated and that they specialize in types of tests to be performed.

1. Employ at Contractor’s expense a qualified independent testing and inspection laboratory acceptable to the Landscape Architect and Owner to perform all tests and certifications as specified herein including both laboratory and field-testing. Tests shall be made in strict compliance with the standards of the AOAC, ASTM, or as described herein.
   a. It is the responsibility of Landscape Contractor in conjunction with the Soil Supplier to submit material for the soil and compost tests.

B. Contractor Experience

1. Candidate Contractor shall submit written documentation of at least five years of contracting and landscape construction experience completing projects of similar scope, complexity and value.
2. Candidate Contractor shall submit written documentation of at least five projects in which engineered blended horticultural soil was used.

3. Candidate Contractor shall submit at least three project references including project address, dollar value, owner’s and landscape architect’s contact information (name, phone, and email).

C. Critical Path Processing - Soils Testing Report Submittals:

1. CRITICAL PATH PROCESSING: The Contractor shall be responsible for recognizing that these critical project materials warrant timely attention, that the procurement process and testing protocols to achieve approved materials SHALL BE CONSIDERED A LONG LEAD TIME ITEM. Under no circumstance shall failure to comply with all specification requirements be a reason for substitution of unacceptable material(s).

D. Construction Observations

1. The Contractor shall not place any Soil Blend on Subgrade prior to inspection and approval by the Landscape Architect or Owner’s Representative for compliance with grading and compaction and infiltration specifications. At locations selected by the Landscape Architect, the Contractor shall submit five spot grades of the subgrade to the Landscape Architect as described in Section 312000 – Earth Moving. The Contractor shall request inspection seven days before proceeding.

2. The Contractor shall not place any Planting Bed Soil, Horticultural Subsoil or Sand-Based Structural Soil on prepared subgrade prior to inspection and approval by the Landscape Architect for compliance with depth, grading and compaction specifications. The Contractor shall request inspection seven days before proceeding.

3. The Contractor shall not place any Planting Bed Soil on Horticultural Subsoil prior to inspection and approval by the Landscape Architect for compliance with depth, grading and compaction specifications. The Contractor shall request inspection seven days before proceeding.

4. The Contractor shall not place 3/8-inch Crushed Stone on Sand-Based Structural Soil prior to inspection and approval by the Landscape Architect or Owner’s Representative for compliance with depth, grading and compaction specifications. The Contractor shall request inspection seven days before proceeding.

E. Regulatory Requirements

1. Comply with laws, regulations, and quarantines for agricultural and horticultural products.

2. Contractor shall submit certification that all soil blend components and all soil blends meet all environmental standards of the Commonwealth of Virginia.

F. Testing In-Place Soils

1. The Contractor shall provide samples of imported materials for testing as required by the Specifications or as requested by the Landscape Architect, as well as assist the Landscape Architect in performing any field tests deemed necessary by the Landscape Architect to ascertain the acceptability of the Work. No additional payment, in excess of the accepted Contract price, shall be made for the Contractor's assistance in this regard. In the event of unsatisfactory test results, the Contractor shall bear the cost of additional sampling, delivery, inspection and testing charges necessary to ascertain that the Work has been corrected to conform to the Specifications.

G. Planting Soil Testing Protocol

1. The Appendix summarizes the process of planting soil testing, submittal, and evaluation.
1.7 TESTING, SUBMITTALS AND MOCK-UPS

A. Certificates: Provide certificates required by authorities having jurisdiction, especially for any composted materials. Contractor shall submit certification that all soil blend components and all soil blends meet all environmental standards of the Commonwealth of Virginia.

B. Testing for Subgrade, Planting Soil Components and Planting Soil Mixes: Testing is required at the following intervals:

1. Testing of individual components (Base Loam, Sand, and Compost) for planting soil mixes. Tests are as described in this Section 329100, 1.7. Compost maturity and stability as per 2.1.L.1.b, shall be tested every month after initial acceptance and during and until final blend production.
2. After test results for components have been accepted, create sample mixes of each planting soil mix and perform tests described in Section 329100, 1.7.
   a. Planting Soil Mixes shall be compliant to Section 329100, 2.2.
3. After the test results for planting soil mixes have been accepted, and during the production of planting soils, test each planting soil mix stockpile blended for organic matter content, gradation and pH. Approval is required before shipment. Testing applies to all soil layers of the planting profile.
4. In-place tests: Compaction tests of each type of material placed in accordance with Section 329100, paragraph 1.7, D.1. Infiltration tests shall be in accordance with Section 329100, paragraph 1.7, D.2.
5. Testing of Subgrade: Prior to placement of the planting soil profile, test the subgrade as described in this Section, 3.1 E. and 3.4 B. Coordinate the testing of the subgrade with the Sitework Contractor before the planting soil profile is placed.

C. Test Reports: Submit certified reports for tests as described in this Section.

1. Mechanical gradation (sieve analysis) shall be performed and compared to the USDA Soil Classification System using sieve size nos. 10, 18, 35, 60, 140 and 270. Percent clay (0.002 mm) shall be reported separately in addition to silt (ASTM D-422-63, hydrometer method).
2. The silt and clay content shall be determined by a Hydrometer Test of soil passing the #270 sieve.
3. Chemical analysis shall be undertaken for Ammonium Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, Aluminum, Iron, Manganese, Lead, Cation Exchange Capacity, Soluble Salts, organic matter content, acidity (pH) and buffer pH.
4. Tests shall be conducted in accordance with Recommended Soil Testing Procedures for the Southeastern United States. Tests include the following:
   a. Test for soil Organic Matter by loss of weight on ignition.
   b. Test for soil CEC by exchangeable acidity method.
   c. Test for soil Soluble Salts shall be by the 1:2 (v:v) soil:water Extract Method.
   d. Test for Buffer pH by the SMP method.
   e. Tests for pH shall be conducted on a 1:1 soil to distilled water ratio.
5. Certified reports on analyses from producers of composted organic materials shall be required and new test reports shall be submitted when new sources are changed. Analyses shall include all tests for criteria specified in 2.1, L.
a. Hydraulic Conductivity tests shall be taken of samples during QA/QC testing at the Soil Supplier's facility. Samples from each stockpile for each soil blend shall be tested.

7. Testing Agencies: The following firms are acceptable testing agencies for the various components.
   a. Leaf Yard Waste Compost Stability Test and Herbicide Bioassay Test: Woods End Research Laboratory, P.O. Box 297, Mt. Vernon, ME, 04352, tel: 201.293.2457, fax: 201.293.2488.
   b. All other tests except those listed above: Certified Testing laboratory (CTL), 155 US Route 130, Bordentown, NJ 08508 tel: 609.298.3255, fax: 609.298.7288 or approved equal.

   a. Density tests shall be performed on samples collected at the Soil Supplier's facility, to obtain the optimum moisture content and maximum dry density values.
   b. At least four different moisture contents shall be used to create the Standard Proctor curve with the lowest being 10%±1%.

9. Test Results Timeliness
   a. All laboratory test results must be conducted within 90 days of submittal.

D. In-Place Testing

   a. In-place density tests shall be carried out at a rate of one test per each bed or separate tree planting location for each type of soil blend, i.e., for each layer in the soil profile, placed and subgrade within each bed.
   b. Density Test results shall be emailed to the Landscape Architect and Soil Scientist within two business days.
   c. ASTM D6938-08a instruments shall be standardized according to manufacturer's directions in the exact location where field measures will be made. Standardizations shall be completed twice a day.

2. In-place infiltration tests shall be performed using Turf-Tec IN2-W Infiltrometer utilizing manufacturer's operating instructions including one pre-soak and refilling the instrument before final measurement. Turf-Tech IN2-W Infiltrometer as manufactured by Turf Tec International, 1471 Capital Circle NW, Suite #13, Tallahassee, FL 32303. Order Line 800-258-7477, Phone 850-580-4026, Fax 850-580-4027.
   a. In-place infiltration tests shall be carried out at a rate of one test per each bed or separate tree planting location for each type of soil blend placed and subgrade within each bed.
   b. Infiltration rates shall be compliant with rates specified for each blend.
   c. Infiltration Test results shall be emailed to the Landscape Architect and Soil Scientist within two business days.
3. In addition, in-place soil blends may be sampled and tested by the Owner. Tests for gradation and organic matter content shall be compliant with Specifications for that blend.

E. Samples: Prior to ordering the below listed materials, submit representative composite samples to the Landscape Architect, Owner and Soil Scientist for selection and approval. Representative composite samples shall be composed of at least five equal-sized subsamples mixed thoroughly and resampled for submittal. Do not order materials until Landscape Architect’s, Owner’s Representative’s and Soil Scientist’s approval has been obtained. Delivered materials shall closely match the approved samples.

1. Components
   a. Compost: duplicate samples of 1 gallon for initial evaluation and each month while soils are being produced.
   b. Base Loam: duplicate samples of 1 gallon.
   c. Medium to Coarse Granitic Sand: duplicate samples of 1 gallon.

2. Test Blends
   a. Planting Bed Soil: duplicate samples of 1 gallon.
   b. Sand-Based Structural Soil: duplicate samples of 1 gallon.
   c. Horticultural Subsoil: duplicate samples of 1 gallon.
   d. High Use Turf Soil: duplicate samples of 1 gallon.

3. Production Stockpiles
   a. Planting Bed Soil: duplicate samples of 1 gallon.
   b. Sand-Based Structural Soil: duplicate samples 1 gallon.
   c. Horticultural Subsoil: duplicate samples of 1 gallon.
   d. High Use Turf Soil: duplicate samples of 1 gallon.

4. Materials
   a. Filter Fabric Mirafi 140N or equal: duplicate one square foot samples.
   b. 3/8-inch Crushed Stone: duplicate samples of 1 gallon.
   c. Perforated Aeration 4-inch pipe: duplicate one-foot samples.
   d. Nonperforated Aeration 4-inch pipe: duplicate one-foot samples.
   e. Document Certification that compost feed stock is leaf/yard waste.

F. Sources for Base Loam, Sand, and Compost: Submit information identifying sources for all soil components and the firm responsible for mixing of planting soil mixes.

1. Landscape Architect, Soil Scientist and Owner shall have the right to reject any soil supplier.

2. Soil mix supplier shall have a minimum of five years experience at supplying custom planting soil mixes.

3. Submit supplier name, address, telephone and fax numbers and contact name.

4. Submit certification that accepted supplier is able to provide sufficient quantities and qualities of materials for the entire project.

5. Final approval of soil supplier shall be made after on-site review of supplier’s facility by the Soil Scientist.

1.8 DELIVERY, STORAGE AND HANDLING

A. Refer to Division 1 or General Requirements, for overall material handling requirements.
B. In addition, the following provision is established: Material should not be handled or hauled, placed or compacted when it is wet as after a heavy rainfall or is frozen. Soil should be handled only when the moisture content is within the moisture range specified in 329100, 1.10.

C. Store and handle packaged materials in strict compliance with manufacturer’s instructions and recommendations. Protect all materials from weather, damage, injury and theft.

D. Sequence deliveries to avoid delay. On-site storage space is extremely limited and shall be permissible only with written notice from the owner. Deliver materials only after preparations for placement of planting soil have been completed.

E. Prohibit vehicular and pedestrian traffic on or around stockpiled planting soil.

F. Blended soil mixes that are to be stockpiled longer than two weeks shall not be placed in mounds greater than six feet high. If soil stockpiles greater than six feet high are present longer than two weeks then the contractor shall break down and disperse soil so that mounds do not exceed the six foot height restriction for longer than two weeks.

G. Vehicular access to the site is restricted. Before construction, the Contractor shall submit for approval a plan showing proposed routing for deliveries and site access.

1.9 MOCK-UPS

A. General: If the original mock-up is not approved, the Contractor shall provide additional mock-ups, as required, at no cost to the Owner until an approved mock-up is obtained. Mock-up shall be approved before final soil placement is begun. The approved mock-up shall become the standard for the entire job. Mock-up shall be built in a location as directed by Landscape Architect and shall not be constructed on a location becoming part of the final work, unless otherwise noted, and shall remain undisturbed until all work is completed. When so requested, build mock-ups of different materials simultaneously to allow the Landscape Architect to review all elements at once. Demolish and remove mockups when directed. Build mockups to comply with the following requirements, using materials indicated for the completed Work, including the same base construction. All soil tests shall be compliant. Standard Proctor tests of all soils shall be submitted for evaluation and review, field testing agency equipped with various compaction and moisture testing instruments, contractor equipped with a range of compaction means, and soils with compliant moisture content.

B. Structural Soil Mockup: Upon acceptance of all materials and prior to installing Sand-Based Structural Soil, the Contractor shall construct mock-up on site as indicated below. Build mock-up of Structural Soil that will support Decomposed Granite and Synthetic Turf to allow the Landscape Architect to review the installation methods. Approved materials required include Sand-Based Structural Soil, 3/8” Crushed Stone, Aeration Pipe and Filter Fabric as specified.

C. Plant Bed Soil Mockup: Upon acceptance of all materials and prior to installing Horticultural Subsoil and Planting Bed Soil, the Contractor shall construct mock-up on site as indicated below. Build mock-up of Horticultural Subsoil and Planting Bed Soil in a bed to allow the Landscape Architect to review the installation methods. Approved materials required include Horticultural Subsoil and Planting Bed Soil as specified.

1.10 PROJECT/SITE CONDITIONS

A. Soil Moisture Content
1. Contractor shall not move, blend or grade 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, nor when it is frozen. Apply water, if necessary, or allow drying to bring soil moisture between 60% of optimum moisture content on the dry side of optimum and optimum moisture content as determined by ASTM D698 for compaction, grading and plantings.

2. Field Soil Moisture Screening Test
   a. Form soil in palm of hand, if soil retains shape and crumbles upon touching, the soil may be worked.
   b. If the soil will not retain shape it is too dry and shall not be worked.
   c. If the soil retains shape and will not crumble, it is too wet and shall not be worked.
   d. If the soil glistens or free water is observed when the sample is patted in the palm of hand the soil is too wet and shall not be worked.
   e. Field Moisture Screening Test shall not be used for compliance to Specification Requirements.

1.11 ACCEPTANCE
A. Request for Acceptance: In writing, request Landscape Architect’s and Soil Scientist’s inspection for acceptance at least 10 days in advance of preferred inspection date. Do not request inspection for acceptance until work is 100% complete and in compliance with the Contract requirements.
B. Final Acceptance: Final Acceptance shall be the day on which the project is 100% complete and accepted by the Landscape Architect and Owner, including “Punch List” items. Maintenance and Warranty work shall commence at Final Acceptance.

1.12 WARRANTY AND MAINTENANCE
A. Warranty: Provide written warranty agreeing to remove and replace work that exhibits defects in materials or workmanship. Defects shall include settlement, poor drainage, anaerobic soils, compacted soils or any other conditions that are detrimental to healthy plant growth. Length of Warranty shall be two years from Final Acceptance.
B. Contractor shall begin maintenance immediately after placement. Contractor shall repair slope erosion, remove silt and clay deposits in low areas, maintain soil levels around plant root balls and soil saucers, and monitor irrigation rate and frequency to maintain soil moisture content within horticultural sustaining limits.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS
A. Soil Performance Criteria
1. All soil blends specified below shall meet all parameters as noted.
   a. Soil blends shall be Free-Draining: ACHIEVING MINIMUM SATURATED HYDRAULIC CONDUCTIVITY VALUE (SHCV) FOR EACH BLEND IS OF PARAMOUNT IMPORTANCE. SHVC for each soil blend is specified below.
b. Soil blends shall NOT be Over-Compacted. COMPLIANCE WITH IN-PLACE COMPACTION VALUE FOR EACH SOIL BLEND IS OF PARAMOUNT IMPORTANCE. Compaction value for each soil blend is specified below.

B. General

1. All planting mix material shall fulfill the requirements as specified and be tested to confirm the specified characteristics.

2. Samples of individual components of planting soil mixes in addition to blended plant mixes shall be submitted by the Contractor for testing and analysis to the approved testing laboratory. Comply with specific materials requirements specified.
   a. No base component material or soil components for plant mixes shall be used until certified test reports by an approved agricultural chemist have been received and approved by the Landscape Architect and Soil Scientist.
   b. As necessary, make any and all soil mix amendments at any time until completion.

3. The Landscape Architect and Soil Scientist may test at their discretion all soil samples for Quality Control and Quality Assurance. If samples fail to be compliant with specifications, the Contractor shall pay all testing fees.

C. Base Loam

1. The Contractor shall supply Base Loam from off-site sources. Base Loam as required for blending with other components shall be a naturally occurring soil formed from geologic soil-forming processes without admixtures of sand or organic matter sources (composts). Base Loam shall be free of subsoil, Horizon B and C, large stones, earth clods, sticks, stumps, clay lumps, roots or other objectionable, extraneous matter or debris. Base Loam shall also be free of quack-grass rhizomes, Agropyron Repens, and the nut-like tubers of nutgrass, Cyperus Esculentus, and all other primary noxious weeds. Base Loam shall not be delivered or used for planting while in a frozen or muddy condition. Base Loam for mixing shall conform to the following grain size distribution for material passing the #10 sieve:

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<th>U.S. Sieve Size Number</th>
<th>Percent Passing Minimum</th>
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2. The ratio of the particle size for 80% passing ($D_{80}$) to the particle size for 30% passing ($D_{30}$) shall be 8 or less ($D_{80}/D_{30} < 8$). Maximum size shall be one-inch largest dimension. The maximum retained on the #10 sieve shall be 15% by weight of the total sample. Tests shall be by combined hydrometer and wet sieving in compliance with ASTM D422 after destruction of organic matter by ignition. The organic content shall be between 4.0 and 8.0 percent by weight.

3. Chemical analysis shall be undertaken for Ammonium Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, Aluminum, Iron, Manganese, Lead, Cation Exchange Capacity, Soluble Salts, organic matter content, acidity (pH) and buffer pH.
D. **Sand**

1. Sand for Soil Mixes shall be uniformly graded medium to coarse sand consisting of clean, inert, rounded to sub-angular grains of quartz or other durable rock free from loam or clay, surface coatings, limestone, mica, calcareous materials and deleterious materials with the following gradation.

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2. Maximum size shall be one-inch largest dimension. The maximum retained on the #10 sieve shall be 10% by weight of the total sample. The ratio of the particle size for 70% passing (D70) to the particle size for 20% passing (D20) shall be 3.0 or less (D70/D20 <3.0). Tests shall be by combined hydrometer and wet sieving in compliance with ASTM D422 after destruction of organic matter by ignition. Sand pH shall be 7.2 or less.

E. **Leaf Yard Waste Compost**

1. Organic Matter for amending planting media shall be a stable, humus-like material produced from the aerobic decomposition and curing of Leaf Yard Waste Compost, composted for a minimum of one year (12 months). The Leaf Yard Waste Compost shall be free of debris such as plastics, metal, concrete or other debris. The leaf yard waste compost shall be free of stones larger than 1/2", larger branches and roots. Wood chips over 1" in length or diameter shall be removed by screening. The compost shall be a dark brown to black color and be capable of supporting plant growth with appropriate management practices in conjunction with addition of fertilizer and other amendments as applicable, with no visible free water or dust, with no unpleasant odor, and meeting the following criteria as reported by laboratory tests.

a. The ratio of carbon to nitrogen shall be in the range of 12:1 to 25:1.

b. Stability shall be assessed by the Solvita procedure. Protocols are specified by the Solvita manual (version 5.0). The compost must achieve a maturity index of 6 or more as measured by the Solvita scale. Stability tests shall be conducted by Woods End Research Laboratory, Mt. Vernon, Maine.

c. Herbicide injury result shall be zero by auxinic herbicide bioassay test.

d. Organic Content shall be at least 20 percent (dry weight). One hundred percent of the material shall pass a 3/8-inch (or smaller) screen. Debris such as metal, glass, plastic, wood (other than residual chips), asphalt or masonry shall not be visible and shall not exceed one percent dry weight. Organic content shall be determined by weight loss on ignition for particles passing a number 10 sieve according to procedures performed by the West Experiment Station at the University of Massachusetts, Amherst or equal as follows. A 50-cc sub-sample of the screened and mixed compost is ground to pass the number 60 sieve. Two to three grams (± 0.001g) of ground sample, dried to a constant weight at 105 degrees C is placed into a muffle furnace. The temperature is slowly raised (5C/minute) to 450C and maintained for three hours. The sample is removed to an oven to equilibrate at 105C and the weight is taken. Organic matter is calculated as loss on ignition.
e. **pH**: The pH shall be between 6.5 to 7.2 as determined from a 1:5 soil-distilled water suspension using a glass electrode pH meter American Society of Agronomy Methods of Soil Analysis, Part 2, 1986.

f. **Salinity**: Electrical conductivity of a one to five soil to water ratio extract shall not exceed 2.0 mhmhos/cm (dS/m).

g. **The compost shall be screened to 3/8 inch maximum particle size and shall contain not more than 3 percent material finer that 0.002mm as determined by hydrometer test on ashed material.**

h. **Nutrient content shall be determined by the University of Massachusetts Soil Testing Laboratory or equivalent laboratory and utilized to evaluate soil required amendments for the mixed soils. Chemical analysis shall be undertaken for Ammonium Nitrogen, Phosphorus, Potassium, Calcium, Aluminum, Magnesium, Iron, Manganese, Lead, Soluble Salts, Cation Exchange Capacity, soil reaction (pH), and buffer pH.**

**F. Filter Fabric**

1. Filter fabric shall be Mirafi 140N ([http://www.mirafi.com](http://www.mirafi.com)) or approved equal.

**G. 3/8-Inch Crushed Stone (CS)**

1. **3/8-inch stone shall be durable crushed stone consisting of angular fragments obtained by breaking and crushing solid or shattered natural rock, and free from a detrimental quantity of thick, flat, elongated or other objectionable pieces.**

2. **3/8-inch stone shall be free from clay, loam or other deleterious material and not more than 0.1% of satisfactory material passing the No. 200 sieve will be allowed to adhere to the crushed stone. 3/8-inch stone shall be double washed.**

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<td>#8 sieve</td>
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<td>#16 Sieve</td>
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**H. Perforated Aeration Pipe**

1. **Aeration pipe shall be 4 inch ADS Single Wall Corrugated Polyethylene Pipe, manufactured by ADS Company, Columbus, OH 43221, or approved equal. Pipe shall be manufacturer’s standard perforated configuration of suitable strength for the intended use. Jointing shall be made using manufacturer’s standard snap coupling type fittings.**

**I. Non-perforated Aeration Pipe**

1. **Aeration pipe shall be 4” ADS Single Wall Corrugated Polyethylene Pipe, manufactured by ADS Company, Columbus, OH 43221, or approved equal. Pipe shall be manufacturer’s standard non-perforated configuration of suitable strength for the intended use. Jointing shall be made using manufacturer’s standard snap coupling type fittings.**

2. **Aeration Pipe Cap: Provide metal pipe cap, Zurn Z400B Type ‘B’ Round Strainer with heel proof square openings and secured grate, provided by Zurn Industries, Specification Drainage Operation, 1801 Pittsburgh Avenue, Erie, PA, Tel: 855.663.9876, [www.zurn.com](http://www.zurn.com), or approved equal.**
2.2 PLANTING SOIL MIXES

A. Uniformly mix ingredients by either windrowing/tilling on an approved hard surface area or by processing through a screener. Organic matter shall be maintained moist, not wet, during mixing. Amendments shall not be added unless approved to extent and quantity by the owner and additional tests have been conducted to verify type and quantity of amendment is acceptable. Percentages of components, unless otherwise noted, will be established upon completion of individual test results for components of the various mixes. Approximate mixing ratios are provided, but may require adjustment, depending on the final materials. As necessary, the contractor shall adjust suggested ratios to produce compliant blends.

B. Planting Soil Mixes specified below are based on blends of Base Loam with approved organic matter and sand. After component percentages are determined by the Contractor, each planting soil mix shall be tested for physical and chemical analysis under 1.7 of this Specification Section.

C. Planting Bed Soil

1. Planting Bed Soil shall consist of a blend of approximately one part by volume of Sand, one part by volume of Base Loam and one part by volume of Leaf Yard Waste Compost (1S:1L:1C). Blending of the components shall be carried out with earth moving equipment or screener prior to placement. The components shall be blended to create a uniform mixture as determined by the Landscape Architect. The final mix shall have an organic content between 5.0 and 7.0 percent by weight and conform to the following gradation requirements for material passing a Number 10 sieve.

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3. Maximum size shall be one-half inch largest dimension. The maximum retained on the #10 sieve shall be 15% by weight of the total sample. The ratio of the particle size for 80% passing (D80) to the particle size for 30% passing (D30) shall be 8.0 or less, (D80/D30 <8.0). The final mix shall have a saturated hydraulic conductivity of not less than 2.0 inches per hour according to ASTM D2434 when compacted to a minimum of 85 percent Standard Proctor. Tests shall be by combined hydrometer and wet sieving in compliance with ASTM D422 after destruction of organic matter by ignition.

4. Chemical analysis shall be undertaken for Nitrate Nitrogen, Ammonium Nitrogen, Phosphorus, Potassium, Calcium Magnesium, Aluminum, Iron, Manganese, Lead, Cation Exchange Capacity, Soluble Salts, organic matter content, acidity (pH) and buffer pH.

5. pH shall be 6.0 to 6.5.

D. Sand-Based Structural Soil

1. Base Loam, Sand and Compost, each as specified above, shall be combined in an approximate mix ratio of four parts by volume Sand to one part by volume Base Loam to
one and one-half parts by volume Compost (4S:1L:1.5C) to create a uniform blend which meets the following requirements.

2. Gradation for Material Passing the Number 10 Sieve:

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<thead>
<tr>
<th>U.S. Sieve Size Number</th>
<th>Percent Passing</th>
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3. Maximum size shall be one-inch largest dimension. The maximum retained on the #10 sieve shall be 15% by weight of the total sample.

4. Ratio of the particle size for 70% passing (D70) to the particle size for 20% passing (D20) shall be 3.5 or less, (D70/D20 <3.5).

5. Saturated hydraulic conductivity of the mix: not less than 4 inches per hour according to ASTM D 2434 when compacted to a minimum of 96% Standard Proctor, ASTM 698.

6. Chemical analysis shall be undertaken for Ammonium Nitrogen, Phosphorus, Potassium, Calcium Magnesium, Aluminum, Iron, Manganese, Lead, Cation Exchange Capacity, Soluble Salts, organic matter content, acidity (pH) and buffer pH.

7. Organic content: between 2.0 and 3.0 percent by weight.

8. The pH shall be between 6.0 and 6.5.

E. Horticultural Subsoil

1. Horticultural Subsoil shall consist of a combination of approximately 2 parts Sand and 1 part Base Loam (2S:1L). The following gradation for material passing a Number 10 Sieve shall be achieved in the final mix.

<table>
<thead>
<tr>
<th>U.S. Sieve Size Number</th>
<th>Percent Passing</th>
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<tbody>
<tr>
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</table>

2. Maximum size shall be one half-inch largest dimension. The maximum retained on the #4 sieve shall be 10% by weight of the total sample. The ratio of the particle size for 80% passing (D80) to the particle size for 30% passing (D30) shall be 6.5 or less, (D80/D30 <6.5). The final mix shall have an organic content between 1.5 and 3.0 percent. The final mix shall have a saturated hydraulic conductivity of not less that 2.5 inches per hour according to test procedure ASTM D2434 when compacted to a minimum of 92 percent Standard Proctor ASTM D698. Tests shall be by combined hydrometer and wet sieving in compliance with ASTM D422 after destruction of organic matter by ignition.
3. Chemical analysis shall be undertaken for Ammonium Nitrogen, Phosphorus, Potassium, Calcium Magnesium, Aluminum, Iron, Manganese, Lead, Cation Exchange Capacity, Soluble Salts, organic matter content, acidity (pH) and buffer pH.

4. pH shall be 6.0 to 6.5.

F. High Use Turf Soil
1. Base Loam, Uniform Sand and Compost, each as specified above, shall be combined in an approximate mix ratio of two parts by volume Sand to one part by volume Base Loam to one part by volume organic amendment (2S:1L:1C) to create a uniform blend. The following gradation for material passing a Number 10 Sieve shall be achieved in the final mix.

2. Gradation for Material Passing the Number 10 Sieve:

<table>
<thead>
<tr>
<th>U.S. Sieve Size Number</th>
<th>Minimum</th>
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<td>0.002mm</td>
<td>2</td>
<td>4</td>
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</table>

3. Maximum size shall be one half-inch largest dimension. The maximum retained on the #10 sieve shall be 20% by weight of the total sample.

4. Ratio of the particle size for 70% passing (D70) to the particle size for 20% passing (D20) shall be 4.2 or less (D70/D20 <4.2).

5. Saturated hydraulic conductivity of the mix shall not be less than 4.0 inches per hour according to ASTM D2434 when compacted to a minimum of 85 percent Standard Proctor.

6. Organic content shall be between 4.5 and 6.0 percent by weight.

7. pH shall be between 6.2 and 6.8

8. Chemical analysis shall be undertaken for Phosphorus, Potassium, Calcium Magnesium, Aluminum, Iron, Manganese, Cation Exchange Capacity, Soluble Salts, acidity (pH) and buffer pH.

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**PART 3 – EXECUTION**

**3.1 COORDINATION**

A. Verify that all Submittals and Test Results required herein have been reviewed and accepted by the Soil Scientist.

B. Refer to General Requirements.
C. Coordinate activities with other project Contractors so that there is no soil disturbance from traffic or other construction activities subsequent to placement of planting soil mixes. Report disturbances to Soil Scientist and Landscape Architect and implement corrective measures as necessary.

D. Pre-Installation Examination Required: The Contractor shall examine previous work, related work, and conditions under which this work is to be performed and shall notify Landscape Architect in writing of all deficiencies and conditions detrimental to the proper completion of this work. Beginning work means Contractor accepts substrates, previous work, and conditions. The Contractor shall not place any planting soil until all work in adjacent areas is complete and approved by the Landscape Architect and Soil Scientist.

E. Examination of Subgrade: The subgrade shall be examined by the Contractor prior to the start of soil placement and planting. Any deficiencies shall be noted and related to the Landscape Architect in writing prior to acceptance of the subgrade by the Landscape Contractor. Deficiencies include, but shall not be limited to the following:
   1. Construction debris present within the planting areas.
   2. The subgrade is at incorrect depths for installing the designed soil profile
   3. Subgrade not compacted as specified.

F. Planting Soil Preparation: Refer to Part 2 of this section for planting soil and mixtures. Examine soil and remove foreign materials, stones over 1/2", and organic debris over 2" in length. Mix-in fertilizers and amendments as required by tests and as approved by the Landscape Architect and Soil Scientist. All preparation and mixing shall be accomplished when the soil moisture content is less than field capacity. If lime is to be added, it shall be mixed with dry soil before fertilizer is added and mixed.

3.2 EXCAVATION AND REMOVAL

A. Refer to Section 312000 – Earth Moving.

3.3 MIXING OF PLANTING SOIL MIXES

A. Planting mixtures shall be produced with equipment that blends together each component in a thorough and uniform manner.

3.4 BACKFILLING OF PLANTING SOIL LAYERS

A. Refer to Section 312000 – Earth Moving, for establishment and verification of subgrade.

B. Planting Soil Placement Preparation:
   1. Notify the Landscape Architect and Soil Scientist of soil placement operations at least seven calendar days prior to the beginning of work.
   2. The Landscape Architect will stake locations for trees and shrubs during placement of the planting soils.
   3. After subgrade compaction the upper four inches shall be loosened with the teeth of an excavator bucket before placement of all planting soils.

C. Placement of all Horticultural Soils
1. Placement of all Planting Soils and plant stock shall be placed simultaneously to prevent excessive traffic over soil lifts and the final grade so as to prevent the creation of undesirable soil compaction. The Landscape Architect will stake trees during placement of the planting soils. Soil backfill around the plant root ball shall be layered in the same depth and sequence as the surrounding soil profile. Compaction due to moving and placement of plants, removal of excess soils or from any other operation including foot traffic shall be decompacted.

2. All Planting Soils shall be placed in lifts not to exceed 8 inches in thickness and compacted to meet minimum and maximum requirements as specified below. The surface of each compacted lift shall be scarified by raking or other approved methods to a minimum depth of one inch prior to placement of the following lift.
   a. A transition zone shall be formed between the Horticultural Subsoil and the existing subgrade soil by placing one inch of Horticultural Subsoil over the prepared subgrade and raking a two-inch thickness.
   b. A transition zone shall be formed between the Planting Bed Soil and the existing subgrade soil by placing one inch of Planting Bed Soil over the prepared subgrade and raking a two-inch thickness.
   c. A transition zone shall be formed between the Sand-Based Structural Soil and the existing subgrade soil by placing one inch of Sand-Based Structural Soil over the prepared subgrade and raking a two-inch thickness.
   d. A transition zone shall be formed between the High Use Turf Soil and the existing subgrade soil by placing one inch of High Use Turf Soil over the prepared subgrade and raking a two-inch thickness.
   e. A transition zone shall be formed between the Horticultural Subsoil and Planting Bed Soil by placing one inch of Planting Bed Soil over the Horticultural Subsoil and raking a two-inch thickness.
   f. High Use Turf Soil shall be compacted to between 84 and 86 percent Standard Proctor.
   g. Planting Bed Soil shall be compacted to between 83 and 85 percent Standard Proctor.
   h. Horticultural Subsoil shall be compacted to between 84 and 86 percent Standard Proctor, except soils beneath the rootballs shall be compacted to between 88 and 92% Standard Proctor to create a firm pedestal and prevent settlement of the rootballs.
   i. Stripped, stockpiled and screened Site Topsoil in Meadow Area shall be compacted to between 84 and 86 percent Standard Proctor
   j. In all cases, the soil being placed shall be in a dry to damp condition. No wet soils shall be placed. All testing of in-place density for planting materials shall be made according to ASTM D-698.
   k. VIBRATORY COMPACTION IS PROHIBITED ON PLANTING SOILS OF ALL TYPES EXCEPT SAND-BASED STRUCTURAL SOIL.

3. Placement of Sand-Based Structural Soil
   a. After subgrade levels have been reached, and immediately prior to placing Sand-Based Structural Soil the entire subgrade area shall be thoroughly compacted. Sand-Based Structural Soil shall be spread in lifts not greater than 8 (eight) inches and compacted with a minimum of two passes of vibratory compaction equipment to a density between 94 and 96 percent Standard Proctor. Sand-Based Structural Soil shall be placed within the areas shown on the Drawings.

4. All Planting Soils and Subsoil shall never be moved or worked when wet or frozen.
5. The Contractor shall place barricades as required to prevent any unnecessary compaction of planting soil from vehicles, equipment, or pedestrian traffic.

6. Percolation tests of all Planting Soils shall be performed using Turf-Tec IN2-W Infiltrometer utilizing manufacturer’s operating instructions.
   a. In-place infiltration tests shall be carried out at a rate of one test per each bed or separate tree planting location for each type of material placed.
   b. Landscape Architect or the Owner’s Representative may direct additional testing in locations subject to compaction or adverse Contractor operations.
   c. Placed planting soils exhibiting noncompliant percolation values shall be removed or restored to compliant conditions.
   d. In-place field tests must meet or exceed Saturated Hydraulic Conductivity standards specified in Section 2.2 for each blend.
   e. If test results are less than specified standards, the Landscape Architect and Soil Scientist will evaluate possible solutions including removal of the soil blend and installation of compliant blend soil. Any repair/replacement operation by the Contractor shall be at no additional charge.

3.5 PROTECTION AND ADJUSTMENTS

A. Protect newly graded areas from traffic, freezing and erosion. Keep free of trash, debris or construction materials from other work.

B. Repair and re-establish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or compacted due to subsequent construction operations or weather conditions. Scarify or remove and replace material to a depth as directed by the Landscape Architect; reshape and re-compact at optimum moisture content to the required density.

C. Where settling occurs, before final acceptance or during the warranty period, remove finish surfacing, backfill with additional approved material, compact to specified rates, and restore any disturbed areas to a condition acceptable to the Owner.

3.6 COORDINATION AND EXCESS MATERIALS

A. Coordinate activities with other project contractors so that there is no soil disturbance from traffic or other construction activities subsequent to placement.

B. Excess Planting Soil Mixture and Materials: Remove the excess planting soil mixture and materials from the site at no additional cost to the Owner unless otherwise requested.

3.7 POST-INSTALLATION TESTING

A. In-place density testing is required in all areas. The standard test for surface and subsurface density shall be ASTM D-698.

END OF SECTION

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APPENDIX: PLANTING SOIL TESTING PROTOCOL

**Pre-Construction Conference**

**Soil Blend Production**

**PHASE I - Component Approval**
- Base Loam Testing
- Sand Testing
- Compost Testing

**PHASE II – Small Batch Approval 20cy**
- Mechanical & Chemical Testing
- Saturated Hydraulic Conductivity
- Standard Proctor Test ASTM 698

**PHASE III – Production Stockpile Approval** – for each stockpile & each blend
- Mechanical & Chemical Testing
- Compost Testing every 30 days

**Ship to Site**

**PHASE IV – Confirmation Test on Site**
- Mechanical & Chemical Testing

**Construction Execution**

**PHASE V – Preparation of Subgrade for Soil Placement**
Percolation Testing on Subgrade (Separate from Planting Soil Testing)

**Construction Observation**
Notification Requirements

**PHASE VI – Planting Soil Placement**
In-Place Soil Moisture, Infiltration, and Compaction Testing

**Planting Requirements**
- Final Compaction Testing
- Final Infiltration Testing

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SECTION 329200 - LAWNS AND GRASSES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Seeding.
2. Lawn renovation.

B. Related Sections include the following:

1. Division 31 Section "Site Clearing" for topsoil stripping and stockpiling.
2. Division 31 Section "Earth Moving" for excavation, filling and backfilling, and rough grading.
3. Division 32 Section "Planting Soil" for soil preparation of areas to receive lawns and grasses.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture stating the botanical and common name and percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

1. Certification of each seed mixture for turfgrass sod identifying source, including name and telephone number of suppliers.

C. Product Certificates: For soil amendments and fertilizers, signed by product manufacturer.

D. Qualification Data: For landscape Installer.

E. Material Test Reports:

1. Existing surface soil
2. Imported topsoil.

F. Planting Schedule: Indicating anticipated planting dates for each type of planting.

G. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of lawns during a calendar year. Submit before expiration of required maintenance periods.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful lawn establishment.
1. Installer’s Field Supervision: Require Installer to maintain an experienced full-time English-speaking supervisor on Project site when planting is in progress.

B. Soil-Testing Laboratory Qualifications: An independent laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

C. Topsoil Analysis: Furnish soil analysis by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ratio; deleterious material; pH; and mineral and plant-nutrient content of topsoil.

1. Report suitability of topsoil for lawn growth. State recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce a satisfactory topsoil.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.4 DELIVERY, STORAGE, AND HANDLING

A. Seed: Deliver seed in original sealed, labeled, and undamaged containers.

B. Sod: Harvest, deliver, store, and handle sod according to requirements in TPI's "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" in its "Guideline Specifications to Turfgrass Sodding."

1.5 SCHEDULING

A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.

1. Spring Planting: March 1 to June 15
2. Fall Planting: October 1 to December 1

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit.

1.6 LAWN MAINTENANCE

A. Begin maintenance immediately after each area is planted and continue until acceptable lawn is established, but for not less than the following periods:

1. Seeded Lawns: 60 days from date of Substantial Completion.
   a. When full maintenance period has not elapsed before end of planting season, or if lawn is not fully established, continue maintenance during next planting season.
2. Sodded Lawns: 30 days from date of Substantial Completion.

B. Maintain and establish lawn by watering, fertilizing, weeding, mowing, trimming, replanting, and other operations. Roll, regrade, and replant bare or eroded areas and re-mulch to produce a uniformly smooth lawn.
1. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch. Anchor as required to prevent displacement.

C. Watering: Provide and maintain temporary piping, hoses, and lawn-watering equipment to convey water from sources and to keep lawn uniformly moist to a depth of 4 inches (100 mm).

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
2. Water lawn at a minimum rate of 1 inch (25 mm) per week.

D. Mow lawn as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 40 percent of grass height. Remove no more than 40 percent of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:

1. Mow grass 2 to 3 inches (50 to 75 mm) high.

E. Lawn Postfertilization: Apply fertilizer after initial mowing and when grass is dry.

1. Use fertilizer that will provide actual nitrogen of at least 1 lb/1000 sq. ft. (0.45 kg/92.9 sq. m) to lawn area.

PART 2 - PRODUCTS

2.1 SEED

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Journal of Seed Technology; Rules for Testing Seeds" for purity and germination tolerances.

B. Seed Species: State-certified seed of grass species, as follows:

C. Seed Species: Seed of grass species as follows, with not less than 95 percent germination, not less than 95> percent pure seed, with no weed seed:

1. Sun and Partial Shade: Proportioned by weight as follows:
   a. 85 percent tall fescue (Festuca rubra), minimum of three (3) varieties listed below
      Annapolis  Golconda  Persuasion  Sunset Gold
      Avenger II  GoldMedallion  Raptor III  Supersonic
      Black Tail  GTO  Rebel IV  Technique
      Bladerunner II  Hemi  Reflection  Temple
      Bullseye  Inferno  Regenerate  Thor
      Catalyst  Integrity  Rendition RX  Titanium 2LS
      Dakota  Justice  Rockwell  Titan Rx
      Embrace  Leonardo  Saltillo  Turbo
      Falcon V  Maestro  Screamer LS  TurboRZ
      Firecraker SLS  Michelangelo  Speedway  Xtender
      Guardian 41  Mustang 4  Spyder LS  Xtremegreen
      Gazelle II  Penn RK4  SR 8650

   b. Confirm against current Virginia Tech Extension “2019 Virginia Turfgrass Variety Recommendations” list before selection:

   c. 15 percent equal mix of the following:
1) Dutch White Clover Seeds
2) Crimson Clover Seeds
3) Partridge Pea Seeds

2.2  TURFGRASS SOD

A. Turfgrass Sod: Certified, including limitations on thatch, weeds, diseases, nematodes, and insects, complying with TPI's "Specifications for Turfgrass Sod Materials" in its "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture, strongly rooted, and capable of vigorous growth and development when planted.

B. Turfgrass Species: Sod of grass species as follows, with not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5 percent weed seed:
1. Sun and Partial Shade: Proportioned by weight as follows:
   a. 20 percent Kentucky bluegrass (Poa pratensis).
   b. 60 percent tall fescue (Festuca rubra), minimum of three (3) varieties listed below:

   Annapolis  Goconda  Persuasion  Sunset Gold
   Avenger II  GoldMedallion  Raptor III  Supersonic
   Black Tail  GTO  Rebel IV  Technique
   Bladerunner II  Hemi  Reflection  Temple
   Bullseye  Inferno  Regenerate  Thor
   Catalyst  Integrity  Rendition RX  Titanium 2LS
   Dakota  Justice  Rockwell  Titan Rx
   Embrace  Leonardo  Saltillo  Turbo
   Falcon V  Maestro  Screamer LS  TurboRZ
   Firecracker SLS  Michelangelo  Speedway  Xten
   Guardian 41  Mustang 4  Spyder LS  Xtremegreen
   Gazelle II  Penn RK4  SR 8650
   c. 10 percent perennial ryegrass (Lolium perenne).
   d. 10 percent redtop (Agrostis alba).

2.3  PLANTING ACCESSORIES

A. Selective Herbicides: EPA registered and approved, of type recommended by manufacturer for application.
1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.

2.4  MULCHES

A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.

B. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch (25-mm) sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
1. Organic Matter Content: **50 to 60** > percent of dry weight.
2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.

C. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic; free of plant-growth or germination inhibitors; with maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.

D. Non-asphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.

### 2.5 EROSION-CONTROL MATERIALS

A. Erosion-Control Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples, 6 inches (150 mm) long.

B. Erosion-Control Fiber Mesh: Biodegradable twisted jute or spun-coir mesh, a minimum of 0.92 lb/sq. yd. (0.5 kg/sq. m), with 50 to 65 percent open area. Include manufacturer's recommended steel wire staples, 6 inches (150 mm) long.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

A. Examine areas to receive lawns and grass for compliance with requirements and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

1. Protect adjacent and adjoining areas from hydroseeding overspray.

B. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

#### 3.3 SOIL PREPARATION

A. Division 32 Section “Planting Soil Preparation”.

#### 3.4 SEEDING

A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph (8 km/h). Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
1. Do not use wet seed or seed that is moldy or otherwise damaged.

B. Sow seed at the rate of 5 to 8 lb/1000 sq. ft. (2.3 to 3.6 kg/92.9 sq.m).

C. Rake seed lightly into top 1/8 inch (3 mm) of topsoil, roll lightly, and water with fine spray.

D. Protect seeded areas with slopes exceeding 1:6 with erosion-control fiber mesh and 1:4 with erosion-control blankets installed and stapled according to manufacturer's written instructions.

E. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre (42 kg/92.9 sq. m) to form a continuous blanket 1-1/2 inches (38 mm) in loose depth over seeded areas. Spread by hand, blower, or other suitable equipment.

1. Anchor straw mulch by crimping into topsoil with suitable mechanical equipment.
2. Bond straw mulch by spraying with asphalt emulsion at the rate of 10 to 13 gal./1000 sq. ft. (38 to 49 L/92.9 sq. m). Take precautions to prevent damage or staining of structures or other plantings adjacent to mulched areas. Immediately clean damaged or stained areas.

F. Protect seeded areas from hot, dry weather or drying winds by applying compost mulch within 24 hours after completing seeding operations. Soak and scatter uniformly to a depth of 3/16 inch (4.8 mm) and roll to a smooth surface.

3.5 HYDROSEEDING

A. Hydroseeding: Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.

1. Mix slurry with non-asphaltic tackifier.
2. Apply slurry uniformly to all areas to be seeded in a one-step process. Apply mulch at a minimum rate of 1500-lb/acre (15.3-kg/92.9 sq. m) dry weight but not less than the rate required to obtain specified seed-sowing rate.
3. Apply slurry uniformly to all areas to be seeded in a two-step process. Apply first slurry application at a minimum rate of 500-lb/acre (5.1-kg/92.9 sq. m) dry weight but not less than the rate required to obtain specified seed-sowing rate. Apply slurry cover coat of fiber mulch at a rate of 1000 lb/acre (10.2 kg/92.9 sq. m).

3.6 SODDING

A. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.

B. Remove netting prior to sod installation.

C. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to subgrade or sod during installation. Tamp and roll lightly to ensure contact with subgrade, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.

1. Lay sod across angle of slopes exceeding 1:3.
2. Anchor sod on slopes exceeding 1:6 with wood pegs or steel staples spaced as recommended by sod manufacturer but not less than 2 anchors per sod strip to prevent slippage.

D. Saturate sod with fine water spray within two hours of planting. During first week, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches (38 mm) below sod.

3.7 LAWN RENOVATION

A. Renovate existing lawn.

B. Renovate existing lawn damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.

1. Reestablish lawn where settlement or washouts occur or where minor regrading is required.

C. Remove sod and vegetation from diseased or unsatisfactory lawn areas; do not bury in soil.

D. Remove topsoil containing foreign materials resulting from Contractor's operations, including oil drippings, fuel spills, stone, gravel, and other construction materials, and replace with new topsoil.

E. Mow, dethatch, core aerate, and rake existing lawn.

F. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.

G. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off Owner's property.

H. Till stripped, bare, and compacted areas thoroughly to a soil depth of 6 inches (150 mm).

I. Apply soil amendments and initial fertilizers required for establishing new lawns and mix thoroughly into top 4 inches (100 mm) of existing soil. Provide new planting soil to fill low spots and meet finish grades.

J. Apply seed and protect with straw mulch as required for new lawns.

K. Water newly planted areas and keep moist until new lawn is established.

3.8 SATISFACTORY LAWNS

A. Satisfactory Seeded Lawn: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. (0.92 sq. m) and bare spots not exceeding 3 by 3 inches (76 by 76 mm).

B. Reestablish lawns that do not comply with requirements and continue maintenance until lawns are satisfactory.
3.9 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by lawn work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Erect barricades and warning signs as required to protect newly planted areas from traffic. Maintain barricades throughout maintenance period and remove after lawn is established.

C. Remove erosion-control measures after grass establishment period.

END OF SECTION 02920
SECTION 329201 – MEADOW PLANTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including the General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes but is not limited to:
   1. Review of conditions and materials affecting planting.
   2. Seeding temporary and permanent meadow mixes.
   3. Plantings of plugs and potted plants.
   4. Establishment of temporary and permanent meadow.
   5. Coordination with other trades.
   6. Warranty period.
   7. Meadow maintenance.

1.3 RELATED SECTIONS

A. The following items of related work are specified and included in other Sections of the Specifications:
   1. Section 061064 – Wood Path on Grade and Steps
   2. Section 329100 – Planting Soil
   3. Section 329200 – Lawns and Grasses
   4. Section 321300 – Exterior Plants

1.4 DEFINITIONS

A. Final Acceptance: The time at which all work has been performed and accepted by the Landscape Architect in writing, including any work noted on the “Punch List”.

B. Management Period: Time frame that begins after seeding occurs and ends at acceptance of permanent meadow area.

C. Live Plants: All trees, shrubs, and perennial plants installed from a containerized or balled and burlap condition.

D. Pure Live Seed (PLS): PLS is a means of expressing seed quality. PLS is the percentage of seed (i.e. good viable seed) that has the potential to germinate within a measured one-pound weight of any seed lot, expressed in pounds per acre as the basis for calculation of seeding rates.

1.5 SUBMITTALS

A. Product and Installation Data: Provide for each element of construction listed.
1. Meadow Mix Seed: Certification of mix proportions, Pure Live Seed percentages, and viability date.
2. Equipment: Provide list of power equipment to be used for seed bed preparation, including equipment model and type.

B. Plant List and Nursery Source Identification:
1. Submit a complete list of all plant material for Project with nursery source identification for each plant.
   a. Include in plan list the botanical and common names, size, quantity, and source locations for all plant materials.
   b. Include names, addresses, and phone numbers of each nursery source associated with each plant item.
   c. Plant lists shall clearly identify deviations from the specified plants and any approved substitutions. Submit substitution requests, if any, to landscape architect. Where deviations or other changes occur in plant list, identify both the original specified plant item and the new plant item.
   d. Plant lists with submittal shall be available at the nursery for inspection and selection. Contractor shall evaluate and verify at proposed nursery source that plant material conforms to the requirements of the Contract Documents prior to scheduling the Landscape Architect’s inspection and selection/tagging trip.
2. Maintain and re-submit updated plant list and source identification as deviations or other changes occur until Final Completion. Submit as a record document at completion of Contract work.
3. Color digital photographs of plant material within five (5) days of Landscape Architect’s request.
   a. Take photographs from an angle depicting true size and condition of the typical plant to be furnished.
   b. For species where more than 20 plants are required, include a minimum of three (3) photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.
4. Documentation of Unavailability of Plant Material: Before changes or substitutions are made due to unavailability of plant material, the Contractor shall submit satisfactory evidence that he/she has been unable to locate the specified material and has undertaken other methods of locating plant material acceptable to the Owner and Landscape Architect.
5. Qualification Data: In addition to requirements of Section 01330 – Submittal Procedures, provide information requested in this Section.
6. Installer Certificates: In addition to requirements of Section 1330 – Submittal Procedures, provide information requested in this section.
7. Written schedules for all aspects of installation including equipment to be used. Provide schedule within two (2) weeks of contract award for review and discussion. If schedule changes, resubmit updated schedule. Schedule should include written warranty as per 1.11A of this Section.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:
1. Plant and Seed Installer: A qualified landscape installer whose work has resulted in successful establishment of native meadows from plant and seed on at least three projects of similar size and scope.
B. Supplier Qualifications: Minimum 10 years in business.

C. Pre-installation Conference: A pre-installation conference with the Installer, Owner, Landscape Architect, and Owner’s Representative is required for the work of this section.

D. Inspection: Inspection of plants by the Landscape Architect may be made at the growing site at any time, but such inspection will not preclude rejection after delivery to the job site for plants that exhibit dry base soil, cracked or damaged root ball, poor plant form, wilting, infestation, abnormal color, or disease. Any plant so rejected shall be removed from the site immediately and replaced with acceptable plants. Inspection of plants shall include conformity to quantity, specified nomenclature, and health requirements.

1. The Landscape Architect shall have the right to reject any seed or plant supplier if he/she determines, before, during or after inspecting or receipt of seed or plants, any of the following:
   a. The seed or plants do not meet the quality standards set forth herein.
   b. The plant supplier’s cultural practices or management procedures do not meet specified standards.
   c. The suppliers cannot supply the specified seed and/or plant or acceptable substitution species.

1.7 DELIVERY, STORAGE AND HANDLING

A. In addition to the requirements of Section 016000 – Product Requirements and Section 12500 – Substitution Procedures, provide the following:

1. General:
   a. Deliver materials only after preparation for on-site seeding or planting have been completed and accepted, including but not limited to: cover crop and subsequent preparation for final seeding and planting, rough grading, utilities, and soil installation.
   b. Prohibit traffic and construction on or around areas to be seeded once soils are placed and prepared for seed installation.
   c. Prohibit storage of any equipment or materials on area to be seeded once soils are placed and prepared for seed installation.

B. Seed:

1. Seed shall be stored at temperatures between 40 and 60 degrees Fahrenheit (F) and with relative humidity of between 25-60%.
2. Seed that has become wet or moldy shall not be accepted.
3. Transport: Temperature shall not exceed 105 degrees F at any time. If transit from cold storage to sowing is greater than ten (10) days, seed must be kept under storage temperatures and relative humidity described above.

C. Plants:

1. Plants shall be closely monitored for sufficient root moisture and shall be protected from sun and wind. Stored plants shall be watered and misted several times a day, if necessary, to maintain proper root moisture and to reduce transpiration in sunny and windy locations. Plants shall not be stored more than two (2) days without written acceptance by the Landscape Architect.
2. For plants stored longer than two (2) weeks, the Landscape Architect shall have the right to reject the plants. Rejected plants shall be promptly removed from the site.
1.8 PROJECT CONDITIONS AND COORDINATION

A. Concealed Conditions: Notify Construction Manager before planting when below grade conditions detrimental to proper plant growth are encountered. Do not proceed with seeding or planting without specific written instructions from the Landscape Architect.

B. Planting and hardscape work will be underway during seeding and planting and the contractor shall coordinate their work with other Trades. The contractor shall take care to avoid damaging any adjacent work or work beyond the limit of work. Should damage occur, the Contractor shall repair elements to the Landscape Architect’s satisfaction.

C. Sequence of Planting: Sequence installation so that trees and shrubs that are within the seeded and/or planted areas are installed before seeding unless otherwise approved by the Landscape Architect. Restore damaged meadows if tree and shrub planting is delayed. Complete planting work as quickly as possible on portions of the site as they become available for planting.
   1. If meadow damage occurs because of tree/shrub planting delays, contractor is responsible to restore the seeded areas to the condition prior to damage.

D. Restrict traffic from meadow areas until they are established. Erect signs and barriers as required. Any damage incurred to the meadow because of traffic or lack of protecting the meadow areas shall be repaired by the Contractor at no additional cost.

1.9 INSTALLATION SEASONS

A. Work only within seasonal limitations for proper planting and seeding. These are optimal times for rapid establishment, optimal groundcover, and suppression of weeds. If sowing is being done between July 1 and August 31, use 25% more seed per unit area and expect increased weed management.

<table>
<thead>
<tr>
<th>Plant Material</th>
<th>Planting Seasons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seed</td>
<td>Mar 1 to June 15 and Oct 1 to Dec 1</td>
</tr>
<tr>
<td>Potted Plants/Plugs</td>
<td>Mar 1 to May 15 and Sep 1 to October 15</td>
</tr>
</tbody>
</table>

B.

1.10 FINAL ACCEPTANCE

A. General
   1. Final Acceptance occurs after all items have been approved by the Landscape Architect.
   2. Partial acceptances will not be granted.
   3. The request for inspection shall be received in writing at least ten (10) calendar days before the anticipated date of inspection. Do not request inspection for acceptance until installation work for the activity is 100% complete and past the 120 growing days needed for meadow acceptance. Project must be in compliance with the Contract requirements. Acceptance of seed and plant material by the Landscape Architect shall before general conformance to specified size, character and quality and not relieve the Contractor of responsibility for full conformance to the contract documents, including correct species.
   4. The Contractor is responsible for the condition and quality of work and materials during construction, and until Acceptance. Contractor shall bear the total cost of replacing all plant material until this time.

B. Site Preparation
1. Prior to seeding, site must be inspected by Landscape Architect to ensure that weed control is acceptable, seed bed is in appropriate condition for seeding and the site has been correctly delineated.
2. If it is determined that conditions are not acceptable for seeding, these areas should be mitigated and inspected by Landscape Architect, prior to seeding.

C. Seed
1. After seeding, site must be inspected by Landscape Architect to ensure that seeding has been completed as per specifications.
2. If the seeding is not in conformance, the contractor shall correct non-conforming items prior to a follow-up inspection by the Contracting Officer. Acceptance will be confirmed in writing.
3. Acceptance of the seeding shall be for general conformance to quality and shall not relieve the Contractor of responsibility for full conformance to the Contract Documents, including correct species.

D. Live Plants
1. After installing live plants, site must be inspected by Landscape Architect to ensure that live plant installation has been completed as per specifications.
2. If the plant installation is not in conformance, the contractor shall correct non-conforming items prior to a follow-up inspection by the Contracting Officer. Acceptance will be confirmed in writing.
3. Acceptance of the live plant installation shall be for general conformance to quality and shall not relieve the Contractor of responsibility for full conformance to the Contract Documents, including correct species.

E. Meadow Acceptance
1. 120 days from completion of final meadow seeding and between May and September, the meadow areas shall be an acceptable stand of meadow which is defined to mean a uniform coverage with well established, close stands of plants that meet the following criteria:
   a. A minimum of 10 thriving desirable plants per square foot, excluding cover crop.
   b. No bare or dead spots over 36” maximum in any dimension.
   c. No more than 10% of the meadow is bare.
   d. Free from disease, and detrimental insect infestation.
   e. No more than 5% of the area is covered in target weeds (as listed in Section 4.2 of this document).
2. If seeding is completed after October 1, it is considered a dormant seeding and acceptance should occur 120 days from May 1 of the following year.
3. Upon acceptance of the meadow, the warranty period begins.

F. Management Prior to Acceptance: Begin management immediately following completion of seeding. Management practices shall continue until Final Acceptance of meadow. At final acceptance, the warrant period begins.

1.11 WARRANTY
A. Provide a written warranty agreeing to remove and replace work that exhibits defects in materials or workmanship for the specified periods. “Defects” is defined to include, but is not limited to, death, unsatisfactory growth, failure to adequately root into soil, disease, abnormal foliage density, abnormal size, abnormal color, failure to thrive, and other unsatisfactory characteristics.
B. Meadow Replacement: Replace defective meadow with new seeding and planting that will provide plants of same type, species, character, and quality of originally accepted work. If a replacement is unacceptable during its one-year warranty, the Contractor shall provide another replacement or, when approved by the Owner, equivalent cash payment.
   1. Perform soil tests for soil biology, compaction, and infiltration to determine the reason for failure and correct any defects before replacing meadow. Provide as many test as needed to determine cause for failure.

C. Planting Seasons for Replacements:
   1. Planting for replacement and warranty work for meadows (seeding, planting) shall comply with calendar and methods specified herein.

D. Warranty Period for Meadow – Base Scope
   1. Warranty period for seed and live plants shall be 1 year from date of acceptance.
   2. Owner Responsibility and Warranty Exclusions.
      a. The Contractor’s warranty shall exclude problems due to improper or inadequate management, or vandalism.
         1) During the warranty period, the Contractor shall visit the site at least three times during the growing seasons to review the conditions of the accepted work. The Contractor shall submit in writing to the Owner regarding the Owner’s management practices and/or any vandalism. The content of this notice shall include a list of specific plants involved, the presumed problem, and a method of remedy for the problem(s) cited. The Owner shall make reasonable efforts to correct the problems city by the Contractor but the Owner shall not be held responsible for the Contractor’s defects in materials or workmanship that result in decline or death of plants.
         2) Failure of the Contractor to make the required reviews of the site during the warranty period and to submit written notice to the Owner during the warranty period shall negate the Contractor’s ability to make a claim against the Owner for negligence of management.
         3) Damage due to flooding is not excluded from the warranty.

E. Warranty Period for Meadows – Landscape Alternative #5
   1. Warranty period for seed and live plants shall be 2 years from date of acceptance.
   2. Owner Responsibility and Warranty Exclusions.
      a. The Contractor’s warranty shall exclude problems due to improper or inadequate management, or vandalism.
         1) During the warranty period, the Contractor shall visit the site at least three times during the growing seasons to review the conditions of the accepted work. The Contractor shall submit in writing to the Owner regarding the Owner’s management practices and/or any vandalism. The content of this notice shall include a list of specific plants involved, the presumed problem, and a method of remedy for the problem(s) cited. The Owner shall make reasonable efforts to correct the problems city by the Contractor but the Owner shall not be held responsible for the Contractor’s defects in materials or workmanship that result in decline or death of plants.
         2) Failure of the Contractor to make the required reviews of the site during the warranty period and to submit written notice to the Owner during the warranty period shall negate the Contractor’s ability to make a claim against the Owner for negligence of management.
         3) Damage due to flooding is not excluded from the warranty.
PART 2 - PRODUCTS

2.1 CHEMICAL AND BIOLOGICAL ADDITIVES

A. Installing contractor shall procure all requisite state and local permits prior to the first application of herbicide. Submit copies of permits to the Landscape Architect.

B. Glyphosate Herbicide: Aqua Neat or approved equivalent. Only use products rated for use in aquatic environments. Use rate as specified on label.

C. Triclopyr Herbicide: Garlon 3A or approved equivalent. Post emergent Broadleaf specific for use in aquatic environments. Use rate as specified on label. Should only be used as part of site preparation and meadow management to control non-grass plants.

D. Seed Mix Bulking Agent: Use sand, sawdust, rice hulls, fine flake pine shavings, or equal approved product by the Landscape Architect.

2.2 EQUIPMENT

A. Detatcher or power rake (walk behind or equipment mounted) as needed to prepare areas. Contractor may suggest alternative types of equipment to be approved by project Landscape Architect.

2.3 MEADOW SEED

A. General: Provide fresh, new crop seed that is 90% Pure live Seed or better. In no case shall weed seed content exceed 1% by weight. All seed shall comply with Federal and State seed laws. Seed shall not be coated with herbicides and/or fungicides.

B. Approved Seed Mix Suppliers

3. Or equal approved by the Landscape Architect.

C. Seed Mixes

1. See Plant Schedule in the Drawings for meadow seed mixes.
2. See acceptable suppliers listed in 2.3B of this section.
3. Seed mixes shall be delivered in individual bags labeled by mix and then by seed size within each mix.
   a. Small Seed: 25,000 seeds per ounce or less. Individual seeds can be picked up by hand.
   b. Very Fine Seed: 25,000 seeds per ounce or more. Individual seeds are too small to be picked up by hand.
   c. Grain: Cover crop grain seed and large wildflower seed (1/8-1/4" in size).
   d. Fluffy Seed: Seed with fluffy, feathery seed coat.

2.4 PLANT MATERIALS

A. General Material Requirements

2. Plant List: Sources of supply shall have been investigated by Contractor prior to submitting bid and, if requested, included as part of the bid proposal. Confirm that size, variety, and quality of plant material specified on plant list can be supplied.
   a. Failure to take this precaution does not relieve the Contractor from responsibility for furnishing and installing all plant material in strict accordance with the Contract requirements and without additional expense to the Owner.
   b. Unauthorized substitutions of plant materials specified will not be permitted. If substantiated written proof is supplied that a specified plant is not obtainable, request a proposal for an alternate selection by the Landscape Architect and Owner’s Representative and provide selected plants at no additional cost to the Owner.

3. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.

4. Container grown plants shall be healthy, vigorous, well rooted, and established in the container in which they are growing. A container grown plant shall have a well-established root system reaching the sides of the container to maintain a firm root ball but shall not have excessive root growth encircling the inside of the container. Container class in accordance with Contract Drawings.

2.5 PLANT TREATMENT MATERIALS

A. Provide transplant enhancer from a single source
   1. TOTAL INSTALLATION Transplant Concentrate and Plant Enhancer
      Manufacturer:
      BioPlex Plant Survival Solutions
      114 Manheim Street
      Mt Joy, PA 17552
      Tel: 800-441-3573

B. Provide hydrgel from a single source
   1. Advanced Polymer Gel Crystals
      Manufacturer:
      BioPlex Plant Survival Solutions
      114 Manheim Street
      Mt Joy, PA 17552
      Tel: 800-441-3573

2.6 SOIL AMENDMENTS

1. Soil amendments shall not be used for meadow plantings unless accepted in writing by the Landscape Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Pre-Installation Examination Required: Before beginning any meadow related work items (site preparation, seeding, planting), the Contractor shall examine previous work, related work, and conditions under which this work is to be performed and notify the Landscape Architect in
writing of all deficiencies and conditions detrimental to the proper completion of this work. Beginning work means Contractor accepts substrates, previous work, and conditions. The Contractor shall not commence work associated with the installation of Meadows until all work in the work areas is complete and accepted by the Landscape Architect. The Contractor shall confirm that:

1. Fine grading is accepted and remains free of debris
2. Area is free of weeds.
3. All construction within the seeding/planting area is complete prior to planting and/or seeding.

3.2 SITE PREPARATION

A. General

1. Perform examination of previous work completed by others.
2. Limit of seeding and planting shall be as shown on the drawings.
3. Use adequate precautions to prevent damage to existing conditions to remain such as structures, utilities, plant material and walks, on or adjacent to the site.
4. Use every possible precaution to prevent excessive compaction of planting area soil within or adjacent to the areas of work.
5. The seedbed must be firm and clear of actively growing weeds before planting meadow.
6. A properly compacted seedbed should not allow a shoe to sink more than ½” when walking on the seedbed.
7. Landscape Architect must inspect site prior to seed installation and provide site preparation acceptance.

B. Vegetation Management in Meadow Areas Beyond the Limit of Grading

1. During initial site clearing and grubbing of the site, cut back all woody vegetation that is less than 6” diameter at breast height within the meadow area that occurs beyond the limits of grading. Cut woody vegetation flush to existing grade (+/- 1”). DO NOT remove any trees that have been marked to remain.
2. Dispose of all cut material off-site.
3. Follow-up immediately after cutting with a triclopyr based herbicide treatment around the entire perimeter of the newly cut stump.
   a. Stump spray must occur on the same day that cutting occurs.
   b. Contractor is responsible for ensuring no re-growth of cut stumps or roots occurs during the duration of the project (through final acceptance).
4. Eight Weeks Prior to Seeding
   a. Spot spray all herbaceous and woody vegetation (use glyphosate, triclopyr, or similar as per recommendations of licensed herbicide applicator).
      1) Note: Spot spray should occur a minimum of two weeks after the initial clearing and stump spraying described in item 3.2B1.
5. Six Weeks Prior to Seeding:
   a. Flush cut (+/- 1”) all dead vegetation using appropriate equipment.
   b. Rake and remove dead material and thick leaf deposits to expose approximately 25% bare soil. Leave sufficient amount to serve as post seeding mulch. Dead roots and crowns shall remain to provide stabilization during germination of the meadow seed.
   c. Remove and dispose (off-site) all rocks (including surface stones) and clods six (6) inches or larger. Remove all sticks, roots, and other debris that has been exposed during area preparation.
6. Three Weeks Prior to Seeding:
MEADOW PLANTING

3.3 MEADOW SEED MIX INSTALLATION

A. General
1. Install meadow seed mix during the installation seasons established in 1.9A of this Section.
2. Prior to seeding and planting, verify meadow area is prepared and ready for vegetation installation. Review area with Landscape Architect before beginning work.
   a. Cut and/or spray all weeds from meadow planting areas prior to start of any seeding sequence as per site preparation specifications listed in sections 3.1 to 3.2 of this section.
   b. Site Preparation has been accepted by the Landscape Architect.
3. Install all trees and shrubs, prior to the start of seedbed preparation, described in this section. Tree installation and seed bed preparation can occur concurrently if planting activities do not overlap areas that have been prepared for seeding. If areas prepared for seeding are impacted by planting activities, seed be preparation in these areas should be repeated.
4. Only experienced workers under the supervision of a qualified foreman shall execute seeding. Seeding shall consist of soil preparation, hand broadcast of seed mix, rolling, weeding, water, and otherwise providing all labor and materials necessary to secure the establishment of acceptable vegetative layer.

B. Scarify soil to depth of approximately ½” using appropriate equipment. Repeat as needed to create a seedbed with approximately 50% of the soil exposed. No tilling should be performed, as this will increase weed presence due to the release of dormant weed seeds below the soil surface. Use metal rakes where machine access is not possible.

C. Segregate the seeds according to mix and then by seed size. For the hand broadcast method, “Fluffy,” “Small,” and “Grain” seed can be combined (henceforth referred to collectively as “Large” seed). “Very Fine” seed (seed which cannot be picked up individually by hand) must always remain separate.

D. Bulk up “Large” seed by mixing with an inert bulking material such as sawdust, sand, or flake pine shavings. Seed and bulking material can be mixed on tarps spread on the ground. Slightly dampening the bulking material will help the seed to be evenly distributed throughout the bulked material. Use enough bulking material to allow seed to be evenly distributed over the entire project area.
1. **Note:** Once seed has been mixed with wet material, seeding must happen within 24 hours. Only seed that can be installed in a single work day should be mixed at any given time.

E. Hand sow large seed that has been bulked up with wet inert material. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.

F. Rake lightly to cover large seed. Do not exceed ¼” soil coverage over seed.

G. Bulk up the “Very fine” seed in the manner described above and broadcast evenly over the prepared surface. Do not incorporate into the soil as these species need light to germinate and will not do so if buried in the soil.
   1. **Note:** Once seed has been mixed with wet material, seeding must happen within 24 hours.

H. Lightly roll seed areas using a manual lawn roller to press all surface seed into soil. Soil should not be disturbed to prevent covering very fine seed. Do not use compaction equipment.

3.4 **MEADOW TREE AND SHRUB INSTALLATION**

A. Install all trees and shrubs in accordance with Section 321300 – Exterior Plants.

3.5 **MEADOW HERBACEOUS PLANT INSTALLATION**

A. Planting shall occur one full growing season after meadow seeding within the window listed in this document.

B. Plant Layout
   1. Install in loose, interconnection drifts, at the spacing and locations indicated in the drawings. Verify layout and spacing with the Landscape Architect in the field, prior to installation.

C. Planting Plants: Plantings shall be made according to the location indicated on the Drawings and shall consist of species as indicated on the Drawings. Landscape Architect shall review the installation of the plants.

D. Dip plant roots into hydrated hydrogel mix. Ensure even coating. Strictly follow manufacturer’s instructions for dipping roots.

E. Spray plants with transplant enchanter prior to planting. Strictly follow manufacturer’s instructions for installation.

F. Install the plant so the stem base is at or slightly above finish grade.

G. Install plants to their full depth without bending them. Plants demonstrating “J-Roots” shall not be acceptable.

H. Backfill planting holes with onsite soils and tamp the soil around each plant in place so that it is firmly seated in the soil, with no air pockets.

I. Plant at average spacing indicated on plant schedule. Plants shall not be planted in an even grid or uniform pattern.
J. Once planting is complete, areas where herbaceous plants have been installed should be staked with 24” wooden survey stakes on approximately 2’ spacing along the perimeter.
   1. Paint the upper 1/3 of each stake with weather-proof white paint to increase visibility.
   2. Maintain staking through warranty period.

K. Do not mulch individual herbaceous plants or groups of herbaceous plants within the meadow.

3.6 CLEAN-UP AND PROTECTION

A. Store materials and equipment remaining on site in locations which do not interfere with construction operations or management activities.

B. The Contractor shall be responsible for keeping all paving surfaces clean during placement of seeding and planting operations. Remove equipment from the site promptly when no longer in use.

C. Provide temporary protection to ensure work is without damage or deterioration after installation.

D. Protection from Traffic:
   1. After seed installation, do not operate equipment or vehicles, or allow any foot traffic over the seeded areas until plants are established enough to prevent soil from eroding.
   2. Do not operate equipment or vehicles on meadow and pasture areas until ground is firm enough that ruts will not occur.
   3. Do not operate equipment or vehicles on meadow and pasture areas that will cause excessive soil compaction.

PART 4 - MANAGEMENT PROCEDURES AND ACTIVITIES DURING MEADOW ESTABLISHMENT

4.1 GENERAL WEED CONTROL

A. General
   1. Never pull weeds from the base as part of meadow management.
   2. Weeds shall never exceed 12” in height during the Management Period.
   3. Weed species shall never be allowed to set seed.

B. High Priority Weed Species
   1. Selectively cut, trim or pull aggressive weed plants from the meadow on a monthly basis. The following weeds are aggressive species; however, the final list shall be finalized by the Landscape Architect at the start of the Management Period:
      a. Alliaria officinalis, Garlic Mustard
      b. Artemesia vulgaris, Mugwort
      c. Bromus tectorum, Cheatgrass/Downy Brome
      d. Calystegia sepium, Hedge Bindweed
      e. Celastrus orbiculatus, Oriental Bittersweet
      f. Cirsium arvense, Canada Thistle
      g. Convolvulus arvensis, Field Bindweed
      h. Cuscuta sp., Dodder
      i. Cyperus esculentus, Yellow Nutsedge
      j. Echinochola crus-galli, Barnyard Grass
      k. Fallopia japonica, Japanese Knotweed
      l. Galium sp., Bedstraws
      m. Lonicera japonica, Japanese Honeysuckle
n. Lythrum salicaria, Purple Loosestrife
o. Melilotus sp. (albus/officinalis?), Sweet Clover sp.
p. Persicaria perfoliata, Mile-a-Minute Vine
q. Phalaris arundinacea, Reed Canary Grass
r. Plantago sp., Plantain sp.
s. Robinia psuedoacacia, Black Locust
t. Rumex sp, Curly Docks
u. Securigera varia, Crown Vetch
v. Solanum carolinense, Horsenettle
w. Solanum nigrum, Black Nightshade
x. Solanum dulcamara, Bittersweet Nightshade
y. Vitis sp. Wild Grape

C. Meadow Mowing Regime

1. Year 1
   a. In the first growing season weeds should not be allowed to exceed 12” in height. As weeds approach 12” the meadow, mow or cut all herbaceous growth to approximately 4-6” (approximately once per month). Use flail or rotary-style equipment that will chop dead growth. Sickle bar type mowers that cut at the base of vegetation and drop plant material intact should not be used as the intact cut plant material can inhibit seedling development.
      1) In areas with live plants (shrubs), hand cut or string trim weeds.
      2) In locations inaccessible to a mower (wet areas, steep slopes, etc.), string trim vegetation to the specified height.
      3) Contractor shall be responsible for at least 4 cuttings (June, July, August, and a date to be determined based on meadow development). Rate of growth shall dictate the quantity and timing of cuttings.
      4) Leave cut material as it returns organic matter and nutrients to the soil. Any thick accumulations of cut material that remain to the point where soil cannot be observed through the cut material should be dispersed evenly over the site or removed.

2. Year 2
   a. Prior to the emergence of new spring growth, mow previous year’s herbaceous growth to approximately 4-6”. Use flail or rotary-style equipment that will chop dead growth. Sickle bar type mowers that cut at the base of vegetation and drop plant material intact should not be used as the intact cut plant material can inhibit development of seedlings.
      1) In locations inaccessible to a mower (wet areas, steep slopes, etc.), string trim vegetation to specified height.
      2) Leave cut material as it returns organic matter and nutrients to the soil. Any thick accumulations of cut material that remain to the point where soil cannot be observed through the cut material should be dispersed evenly over the site or removed.

D. Maintenance Weed Control

   a. Schedule control treatment(s) as needed. When using herbicides, spot treatment is preferable but in cases of widespread infestation, affected areas should receive blanket applications per the herbicide label.
   b. To maintain a “cared” for appearance as desired (in areas visible from trails and sidewalks), schedule string trimming of dead treated vegetation two (2) weeks
following any herbicide applications. Cutting treated top growth should not occur less than two (2) weeks after systemic herbicide application to ensure herbicide can translocate to the roots of target vegetation.

c. Monitor treated area(s) to ensure treatment effectiveness. Schedule and conduct follow-up treatment(s) as necessary.

E. Repair of Meadows
1. If meadow is damaged, remove damaged materials if necessary. Reestablish meadow as originally installed following the establishment timeframes. Request Landscape Architect approval prior to beginning repairs.
2. If meadow exhibits unsatisfactory growth, perform soil testing for chemical properties, compaction and infiltration rates. Adhere to Landscape Architect’s recommended remediation. Remediation may include soil additives or topdressing.

4.2 Reseeding of Meadows
A. Over-seed/top-dress meadow in fall (September 1 – November 31) if required. This work will be required as indicated by the acceptance criteria outlined in Part 1. Only bare areas (or areas made bare prior to top-dressing) should be seeded.
B. Reseeding shall be performed at the request of the Landscape Architect. Reseeding shall be required if meadow establishment/performance is poor, dead spots are apparent, or other unsuitable conditions are present.
C. Work shall be performed according to installation seasons described in 1.9A of this Section.
D. If needed, remove all weeds in areas to be reseeding (either via light grubbing or herbicide application). Consult with landscape architect to determine best protocol.
E. Cut or trim vegetation to maximum of 2” prior to reseeding. Remove cut vegetation from the meadow.
F. Seed using methodology in Section 3.3 of this Section.

4.3 Replacement Planting
A. Replanting shall be performed at the request of the Landscape Architect. Replanting shall be required if herbaceous plant establishment/performance is poor, dead spots are apparent, or other unsuitable conditions are present.
B. Work shall be performed according to installation seasons described in 1.9A of this Section.
C. Cut or trim surrounding vegetation to maximum of 2” prior to replanting (if in a seeded area). Remove cut vegetation from the meadow.
D. Plant using methodology in Section 3.5 of this Section.

END OF SECTION 329200.01
SECTION 329300 - EXTERIOR PLANTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Trees.
2. Shrubs.
3. Plants, including perennials, ornamental grasses, and bulbs.
4. Planting Accessories.
5. Edgings.
6. Mulch.
8. Disposition of Existing Trees indicated on sheet L-300 of the drawings.

B. Related Sections include the following:

1. Division 31 Section "Site Clearing" for topsoil stripping and stockpiling, and site clearing.
2. Division 31 Section "Earth Moving" for excavation, filling, and rough grading and for subsurface aggregate drainage and drainage backfill materials.
3. Division 32 Section “Planting Irrigation”
4. Division 32 Section “Planting Soil”
5. Division 32 Section “Lawns and Grasses” for turfgrass plantings.
6. Division 32 Section “Meadow Planting” for meadow and wildflower plantings.

1.2 DEFINITIONS

A. Balled and Burlapped Stock: Exterior plants dug with firm, natural balls of earth in which they are grown, with ball size not less than [diameter and depth recommended by ANSI Z60.1 for type and size of tree or shrub required; wrapped, tied, rigidly supported, and drum-laced as recommended by ANSI Z60.1.

B. Balled and Potted Stock: Exterior plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than diameter and depth recommended by ANSI Z60.1 for type and size of exterior plant required.

C. Bare-Root Stock: Exterior plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than minimum root spread according to ANSI Z60.1 for kind and size of exterior plant required.

D. Container-Grown Stock: Healthy, vigorous, well-rooted exterior plants grown in a container with well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for kind, type, and size of exterior plant required.

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

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Verification: For each of the following:
   1. Edging materials and accessories, of manufacturer's standard size, to verify color selected.

C. Product Certificates: For each type of manufactured product, signed by product manufacturer, and complying with the following:
   1. Manufacturer's certified analysis for standard products.
   2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.

D. Qualification Data: For landscape Installer.

E. Planting Schedule: Indicating anticipated planting dates for exterior plants.

F. Photographs: Submit photographs of plants, as requested by the Landscape Architect, prior to Observation, as listed under Quality Assurance, below. Photographs shall include a person holding a clearly-marked measuring rod next to plants. Photographs shall exhibit the size, growth habit, and general visual quality of plants. Photographs of dense clusters of plants, in which one plant is not distinguishable from another, are not acceptable. Digital photographs submitted via email are acceptable.

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

1.4 QUALITY ASSURANCE

A. Tree Pruning and Removal Qualifications: A certified arborist and landscape firm with five (5) years' experience doing tree removals and pruning.

B. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of exterior plants.
   1. Installer's Field Supervision: Require Installer to maintain an experienced full-time, English-speaking, supervisor on Project site when exterior planting and regular maintenance is in progress.

C. Provide quality, size, genus, species, and variety of exterior plants indicated, complying with applicable requirements in ANSI Z60.1, "American Standard for Nursery Stock."
   1. Substitutions of plants will not be permitted unless authorized in writing by the Landscape Architect, prior to purchase for this Project.
2. Selection of exterior plants purchased under allowances will be made by Landscape Architect, who will tag plants at their place of growth before they are prepared for transplanting.

D. Tree and Shrub Measurements: Measure according to ANSI Z60.1 with branches and trunks or canes in their normal position. Do not prune to obtain required sizes. Take caliper measurements 6 inches above ground for trees up to 4-inch caliper size, and 12 inches above ground for larger sizes. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip-to-tip.

E. Observation: Landscape Architect may observe trees and shrubs either at place of growth or at site before planting for compliance with requirements for genus, species, variety, size, and quality. Landscape Architect retains right to observe trees and shrubs further for size and condition of balls and root systems, insects, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.

1. Notify Landscape Architect of sources of planting materials seven days in advance of delivery to site.

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store, irrigate, maintain, and otherwise protect balled and burlapped trees in a manner that prevents mechanical injury and physiological stress between the time of digging and delivery.

B. Deliver exterior plants freshly dug.

1. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting.

C. Do not prune trees and shrubs before delivery, except as approved by Landscape Architect. Protect bark, branches, and root systems from sun scald, drying, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Irrigate balled and burlapped plants thoroughly immediately prior to transport. Provide protective covering of exterior plants during delivery. Do not drop exterior plants during delivery.

D. Handle planting stock by root ball. Planting stock with cracked or broken root balls will not be accepted.

E. Deliver exterior plants after preparations for planting have been completed and install immediately. If planting is delayed more than six hours after delivery, set exterior plants trees in shade, protect from weather and mechanical damage, and keep roots moist.

1. Heel-in bare-root stock. Soak roots in water for two hours if dried out.
2. Set balled stock on ground and cover ball with woodchip mulch or other acceptable material.
3. Do not remove container-grown stock from containers before time of planting.
4. Water root systems of exterior plants stored on-site with a fine-mist spray. Water as often as necessary to maintain root systems in a moist condition.
1.6  COORDINATION

A. Contractor is responsible for determining plant quantities per planting plan. Contractor is responsible for filling all areas on plans shown to be planted on planting plan. Contractor shall prepare his or her own quantity list from the plan(s). All ground cover, perennial, and annual beds are to be filled at the specified spacing.

B. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.
   1. Spring Planting: March 15 to June 15
      a. Quercus species
      b. Deciduous material
      c. Herbaceous material
   2. Fall Planting: September 15 to October 31
      a. Evergreen material
      b. Deciduous material other than Quercus spp.
      c. Herbaceous material
   3. No Planting shall occur between June 15 and September 14, inclusive, except annuals, or as authorized by the Landscape Architect.

C. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit.

D. Coordination with Other Work: Coordinate planting with all other work of the project, including the following:
   1. Landscape Irrigation: Coordinate planting with location of irrigation equipment. Coordinate aiming of landscape irrigation equipment to ensure that plantings do not impair the irrigation system from functioning as designed. Ensure that plant locations do not block irrigation spray and do not interfere with other irrigation equipment, including moisture sensors and rain sensors.
   2. Site Lighting and Electrical Equipment: Coordinate planting with site lighting to ensure that plantings do not impair site lighting from illuminating the site as designed. Following planting installation, coordinate aiming of site lighting that is intended to illuminate plants.
   3. Tree Soil Panels with Brick Pavers over Steel Grating: Coordinate planting with brick paving over steel grating. Soil panels shall be excavated following construction of curbing and sidewalks. Soil panels and soil panel sub-drainage shall not become contaminated, compacted or otherwise disturbed during steel grating or brick paving operations.
   4. Root Path work shall be performed following completion of sidewalk hard surface demolition, and utility trenching or any other subsurface construction. Root Path work shall be performed prior to sidewalk base course, sidewalk pavement and root guide installation.
   5. Coordinate Root Guide work with tree soil panel excavation, sidewalk work and root path work. Root Guide work shall be performed following completion of root path work, sidewalk work and tree soil panel excavation. Root Guide work shall be performed prior to completely filling tree soil panels with topsoil.

E. Coordination with Lawns: Plant trees and shrubs after finish grades are established and before planting lawns, unless otherwise acceptable to Landscape Architect.
   1. When planting trees and shrubs after lawns, protect lawn areas and promptly repair damage caused by planting operations.
1.7 WARRANTY

A. Special Warranty: Warrant all exterior plants covered by this Section, for the warranty period indicated, against defects including death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, or abuse by Owner, or incidents that are beyond Contractor's control.

1. Warranty Period for Exterior Plants:
   a. From date of Installation to Substantial Completion.
   b. Two years from date of Substantial Completion.

2. Remove dead exterior plants immediately. Replace immediately unless required to plant in the succeeding planting season.

3. Replace without cost to Owner, as soon as weather and soil conditions permit, exterior plants that are more than 25 percent dead or in an unhealthy condition as determined by the Landscape Architect at end of warranty period.

1.8 MAINTENANCE

A. Maintenance Period for all exterior plants covered by this Section: Concurrent with Warranty Period and same duration as Warranty Period. Maintenance requirements are itemized in Part 3 of this Section.

B. Owner will assume maintenance following completion of Maintenance Period.

PART 2 - PRODUCTS

2.1 TREE AND SHRUB MATERIAL

A. General: Furnish nursery-grown trees and shrubs in accordance with good horticultural practices under climatic conditions similar to those of the Project for at least two years, unless specifically noted otherwise. Trees and shrubs shall comply with ANSI Z60.1, with healthy root systems developed by transplanting or root pruning. Trees and shrubs shall exceed AAN standards for quality by being exceptionally heavy, uniform, so trained or favored in development and appearance as to be superior in form, density and spread of branches, compactness, and symmetry. Determination of quality shall be made by the Landscape Architect. Provide well-shaped, fully branched, healthy, vigorous stock free of disease, insects, eggs, larvae, and defects such as knots, sun scald, leaf spotting, injuries, abrasions, and disfigurement.

B. Trees shall be planted such that the root flare is 1" above adjacent grade, unless the drawings indicate otherwise. Tree planting height shall be dictated by the actual root flare rather than the top of rootball as received from growers or nurseries.
   1. Tops of tree rootballs shall be no higher than 2" above the tops of main order tree roots.
   2. If main order roots are buried greater than 2" but less than 4" below the top of tree rootballs, contractor must trim rootballs by carefully removing soil from the top of the rootballs so that main order roots are within 2" of the top of rootball.
   3. If main order roots are buried greater than 4" below the top of rootball, the tree will be rejected, and the contractor must remove the tree from the jobsite.
   4. The contractor is responsible for ensuring that trees received on site and planted on site meet the aforementioned specifications regarding tree root flare and rootball. The contractor is responsible for ensuring that the landscape architect has an opportunity to review the tree root flares of trees in the grower’s field or nursery yard. If tree root flares

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are obscured (due to trunk wrap or burlap or other obstructions), landscape architect's acceptance of trees in the grower's yard or nursery shall constitute acceptance of trees WITH THE EXCEPTION of trees whose root flare is buried greater than 4" below top of rootball. In the event that contractor does not allow Landscape Architect to visually observe tree root flares during tree selection at grower's yard or nursery, Landscape Architect reserves the right to reject any tree delivered to the site if tree's root flare is buried greater than 4" below top of rootball, even if Landscape Architect previously accepted said trees at the grower's yard or nursery.

C. Grade: Provide trees and shrubs of sizes and grades complying with ANSI Z60.1 for type of trees and shrubs required. Trees and shrubs of a larger size may be used if acceptable to Landscape Architect, with a proportionate increase in size of roots or balls.

D. Label each tree and shrub with securely attached, waterproof tag bearing legible designation of botanical and common name.

E. Label at least one tree and one shrub of each variety and caliper with a securely attached, waterproof tag bearing legible designation of botanical and common name.

F. If formal arrangements or consecutive order of trees or shrubs is shown, select stock for uniform height, branching height, and spread, and number label to assure symmetry in planting.

2.2 SHADE AND FLOWERING TREES

A. Shade Trees: Single-stem trees with straight trunk, well-balanced crown, and intact leader, of height and caliper indicated, complying with ANSI Z60.1 for type of trees required.

1. Provide balled and burlapped, balled and potted, or container-grown trees.
2. Branching Height: One-third to one-half of tree height. For street trees branching height shall be one half of tree height.

B. Small Upright or Spreading Trees: Branched or pruned naturally according to species and type, with relationship of caliper, height, and branching according to ANSI Z60.1; stem form as follows:

1. Stem Form: as indicated in the plant list on L-703 of the drawings.
2. Provide balled and burlapped trees.

C. Multi-stem Trees: Branched or pruned naturally according to species and type, with relationship of caliper, height, and branching according to ANSI Z60.1; stem form as follows:

1. Stem Form: as indicated in the plant list on L-703 of the drawings.
2. Provide balled and burlapped trees.

2.3 DECIDUOUS SHRUBS

A. Form and Size: Deciduous shrubs with not less than the minimum number of canes required by and measured according to ANSI Z60.1 for type, shape, and height of shrub.

1. Provide container-grown shrubs.
2.4 PLANTS

A. Perennials: Provide healthy, field-grown plants from a commercial nursery, of species and variety shown or listed.

B. Bulbs:
   1. Top Size, including corresponding designation of “Jumbo”, “Giant” or “Extra Large”, per ANSI 11.

2.5 PLANTING SOIL

A. Division 32 Section "Planting Soil".

2.6 MULCHES

A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:
   1. Type: Shredded hardwood bark mulch,

B. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch (25-mm) sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
   1. Organic Matter Content: 50 to 60 percent of dry weight.

2.7 STAKES AND GUYS

A. Install Stakes and Guys per methods and locations as shown on the Drawings.

B. Upright and Guy Stakes: Rough-sawn, sound, new hardwood, redwood, or pressure-preservative-treated softwood, free of knots, holes, cross grain, and other defects, 2 by 2 inches (50 by 50 mm) by length indicated, pointed at one end.

C. Guy Ties and Guards:
   1. Guy and Tie Wire: ASTM A 641/A 641M, Class 1, galvanized-steel wire, 2-strand, twisted, 0.106 inch (2.7 mm) in diameter.
   2. Guy Cable: For large trees: 5-strand, 3/16-inch- (4.8-mm-) diameter, galvanized-steel cable, with zinc-coated turnbuckles, a minimum of 3 inches (75 mm) long, with two 3/8-inch (10-mm) galvanized eyebolts.
   3. Hose Chafing Guard: Reinforced rubber or plastic hose at least 1/2 inch (13 mm) in diameter, black, cut to lengths required to protect tree trunks from damage.
   4. Woven Fabric Guy Ties: Flat, woven, non-fraying, polypropylene material, ¾” wide, white. Arbor Tie or approved equivalent.


E. Flags: Standard surveyor’s plastic flagging tape, white, 6 inches (150 mm) long.
2.8 LANDSCAPE EDGINGS

A. Aluminum Edging: Standard-profile extruded-aluminum edging, ASTM B 221 (ASTM B 221M), alloy 6063-T6, fabricated in standard lengths with interlocking sections with loops stamped from face of sections to receive stakes.
   1. Edging Size: 3/16 inch (4.8 mm) wide by 5-1/2 inches (140 mm) deep.
   2. Stakes: Aluminum, ASTM B 221 (ASTM B 221M), alloy 6061-T6, approximately 1-1/2 inches (38 mm) wide by 12 inches (300 mm) long.

2.9 MISCELLANEOUS PRODUCTS

A. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs, designed to permit transpiration but retard excessive loss of moisture from plants. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.

B. Tree Watering Bags: UV-treated polyethylene irrigation bag reinforced with nylon webbing. All sides to be watertight with ¼" thick heat seals. Bags shall have nylon zippers to allow to be secured to tree or secured to other bags for multiple-bag configuration.
   1. Manufacturer: TreeGator, 1-866-873-3428, or approved equivalent.

C. Soil Stabilization System:

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive exterior plants for compliance with requirements and conditions affecting installation and performance. Notify Landscape Architect, in writing, of any conditions that might prevent satisfactory completion. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Test drainage of pits and planting beds. Notify Landscape Architect of potential poor drainage of tree and shrub pits and planting beds. Recommend a program for correction of poor drainage conditions and submit proposal to Landscape Architect. Do not proceed with planting operations in areas of poor drainage until conditions are corrected, or direction is given by the Landscape Architect.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, and lawns and existing exterior plants from damage caused by planting operations.

B. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
C. Lay out individual tree and shrub locations and areas for multiple exterior plantings. Stake locations, outline areas, adjust locations when requested, and obtain Landscape Architect's acceptance of layout before planting. Make minor adjustments as required.

D. Lay out exterior plants at locations directed by Landscape Architect. Stake locations of individual trees and shrubs and outline areas for multiple plantings.

E. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks, branches, stems, twigs, and foliage to protect during digging, handling, and transportation.
   1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.

3.3 REMOVAL AND PRUNING OF EXISTING TREES (Sheet L-300)

A. Preparation
   1. Mark trees to be removed or pruned as indicated on Sheet L-300, using a different marking for each condition.
   2. No action may take place without written approval of the Landscape Architect.
   3. Work must be done under the supervision of an approved Certified Arborist

B. Existing Tree – Remove:
   1. Cut tree to ground.
   2. Grind the stump to a depth of 12 inches.

C. Existing Tree – Cut to Ground:
   1. Remove tree and cut so that the remaining stump is flush to the ground.
   2. Leave roots in place.

D. Existing Tree – To Remain with Major Pruning:
   1. Review each tree to be pruned for opening views of the river with Arborist and Landscape Architect.
   2. Prune only as directed by the Landscape Architect or the Arborist and in compliance with ANSI A300 (Part 1), “Tree, Shrub, and Other Woody Plant Maintenance – Standard Practices (Pruning).”
   3. Landscape Architect or their representative must be on site during all the pruning work.

3.4 PLANTING BED ESTABLISHMENT

A. Division 32 Section “Planting Soil Preparation”.

3.5 TREE AND SHRUB PLANTING

A. Set balled and burlapped stock plumb and in center of pit or trench with root flare 1 inch (25 mm) above adjacent finish grades.
   1. Cut burlap and wire baskets from top half of root balls, but do not remove from under root balls. Discard removed burlap and wire baskets; do not turn down baskets and leave in tree or shrub pits. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
2. Place planting soil mix around root ball in layers, tamping to settle mix and eliminate voids and air pockets. When pit is approximately one-half backfilled, install transplant inoculants per manufacturer's directions and water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed. Water again after placing and tamping final layer of planting soil mix.

3. Prepare surface of planting bed as shown on drawings.

B. Set balled and potted or container-grown stock plumb and in center of pit or trench with root flare 1 inch (25 mm) above adjacent finish grades.

1. Carefully remove root ball from container without damaging root ball or plant.
2. Make four (4) evenly spaced vertical cuts in the sides of the root ball with a clean, sharp utility knife. Cuts are to be one inch (1") deep and are to extend the full height of the rootball.
3. Place planting soil mix around root ball in layers, tamping to settle mix and eliminate voids and air pockets. When pit is approximately one-half backfilled, install transplant inoculants per manufacturer’s directions and water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed. Water again after placing and tamping final layer of planting soil mix.
4. Prepare surface of planting bed as shown on drawings.

C. Organic Mulching: Apply 2-inch (50-mm) average thickness of organic mulch extending 12 inches (300 mm) beyond edge of planting pit or trench. Do not place mulch within 3 inches (75 mm) of trunks or stems.

3.6 TREE AND SHRUB PRUNING

A. Prune, thin, and shape trees and shrubs only as directed by Landscape Architect.

B. If instructed by the Landscape Architect, prune, thin, and shape trees and shrubs according to standard horticultural practice. Prune trees to retain required height and spread. Unless otherwise indicated by Landscape Architect, do not cut tree leaders; remove only injured or dead branches from flowering trees. Prune shrubs to retain natural character. Shrub sizes indicated are sizes after pruning.

3.7 GUYING AND STAKING

A. Guy and Stake trees as indicated on the drawings. Installation of tree support systems shall be completed within 48 hours of planting, utilizing applicable methods as indicated.

3.8 PLANT PLANTING

A. Set out and space ground cover and plants as indicated.

B. Dig holes large enough to allow spreading of roots and backfill with planting soil.

C. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.

D. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
E. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.9 PLANTING BED MULCHING

A. Mulch backfilled surfaces of planting beds and other areas indicated.
   1. Organic Mulch: Apply 2-inch (50-mm) average thickness of organic mulch, and finish level with adjacent finish grades. Do not place mulch against plant stems as indicated on the drawings.

3.10 EDGING INSTALLATION

A. Aluminum Edging: Install aluminum edging where indicated according to manufacturer's written instructions. Anchor with aluminum stakes spaced approximately 36 inches (900 mm) apart, driven below top elevation of edging.

3.11 TREE WATERING BAGS

A. Install a minimum of one tree watering bag per tree. Install multiple bags for trees as recommended by the tree watering bag manufacturer. Fill water bags for each tree.

3.12 INITIAL ACCEPTANCE

A. When all work except maintenance and guarantee program of this contract has been completed, Landscape Architect will perform a Substantial Completion inspection. Provide notification at least ten (10) working days before inspection date.
   1. If required a "punch list" of items to be completed by an agreed upon date will be issued by the Landscape Architect after the Substantial Completion inspection.

B. Work will be considered Substantially Complete after all "punch list" items are complete. Notify the Landscape Architect at least five (5) working days before re-inspection date, to verify completion of the "punch list" items.

C. Substantial Completion certificate will be issued and dated by the Landscape Architect following the "punch list" verification inspection.

3.13 MAINTENANCE

A. Maintain all exterior plants covered by this Section, as required to establish healthy, viable plantings, including the following maintenance requirements during the maintenance period indicated in Part 1 of this Section:
   1. Mowing;
   2. Edging;
   3. Pruning with approval of the Landscape Architect;
   4. Cultivating;
   5. Watering, including filling tree water bags, do not allow plants to wilt at any time;
   6. Weeding;
   7. Fertilizing;
   8. Mulching;
9. Restoring plant saucers for trees;
10. Maintaining trees support systems at correct tension;
11. Resetting plants to proper grade and vertical position;
12. Insect and Pest Control as required to keep plants free of insects and disease;
13. Restoring or replacing damaged tree wrappings;
14. Removal of trash and debris; and
15. Replacing dead or dying plants.

3.14 FINAL ACCEPTANCE

A. Inspection to determine Final Acceptance of planted areas will be made by the Landscape Architect upon Contractor's request at completion of the two-year Warranty Period. Provide notification at least fifteen (15) working days before requested inspection date.
1. Planted areas will be acceptable provided all requirements, including plant replacements and maintenance, have been complied with and healthy, thriving, and growing plants are established.
2. Remove all Tree Staking and Guying materials prior to Final Acceptance inspection.
3. Knock down, regrade, and re-mulch all tree pit saucers prior to Final Acceptance inspection.

3.15 CLEANUP AND PROTECTION

A. During exterior planting, keep adjacent paving and construction clean and work area in an orderly condition.

B. Protect exterior plants from damage due to landscape operations, operations by other contractors and trades, and others. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged exterior planting.

3.16 DISPOSAL

A. Disposal: Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of off Owner's property.

END OF SECTION 329300
SECTION 334100 - STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Pipe and fittings.
   2. Nonpressure transition couplings.
   5. Stormwater inlets.
   6. Pipe outlets.
   7. Stormwater disposal systems.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.
B. Shop Drawings:
   1. Manholes: Include plans, elevations, sections, details, frames, and covers.
   2. Catch basins and stormwater inlets. Include plans, elevations, sections, details, frames, covers, and grates.
C. As-built of the stormwater infrastructure at project completion.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of cast-iron soil pipe and fitting, from manufacturer.
B. Field quality-control reports.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
B. Protect pipe, pipe fittings, and seals from dirt and damage.
C. Handle manholes according to manufacturer's written rigging instructions.
D. Handle catch basins and stormwater inlets according to manufacturer's written rigging instructions.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Architect no fewer than 5 days in advance of proposed interruption of service.
2. Do not proceed with interruption of service without Architect's written permission.

PART 2 - PRODUCTS

2.1 CONCRETE PIPE AND FITTINGS

A. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76.

1. Bell-and-spigot ends and sealant joints with ASTM C 990, bitumen or butyl-rubber sealant
2. Class III, Wall A.

2.2 NONPRESSURE TRANSITION COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:

1. For Concrete Pipes: ASTM C 443, rubber.
2. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

2.3 MANHOLES

A. Standard Precast Concrete Manholes:

1. As indicated on plans and per VDOT Road and Bridge Specifications

B. Manhole Frames and Covers:

1. As indicated on plans and per VDOT Road and Bridge Specifications
2.4 CONCRETE

A. General: Cast-in-place concrete according to ACI 318, ACI 350/350R, and the following:

1. Cement: ASTM C 150, Type II.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.

2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.

1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.

D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.

2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

2.5 STORMWATER INLETS

A. Curb Inlets: Made with vertical curb opening, of materials and dimensions according to VDOT Road and Bridge Standards and Specifications.

B. Combination Inlets: Made with vertical curb and horizontal gutter openings, of materials and dimensions according to VDOT Road and Bridge Standards and Specifications.

C. Frames and Grates: Heavy duty, according to VDOT Road and Bridge Standards and Specifications.

2.6 PIPE OUTLETS

A. Head Walls: Cast-in-place or Precast reinforced concrete, with apron and tapered sides.

B. Riprap Basins: Broken, irregularly sized and shaped, graded stone according to VDOT Road and Bridge Specifications.

C. Rip Rap: According to VDOT Road and Bridge Specifications.
PART 3 - EXECUTION

3.1 EARTHWORK
   A. Excavation, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION
   A. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
   B. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
   C. Install gravity-flow, nonpressure drainage piping according to the following:
      1. Install piping pitched down in direction of flow.
      2. Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."

3.3 PIPE JOINT CONSTRUCTION
   A. Join gravity-flow, nonpressure drainage piping according to the following:

3.4 MANHOLE INSTALLATION
   A. General: Install manholes, complete with appurtenances and accessories indicated.
   B. Install precast concrete manhole sections with sealants according to ASTM C 891.
   C. Where specific manhole construction is not indicated, follow manhole manufacturer's written instructions.
   D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere unless otherwise indicated.

3.5 CATCH BASIN INSTALLATION
   A. Construct catch basins to sizes and shapes indicated.
   B. Set frames and grates to elevations indicated.
3.6 STORMWATER INLET AND OUTLET INSTALLATION
   A. Construct inlet head walls, aprons, and sides of reinforced concrete, as indicated.
   B. Construct riprap of broken stone, as indicated.
   C. Install outlets that spill onto grade, anchored with concrete, where indicated.
   D. Install outlets that spill onto grade, with flared end sections that match pipe, where indicated.
   E. Construct energy dissipaters at outlets, as indicated.

3.7 CONCRETE PLACEMENT
   A. Place cast-in-place concrete according to ACI 318.

3.8 CONNECTIONS
   A. Make connections to existing piping and underground manholes.
      1. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

3.9 CLOSING ABANDONED STORM DRAINAGE SYSTEMS
   A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:
      1. Close open ends of piping with at least 8-inch thick, brick masonry bulkheads.
      2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.
   B. Abandoned Manholes and Structures: Excavate around manholes and structures as required and use one procedure below:
      1. Remove manhole or structure and close open ends of remaining piping.
      2. Remove top of manhole or structure down to at least 36 inches below final grade. Fill to within 12 inches of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.
   C. Backfill to grade according to Section 312000 "Earth Moving."
3.10 IDENTIFICATION

A. Materials and their installation are specified in Section 312000 "Earth Moving." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.

1. Use warning tape or detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.11 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:
   a. Alignment: Less than full diameter of inside of pipe is visible between structures.
   b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
   c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
   d. Infiltration: Water leakage into piping.
   e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to requirements of authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.
5. Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
   a. Test concrete piping according to ASTM C 924.

C. Leaks constitute defects that must be repaired.

D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.
3.12 CLEANING

A. Clean interior of piping of dirt and superfluous materials. Flush with water.

END OF SECTION 334100